CHAPTER 5.0
POTENTIAL ENVIRONMENTAL IMPACT

5.1 INTRODUCTION

Construction of mixed development can bring various adverse or beneficial effects towards the environment. There are certain areas will directly benefit from any of those and others may not. Therefore, a steady balance must be achieved between the interest of the society and the impacts towards the environment. As such, impacts to environment need to be identified, studied and analyzed before any management of the impacts can be carried out.

This chapter will mainly focus on the main features of the principles construction activities that will be carry out during the construction and operation stages of the proposed project. This section will present an overview of the any potential impacts towards the environment generated from the project activities.

The possible environmental impacts are:-

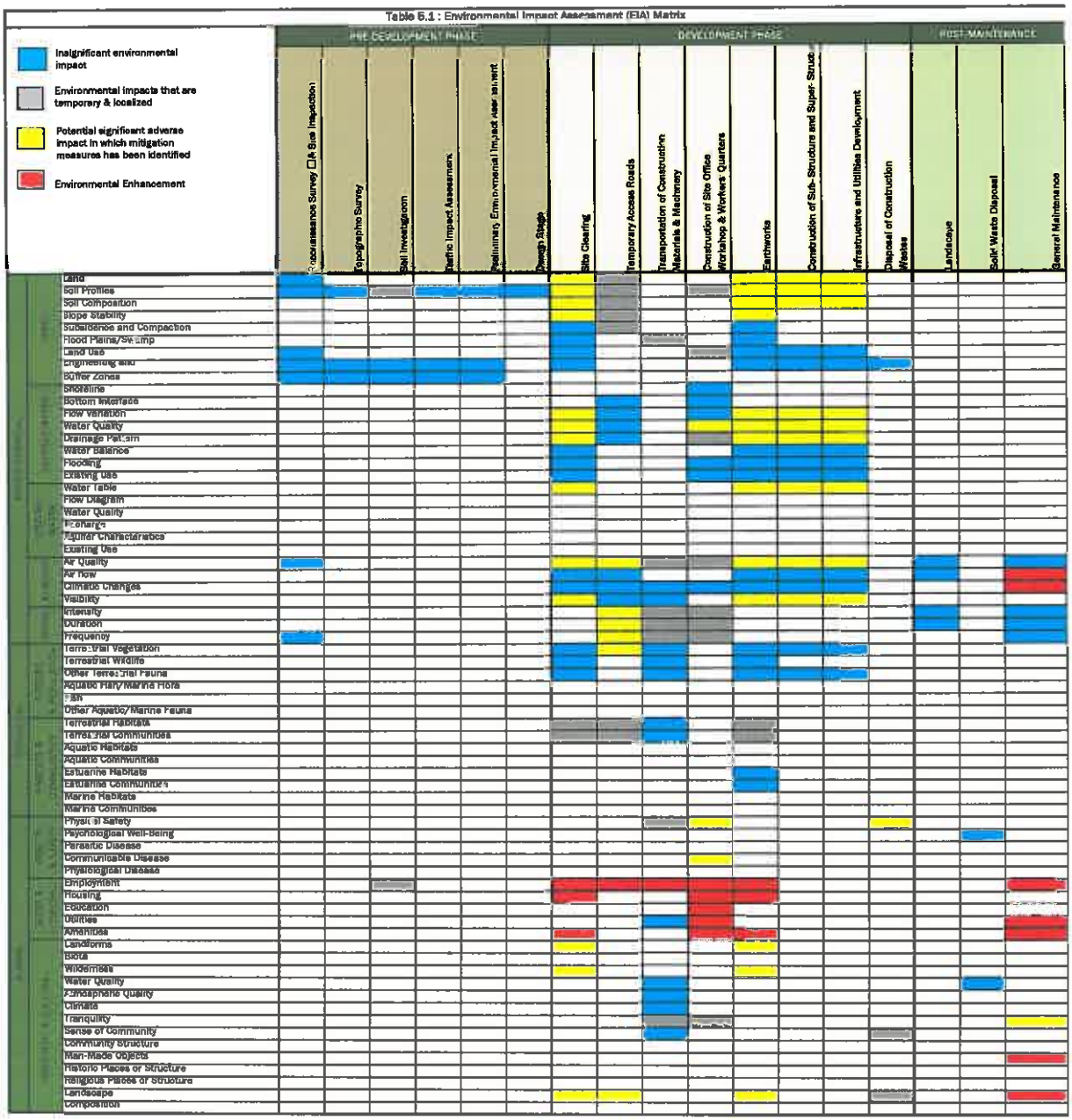
- Loss of natural vegetation
- Loss of habitat
- Accelerated soil erosion and sediment pollution
- Slope failure and landslide
- Increased runoff
- Construction wastes
- Water pollution
- Air pollution
- Noise pollution
- Traffic generation
- Socio-economic impacts

Prediction and assessment of Environmental Impacts:-
Following the identification of the main project activities for each stage of the development and the definition of the existing environment, an EIA matrix has been prepared. The matrix is used to identify and present graphic from the nature and the specific sources of the potential environmental impacts that may occur during the various stages development. In this study, the nature of the environmental impacts is categorized into 4 classes according to the level of significance and whether they are negative, positive and residual in nature;-

- Insignificant environmental impact
- Environmental impacts that are temporary & localized
- Potential significant adverse impact in which mitigation measures has been identified
- Environmental Enhancement

The summary of impacts from projects activities to the environmental components are shown in **Table 5.1**. The matrix presents in a graphic form the sources and significance of the potential environmental impacts that may occur during the three stages. In the study, the nature of the impacts is categorized according to the level of significance and whether they are negative, positive or residual in nature.

Table 5.1 : Environmental Impact Assessment (EIA) Matrix



5.2 PRE-DEVELOPMENT PHASE

5.2.1 Reconnaissance Survey, Site Inspection and Data Collection

There are no significant impacts towards the environment expected since some of the works does not involve any physical changes or disturbance to the environment. Surveying works carried out by surveyors are mainly minimal to gathering latest data about site topographic and contour. These data such as earth level, slope gradient and site surface are important to the engineers to analysis and planning any necessary earthwork and platform preparation.

5.2.2 Soil Investigation

Soil investigation is to carry out and determine the geotechnical conditions of the project site. Laboratory data analysis is then used for engineering design purposes.

Adverse Impacts:

- Bored holes are left after the soil sampling exercise. The deep holes that are creating could be a potential risk to human. However, since the holes are normally small diameter since the holes are normally small in diameter (normally 6 inches in diameter) and located in the water, the risk is deemed minimal. However, all holes shall be marked as precautionary to avoid any harm to human.

5.2.3 Topographic Survey, Traffic Impact Assessment, Preliminary Environmental Impact Assessment and Design Stage

The phase activity that includes planning and design stage will not induce significant adverse impacts on the environment.

5.3 DEVELOPMENT PHASE

5.3.1 Site Clearing

Site clearance implies the removal of existing vegetation resulting in (bare) land being exposed to natural weathering effects such as wind and rain. Without mitigating measures, these two elements could potentially cause deterioration of water, air, noise quality and the loss of precious quantity of soils.

Impacts

- Runoff
- Biomass
- Public utilities:
- Water Quality
- Soil Erosion and Sedimentation

Runoff: The loss in vegetative cover will result in higher runoff rates thereby increasing flows downstream. These activities will also likely to cause impedance to drainage course as well as causing rise in the river bed level thereby reducing the river capacity of conveying runoff. The increased of stream flow and reduction of river capacity to convey runoff will cause flood problems.

Biomass: The clearing of large area of oil palms, shrubs and other growth will create a potentially large volume of biomass. The estate has approximately 503,554 palm oil trees. The amount of biomass generated can be estimated with reference to the Biomass Primer (by: Dr. Sandra Brown, FAO-USEPA). There are various equations to estimate biomass of forest (natural or planted) but requires lots of data like species, diameter at breast height (dbh), height etc. A regression equation is used to estimate the biomass based on climatic zone (Brown et. al, 1989). Assuming that the oil palm plantation is broadleaf forests, and a moist climate (rainfall from 1500 mm/yr – 4000 mm/yr), the equation used to estimate biomass is as follows:

$$Y = 42.69-12.800(D)+1.242(D2)$$

Where,

D = dbh at breast height (cm)

The diameter of a typical oil palm plantation differs depending on age but is generally 2 – 3 feet. A more conservative figure of 2 feet (≈ 61 cm) is used.

Substituting in the equation, therefore:

Total Site Area (acre) =	160.18	acre	
Total Area by cover by palm oil (80 %)=	128.14	acre	
Average distance per tree =	2.00	m	
1 acre =	4,046.83	m^2	
1 tree coverage area =	4.00	m^2	(Assumption 2m X 2m)
Average tree per area =	1,011.71	tree/ac	
Rounder =	1,012	tree/ac	
Total Oil Palm Tree assumption left =	129,682	tree	
Where,			
D = dbh at breast height (cm)			
Diameter (D)	61	@ 2ft	
A more conservative figure of 2 feet (≈ 61 cm) is used.			
Substituting in the equation, therefore: Y=	**42.69-12.800(D)+1.242(D2)**		
Y =	**42.69 - 12.800(61) + 1.242(61^2)**		
Y =	3,883	kg/tree	
Total of Biomass	= 3.883 tonne/tree x 192,973trees		
Total of Biomass	**503,554**	**tonne**	

This regression equation has an r2 value of 0.92 and therefore, it is 92% accurate. However, the biomass is solely based on the number of oil palms in the plantation. An overall biomass estimate should include soil, crop covers as well as other plants in the project site. Therefore, this figure is only preliminary and should not be used for any design purposes. It is only an indicative figure to illustrate the amount of biomass that will be generated.

In the case of the proposed project, the existing site is palm oil estate. Most of the clearing site involve cutting off the oil palm tree and it will be collect to compost. Base on site visit data, almost 80% of site area (128.14 acre) was plant by palm oil tree. Total palm oil tree biomass are about **503,554 tonne** will generate. **(Refer Appendix M - Assumption of Biomass Calculation)**

Public utilities: If land clearing is not planned properly, land clearing at the proposed site could lead to accidents due to broken water mains and electrical.

Water Quality: Water quality is also likely to be affected by erosion phenomenon, especially during storms. Land cleared, if left bare for too long increases the erosion potential. Eroded materials can be channeled to the nearest waterways after a downpour or airborne when blown by winds. Sediments and silts entering the water body are able to reduce the dissolved oxygen level through sediment oxygen demand. It also brings along pollutants (organic and inorganic) and such causes the water body to be unsuitable for aquatic habitat. Organic pollutants (nutrients) will cause eutrophication (a phenomenon where rivers become shallow becoming terrestrial land) and inorganic pollutants will cause the water to be hazardous to life forms.

Sediment loading can be estimated base on MSMA which is published by Department Of Irrigation and Drainage. Volumetric Rational Method can be used to determine annual runoff water. Then, annual pollutant loading **(Refer Appendix N- Annual Pollutant Loading)** are decided by a number empirical approaches have been proposed as a basis for calculating pollutants loads such as Modified Soil Loss Equation-MSLE. **(Refer Appendix O: Modified Soil Loss Equation-MSLE)**

Estimated Calculation – Annual Load Pollutant

Volumetric Rational Formula

R = D. Cv

R = average annual runoff depth (mm)
D = average annual rainfall depth (mm)

Cv = weighted average annual runoff coefficient
Typical value ranging from 0.1 – 0.7 depending on land use
(Forest: 0.1 – 0.3, Pasture: 0.2-0.6, Urban: 0.5-0.

Event Mean Concentration Method

$L = 10^{-4} \times C \times Vr \times A$

L = Annual load of pollutant (kg)
C = EMC of pollutant (mg/l)
Vr = Annual runoff depth (mm)
A = Catchment area (ha)

Table 5.2: Typical Event Mean Concentration values in mg/L

Pollutant	Land use/vegetation categories				
	Native vegetation /forest	Rural grazing	Industry	Urban	Construction
Sediment	85	500	50-2000	50-200	4,000

The quantity of suspended solids/sediments generated can be estimated based on the Urban Storm water Management Manual for Malaysia, published by the Department of Irrigation and Drainage (DID). The Volumetric Rational Method is used to determine the average annual runoff depth. Then, the annual pollutant loading is determined by the Event Mean Concentration (EMC) Method.

Table 5.3: Computation on Sediment Loading from Different Scenario

	Pre-construction	Construction	Post-construction
Weighted average annual runoff coefficient, Cv (mg/l)	0.30	0.50	0.70
Average annual rainfall depth, D (mm)	2,812.80	2,812.80	2,812.80
Average annual runoff depth , R (mm)	843.84	1,406.40	1,968.96
Catchment area, A (ha)	64.82	64.82	64.82
EMC of pollutant Value, C (mg/L)	85.00	4,000.00	100.00
Annual load of pollutant, L (kg/ha)	**1,859.80**	**145,866.52**	**5,105.33**

Source: Perunding UEP Sdn. Bhd.

SDR (%) $= 77.684 \times A^{-0.065} \times (R/L)^{0.213}$

Where,

A is area (acre)
(R/L) is ratio of drainage gradient

Possibility of sediment which may flows to surrounding waterway is **1,859.80 kg/ha** per annum on pre-development stage. This value will increase to **145,866.52 kg/ha** per annum on development / construction stage which are increasing around **99%**.

Then, it would decrease to **5,105.33 kg/ha** per annum on post-development stage. Surface runoff carrying non-point source pollutants are channeled more efficiently by concrete drains into the rivers. However, the more crucial stage is during construction works where the sediment loadings are expected to increase to a very high level. As such, mitigation measures have to be implemented to reduce the level of sediment loading to a more tolerable level.

However, not all lands eroded flows to the river. Erosion from higher topography will settle to lowest ground. While a few of erosion would be trapped by plant. Therefore, Sediment Delivery Ratio (SDR) can be used to estimate the total sediment that flows into river base on site slopes. SDR can be estimated following the formula:
Therefore, value used by the analysis shown as follows:

Table 5.4: Value of R/L and SDR (%)

Catchments	Value of R/L	SDR Value (%)		
		Pre – Development	Development/ Construction	Post – Development
1	0.25	41.57	20.79	31.18

Then, sediment that is expected flow into river is calculated based on following formula:
Sediment that flow into river = Sediment Loading (L) x SDR (%)

Table 5.5: Sediment Loading Into River

Catchments	Sediment into River (tonne /ha per annum)		
	Pre – Development	Development/ Construction	Post – Development
1	0.77	30.32	1.59

The data explain that whole project was developed simultaneously. The fact is the development is on staggered method. Therefore, the truly value expected to be lower.

Soil Erosion and Sedimentation: If the cleared land is left bare for too long, the potential for erosion increases. Indirect impact of the erosion will increase the sediment loading and degrade the water quality. The topsoil is usually the first soil material that is removed by surface erosion. This portion of the soil profile provides the best plant growth medium in terms of both physical and chemical fertility. Suspended sediment abrades and coat aquatic organisms. Excessive sedimentation "paves" the stream beds, blankets the bottom fauna and destroys fish spawning areas. It may also clog smaller drains and streams, reduce the drainage capacity and cause potentially flooding. Turbidity due to the suspended sediment reduces light penetration and photosynthesis, thus reducing phytoplankton growth and food supply to other forms of aquatic life. Eroded soils contain nitrogen, phosphorus and others nutrient. The introduction of the pollutants into the water system could cause eutrophication and trigger algae bloom, which will reduce water clarity, deplete oxygen and create unpleasant odor and taste.

Potential of soil erosion is expected increase at this stage. Site clearing activity would expose site for erosive agent such as surface runoff water. It would influence soil structure. Sediment loading can be estimated base on MSMA which is published by Department Of Irrigation and Drainage. Volumetric Rational Method can be used to determine annual runoff water. Then, annual pollutant loading are decided by a number empirical approaches have been proposed as a basis for calculating pollutants loads such as Modified Soil Loss Equation (MSLE).

Modified Soil Loss Equation (MSLE)

Modified Soil Loss Equation (MSLE) is originally modified from USLE method. USLE has been modified by FRIM for Malaysian conditions (MSMA, 2000).

$$E = R . K . L . S . VM$$

Where;
E = Mean annual soil loss (t/ha)
R = Rainfall erosivity factor
K = Factor of the soil erodibility
L = Factor of slope length
S = Slope steepness factor
VM = Vegetation management factor

Note: In this equation, vegetation management factor (VM) is combination of two factors C and P used in the original USLE.

Factors Influencing Soil Erosion and Sedimentation

(a) Rainfall Factor (R)

The rainfall factor (R) is a measure of the erosive energy of the rainfall. It is express in units of cumulative value of storm rainfall intensity index (EI), for a fixed period of time (MSMAII). The factor E is the total energy for a rainfall and I30 is the rainfall's maximum 30-minute intensity (VT Soil Erosion, 2004). Annual rainfall (P) for this study area is **2812.80 mm.** While the maximum I30 is **196 mm/hr.**

R	=	$(E \times I_{30}) / 170.2$	MSMA(15.11a)
Where,			
I_{30}	=	is the rainfall's maximum 30-minute intensity	
	=	196 mm/hr	
P	=	annual rainfall (mm)	
	=	2812.80 mm	
E	=	annual erosivity (J/m^2)	
E	=	9.28 P – 8 838.15	MSMA(15.11b)
	=	9.28 (2,812.80) – 8 838.15	
E	=	**17,264.63** J/m^2	
Therefore,			
R	=	(17,264.63 x 203) / 170.2	
	=	19,907.08 ton.m/ha.hr	

(b) Soil Erodibility (K)

The soil erodibility (K) is the rate of soil loss per unit of rainfall erosivity actor for a specified soil. It is based on five soil parameters. There are percent silt, percent sand, organic matter content (OM), soil structure (S) and permeability (P) of the soil profile. K can be defined by using equation below.

$K = 2.1 \times 10\text{-}6 (12 - OM) M1.14 + 0.0325 (S - 2) + 0.025 (P - 3)$
Where,
M = (% Silt + % Sand) (100 - % Clay)

(c) Length-Slope Factor (LS)

The length steepness factor (LS) is a combination between the effects of slope and length of eroding surface. It is the ratio of soil loss per unit area from a slope land to that from a standardized measured plot (MSMA, 2000). Wischmeier (1975) was defined LS as state in equation below. Slope length was measured from the highest point to the centre or sediment basin. Percent of slope (S) is obtained from

diversification between highest and lowest point and divided with slope length. The exponent m is based on percent of slope on site.

$$LS = (\lambda / 22.13)^{m} (0.065 + 0.046S + 0.0065S^2)$$

Table 5.6: Exponent m based on slope percent

m value	Percent of slope (%)
0.2	S < 1
0.3	1 < S < 3
0.4	3 < S < 5
0.5	5 < S < 12
0.6	S > 12

(d) Cover Management Factor (C)

The Cover Management factor, C is a ratio, which compares the soil loss from an area with specified cover and management to that from a field under standard cultivated continuous fallow.

(e) Conservation Practice Factor (P)

The Conservation Practice Factor, P is the ratio of soil loss for a given practice to that where there is no conservation practice with farming up and down the slope. It can be expressed as a ratio of the soil loss with practices, such as contouring, strip cropping or terracing (VT Soil Erosion, 2004).

(f) Management Factor (VM)

The vegetation management factor (VM) is defined as the ratio of soil loss from a field subject to a system of control measures to that from the same site without any control provision. It combines two factors C and P used n original USLE (MSMA, 2000). The fraction of impervious area (IA) is assumed as 0.05 while the factor C is depends on the effect of various control practices.

$$VM = C. (1 - IA)$$

(g) Sediment Delivery Ratio (SDR)

$$SDR\% = 77.684 x A^{-0.065} x (R/L)^{0.213}$$

A = Area (acre)
R/L = relief ratio to length (LS/100)

Assessment of Erosion (Soil Loss), Sediment and Total Suspended Rates using MSLE Method

Same with USLE method, soil erosion rate calculation using MSLE method was calculated based on each sediment basin catchments area. The difference is on vegetation management factor (VM) where this factor is combination two factors C and P used in the original USLE.

$$qc = R. K. LS.VM$$

Total amount produced by MSLE to estimate erosion, sediment loading and suspended solid in this project during 3 scenarios as below:-

The total sediment generated during proposed site is cleared without mitigation measure based on MSLE is **77,256.66 ton/year** and will generate **3,755.99 mg/L** suspended solid. Meanwhile the total sediment generated during proposed site is cleared with mitigation measure (90% grassed) is **1,895.79 ton/year** soil loss and will generate a total approximately **9.85 mg/L** total suspended solid.

Table 5.7: Summary of Erosion, Sediment and Total Suspended Solid generate using MSLE method

(Estimated Calculation for Overall Area Of Development)

Scenario	Area (ac)	Erosion, E ton/yr	Sediment Yield (tonne/yr)				Suspended Solid (mg/l)			
			No Silt Trap	25%	50%	80%	No Silt Trap	25%	50%	80%
			Efficiency				Efficiency			
1	155.28	77256.66	26464.67	19848.51	13232.34	5292.93	3755.99	2816.99	1877.99	751.20
2	155.28	8757.92	1348.17	1011.13	674.08	269.63	191.34	143.50	95.67	38.27
3	155.28	1895.79	346.96	260.22	173.48	69.39	49.24	36.93	24.62	9.85

(Estimated Calculation For 1 Acre Area Of Development)

Scenario	Erosion, E ton/yr/ha	Sediment Yield (tonne/yr/ha)				Suspended Solid (mg/l/ha)			
		No Silt Trap	25%	50%	80%	No Silt Trap	25%	50%	80%
		Efficiency				Efficiency			
1	497.53	170.432	127.82	85.22	34.086	24.188	18.141	12.094	4.83768
2	56.40	8.682	6.51	4.34	1.736	1.232	0.924	0.616	0.246
3	12.21	2.234	1.68	1.12	0.447	0.317	0.238	0.159	0.063

Note:
1- Existing Landuse
2- Site is Cleared without Mitigation Measure
3- Site is Cleared with Mitigation Measure (90% Grassed)

Table 5.8: Erosion (Soil Loss), Sediment and Total Suspended Solid generate using MSLE method

Area	Area (ac)	Erosion (ton/yr)	SDR (%)	Sediment Yield Efficiency (tonne/yr)				Suspended Solid (mg/L)			
				No Silt Trap	25%	50%	80%	No Silt Trap	25%	50%	80%
Existing landuse											
SB1	43.71	20118.56	32.24	6486.49	4864.86	3243.24	1297.30	920.59	690.44	460.30	184.12
SB2	28.44	4690.02	26.62	1248.26	936.19	624.13	249.65	177.16	132.87	88.58	35.43
SB3	46.85	32948.85	35.14	11576.87	8682.65	5788.44	2315.37	1643.04	1232.28	821.52	328.61
SB4	25.60	19164.65	36.98	7086.59	5314.94	3543.30	1417.32	1005.76	754.32	502.88	201.15
SB5	10.67	334.57	19.87	66.47	49.85	33.23	13.29	9.43	7.08	4.72	1.89
During construction without mitigation measures											
SB1	43.71	2,506.17	15.21	381.31	285.98	190.65	76.26	54.12	40.59	27.06	10.82
SB2	28.44	1,690.22	15.75	266.19	199.64	133.10	53.24	37.78	28.33	18.89	7.56
SB3	46.85	2,596.53	15.04	390.52	292.89	195.26	78.10	55.42	41.57	27.71	11.08
SB4	25.60	1,422.96	15.63	222.39	166.79	111.19	44.48	31.56	23.67	15.78	6.31
SB5	10.67	542.03	16.19	87.76	65.82	43.88	17.55	12.46	9.34	6.23	2.49
During construction with mitigation measures											
SB1	43.71	962.90	19.94	191.97	143.98	95.99	38.39	27.25	20.43	13.62	5.45
SB2	28.44	270.45	17.12	46.31	34.73	23.16	9.26	6.57	4.93	3.29	1.31
SB3	46.85	356.30	15.83	56.39	42.29	28.20	11.28	8.00	6.00	4.00	1.60
SB4	25.60	217.12	16.82	36.52	27.39	18.26	7.30	5.18	3.89	2.59	1.04
SB5	10.67	89.02	17.70	15.76	11.82	7.88	3.15	2.24	1.68	1.12	0.45

5.3.2 Construction Of Temporary Access Roads

The construction of temporary access roads will create access to previously in accessible areas. The earthworks activities will involves machinery and vehicles entering the project area.

Adverse Impacts:

- Dust problems during dry seasons and water pollution from erosion and sediment transported by surface runoff.
- As long as access road is not close to any residential or work place, noise pollution should be insignificant.
- Temporary access may generate minor traffic inconvenience to the road users, especially for the alignment adjacent to the private property.

5.3.3 Transportation of Construction Materials and Machinery

As the construction activity progresses, construction material such as earth, sand, bricks, concrete and piles will be transporting to the site. The activities involve direct movement of heavy vehicles to the project site and surroundings. The problem of dust is more nuisances since it may cause external and internal health problems. Adverse health effects associated with wood dust exposure include dermatitis, allergic respiratory effects, mucosal and non-allergic respiratory effects, and cancer.

During construction, the number of heavy vehicles like truck, bulldozers and cranes, will fill the streets to perform construction activities. This will increase the amount of traffic on the route connecting to the site, but it is only temporary and lasting only over the duration of construction. This is because after the completion of construction activities, these vehicles are not on the site and will not use the route connecting to the site.

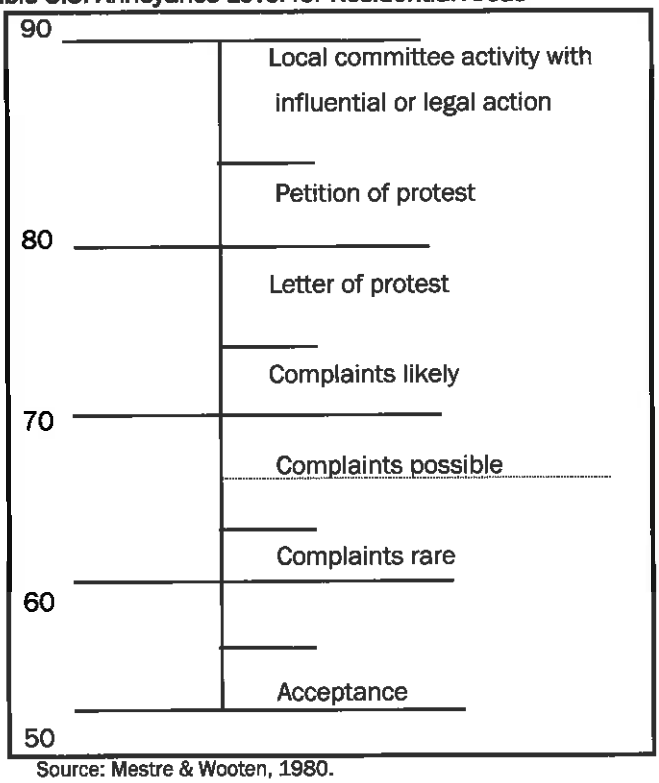
Adverse Impacts:

- **Safety and hazards:** The transportation of construction material such as aggregate trucks potentially falls off from the back of onto ongoing traffic and poses a danger to road user. There will also be an influx of heavy machineries at the project site. Big trailers carrying these machineries will be a constant sight along the project route and may risk the safety or road user. It is expected that traffic will be increased, and there might be the possibility that accident might occur due to falling objects from transport vehicles. These slow moving heavy vehicles can cause disruption to the normal traffic circulation along the existing major roads. Spillage onto the existing road can lead to accidents and traffic jams.

- **Air Quality:** The movement of construction vehicles on unpaved roads and at construction sites can disperse the dust into the atmosphere, thus degrading air quality and reduce visibility. Prolonged exposure to dusts without protection can lead to respiratory problems. Dark smoke emitted by vehicles that utilizes diesel as fuel are polluting in nature. Vehicles such as trucks, lorries and motors will emit pollutants into surrounding air. Its include heavy metal (lead and cadmium) that potentially contribute significantly to air pollution. Dust may also generate form transportation materials that have potential to cause dust generation such as soil, aggregate and sand. Spilled material may be carried by winds or taken in the wake of the moving vehicle and dispersed. Movement of construction vehicle could worsen the air quality and hence affect the nearby residential area.

- **Noise Quality:** Transportation activities also have impact to the noise levels surrounding the project site. During the construction activities, noise will be producing by various sources such as construction vehicles, equipment and machinery (bulldozers, backhoes, end loaders, cranes and trucks). However, not all of this equipment operated at one time. Therefore, it is difficult to quantify the overall noise levels in order to reflect accurately the likely annoyance, which may be producing. A study conducted by Mestre and Wooten, 1980 indicated that the annoyance level for residential areas is 85 dBA. Therefore, the noise generated during the whole construction stage is not expected to have a significant adverse impact.

Table 5.9: Annoyance Level for Residential Areas



Source: Mestre & Wooten, 1980.

- The construction equipment and vehicles usually produce different range of noise levels. Noise generation from machineries such vehicles and generators at the project site can pose a nuisance to the surrounding environment. Sound level at various distances can be estimating using the following formula, assuming there are no barriers and wind. The equation is:

$$Lr = Lw + 10 \log (1/2 \pi r^2)$$

Lw : Noise level at source dB (A)
Lr : Noise level at r meter from dB (A)

- It is estimate that noise level at various distances generated by most heavy machinery. The table shows that it will diminish to a tolerable level at about 50-100 m away from the source except for the usage of piling machines.
- **Table 5.10** shows for estimated heavy machinery noise level at every distance impact to the specific area. Based on Mestre and Wooten, 1980 study, the allowable noise level for residential area is 85 dB(A) and it approved that the noise impact for whole residential area near the project is not exceed the limit.

Table 5.10: Estimated Noise Level, dB (A) at various distance (m)

Heavy Machinery	Typical Noise dB (A)	Estimated Noise Level, dB (A) at Various Distance (m)							
		25	50	100	500	1000	1500	2000	3000
Bulldozer	107	71	65	59	45	39	36	33	29
Crane	112	81	75	69	55	49	46	37	35
Concrete-mixer	116	80	74	68	54	48	45	42	38
Pile driver	139	104	97	91	77	71	67	65	61
Scraper	104	68	62	56	42	36	33	30	26
Grader	104	68	62	56	42	36	33	30	26

Source: EIA Study by Perunding UEP Sdn Bhd (2012)
Note: Based on typical Malaysian climate with 30˚C ambient temperature and 80 % humidity

5.3.4 Construction of Site Office, Workshop and Worker's Quarters

Adverse Impacts:

(Safety and Health impact)

- Vector disease: During the construction stage, a potential problem that may arise from the operation of the proposed project is creation of breeding sites for rodents and disease vectors like flies, cockroaches and mosquitoes. For developers and contractors, there is a responsibility for keeping the construction sites free of potential mosquito breeding areas particularly for the *Aedes* mosquito which is the species responsible for transmission of the dengue virus.
- Improper sanitation facilities for the worker's quartes. Direct sullage and sewage discharge into the waterways will cause water pollution. Failed on-site wastewater disposal systems (septic tank) can contribute large numbers of coliforms and other bacteria (E.coli) to surface water and groundwater.
- If foreigners are employed, then they will have to undergo proper medical checks and approved prior to employment by the construction management. A separate labour camp should be built to house these foreigners, as this would ensure that they have a sense of belonging between the communities.
- Housekeeping of workshops, if not properly maintain, causing spillage of lubricant, grease on the ground, potentially contaminate the soil and surface water.
- Generation of solid waste
- Generation of construction wastes such as leftover steel bar, used lubricant or oil etc. If not disposed properly, it can poses hazard to nearby residents and finally impact to aquatic fisheries when it flow into the rivers.
- Visual impacts and odour problem due to wastes.
- Indiscriminately disposal of solid waste, used oil and grease from the construction as well as sewage discharge from workers camp and site office may deteriorate water quality.

5.3.5 Earthwork

Earthworks involve cutting of slopes and filling of earth at certain stretches of the project to form the desired platform level.

Adverse Impacts:

- Risk of slope failure if no measure of slope protection is implemented
- Erosion due to clearing of vegetation will cause siltation in existing waterway. Existing drainage (especially earth drain) potentially silted and thus no longer functional in discharging surface runoff.
- Soil erosion can generate suspended sediment abrades and coats aquatic organisms. Excessive sedimentation "paves" the streambeds, blankets the bottom fauna and destroys the sprawling areas. It may also clog smaller drains and streams, reduce the drainage capacity of larger streams, and cause flooding.
- Slope & Embankment Stability: The proposed project site is an undulating terrain with streams/tributaries passing through. As such, cut and fill activities will be needed to create the necessary platform level for construction of commercial units. Slopes that are cut too steep will accelerate the erosion process while embankments that are not compacted enough will also erode and thus leading to slope/embankment failures. When riverbanks are cleared of any vegetation, it will be more susceptible to erosion due to both weathering and the flow of rivers. However, this impact is expected to be minimal as most of the streams / tributaries are small and dry during dry days.
- Safety & Hazard: The influx of heavy machinery such as tractor, trucks, cranes in and out of the project site will create hazards to the surrounding areas.

Impacts to air, noise and water pollution regarding earthwork activities are listed below:

Air

- During the construction stage of the project, under prolonged dry weather periods coupled with strong winds, truck movements within the construction site may cause particulate that in turn may be transported to neighboring areas causing possible adverse health, aesthetic and visual impact.

- Dust generated by vehicular movement will be most adverse particularly within cleared areas with exposed and unpaved surfaces. This is caused by entrainment of soil particulate due to winds created by vehicle movement. Dust from such sources is generally or larger particle sizes and is expected to settle down within close proximity to the source unless transported by strong winds exceeding 5 m/sec. Moreover, the project site is located at a good distance from the residential areas; the impact to the latter will therefore be insignificant. The short-term problem will be confined within the development area and manageable. In general, dust particles would normally settle out within 30 m from the source.
- Air quality will be affected during dry spells and earthworks, especially when vegetative covers of top soils are removed. Despite potentially dirtying the main roads, the increased airborne dusts due to vehicle and plant movements will cause cleanliness problems to adjacent residential areas. During the construction stage of the project, on site burning of any construction waste is strictly prohibited. Moreover, the project site is located at a good distance from the residential areas; the impact to the latter will therefore be insignificant. The short-term problem will be confined within the development area and manageable. In general, dust particles would normally settle out within 30m from the source.

Noise

- Noise generated from vehicular movements and machinery used throughout the construction stage is anticipated to occur. Since not all of them operate at one time, it is difficult to quantify the combined noise levels in other to reflect accurately the likely annoyance that may be produced.
- Earthworks activities will see the generation of noise levels which may result higher ambient noise levels to the surrounding areas. Noise generated from vehicular movements and machinery used throughout the construction stage is anticipated to occur. Since not all of them operate at one time, it is difficult to quantify the combined noise levels in other to reflect accurately the likely annoyance that may be produced.

Water

- Degradation of water quality.
- Generate of sediment load into the waterways
- Turbidity due to the suspended sediment reduces light penetration and photosynthesis, thus reducing phyto-planktonic growth and food supply to other forms of aquatic life.
- Potentially dispersed the sediment to the surrounding, could probably affect the water/aquatic environmental policy.
- Erosion due to clearing of vegetation will cause siltation in existing waterway. Existing drainage (especially earth drain) potentially silted and thus no longer functional in discharging surface runoff. Soil erosion can generate suspended sediment abrades and coats aquatic organisms. Excessive sedimentation "paves" the streambeds, blankets the bottom fauna and destroys the sprawling areas. It may also clog smaller drains and streams, reduce the drainage capacity of larger streams, and cause flooding.

Beneficial Impacts:

- Drainage system constructed at the bottom of the slopes will greatly improve where surface runoff can be channeled directly to the river. Thus, lower the risk of low-lying areas flooded after a heavy downpour.

5.3.6 Construction of Sub-Structure and Super-Structure

Construction of building and structure involves the erection of main structure for apartment, commercial buildings and other public buildings recreational facilities. These buildings and structures are constructing in phases stage. However, the impacts generated may significantly pose a threat to the environment and safety of public if no mitigation measures implemented.

Adverse Impacts:

- Building construction is not expected to cause any harm to environmental parameters, except for concreting works. The cement slurry however, is dangerous once its leak into waterways.
- Construction materials (paint, cement, steel, oil and grease) can contaminate the environment if not properly handle or managed.

- Equipment and machinery involves in building construction are potentially polluted to the environment for releasing black smoke or oil and being noisy to surrounding.
- Noise pollution from erection activity, sourcing from workers activities to the plant movement. This is only significant at site boundaries where there are offices, and residential units nearby. However, it is expected that the probable noise pollution is only temporal and for short durations.
- Air pollution from airborne dust generated by wind and activities
- Safety and health of workers are at risk during construction. This risk is definite for all constructions.

5.3.7 Construction of Infrastructure and Utilities Development.

i. Construction of Roads/Traffic

Adverse Impacts: (During Construction)

- Traffic along the area is expected to increase during construction phase. This will also lead to increase risk to the safety of motorist or road users.
- Traffic congestion.

Adverse Impacts: (During Operation & Maintenance)

Regular maintenance of these facilities is needed to make sure that daily residential, commercial activities are not carries on smoothly. Any disruption of these facilities will cause inconvenience and losses especially to the commercial activities. Maintenance of road surface is necessary to ensure a smooth ride for road users. This is also to increase the lifespan of the roads.

- Resurfacing of roads will cause temporary jams to the existing road users as machinery like vibrating compactor, scrappers and premix trucks will be located along the roads.
- Temporary diversion of road will be necessary causing further nuisance to the road users, therefore delaying traveling time if diversion works are not carried out properly.
- This activity also contributes to water pollution when the premix (oil and grease) mixed with surface runoff water and then flow directly to nearby water bodies.
- Road surface that are not well maintained are not only hazardous to road users but are also harmful to the vehicles.
- Increased in vehicular activities will directly increased the air pollution (lead emission, carbon monoxide, sulfur dioxide, nitrogen dioxide and others pollutant in particle (TSP)).

Beneficial Impacts:

The beneficial impacts that expected from the above maintenance road activities are:

- Comfort of driving to access the project side.
- Providing job opportunities as resurfacing works needs manual labour.
- Reduce the risk of road related accident

ii. Drainage systems

Adverse Impacts:

- The proposed project will increase the surface runoff. Typically rain water is captured and retained cover of the green area, some infiltrates into the soil and the natural terrain prolongs the total overland time to surface runoff to reach waterway.
- The stormwater runoff generated by the proposed site shall be discharged directly to the river.
- Potential to occur the flood to occur may potentially cause by network system failing to function during the construction phase.
- The proposed of the project will increase the surface runoff. Before development, the rain water is captured and retained cover of the green area, some infiltrates into the soil and the natural terrain prolongs the total overland time to surface runoff to reach waterway.
- However after development, with the removal of the major vegetation and the conversion of the impermeable ground to impermeable pavements, the overland time of surface runoff will increase, thus causing a higher chance of the occurrence of flash flood in the proposed development site. It is sullage will cause deterioration of the receiving water bodies causing possible generally understood that indiscriminate dumping and discharging of sewage and effect to its biological life.

iii. **Sewage Treatment Plant/ Reticulation System**

Adverse Impacts: (Wastewater enter the existing waterway without treatment)

- It is generally understood that indiscriminate discharging of sewage will cause deterioration of the receiving water bodies causing possible effect to its biological life.

iv. **Water Reticulation System, Electrical Power Distribution and Telecommunications Systems**

Adverse Impacts:

- It will be potentially generate disconnected of power supply such as electrical and telecommunication to surrounding area.
- Existing utilities at the site need to be relocating for the temporary period before the new of utilities construction completed. All the utilities such as sewerage system, water reticulation system, electrical power distribution and telecommunications systems are detected and will be relocated before the project started to avoid discontinuity function of the system.

Beneficial Impacts:

- It will be beneficial to local and nearby residents to have such an infrastructure as to reduce traveling time and cost saving.

5.3.8 Disposal of construction wastes

Adverse Impacts:

- During building construction, the waste is largely made up with material packaging, disused formwork, concrete debris and used containers which may create blockage to drainage system if not properly disposed off. Improper disposal of construction wastes such as left over cement, steel bars, cut off piles are potentially degrading to the environment. Rusts from steel bars and chemicals section can leak out into groundwater and water bodies. Ensure no wastes are dumped into the waterway.
- Accumulated waste will demand space and required extensive clean up exercise once the project completed.
- Scheduled wastes: Impact are generated from construction activities related to handling and manage the scheduled wastes such as oil waste (diesel drum), paint and others.

Scheduled Waste:

- The impacts are generated from construction activities related to handling and manage the scheduled wastes such as oil waste (diesel drum), paint and others.

5.3.9 Abandonment

Adverse Impacts:

- Abandonment of the proposed project would definitely cause impact to the surrounding. However, the severity of such impacts depends on the time/stage of development of abandonment.
- Abandonment of the project at early stage, after site clearing and earthworks will cause pollution of water from soil erosions and air pollution from airborne dust generation. This impact would be prolonged if no vegetative cover is provided to the barren land. The construction materials that are left behind unmanaged would pose potential harm to the environment.

5.4 POST- DEVELOPMENT PHASE

5.4.1 Landscaping

Other maintenance activities identified are such as grass cutting and landscaping

Adverse Impacts:

- Landscaping activities will enhance the aesthetic value along the proposed project and act as natural noise barrier and dust absorber but without proper maintenance, it will destroy the esthetic value of the surrounding.
- Poor landscaping works can hamper visibility of traffic especially at junctions. Unsuitable trees planted at wrong locations can cause accidents.
- Trees and plants also function to minimize pollution especially air and noise pollution. Nutrients and trace elements in underground water can also be absorbed by the trees. Trees and plants to be planted should be referred to the local authority. Certain trees require more maintenance than others.

Figure 5.1: Landscape Has Potential to Control The Environment

5.4.2 Solid Waste Disposal

Adverse Impacts:
Infrequent collection of solid waste from the proposed site and other landuses area would result the following impact: -

- Accumulation of waste at source,
- Dumping of was in unauthorized areas,
- Disposal into the nearby drain, resulting in clogging, and thus, localized flooding, development of disease vector habitats, induce adverse aesthetic consequences and release of offensive odors.
- The improper disposal of solid waste will lead to the accumulation of leachates, which can impose a significant organic load to surface and groundwaters. The impacts are expected to be long terms though localized.
- Under normal operation, solid wastes include general refuse from the residential, commercial and recreational centers. Littering and indiscriminate dumping and discharge of solid wastes will result in the deterioration of the environment with respect to general aesthetic and health impact.
- Solid waste generated is not expected to create any health hazards if proper services are provided and managed.

5.4.3 General maintenance (Infrastructure and Utilities)

Regular maintenance of these facilities is needed to make sure that daily residential, commercial activities are not carries on smoothly. Any disruption of these facilities will cause inconvenience and losses especially to the commercial activities.

i. Maintenance of internal road

Maintenance of road surface is necessary to ensure a smooth ride for road users. This is also to increase the lifespan of the roads.

Adverse Impacts:

- Resurfacing of roads will cause temporary jams to the existing road users as machinery like vibrating compactor, scrappers and premix trucks will be located along the roads.
- Temporary diversion of road will be necessary causing further nuisance to the road users, therefore delaying traveling time if diversion works are not carried out properly.
- This activity also contributes to water pollution when the premix (oil and grease) mixed with surface runoff water and then flow directly to nearby water bodies.
- Road surface that are not well maintained are not only hazardous to road users but are also harmful to the vehicles.
- Increased in vehicular activities will directly increased the air pollution (lead emission, carbon monoxide, sulfur dioxide, nitrogen dioxide and others pollutant in particle (TSP)).

Beneficial Impacts:
The beneficial impacts that expected from the above activities are:

- Comfort of driving to access the project side.
- Providing job opportunities as resurfacing works needs manual labour.
- Reduce the risk of road related accident.

Input from Traffic Impact Assessment[1]

Existing Traffic Pattern

Existing traffic profile shows that AM and PM peak hours is the highest traffic demand. Therefore the traffic analysis is based on the AM and PM peak hours. The traffic upgrading and improvement that is able to sufficiently cater for this maximum flows, will obviously be able to meet the traffic demand during the non-peak hours. (Refer **Table: 5.11 and 5.12**)

Table 5.11: Traffic Attraction for Morning and Evening Peak Hour

Traffic Attraction	%	
	AM	PM
From Jalan Gelang Patah	15	30
From Jalan Tanjung Kupang (via Setia Eco Garden)	10	10
From Kuala Lumpur	45	15
From Singapore	25	40
From Jalan Lima Kedai	5	5
Total	**100**	**100**

Source: Extracted From Traffic Impact Assessment Study for Pembangunan Bercampur Di Atas Lot 663, Lot 664, Lot 804 – Lot 807, Lot 1114, Lot 917 & Lot 920, Mukim Pulai, Daerah Johor Bahru, Johor By Perunding Trafik Klasik Sdn Bhd, 2013

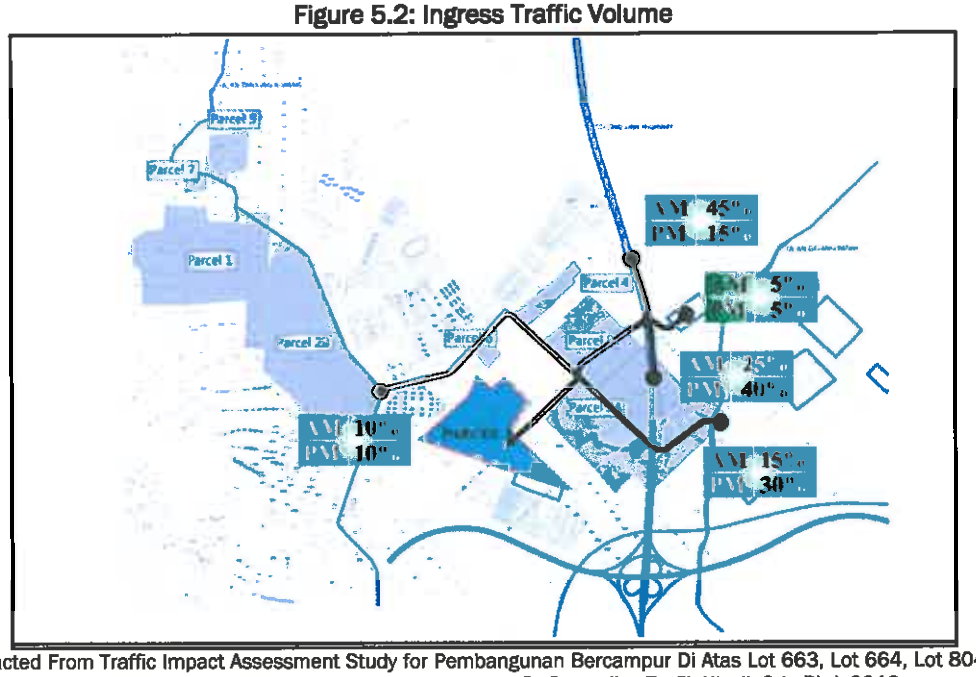
Table 5.12: Traffic Attraction for Morning and Evening Peak Hour

Traffic Generation	%	
	AM	PM
Towards Jalan Gelang Patah	30	15
Towards Jalan Tanjung Kupang (via Setia Eco Garden)	10	10
Towards Kuala Lumpur	20	50
Towards Singapore	35	20
Towards Jalan Lima Kedai	5	5
Total	**100**	**100**

Source: Extracted From Traffic Impact Assessment Study for Pembangunan Bercampur Di Atas Lot 663, Lot 664, Lot 804 – Lot 807, Lot 1114, Lot 917 & Lot 920, Mukim Pulai, Daerah Johor Bahru, Johor By Perunding Trafik Klasik Sdn Bhd, 2013

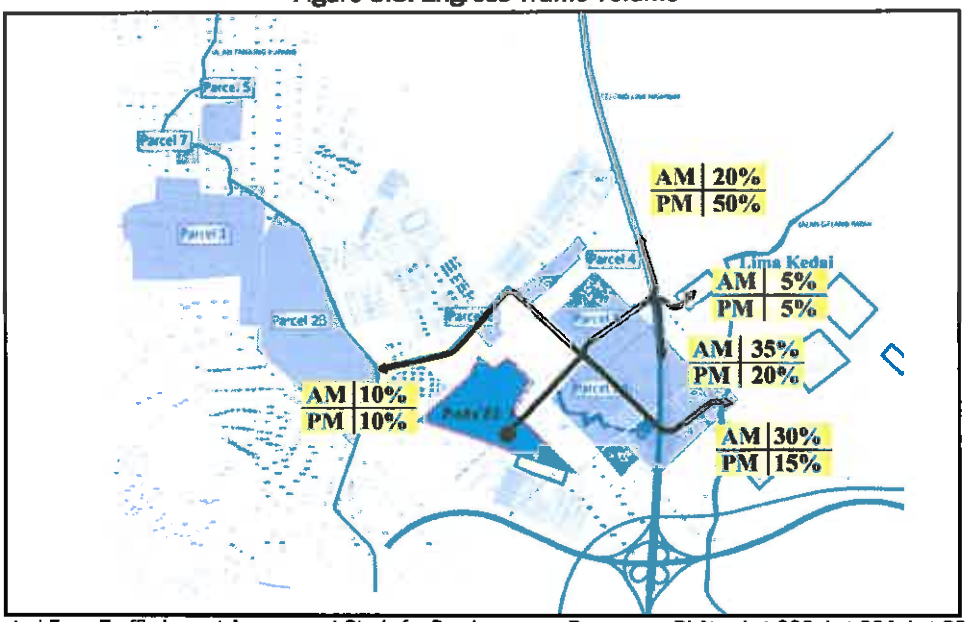
[1] Source: Extracted From Traffic Impact Assessment Study For Pembangunan Bercampur Di Atas Lot 663, Lot 664, Lot 804 – Lot 807, Lot 1114, Lot 917 & Lot 920, Mukim Pulai, Daerah Johor Bahru, Johor By Perunding Trafik Klasik Sdn Bhd, 2013

Figure 5.2: Ingress Traffic Volume



Source: Extracted From Traffic Impact Assessment Study for Pembangunan Bercampur Di Atas Lot 663, Lot 664, Lot 804 – Lot 807, Lot 1114, Lot 917 & Lot 920, Mukim Pulai, Daerah Johor Bahru, Johor By Perunding Trafik Klasik Sdn Bhd, 2013

Figure 5.3: Engress Traffic Volume



Source: Extracted From Traffic Impact Assessment Study for Pembangunan Bercampur Di Atas Lot 663, Lot 664, Lot 804 – Lot 807, Lot 1114, Lot 917 & Lot 920, Mukim Pulai, Daerah Johor Bahru, Johor By Perunding Trafik Klasik Sdn Bhd, 2013

Forecast of Future Traffic

The traffic impact analysis investigates the performance of the road network for the existing Year 2013, the future Year 2021 (medium term) and Year 2026 (long term). In forecasting the future traffic demand along the roads leading to the proposed development, the following factors were taken into consideration:

- An annual traffic growth of **3.0%** was applied over the **8 years (medium term)** and **13 years (long term)** forecast period

Trip Generation

The trip generation stage of a transportation planning process is concerned with the prediction of future trips generated by the proposed development. Therefore, an estimation of trips generated was carried out for the morning and evening peak hours based on the trips rates of similar landuse. **Table 5.13** shows the trip rates used for the analysis.

Table 5.13: Trip Generation Rates for the Proposed Development

Landuse	AM/PM	Trip Rate	%In	%out	pcu/veh ratio
Terrace House	AM	0.78	29	71	0.89
	PM	0.76	60	40	0.85
Semi-D	AM	1.51	35	65	0.96
	PM	1.54	53	47	0.92
Apartment	AM	0.48	27	73	0.91
	PM	0.45	63	37	0.88
Low Cost Flat	AM	0.62	35	65	0.78
	PM	0.60	57	43	0.74
Shop Office	AM	5.17	62	38	0.91
	PM	7.57	47	53	0.87
General Office	AM	1.54	71	29	0.71
	PM	1.43	33	67	0.33

Source: Extracted From Traffic Impact Assessment Study for Pembangunan Bercampur Di Atas Lot 663, Lot 664, Lot 804 – Lot 807, Lot 1114, Lot 917 & Lot 920, Mukim Pulai, Daerah Johor Bahru, Johor By Perunding Trafik Klasik Sdn Bhd, 2013

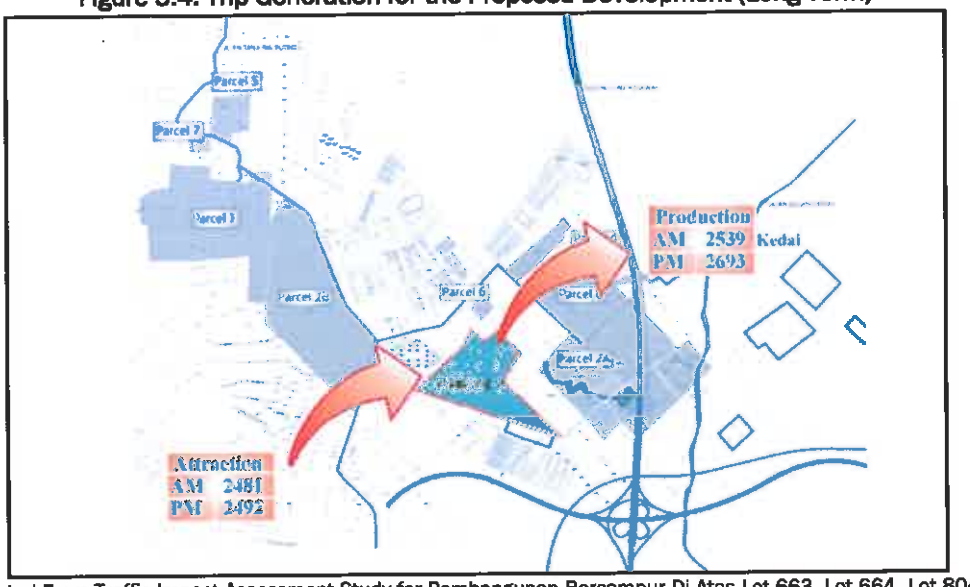
Table 5.14: Trips Generated During AM and PM Peaks for the Proposed Development

Type of Landuse	AM Peak			PM Peak		
	Total (pcu/hr)	In (pcu/hr)	Out (pcu/hr)	Total (pcu/hr)	In (pcu/hr)	Out (pcu/hr)
Medium Term						
Terrace House	784	227	557	730	438	292
Semi-D	226	79	147	221	117	104
Low Cost Flat	152	53	99	140	80	60
Shop Office	918	569	349	1285	604	681
General Office	1696	1204	492	1673	552	1121
Sub Total	*3776*	*2132*	*1644*	*4049*	*1791*	*2258*
Long Term						
Semi-D	152	53	99	140	80	60
Service Apartment	1092	295	797	990	624	366
Sub Total	*1244*	*348*	*896*	*1130*	*704*	*426*
Grand Total		**2481**	**2539**		**2492**	**2693**

Source: Extracted From Traffic Impact Assessment Study for Pembangunan Bercampur Di Atas Lot 663, Lot 664, Lot 804 – Lot 807, Lot 1114, Lot 917 & Lot 920, Mukim Pulai, Daerah Johor Bahru, Johor By Perunding Trafik Klasik Sdn Bhd, 2013

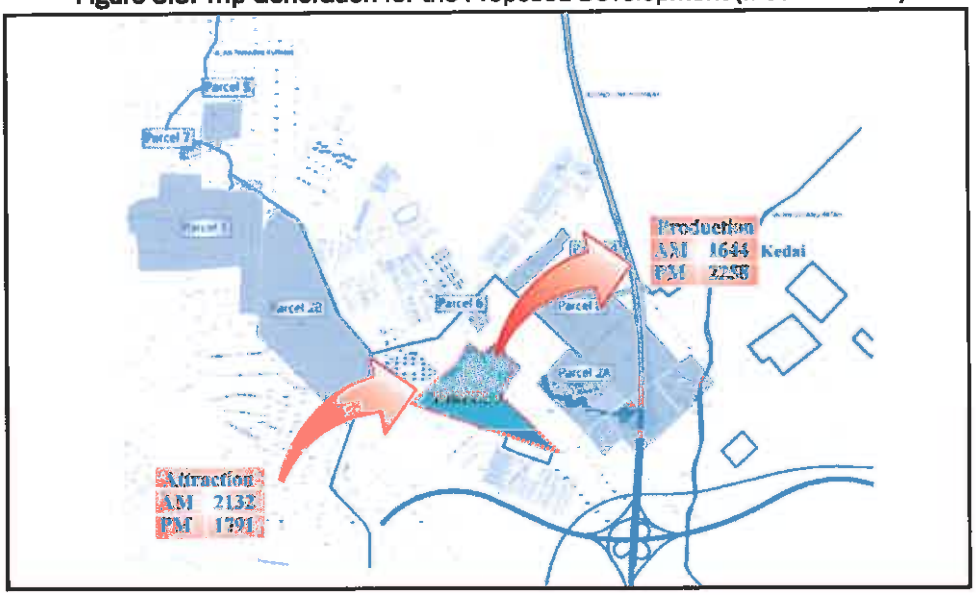
Based on the trip generation exercise, the proposed development for the long term period is estimated to produce **2539 vehicular trips** and attract **2481 vehicular trips** during the morning peak hour. During the evening peak hour, the development is expected to produce **2693 vehicular trips** and attract **2492 vehicular trips** as shown in **Figure 5.4**. For the medium term, it is expected to attract **2132 pcu/hr** and produce **1644 pcu/hr** during morning peak hours. During evening peak hours, it is estimated to attract **1791 pcu/hr** and produce **2258 pcu/hr** of traffic as shown in **Figure 5.5.**

Figure 5.4: Trip Generation for the Proposed Development (Long Term)



Source: Extracted From Traffic Impact Assessment Study for Pembangunan Bercampur Di Atas Lot 663, Lot 664, Lot 804 – Lot 807, Lot 1114, Lot 917 & Lot 920, Mukim Pulai, Daerah Johor Bahru, Johor By Perunding Trafik Klasik Sdn Bhd, 2013

Figure 5.5: Trip Generation for the Proposed Development (Medium Term)



Source: Extracted From Traffic Impact Assessment Study for Pembangunan Bercampur Di Atas Lot 663, Lot 664, Lot 804 – Lot 807, Lot 1114, Lot 917 & Lot 920, Mukim Pulai, Daerah Johor Bahru, Johor By Perunding Trafik Klasik Sdn Bhd, 2013

ii. Drainage systems

It is sullage will cause deterioration of the receiving water bodies causing possible generally understood that indiscriminate dumping and discharging of sewage effect to its biological life.

<u>Estimated Calculation - Surface Run Off</u>

- Peak discharge estimated here is based on available information and several assumptions. Assuming the rainfall duration, t is 30 minutes, the average rainfall intensity, 1 for ARI (average return interval) is computed using the following equation:

Where

$$ln(I) = a + b\ln(t) + c(\ln(t))^2 + d(\ln(t))^3$$

ARI (year)	coef a	b	c	d
2	3.8645	1.1150	-0.3272	0.0182
5	4.3251	1.0147	-0.3308	0.0205
10	4.4896	0.9971	-0.3279	0.0205
20	4.7656	0.8922	-0.3060	0.0192
50	4.5463	1.1612	-0.3758	0.0249
100	5.0532	0.8998	-0.3222	0.0215

Source: Extracted from Table 13.A1, USMM for Johor Bahru

Table 5.15 and 5.16 shows computed peak discharged for pre development and post development. Peak discharge between pre and post – development were show on **Table 5.17**. Based on the **Table 5.17** indicates that, approximately **57.01 %** of the runoff will increase after development (100 YEAR ARI). Thus, on site mitigating measures is essential to ensure that the generate surface run off should not excessively storm into the existing drainage system. The overflow in the drainage system potentially floods the surrounding. **Refer Appendix P: Estimated Calculation: Surface Run Off by Perunding UEP Sdn. Bhd.**

The increase volume should be able to mitigate through the provision of near drainage with improve the proposed project.

Table 5.15: Computed Peak Discharge (Pre – Development)

ARI (year)	Runoff Coefficient C	Area, A (ha)	Rainfall Intensity, i (mm/hr)	Storage Coefficient Cs	Discharge Q(m^3/s)
2	0.20	64.82	99.87	0.84	3.02
5	0.20	64.82	118.36	0.84	3.58
10	0.20	64.82	135.89	0.84	4.11
20	0.20	64.82	153.44	0.84	4.64
50	0.20	64.82	171.75	0.84	5.20
100	0.20	64.82	190.69	0.84	5.77

Source : EIA Study by Perunding UEP Sdn Bhd, 2013

Table 5.16: Computed Peak Discharge (Post – Development)

ARI (year)	Runoff Coefficient C	Area, A (ha)	Rainfall Intensity, i (mm/hr)	Storage Coefficient Cs	Discharge Q(m^3/s)
2	0.85	64.82	55.70	0.85	7.23
5	0.85	64.82	64.42	0.85	8.36
10	0.85	64.82	74.31	0.85	9.65
20	0.85	64.82	84.39	0.85	10.96
50	0.85	64.82	93.19	0.85	12.10
100	0.85	64.82	103.42	0.85	13.43

Source : EIA Study by Perunding UEP Sdn Bhd, 2013
Notes : i. Major Storm : ARI 100 @ ARI 50 ii Minor Storm : ARI 10 @ ARI 5

Table 5.17: Peak Discharge between Pre and Post – Development

Ari (year)	Difference (m3/s)	Percentage (%)
2	4.21	58.19
5	4.78	57.16
10	5.53	57.36
20	6.31	57.60
50	6.90	57.03
100	7.65	57.01

Source : EIA Study By Perunding Uep Sdn Bhd, 2013
Notes : i. Major storm : ARI 100 @ ARI 50 Ii. Minor storm : ARI 10 @ ARI 5

iii. Sewage Treatment Plant/Sewerage Reticulation System

Adverse Impacts:

- Pollution loading from untreated sewage will be the main impact on the surface water quality.
- The high level of Biochemical Oxygen Demand (BOD5) and Suspended Solids (SS) will lower the dissolved oxygen (DO) level in the water. This scenario will harm and kill various types of sensitive aquatic life, which in turn will impact the fishing community downstream.
- The high level of Ammoniacal Nitrogen (AN) in the waterway will make the river/marine water unsuitable for leisure activities for fear of diseases.
- Untreated domestic wastewater is known to be highly pathogenic and contains various germs. The untreated sewage discharge into the watercourse is significant and would cause the degradation of water quality which could harm aquatic life and downstream users.

Figure 5.6: Discharge directly into waterway and cause contamination

DOMESTIC WASTEWATER PREDICTION
(Normal Case Scenario and Worst Case Scenario if STP failure)

(Please refer Appendix Q: DO Sag and BOD Sag Calculation for the Detailed Calculation).

The generated wastewater is expected to contain considerable amount of BOD5 as shown below. The total daily amount of BOD5 is calculated based on the unit concentration of 250 mg/l as recommended by the Ministry of Health, Malaysia. The value of concentration as recommended by the ministry are rather conservatives but adopted here since it has been widely used for design purposes.

The estimation of total BOD5 and SS load into the receiving water bodies are as follows:

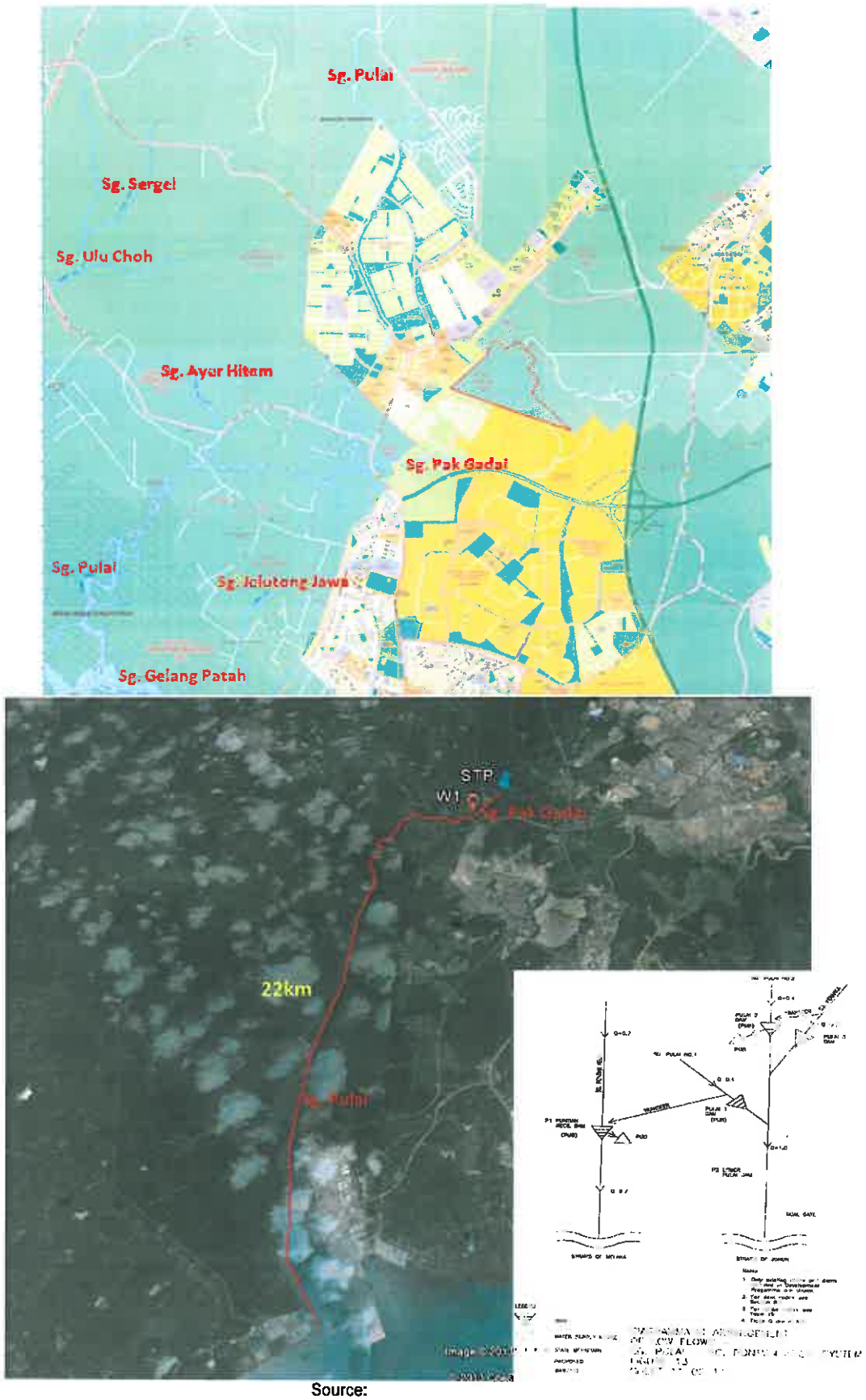
Basic Data:

Flowrate	= 225 Litre/PE.day
Dry Weather Flow. DWF	= 0.225 m^3/day
Suspended Solid,SS	= 300 mg/l or 0.3 kg/m^3
Biological Oxygen Demand for five day, BOD_5	= 250 mg/l or 0.25 kg/m^3
Biological Oxygen Demand 5 day, BOD_5 (Standard A) (10 mg/L at average)	= 20 mg/L
Population Equivalent (PE)	= 27,000 PE

In the case where there is no treatment adopted to treat those pollutants, the receiving waterbody will be exerted with the following loading of BOD5 and SS. Calculation for population loading during operation is as follow:-

Hydraulic flow, Q (daily flowrate) STP	= PE x DWF = 27,000 x 0.225m3/day = 6,705 m^3/day
Untreated Suspended Solid, SS STP	= Q x SS = 6,705 m^3/day x 300 mg/l = 1,823 kg/day
Untreated BOD loading STP	= Q x BOD_5 = 6,705 m^3/day x 250 mg/l = 1,519 kg/day
BOD loading (Standard A) STP	= Q x BOD_5 = 6,075 m^3/day x 20mg/l = 122 kg/day

Figure 5.7: Location and Distance of STP to Straits of Johor



Source:

i. Modification google earth, 2013
ii. Study on comprehensive water resources planning & development in the state of Johor, November 1994. (BAKAJ)

Note:

Normal Flow for the Three River Catchment =1MLD (0.012m3/s)

The generated wastewater will be treated before discharged into the receiving main watercourse. However, this treated wastewater could still introduce some extent of impact on the water quality of the receiving river. Thus the potential impact of the treated domestic wastewater being discharged into the waterbody needs to be assessed accordingly.

The treated sewage will be directly discharged into proposed main drain within the development area and eventually which flows to open sea (Straits of Johor). There no water intake activity at the downstream of the river where the final treated sewage will be discharged.

Based on current practice, wastewater would be channeled out to concealed drainage system after sludge process. Nevertheless, any effluent discharge would result pollution to environment. Hence, condition in-house sewage treatment plant must be well or properly maintained to ensure minimum impact.

Normally the most obvious potential impact of the treated domestic wastewater being discharged is the depletion of dissolved oxygen in the water of receiving watercourse. Based on the results of dissolved oxygen sag analysis, the following sag curve is obtained.

Should the sewage treatment plants break down; direct discharge of sewage will lead to pollution of the rivers. Organic loadings will reduce the level of dissolved oxygen in the waterbody and thus causing the river to be septic. The odour can also occur; causing nuisance to residence nearby.

DO Sag Modelling

This modeling was carried out to determine the time maximum dissolved oxygen deficit occurs and its concentration. Two scenarios will be used –maintain its existing condition and river realignment condition. DO Sag Modeling is carried out based on the Streeter-Phelps model (1925). The Streeter & Phelps model is governed by the following equation:-

$$D_t = \frac{K_1 L_a}{K_2 - K_1}\left(10^{-K_1 t} - 10^{-K_2 t}\right) + D_a 10^{-K_2 t}$$

Where,

D_t = dissolved oxygen deficit at any flow time t downstream, the flow time, t expressed in days
= saturation dissolved oxygen concentration – actual dissolved oxygen concentration
K_1 = coefficient of de-oxygenation, day $^{-1}$
K_2 = coefficient of reaeration, day $^{-1}$
L_a = ultimate BOD in the stream following mixing, mg/liter
D_a = dissolved oxygen deficit upstream of waste discharge, mg/liter

Several assumptions are taken into consideration to minimize uncertainty and reduce the complexity of the model. The assumptions and parameters used in the modeling are as follows:

i. Pollutants are point source only
ii. Baseline Water Quality
W1 (DO=1mg/l, BOD=3.9mg/l)
iii. Tidal influences are not taken into consideration
iv. Respiration, photosynthesis and sediment oxygen demand are not taken into consideration
v. Discharge quality is 20 mg/l in EQA, 1974 (normal operating condition)
vi. Mean velocity of the river, U = 0.15m/s
vii. Mean depth of the river, H=0.1m
viii. Temperature is approximately 29 °C
ix. Typical coefficients, K_1 = 0.15 (normal scenario)
x. Flow rate Water Body, Q= 0.012 m3/s - Sungai Pulai (Bakaj input)

Typical K_1 values

Environment	K_1
Untreated wastewater	0.35 – 0.7
Treated wastewater	0.10 – 0.25
Polluted river	0.10 – 0.25

Source: Gerard Kiely, 1998, Environmental Engineering, Mc Graw Hill

xi. K_2 values are computed from the assumed mean velocity and mean depth. The formula used to derive the re-aeration coefficient is from the Dorian O'Connor formula.

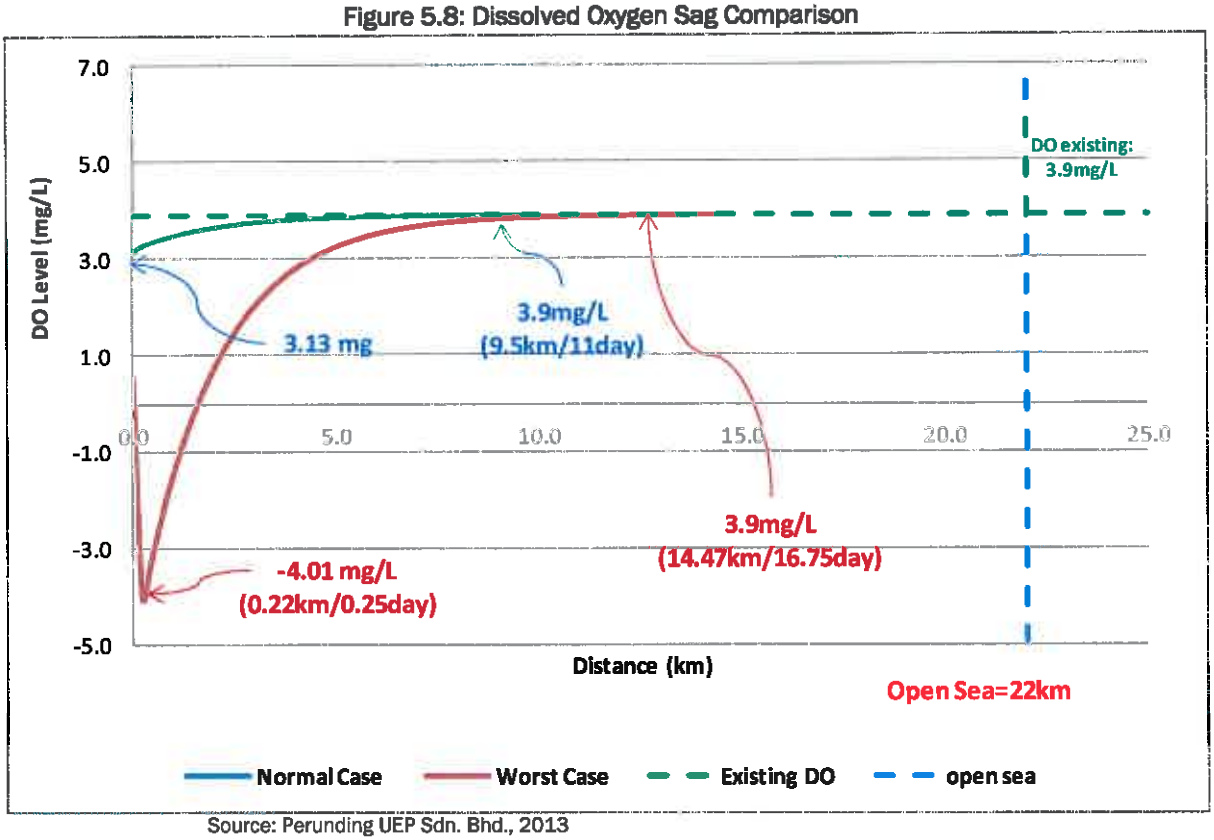
Existing Condition – Normal Case

DO levels predicted at STP discharge point is **3.13 mg/L** at discharge point and slowly increase and approximately **3.9 mg/l** to existing DO **(9.5 km)** after **11 day.**

Existing Conditions – Worst Case

DO levels predicted at STP discharge point is slowly deficit to **-4.01 mg/L** (critical deficit) after **0.25 day** at **0.22 km** before slowly increase and approximately **3.9 mg/L** to existing DO level **(14.47 km)** after **16.75 day.** Figure below present the comparison between existing and worst case condition.

Figure 5.8: Dissolved Oxygen Sag Comparison



Source: Perunding UEP Sdn. Bhd., 2013

BOD Sag Modeling

Biochemical Oxygen Demand (BOD) analysis was carried out based on the BOD_5 value from water samples taken during this EIA study. It is also assumed that the normal BOD_5 level waterbody are **1 mg/L (W1)** under normal natural conditions (existing conditions).

BOD ultimate (Lo) based on BOD_5 sampling at the site.

$BOD_5 = Lo\ (1 - e^{-k1t})$

Typical K_1 values

Environment	K_1
Untreated wastewater	0.35 – 0.7
Treated wastewater	0.10 – 0.25
Polluted river	0.10 – 0.25

Source: Gerard Kiely, 1998, Environmental Engineering, Mc Graw Hill

Kt correction formula:

$KT = K_{20}\,\theta^{(T-20)}$

Where,

$\theta = 1.047$ for $20^oC < T < 30^oC$

T = Temperature

All the assumptions and parameters used in the BOD modeling as DO calculation

Baseline Water Quality
W1 (DO=3.9mg/l, BOD=1mg/l)

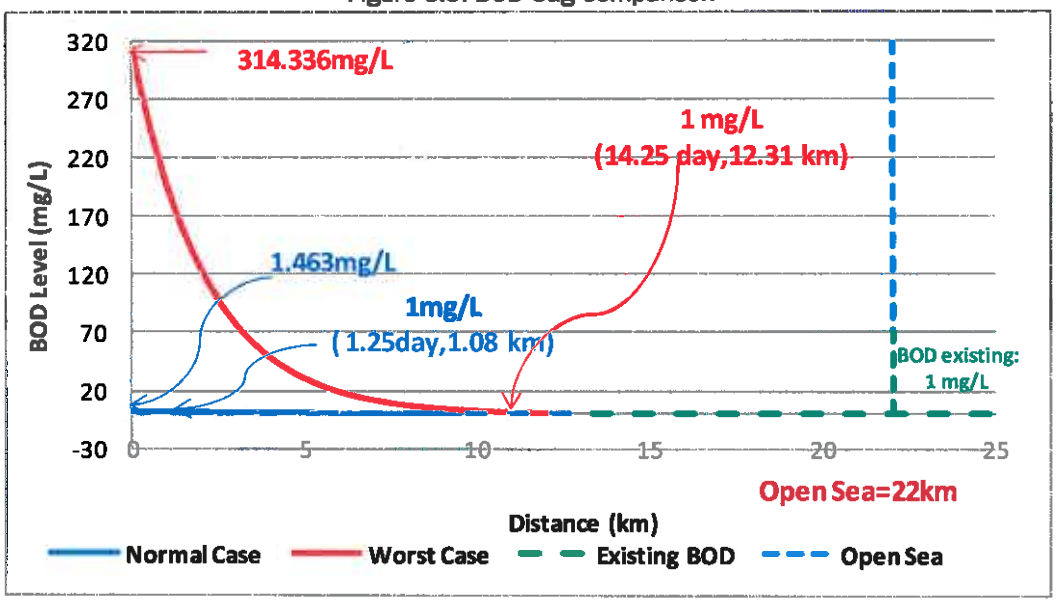
Existing Conditions – Normal Case

By using mass balance steady-state conservative system, BOD level predicted at STP discharge point is approximately **1.463 mg/L**. BOD level then will slowly decrease to existing BOD level **1 mg/L** when it reach **1.08 km** distance after **1.25 day**. Nevertheless, the results are only preliminary modeling of which many assumptions could be inaccurate. A more detailed study of water quality will have to be carried out to obtain accurate water quality behavior.

Existing Conditions – Worst Case

The above scenario describes the normal situation where the sewage treatment plant working in good condition. However , if the treatment plan is not operating as normal or break down or occurs spillage, there will be a large amount of DO's deficit where at one point there will be no DO in waterbody. At this situation, there will be the increase the concentrations of BOD approximately **314.336mg/L**. BOD level will slowly decrease **1 mg/L** to its existing condition when it reach **12.31 km** distance after **14.25 day**. The increases level of BOD will pollute the waterbody since the microorganisms living in anaerobe condition and will emit bad odour. However the this scenario are very rare since every sewage treatment plant (STP) had their own emergency action plan, which mean that when spillage or breakdown occur, there will be responsible parties to take prompt action to stop or to reduce the impact that described above. Beside those, there others factors that could deny this situation such as the vegetation around the waterbody that could supplies oxygen the water. Figure below shows the comparison between the existing (normal case) and worst case scenario if STP failure and overflow.

Figure 5.9: BOD Sag Comparison



Source: Perunding UEP Sdn. Bhd., 2013

iv. Water Reticulation System, Electrical Power Distribution and Telecommunications Systems

- The proposed site lies within the infrastructure and utilities planned in the area are sufficient to cater the projected demand because of development. It will be potentially generate disconnected of power supply such as electrical and telecommunication to surrounding area.