1.2.3 Parit Pokok Mangga

Water quality monitoring was carried at five locations at the study and the results are shown in Table IX-3. Based on the results, the main pollutants appear to be suspended solids, organic and chemical wastes. The most polluted site is PM1 which is near the sea where the suspended solids concentration is 932 mg/l, the BOD 26 mg/l and COD 134 mg/l. The other polluted site is PM3 which is near the market where the BOD and COD levels are very high (42 mg/l and 141 mg/l respectively).

1.2.4 Sg. Ayer Salak

Domestic wastewater comprising of sewage and sludge is a significant source of pollution. At present most of the study area are served by septic tanks that may not provide adequate treatment. Another sources of pollution are squatter areas along riverbanks. Water quality in Sungai Melaka reveal high levels of *E.coli* contamination that is an indication of sewage pollution.

Water quality monitoring was carried at five locations at the study area and the results are shown in Table IX-4. Based on the results, the main pollutants appear to be suspended solids and organic wastes. The most polluted site is AS4 where the suspended solids concentration is 602 mg/l, COD 96 mg/l and the BOD is 25 mg/l. AS3, AS4 and AS5 sampling sites are located near the Bukit Rambai Industrial Park and hence the poor water quality. AS4 is nearest the the industrial estate and therefore the water quality at this location is the poorest.

1.3 Ecology

1.3.1 Sg. Air Mendidih and Line G

The ecology of both priority areas in Sg. Petani is relatively sterile due to the built-up nature of the sites. The ecology is richer in the downstream stretches of Sg. Petani which are lined with mangroves particularly the *Rhizophora.*. Mangroves and gelam are important resources against river bank erosion and as well as breeding grounds for fishes and prawns. River modification and riverbank protection works may destroy these habitat and result in a loss of natural flora as well as important fishery breeding ground.

A reconnaissance survey was initially conducted to assess the types of vegetation and observe the general status and ecological condition at the site. Most of the site is agricultural area with contiguous patches of rubber and oil palm plantation. Animals found at the project site and its vicinity are those commonly associated with oil palm plantations and the clearings surrounding the area. During the site visit conducted in October 1999, fauna such as

monkeys, kingfishers, magpie robin as well as *kedidi* were sighted. The *merbok* is found in abundance at the project site, with several found every few metres on the laterite roads.

Interviews with residents revealed the existence of other fauna including wild boars, snakes, deer and monitor lizards. The amphibian and reptiles commonly found in these areas are tabulated below.

Species	Local Name	Common Name
Amphibians		
Bufo melanostictus	Katak Puru	Common Toad
Rana limnocharic	-	Grass Frog
Leptobrachium nigrops	-	Horned Frog
Reptiles		
Varanus flavescens	Biawak	Monitor Lizard
Draco volans	Cicak Kubin	Flying Lizard
Naja hannah	Ular Tedung	King Cobra
Phython reticulatus	Ular Sawa Cindai	Regal Phyton
Naja naja	Ular Tedung Senduk	Black Cobra

Source : Department of Wildlife and National Park, 1995 and Field Observation, 1999

1.3.2 Parit Pokok Mangga

This area consists of belukar and landscaped road and homes, which is mostly man-influenced and does not support much wildlife. The impact of clearing this forest would not therefore induce significant adverse impacts.

The most sensitive zones to consider in relation to the proposed development site in terms of ecology are the river reserves. These banks occupied by riverine vegetation must be preserved for mitigation purposes against soil erosion, surface run-off and to minimise the effect on water quality in the rivers. The width of land to be preserved will depend on national guidelines regarding development projects beside river banks, the contour of the riverine area and the actual width of the natural river bank. Thus the width may vary as it moves along the river. Preserving a strip of land with natural vegetation is important whether this area is privately owned or belongs to the state.

1.3.3 Sg. Ayer Salak

This area consist of vast paddy land, some old rubber plantation, belukar, landscaped road and homes which is mostly man influenced and does not support significant wildlife. The impact of clearing these areas would not therefore induce significant adverse impacts.

The most sensitive zones to consider in relation to the proposed development site in terms of ecology are riverbanks. These banks occupied by riverine vegetation must be preserved for

mitigation purposes against soil erosion, surface run-off and to minimise the effect on water quality in the rivers. The width of land to be preserved will depend on national guidelines regarding development projects beside riverbanks, the contour of the riverine area and the actual width of the natural riverbank. Thus the width may vary as it moves along the river.

2. EVALUATION OF IMPACTS

The implementation of the priority projects and the numerous activities during the construction will cause environmental impacts. This section describes the major environmental impacts that can be expected.

2.1 Sedimentation

The earthworks and grading of the land during the construction phase can lead to significant impacts in terms of soil erosion and displacement of soil particles. It is considered the most damaging phase of the development cycle for streams and other aquatic resources. Other activities such as movement of machinery and construction normally are less significant.

(1) Sg. Air Mendidih

Channel improvement works along Sg. Air Mendidih will contribute sediment to Sg. Petani. Similarly, the construction of the three detention ponds at upper Line P, upper Line O and Polis Hutan will contribute some amount of sediment. Increased sediment in Sg. Petani has the potential to cause hydrological and environmental problems such as rise in river bed, deterioration in water quality.

(2) Line G

Channel improvement is limited to a small stretch at the bottom of line G and therefore sedimentation may not be a problem. The transfer of water via the diversion channel could alter the sediment balance. The construction of the two new detention ponds at upper Line G and middle Line G will help reduce sediment delivery from the upper reaches to the lower reaches.

(3) Parit Pokok Mangga

The sediment delivery into the Parit Pokok Mangga will deteriorate water quality, riverbed, aquatic life habitat and reduced aesthetics and scenic quality of the riverside. However, the ecological resources within this stream are limited and the impacts therefore will be somewhat minimal.

(4) Sg. Ayer Salak

The main sources of sediment in this project will be during the construction of the five detention ponds and the channel improvement along Parit AB.

2.2 Impacts on River Water Quality

River water pollution comes from many sources. Construction activities such as land clearing will result in loss of nutrient and nutrient loading into the river system. This can lead to increase in suspended solids, BOD, COD, and turbidity. Subsequently, reduced dissolved oxygen in the river and depletion of aquatic life. Biomass disposal site may also contribute organic pollution in to the river system. Other important sources of pollution are the used oil and grease from construction machinery.

(1) Sg. Air Mendidih

The implementation of the five new detention ponds will lead to reduced suspended solids in the river system. The ponds will help lower the sediment load by allowing settlement. Together with the sediment particles, associated pollutants may also be reduced accordingly.

(2) Line G

At Line G, there may be water quality problems during the rehabilitation of the two ponds at Taman Keladi and Taman Sri Wangi. This is because the two ponds are currently in a poor condition with large quantities of sludge. Disposal of the sludge may pose water quality problems. The use of machinery such as backhoes and suction pumps will churn the bottom sludge leading to bad odour.

(3) Parit Pokok Mangga

Water quality problems could arise if the diversion scheme causes a reduction in dry weather flow. The Parit Lower Pokok Mangga will have a much smaller catchment area if the diversion scheme is implemented and this could lead to water quality problems due to reduced dilution effect. The upper Pokok Mangga basin could face similar problems.

(4) Sg. Ayer Salak

The construction of the five detention ponds will generally help lower pollutant levels in the Sg. Ayer Salak. The contribution of the two ponds at Middle AB11 and Middle

AB1 is a bit more complex because of the swampy nature of the ground. While the retention of the water can help reduce suspended solids and associated pollutants, there could be water quality problems arising due to the swamp. This could primarily be in terms of increased BOD and acidity.

2.3 Impacts on Air Quality and Noise Levels

At all four sites, air pollution is not expected to be a problem. The movement of vehicles to and from the site, and within the site itself, is capable of inducing adverse impacts such as littering the adjacent roadways and dust dispersions within the site on dry days. In addition, visual encumbrances may materialise. Dust generation will be pronounced during earthworks and construction activities. Dust generated by earthworks. It is thus expected to be a short-term problem. Nevertheless, such activities if carried out without due consideration can be a major problem and nuisance to surrounding population and vegetation.

During site preparation, noise will be generated by activities such as land clearing, earthworks and channel improvement. Noise generation from these activities will be variable, both in level and duration. During the construction phase, noise will be produced by machines such as dozers, backhoes, end loaders, cranes, concrete trucks and diesel generating sets. The nearby communities may experience elevated noise levels. However, the disturbances are not expected to be not significant. The proposed pumping stations at Pokok Mangga may induce additional noise but the impacts are likely to be insignificant.

2.4 Impact on Ecology

The ecological impacts are as mentioned below.

(1) Sg. Air Mendidih

The drainage improvement works at Air Mendidih are not likely to be any significant impact on the ecology. The channel improvement works in the lower reaches of Sg. Air Mendidih may cause some disturbance to aquatic lifeforms but the impacts are likely to be small.

(2) Line G

The ecological resources along Line G are limited and the drainage improvement works at Line G are not likely to be any significant impact on the ecology.

(3) Parit Pokok Mangga

This area consists of belukar and landscaped road and homes, which is mostly man, influenced and does not support significant wildlife. The impact of clearing this forest would not therefore induce significant adverse impacts.

The most sensitive zones to consider in relation to the proposed development site in terms of ecology are the river reserves. These banks occupied by riverine vegetation must be preserved for mitigation purposes against soil erosion, surface run-off and to minimise the effect on water quality in the rivers. The width of land to be preserved will depend on national guidelines regarding development projects beside river banks, the contour of the riverine area and the actual width of the natural river bank. Thus the width may vary as it moves along the river. Preserving a strip of land with natural vegetation is important whether this area is privately owned or belongs to the state.

(4) Sg. Ayer Salak

This area consist of vast paddy land, some old rubber plantation, belukar, landscaped road and homes which is mostly man influenced and does not support significant wildlife. The impact of clearing these areas would not therefore induce significant adverse impacts.

The most sensitive zones to consider in relation to the proposed development site in terms of ecology are riverbanks. These banks occupied by riverine vegetation must be preserved for mitigation purposes against soil erosion, surface run-off and to minimise the effect on water quality in the rivers. The width of land to be preserved will depend on national guidelines regarding development projects beside riverbanks, the contour of the riverine area and the actual width of the natural riverbank. Thus the width may vary as it moves along the river.

2.5 Movement of Construction Vehicles

At all four sites, there will be some impacts due to the construction traffic, which will consist of both heavy and light vehicle movements. The volume of the construction traffic will depend on the factors such as development phase, quantities of construction materials and workforce.

The main construction traffic will consist of heavy construction transport vehicles carrying construction material. Movement of trucks carrying earth will be balanced within the Project

site and the adjacent development, as most fill material will be obtained from the dredging works.

The other component of construction traffic will be ancillary light vehicular traffic that is generated by construction workforce. This will include work trips of construction workers and staffs. This will include work trips of construction workers and staff to and from their homes and also trips made by dependants of the workforce.

2.6 Disposal of Sludge and Dredged Material

The disposal of sludge will be a problem at all four sites. In the process of improving river channels, and rehabilitating retention ponds, significant amounts of sludge or dredged material will need to be removed. Sludge materials are known to contain toxic compounds namely heavy metals that could further pollute the river. Heavy metals tend to bind to sediments in the river bed and when disturbed may be released from the sediment and be adsorbed by the aquatic flora and fauna. This may then cause an accumulative effect of the surrounding biota and prove detrimental especially in view of the fact that aquaculture activities are done downstream. Water quality in the adjacent river stretches will recover with time but effects of bio-accumulation of toxic compounds on aquatic fauna is unknown.

The sludge material once removed from the river bed must be disposed at a proper site that will not cause further environmental pollution. Indiscriminate disposal of the sludge on land may cause land contamination that may release leachate into surrounding waterways. Options to dispose the sludge on sea will cause adverse impacts to marine biological life-form.

2.7 Socio-Economic Impact

The implementation and operation of the proposed projects will increase the land value and reduce occurrence of flood. There would be an improved quality of life by virtue of the drainage implementation. Provided sound conservation measures are adopted and guidelines for urban development are properly adhered to, the proposed project would result in a more optimal and productive land-use.

(1) Sg. Air Mendidih

Several minor social impacts could arise from this project. The proposed on-site detention ponds at Sek Men Sains and IKM would render the area unusable for periods of time as well as cause unaesthetic conditions after the flood has subsided. The channel improvement along the lower reaches may require land acquisition. Some houses are located very close to the riverbanks and the construction works may

cause nuisance conditions to the households. The construction of the three detention ponds is not likely to cause any significant socio-economic impacts.

Fifteen (15) residents in the vicinity of the proposed drainage works were interviewed using a structured questionnaire (refer to Table IX-5). Although all respondents viewed the proposed drainage works positively, they were of the opinion that there could be problems during the construction period. Most respondents thought that flooding, pest and smell could be a problem during the construction stage.

(2) Line G

As at Air Mendidih, the social impacts, if any, would arise from the channel improvement works along the lower reaches of Line G and along Parit AB11. There are several houses very close to the stream and the channel improvement works will cause adverse impacts.

Ten (10) residents in the vicinity of the proposed drainage works were interviewed using a structured questionnaire (refer to Table IX-5). Since most respondents were living in areas subject to frequent flooding, all of them viewed the proposed project positively. As with residents at Air Mendidih area, most respondents anticipated problems during the construction phase, namely smell, pests and flooding.

(3) Parit Pokok Mangga

The channel improvement along the Parit Pokok Mangga may require land acquisition. Considering that some houses are located very close to the stream banks, the construction works may cause nuisance conditions to the affected households. Similarly, the construction of the new trunk drains in the lower Pokok Mangga basin could cause nuisance conditions. The use of machinery such as backhoes and suction pumps during the rehabilitation of detention ponds will churn the bottom sludge. This will cause bad odour and may be a nuisance to nearby residents.

Ten (10) residents in the vicinity of the proposed drainage works were interviewed using a structured questionnaire (refer to Table IX-6). All respondents seemed to view the project positively, saying that it would lead to overall improvements in landscape and water quality. Some respondents anticipated problems during the construction periods such as pests, smell and flooding.

(4) Sg. Ayer Salak

The channel improvement along the Parit AB may require land acquisition. Some houses are located very close to the riverbanks and the construction works may cause nuisance conditions to the households. The rehabilitation of the Bukit Rambai detention pond will be a positive social impact as the resident in the area have put up with the poor condition for many years. There could be increased odour during the rehabilitation period but this is expected to be a short-term problem.

Fifteen (15) residents in the vicinity of the proposed drainage works were interviewed using a structured questionnaire (refer to Table IX-6). As in Pokok Mangga, most respondents viewed the proposed project positively. Almost all respondents thought that the project will lead to improvement in landscape, water quality and tranquillity.

3. MEASURES FOR ENVIRONMENTAL IMPROVEMENT

Measures to prevent, alleviate or remedy the anticipated impacts evaluated to be significant are discussed in this section. Mitigation measures listed for implementation during the construction phase should also be specified in the Contract Documents, which regulate the performance of contractors involved in the construction. Based on the initial screening of impacts from the proposed urban drainage improvement works, the following preliminary recommendations are proposed.

3.1 Sedimentation Control

Sedimentation can be controlled via a series of measures. These measures include:

(a) Sediment Retention Pond
(b) Sediment Basin
(c) Filter Dam and Sediment Weir
(d) Sump
(e) Sump Pit
(f) Vegetative Buffer Strip
(g) Shake Down Area

In order to sedimentation, turfing shall be carried out as soon as practicable on all earth slopes and other slopes. Silt trap or sediment basin should be built to minimise the amount of sediment leaving the construction site into rivers/ streams and other water bodies. This is

important to protect the quality of water in the stream as well as to avoid liability due to excessive siltation downstream.

The Contractors must be aware that silt traps are temporary structures and shall be removed upon completion of the development. The silt trap must be sited in a manner that failure of the structure would not result in loss of life or interruption of use or service of public utilities. The catchment area upstream of a single silt trap should not be greater than 60 hectares.

3.2 Disposal of Construction Debris

Liaison shall be made with the appropriate Local Authority on suitable sites where construction spoils and waste material can be adequately disposed. The manner, in which the disposal shall be carried out including the essential precautions to be taken to minimize water and air pollution, drainage impedance, fire hazards and disruption to ecosystems, shall be verified and agreed upon.

Wastes generated during the construction phase, especially oil and grease from machinery, can impose severe pollution on the streams. Contractors and construction workers have a reputation for not caring for cleanliness of the surrounding area, much less for the streams they cannot see. It must be included in terms and conditions of Contract that wastes during construction period are removed from the Project area. It is also strongly recommended that supervision from the consulting engineers be extra stringent during the period of construction.

The Contractor shall refrain from disposing off used oil and grease from his equipment and machinery into streams, drains or pools or vegetation in the area. The Contractor shall provide for the prompt removal of all oil and grease spillage from his or his sub-contractor's vehicles and equipment by reason of his work or carelessness in execution of the Works. The Contractor shall take such measures necessary to collect and store used oil and grease from his vehicles and machinery in a manner deemed proper for the prevention of pollution to adjacent watercourses and groundwater.

3.3 Dust Control

There is some concern over noise and dust impacts, which can cause inconveniences to the population in the adjacent areas. Machinery operating in these sectors could generate sufficient fugitive dusts for dispersion effects to be felt within the adjacent housing estates. In order to mitigate this, controlled wetting of the exposed earth shall be periodically carried out. This would tend to bind the loose soil particles and lessen the amount of dust that is generated. A further measure to reduce dust dispersion is to limit the speed of travel of earth

moving equipment and dump trucks as the amount of dust dispersion is related to vehicle speed. For similar reasons open burning of vegetative residues shall be prohibited.

The Contractor shall provide suitable spraying equipment for regular spraying of water over the existing roads used by the Contractor and over completed as well as incomplete road and other barren areas of the site and as and when directed by the Engineer.

The Contractor shall provide for the prompt removal of all dirt and other materials spilled from his or his sub-contractor's vehicles on public or private roadways over which such materials are hauled or on to which such materials are dumped, washed or otherwise deposited by reason of his work or carelessness in execution of the Works and avoid interfering with drainage or creating a traffic hazard to vehicles or impeding the passage of pedestrians. In order to suppress dust from being transported outside the site and on to public roads by construction equipment and dump trucks, it is essential to ensure that such vehicles are washed prior to their leaving the site. In addition they must be made to drive through a pool of water formed at the exit point.

3.4 Noise Control

Hoarding must be put up along the boundary of the Project area to further mitigate against adverse noise, fugitive dust and visual aesthetic impacts. All work shall be carried out without unreasonable noise and disturbance. The Contractor shall indemnify and keep indemnified the Employer from and against any liability for damages on account of noise or other disturbance created while or in carrying out of the Works and from and against all claims demands proceedings damages costs charges and expenses whatsoever in regard or in relation to such liability.

The Contractor shall ensure that all equipment and machinery are in proper working condition so as to minimise the amount of noise generated. The Engineer may require the Contractor to replace any machinery that to his discretion is emitting excessive noise. The Contractor shall comply with the general recommendations set out in BS 5228: Code of Practice for Noise Control on Construction and Demolition Sites.

Noise emanating from the pumping stations can be minimized by provision of proper housing and maintenance.

3.5 Protection of River Water Quality

Domestic sewage originating from proper residential houses as well as squatter areas will need to be treated prior to discharge into drains and rivers. This will call for the

implementation of a centralized sewage system for the study areas especially the urban centres. The current method of treatment with septic tanks is insufficient to ensure the river water quality. This will also call for the relocation of squatters living in the drainage and river reserves.

Existing urban runoff are channelled into the retention ponds within the study area. This significantly contaminated water will have to be treated prior to discharge. Therefore a possible treatment option will include converting an existing retention pond with sufficient space to a constructed wetland as means of treating the water.

Industrial effluents will have to be controlled to prevent degradation of river water quality. The rising trend in of growing industrial areas in the study area may not prove to be beneficial to the rivers that receive the waste effluent. Strategies in tackling these issues will have to involve both management and technological measures. Management measures will include the proper siting of industries as well as screening of polluting industries. Technological measures will include the implementation of cleaner technology such as zero discharge of wastewater and good housekeeping practices.

3.6 Channel Dredging

Proper dredging and disposal of sludge will need to be carried out for all four sites. The sludge material will need to be assessed to determine its toxicity and contaminants. A number of disposal options are available depending on the toxicity of the sludge.

(1) Non-Toxic

(a) Off-shore disposal

(b) The sludge material can be composted and subsequently applied for agricultural purposes. Nevertheless, the sludge material also has been found to contain high levels of sodium chloride content that may render it unsuitable for agiculture.

(c) The sludge materials to be used as fill material along the river corridor. This may cause odour problems in the initial stages. The sludge material will also eventual decompose and load the river with organic and nutrients.

(d) In Sg. Petani, the sludge materials to be disposed in the Merbok Forest Reserve adjacent the tidal swampland with an estimated cost of RM 2.5 million

(Perunding Bakti, 1997). This measure has the potential to reduce much of the organic load and heavy metals similar to the function of constructed wetlands.

(2) Toxic

(a) In the event, that sludge is found to contain the toxic materials, it should be disposed as hazardous waste through a company in Malaysia that is licensed to treat toxic waste. The cost will be high depending on the type of toxic contaminants detected in the sludge material but other methods of disposal may still cause environmental contamination.

(b) Dredging will have to taken into account the potential impacts on fisheries and aquatic resources.

(c) Temporary diversion of the stretches undergoing dredging should be considered. If possible the dredged area should be allowed to stabilize prior to allowing free flow of water again.

3.7 Natural River Engineering

Channel modification should include 'natural river engineering' whereby wildlife conservation and natural beauty are enhanced. This means engineering a river that resembles the natural river. This encourages the formation of a rich and stable ecosystem. Currently there have not been specific areas identified for river improvement works. As such mainly general principles are outlined below for an environmentally friendly approach to river engineering. The characteristic of natural river that are to emulated are as follows:

(a) There should be wide and narrow spans along the river to increase habitat diversity. Thus angle of slope of the banks and the width and alignment of the channel and berm should be varied.

(b) There should be areas of soil accumulation as well as areas of soil erosion.

(c) There should involve the construction of low flood banks set back from the river or retarding basins which allow for overflow on to land used for recreational purposes.

(d) There should be areas for flora and fauna to exist in large numbers especially in certain conditions along the river.

Natural boulders and rocks of significant sizes should be left to provide places for refuge and rest for fish especially during excavation works.

3.8 Rehabilitation of Detention Ponds

One of the key recommendations in the priority projects is the rehabilitation of existing detention ponds. While the rehabilitation of these ponds will lead to an overall improvement in water quality, aesthetics and public health, the process of rehabilitation could lead to some adverse impacts, albeit in the short-term.

The clearing of the rubbish, scum, weeds and accumulated bottom sediments will cause short-term water quality problems in the downstream areas. The use of machinery to dredge out the bottom sediment will cause resuspension of bottom sediment and coupled with other pollutants. An important measures during the rehabilitation period is to ensure that discharge from the detention pond is stopped during the dredging period.

The wet retention ponds could also be utilized for fish breeding such as the one in Kawasan Industri LPK as they function to control mosquito breeding.