2.2.3 Sg. Lereh

The main tributaries of Sg. Lereh are Sg. Udang and Sg. Seberang Gajah that flow in the north-east direction before join into Sg. Lereh and later into the Straits of Melaka. Sg.Udang which has its origin from the forest reserve passes through agricultural areas and traditional villages. The major pollution sources are effluent from the Industrial estates and also nutrien-laden runoff from the agricultural areas. The Sg. Seberang Gajah passes mainly through agricultural areas.

3. ENVIRONMENTAL ISSUES

The main environmental issues related to urban drainage improvement works are highlighted below in relation to probable improvement works in the study area and are as listed below :-

3.1 Channel Dredging

Dredging is expected to be done in the Sg. Petani river adjacent the town area to remove sludge as well as for Sg. Melaka adjacent the Batu Berendam area. Sludge and riverbed sediment 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.

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

Previous study on the river bed (JPS, 1990) in the Sg. Petani town area has revealed the presence of sludge material from deposits of organic and solid wastes over the years. The sludge consists of silt, nutrients and organic matter such as rotting vegetation and toxic substances namely heavy metals. The sludge thickness in the river varies from 2.7-4.0 m. The organic matter undergoes decomposition under anaerobic conditions and when disturbed releases foul odour and gases.

Thus the dredging of the Sg. Petani river bed to enlarge the channel to increase the capacity of the river will also involve clearing the river of the sludge material. Impacts arising from dredging the Sg. Petani riverbed include:

(a) An estimated 150,000 m3 of sludge will need to be removed from the Sg. Petani riverbed. 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.

(b) 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.

(c) Dredging may also include other rivers in the study area. Generally dredging activities here is expected to be not as severe as for Sg. Petani. The main impacts will include benthic disturbances, water quality degradation and impacts on aquatic organisms and water and soil contamination resulting from improper disposal of dredged material. The constituents and environmental quality of the dredged material will have to be studied in order to advocate proper methods of disposal.

3.2 Water Quality

Domestic wastewater comprising of sewage and sullage are a significant source of pollution especially in the town centre. At present most of the study area is served by septic tanks that may not provide adequate treatment. Previous study (MDKM, 1992) indicate that there are 5 imhoff tanks, 6 oxidation ponds and RBC which serves the various housing schemes and commercial centres. Another sources of pollution are squatter areas along riverbanks especially along Sg. Petani. There are approximately 16 squatter settlements along Sg. Petani and its tributaries. Most of these homes are temporary wooden structures that results in discharging of garbage and raw sewage into the river indiscriminately. Water quality data on Sg. Petani and Sg. Bakar Arang indicate that it is highly polluted with *E. coli*, an indicator of sewage pollution.

The water quality noted here is typical of urban areas where surface runoff from these areas collect a wide range of pollutants especially organic matter originating from sewage. Most of the septic tanks utilized in the area tend to overflow to the surrounding drain and thus flows into the river. The effluent though partially treated are still a significant source of BOD loading in the river. Sewage from squatter houses on the other hand usually do not go through any form of treatment prior to being discharged into the river.

The other associated water quality problems is the greatly enhanced nutrient levels especially inorganic forms of phosphorus and nitrogen. Water entering the Sg. Petani town may already carry a considerable burden of nutrients originating form the surrounding agricultural lands but large extra amounts are added by sewage treatment facilities that are only designed to remove organic matter and other suspended solids. This thus causes eutrophication of water that eventually leads to massive algae blooms as evidenced in many of the rivers and retention ponds in the study area. When the algae die, their decay can produce deoxygenating and thus the deterioration in water quality.

Water pollution problems in the study area if not tackled will consequently effect the urban drainage improvements works by negating any positive benefits. Deterioration in water quality may cause river and streams to be eutrophicated and eventually clogged by water lilies. This reduces water flow and decreases the capacity of the water body thus possibly leading to flooding in extreme situations and negating the positive benefits derived from urban drainage improvement works.

3.3 Ecological Destruction

River improvement works traditionally are known to destroy various habitats and environmentally sensitive areas in order to order to alleviate flooding. This usually results in wide straight rivers running in deepened beds between high uniformly strengthened banks. Alternatively streams may be removed from the landscape altogether by culverting. The course of such urban drainage works in the study area may cause negative impacts to the environment. These impacts are:

(a) The destruction of trees and shrubs growing besides water courses is particularly contentious as increased light levels tends to accelerate weed growth which itself can create a flooding hazard. This will be particularly significant in the more larger rivers such as Sg. Petani and Sg. Pasir.

(b) The downstream stretches of Sg. Petani are lined with mangroves particularly the *Rhizophora*. The mangroves extend approximately upstream until the Sg.

Petani-Sg. Bakar Arang confluence. Urban construction activities especially adjacent the river bank have had considerable negative impacts to the mangroves. Mangroves are an important resource against river bank erosion and as well as breeding grounds for fishes and prawns. River modification and riverbank protection works may destroy the mangrove habitat especially along the banks of Sg. Petani. This will result in a loss of natural flora as well as important fishery breeding ground in view of the aquaculture activities downstream.

(c) Channelization and channel modification activities can lead to a loss of instream and riparian habitat and ecosystems. Rivers that are simple with a channel that is relatively uniform along its length would in turn have a water flow with uncomplicated characteristics. As a result the simple environmental conditions around the river would produce an ecosystem that is unstable and lacking in diversity. This is expected to be significant especially in the major rivers such as Sg. Petani, Sg. Pasir and Sg. Lalang. Problematic flow modification may sometimes result in reversal of flow regimes and disorientation of fish that swim to breeding areas. Eroded sediments may deposit in new areas covering benthic communities and altering instream habitats.

3.4 Retention Ponds

There are a large number of retention ponds in Sg. Petani and Melaka, mostly being wet retention ponds. This large number though extremely beneficial and proactive for the purpose of flood attenuaiton, suffers from other environmental problems. A large number of these ponds are poorly maintained with related problems such as water stagnation due to eutrophication and water lilies. These ponds also receive rubbish and sewage from the surrounding areas thus compounding the problem. The main impacts from these ponds are:

(a) Deterioration of water quality in these ponds may pose a health hazard due to accumulation of scum and sludge. These may cause proliferation of infectious microorganism and pests that will eventually contaminate the surrounding water bodies. Thus water quality leaving these retention ponds do not improve but may rather deteriorate.

(b) Algae bloom and proliferation of water lilies has reduced the water flow in these ponds as well as reduced the retention capacity of the pond. This

inevitably reduces the effective function of these ponds and as such in the long term may pose problems leading to flooding.

(c) Some of these wet retention ponds take up large areas that can actually be more beneficial and cost efficient if they were converted to dry ponds.

3.5 Industrial Effluent

The two main industrial areas in Sg. Petani area are the Bakar Arang industrial area and the LPK Sg. Petani industrial area. Both these industrial areas drain into Sg. Petani and Sg. Lalang respectively. In Melaka, the main industrial areas are Cheng Industrial Park, Kerubung Industrial Park, Batu Berendam Industrial area and Air Keroh Industrial estate. The main industry types here are electronics, manufacturing rubber and plastic products, food and beverage, tobacco and timber products. The main impacts from these industries are toxins a variable group of contaminants. Among the commonest are the heavy metals, cyanides and phenols. The continual discharge of these effluents will contaminate the river water and soil that may eventually produce dead stretches of rivers in extreme circumstances.

4. RECOMMENDATIONS

Based on the initial screening of impacts from the proposed urban drainage improvement works, the following preliminary recommendations are proposed:

4.1 Channel Dredging

Proper dredging and disposal of sludge from Sg. Petani will need to be done. The sludge material will need to be assessed to determine its toxicity and contaminants. If found to be non-toxic a number of disposal options are available.

(1) Non-Toxic

(a) Off-shore disposal approximately 30 km from site with an estimated cost of RM 4.5 million (Perunding Bakti, 1997).

(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) 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 the sludge material is found to be toxic then the only recourse will be to dispose the sludge material to Kualiti Alam as hazardous 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 especially in the Sg. Petani river. Dredging activities and impacts on the mangrove area along Sg. Petani should be minimal.

(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.

4.2 River Engineering

(1) 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.

(2) Vegetation should be use to protect the river banks especially areas that are prone to erosion. The existing mangroves and nipah along the banks of Sg. Petani, Sg. Pasir and Sg. Lalang should be preserved to act as natural riverbank erosion control mechanisms. Of significance are the *Rhizophora* that line the banks of Sg. Petani. Along stretches of river where vegetation clearing is necessary for channelization, it is essential that similar or suitable flora be replaced to re-establish nature's system to filter pollutants from surface runoff and provide a habitat for fauna.

(3) Spur dikes and weir should be used if possible to reduce the effects of erosion caused by water flow. They help decrease the gradient of the riverbed and slow down the flow of the river. Though most of the rivers in the study area appear slow moving, such structures will prove to be useful during flood events as well as to purify the water through aeration. Nevertheless, these structures may not prove to be useful in relatively shallow streches of rivers such as Sg. Tukung and Sg. Layar Besar.

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

4.3 Retention Ponds

The overwhelming number of retention ponds in the study area serves a useful purpose in alleviating flood events. Nevertheless, the present state of these retention ponds should be improved in order to ensure that it functions efficiently as well as effectively. Therefore the following are suggested:

(a) The existing wet retention ponds should be converted to dry retention ponds. This will reduce or eliminate the current problem of the accumulation of scum and rubbish as well as the potential outbreak of water borne diseases in the area. The full buffering capacity of these ponds will also be achieved since it would no longer be affected by eutrophication and infestation by water lilies that reduce its retention capacity. Furthermore, the conversion of these ponds to dry retention ponds would also enable the area to be used for other purposes

such as recreational or as for parking. The conversion of these wet ponds to dry ponds would be relatively simple that is by lowering the outlet of the pond in relation to its inlet. A channel to drain the dry flow can be placed along the border of the pond to enable maximum unhindered use of the pond for other purposes.

(b) The existing retention ponds should also be desludged and cleared of accumulated rubbish and scum. The rubbish traps at the inlet of these retention ponds should be cleared more frequently as compared to the current frequency of twice a year.

(c) Wet retention ponds should also be utilized for fish breeding such as the one in Kawasan Industri LPK as they function to control mosquitoe breeding.

(d) Retention ponds that are relatively small should not be constructed, as they may not be capable of functioning effectively such as the ones in Taman Permai in Sg. Petani.

4.4 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. This will also call for the relocation of squatters living in the drainage and river reserves.

A possible treatment option will include converting an existing retention pond with sufficient space to constructed wetlands as means of treating the water. Constructed wetlands are able to remove a wide variety of contaminant such as heavy metals and organics.

Industrial effluents will have to be controlled to prevent degradation of river water quality. Strategies in tackling these issues will have to involve both management and technological measures.

4.5 Land Use Planning

The proper management of water quality in the rivers within the study area will be of utmost important to ensure that the urban drainage improvement works derive its maximum benefits. The main areas that will need to be tackled are as follows:

(a) 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.

(b) Existing urban runoff are channeled 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. This will have to be implemented as a demonstration project in one of the larger retention ponds such as the one in Taman Sejati Indah, Taman Ria or Taman Ria Jaya. Constructed wetlands are able to remove a wide variety of contaminant such as heavy metals and organics.

(c) 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.