SUNGAI LANGAT

STATE OF THE RIVER REPORT 2015

Industrial

SUNGAI LANGAT

STATE OF THE RIVER REPORT 2015

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ACRONYMS

ABASS	Konsortium Aliran Bekalan Air Selangor Selatan Sdn. Bhd.
APMM	Agensi Penguatkuasaan Maritim Malaysia / Maritime Enforcement Agency Malaysia
ASEAN	Association of South East Asian Nations
BOD	Biochemical oxygen demand
COD	Chemical oxygen demand
DAF	Dissolved air flotation
DBKL	Dewan Bandaraya Kuala Lumpur / Kuala Lumpur City Hall
DOA	Jabatan Pertanian / Department of Agriculture
DOF	Jabatan Perikanan / Department of Fisheries
EIA	Environmental Impact Assessment
EPU	Economic Planning Unit
FRIM	Forest Research Institute Malaysia
GEC	Global Environment Centre
GPT	Gross pollutant trap
GRT	Gross rate tonnage
IADA	Integrated Agricultural Development Area
ISO	International Standard Organisation
IWK	Indah Water Konsortium Sdn. Bhd.
JAS	Jabatan Alam Sekitar/Department of Environment
JKNS	Jabatan Kesihatan Negeri Selangor / Selangor State Department of Health
JKT	Jabatan Kerajaan Tempatan / Department of Local Government
JKPTG	Jabatan Ketua Pengarah Tanah dan Galian/ Department of Director General of Lands and Mines
JKR	Jabatan Kerja Raya / Public Works Department
JLM	Jabatan Laut Malaysia / Marine Department Malaysia
JMG	Jabatan Mineral dan Geosains / Department of Mineral and Geoscience
JPBD	Jabatan Perancangan Bandar dan Desa / Department of Town and Country Planning
JPNS	Jabatan Perhutanan Negeri Selangor / Selangor Forestry Department
JPP	Jabatan Perkhidmatan Pembetungan/ Sewerage Services Department
JPS	Jabatan Pengairan dan Saliran / Department of Irrigation and Drainage
JPSPN	Jabatan Pengurusan Sisa Pepejal Negara / Department of National Solid Waste Management
JPV	Jabatan Perkhidmatan Veterinar / Department of Veterinary Services
JUPEM	Jabatan Ukur dan Pemetaan Malaysia / Department of Measurement and Maps Malaysia
KKM	Kementerian Kesihatan Negara / Ministry of Health
KeTTHA	Kementerian Tenaga, Teknologi Hijau dan Air / Ministry of Energy, Green Technology and Water

KISDAR	Kolej Islam Selangor Darul Ehsan
KPI	Key performance index
KUIS	Kolej Universiti Islam Antarabangsa Selangor
KSSB	Kumpulan Semesta Sdn. Bhd.
LKIM	Lembaga Kemajuan Ikan Malaysia / Malaysian Fisheries Development Authority
LLM	Lembaga Lebuhraya Malaysia / Malaysian Highway Authority
LUAS	Lembaga Urus Air Selangor/Selangor Water Management Authority
MARDI	Institut Penyelidikan Dan Kemajuan Pertanian Malaysia / Malaysian Agricultural Research Development Institute
MCM	Million cubic metre
MLD	Million litres per day
MNS	Malaysian Nature Society
MOA	Kementerian Pertanian dan Industri Asas Tani Malaysia / Ministry of Agriculture and Agro-Based Industries
MyGAP	Malaysian Good Agricultural Practices
NAHRIM	National Hydraulic Research Institute Malaysia
NGO	Non-governmental organisation
NH_3-N	Ammoniacal nitrogen
NTU	Nephelometric turbidity unit
PAAB	Pengurusan Aset Air Berhad
PAMPS	Penyaluran Air Mentah Pahang Selangor
PE	Population equivalent
PERHILITAN	Jabatan Perlindungan Hidupan Liar dan Taman Negara/ Department of Wildlife and National Parks
PNSB	Puncak Niaga (M) Sdn. Bhd.
RDF	Refuse derived fuel
SAAB	Sijil Amalan Akuakultur Baik / Good Aquaculture Practice Scheme
SPAN	Suruhanjaya Perkhidmatan Air Negara / National Water Services Commission
SPLAM	Skim Pensijilan Ladang Akuakultur Malaysia / Malaysian Aquaculture Farm Certification Scheme
SPLASH	Syarikat Pengeluar Air Sungai Selangor Sdn. Bhd.
SS	Suspended solids
STATS	Jabatan Perangkaan / Department of Statistics
STP	Sewage treatment plant
SYABAS	Syarikat Bekalan Air Selangor Sdn. Bhd.
TN	Total nitrogen
TOL	Temporary occupation license
TP	Total phosphorus
TSS	Total suspended solids
UKM	Universiti Kebangsaan Malaysia
UPEN	Unit Perancangan Ekonomi Negeri / State Economic Planning Unit
VFS	Vegetative filter strips
WQ	Water quality
WQI	Water quality index
WSIA	Water Services Industry Act
WSP	Water Safety Plan
WTP	Water treatment plant

WHAT IS THE STATE OF THE RIVER REPORT?

This is the fourth edition of the State of the River Report produced by Lembaga Urus Air Selangor (LUAS). Starting with the first edition in 2006, the reports have been providing a snapshot of the river's health in five year intervals. This latest report covers the period from 2012 to 2015.

The river's health is reported and assessed from various perspectives, including water quality, water availability, level of water stress in the river basin, and river ecology. The report also looks at human activities within the river basin that may contribute as sources of pollution and degradation of the riverine ecosystem and the impacts that they have on humans and the environment.

The role of the State of the River Report is to highlight issues and inform its readers on the status of the various facets of the river basin. As such, this report will be divided into several parts:

About the River Basin provides an overall overview of the river basin.

State of the River 2012-2015 gives an indicator of the health of the river and highlights issues or matters of significance that should be considered and addressed by river basin managers and relevant government agencies for future planning and action.

Resources in the River Basin is a handbook that presents some facts and figures on the availability of the water resources and various activities within the basin.

River Related Activities and Sources of Pollution present the various human activities in the river basin and how they generate pollution.

Impacts of Pollution and Human Activities presents the downside of human activities and how it affects humans as well as the ecosystems around them.

Interspersed throughout the sections are issues and challenges as well as suggestions made by various stakeholders in addressing these problems.

In the spirit of Integrated River Basin Management, which requires participation and coordination by all agencies related in some way to the rivers' waters—either in water resources management, water abstraction, consumption, monitoring or any other use—the State of the River Report serves to inform and unify all agencies towards better stewardship of our ever-increasingly precious resource, our river water.

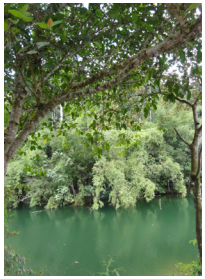
Why Should We Care?

Simply put, water is life. As stated in Malaysia's water vision for the 21st century, water sustains all aspects of human livelihood. To continue growing as a nation in a sustainable manner, we must consider:

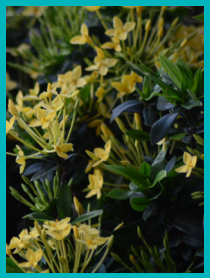
- **Water for people:** universal access to safe, adequate and affordable water supply, hygiene and sanitation
- **Water for food and rural development:** provision of sufficient water that will ensure national food security and promote rural development
- **Water for economic development:** provision of sufficient water to spur and sustain economic growth within the context of a knowledge-based economy and e-commerce
- **Water for the environment:** protection of the water environment to preserve water resources (both surface water and groundwater) and natural flow regimes, bio-diversity and the cultural heritage, along with mitigation of water-related hazards

But at the same time that we are growing dependent on access to more water, the amount of water available to us to is diminishing. While the demand for water is increasing, irregularities in seasonal weather patterns divert rainfall from critical catchment areas or result in deluge of torrential rainfall or floods that flow water out towards the sea. However, water shortages and other river related problems are not caused only by acts of nature; human oversights in proper water resource management make the situation even more critical.

Thus, proper water resource management at the state and federal levels is key to safeguarding and ensuring the sustainability of our river basins. Through this report, LUAS aims to create a platform for future discussion and joint problem-solving among agencies towards a future where the coming generations can continue to enjoy the beauty and bounty of our rivers.



Pristine waters of upper Sungai Langat



Flora along Sungai Langat

Contributors to this Book

The State of the River Report 2015 was commissioned by LUAS, the water resources management board for the State of Selangor. Its functions include managing the state's water resources to ensure good quality water in sufficient amounts to meet the state's economic and social needs.

However, as a report of the river includes perspectives from various sectors, other agencies contributed to the contents of this report. Thus, the contents presented within this report came from comments, feedback, and input from various agencies and organisations within Selangor.

LUAS wishes to thank all agencies that contributed to the content of this report and aspires for the book to initiate further collaboration and coordination in an integrated approach to river management. A list of all the contributors is can be found in Appendix E of this report.

How Sungai Langat Got Its Name

Sungai Langat was named after the town located at the river's estuary. 'Langat' is derived from the Minangkabau word that means 'air hangat' or lukewarm water. The name was given by traders who found that the river water near the estuary was always warm.

Other sources say that the presence of the Selangat fish that was often caught by fishermen gave rise to the name.

Malayan Peninsula. View of a Chinese village at Langat in Jugra, Straits Settlement, June 1874
Source: The National Archives (United Kingdom)

ABOUT THE **RIVER BASIN**

THE RIVER BASIN

Sungai Langat tributaries:

Sg. Mersing	*Sg. Pangsoon*
Sg. Congkak	*Sg. Batang Nilai*
Sg. Lui	*Sg. Ramal*
Sg. Lenggeng	*Sg. Pajam*
Sg. Gabai	*Sg. Tekala*
Sg. Gemi	*Sg. Saring*
Sg. Batang Ai	*Sg. Rinching*
Sg. Chua	*Sg. Jenderam*
Sg. Chincang	*Sg. Banting*
Sg. Keluang	*Sg. Deman*
Sg. Dua	*Sg. Semungkis*

Location

The Sungai Langat basin is the second largest river basin among the seven basins in Selangor with a length of approximately 200 kilometres and an area of 2,423 square kilometres. It extends into two states, with 76% of the river basin in Selangor and 20% in Negeri Sembilan. A smaller portion of the basin, about 4%, covers part of the Federal Territory of Putrajaya and the Klang and Petaling Jaya districts. The river basin originates from the Titiwangsa Range in Gunung Nuang before draining into the Straits of Melaka.

Tributaries

The main tributaries of the Sungai Langat Basin are Sungai Semenyih, Sungai Beranang, and Sungai Labu. There are 40 other smaller tributaries.

Major Towns and Administrative Bodies

The basin has eight city councils and district offices. The major towns and cities are Bangi, Kajang, Sepang, Dengkil, Hulu Langat, Cheras, Nilai, Banting, Putrajaya, and Semenyih.

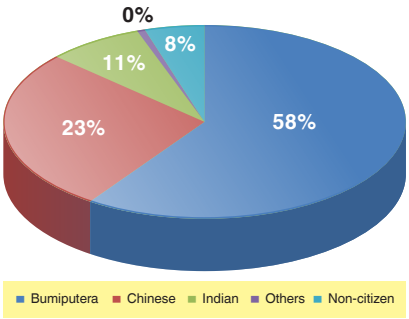
STATE / TERRITORY	DISTRICT
Selangor	Majlis Perbandaran Klang Majlis Perbandaran Kuala Langat Majlis Perbandaran Kajang Majlis Perbandaran Sepang
Negeri Sembilan	Majlis Perbandaran Nilai
Federal Territory of Putrajaya including Cyberjaya	Perbandaran Putrajaya, Cyberjaya
Federal Territory of Kuala Lumpur	Dewan Bandaraya Kuala Lumpur

Jabatan Perangkaan
MALAYSIA

***DOSM** is an agency that provides statistical services and conducts census of the population*

Population

The population of the Sungai Langat basin for 2015 is based on the 2010 census taken by Jabatan Perangkaan Malaysia (DOSM). The 2015 population for the basin is approximately 1,499,079. Bumiputeras make up the majority at 869,466 (58%) while the Chinese number at 344,788 (23%) and Indians at 164,899 (11%). Denizens of other races make up the balance at 119,926 (8%).

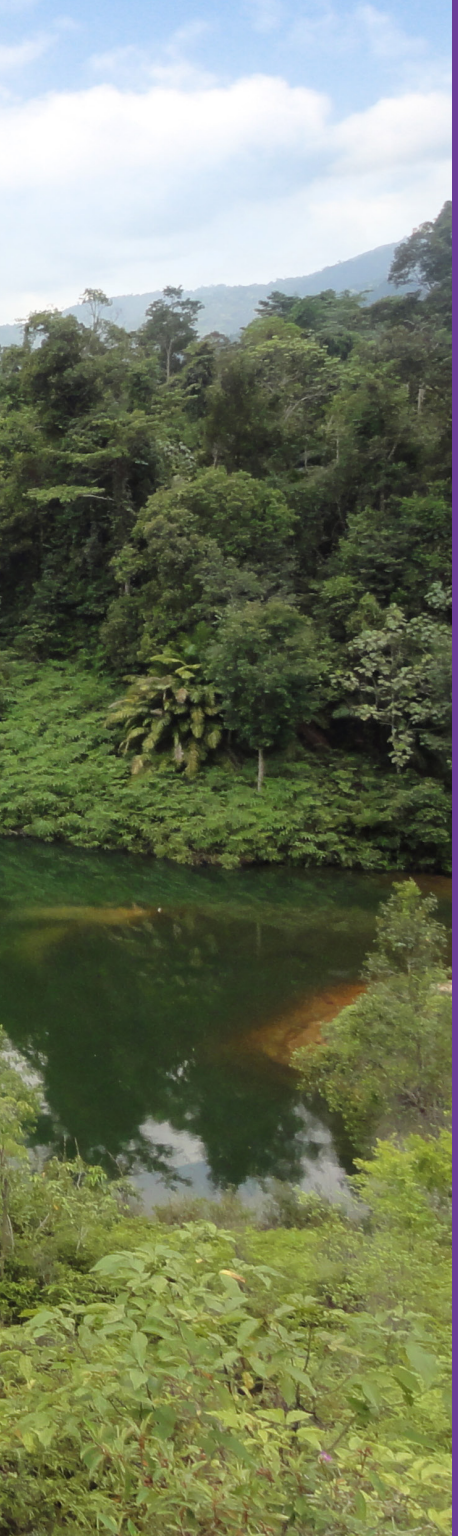


Breakdown of the Sungai Langat basin population

Main Uses of the River

The Sungai Langat basin has undergone widespread development involving many activities such as urban and industrial land development, agriculture, sand abstraction, quarrying, and navigation. The river provides important natural resources to support economic activities in the state. One of the resources is water: the river supplies about 1,000 million litres per day (MLD) of potable water, which is about 30% of the total supply requirement of Kuala Lumpur and Selangor.

Another important activity is sand mining. Large tracts of sand exist in tin mine tailings and along certain river stretches. Categorised as 'industrial sand', it is used for road construction to meet the needs of the growing construction industry. Further downstream, the river is used by barges to transport scrap iron. Other uses of the river include recreation, fishing, and irrigation.



Water Supply
Irrigation (direct abstraction from river) and public consumption

Sand Mining
A major industry with significant impact on the economy within the river basin

Navigation
Inland navigation serves a vital economic function within the basin by facilitating river crossings, sand barging, and commercial harbour activities

Tourism/Recreation
Riverine attractions within the basin include picnicking, hiking, recreational fishing, water sports, and river cruises. These attractions are found primarily along the middle section of Sungai Langat to the river's delta. Growing interest in recreation and tourism has led to the setup of recreational areas at Sungai Gabai and Sungai Congkak.

While these activities bring economic benefits to the state, the way in which they have been carried out has had negative impact on the environment as well as human health. The rivers of the Sungai Langat basin are showing signs of stress under these impacts, indicated by sedimentation, deterioration of water quality from industrial and domestic pollution, degradation of riparian zones, depletion of biodiversity, increased frequency and severity of floods, stream bank erosion, and loss of buffer zones against pollution.

Distinctive Features of the Basin

Tourism Selangor *is a state government agency that attracts local and international tourists to Selangor by increasing the profile of the state*

Tourism map of the Sungai Langat basin
Source: Tourism Selangor 2015

The Sungai Langat basin showcases natural and manmade features that add uniqueness to the basin.

In the upper basin areas, there are many scenic sites for picnics, swimming and recreational activities such as **Sungai Pangsun**, **Sungai Gabai Waterfalls**, **Sungai Tekala Waterfalls**, and **Sungai Batangsi Waterfalls**.

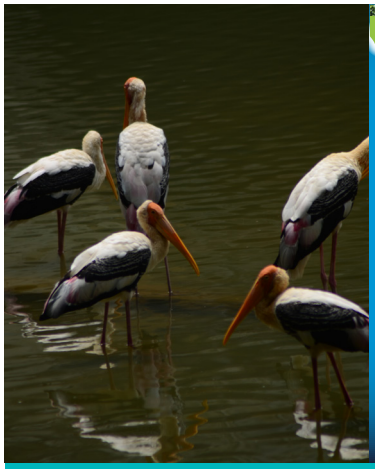
The middle section of the basin offers the natural beauty of the **Paya Indah Wetlands**. Not too far off is the **Kuala Lumpur International Airport**, Malaysia's main international airport and is also one of the major airports of South East Asia. It is about 50 kilometres from Kuala Lumpur, in the Sepang district towards the south of Selangor. Ranked as the 5th busiest international airport in Asia, the main terminal building area features a 'Rainforest in the Airport' whereby an entire section of rain forest was transplanted from the jungle into the airport.

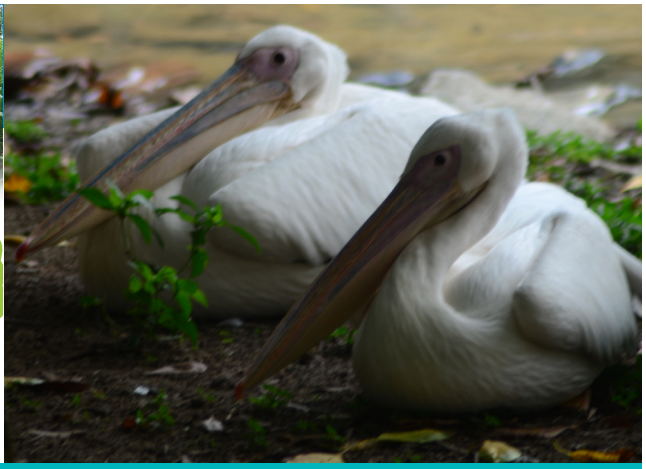
Not far from the airport is **Putrajaya**, which is the administrative centre for the Federal Government whose grand and soaring architecture epitomises the vision of a modern Malaysia with the latest infrastructure and modern facilities.

Next to Putrajaya is the Silicon Valley of Malaysia, **Cyberjaya**, a town with a science park as the core that forms a key part of the Multimedia Super Corridor in Malaysia. It is located in the district of Sepang, Selangor and is situated about 50 kilometres south of Kuala Lumpur.

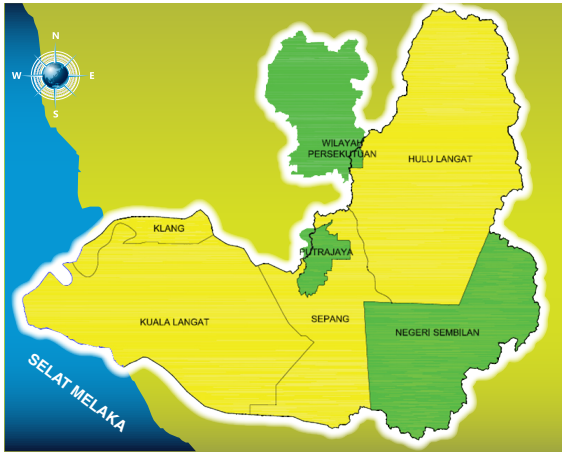
One of the defining water features of Putrajaya is the 400-hectare **Putrajaya Lake** that was designed to enhance the aesthetic appeal of the federal administrative capital. The lake was created by inundating the valleys of Sungai Chuau and Sungai Bisa. It offers a cool venue for sports and recreational activities while also serving as a tourist attraction.

Putrajaya Wetlands has been planted with a variety of aquatic plants to remove nutrients and pollutants from the upstream Sungai Chuau river basin, thus protecting Putrajaya Lake by acting as a natural filter. In addition to being a water cleansing and filtration system, the wetlands also contributes to flood mitigation, nature conservation, ecotourism, recreation, research as well as education and protection against soil erosion.





Peat swamp forests support biodiversity, regulate water, and have the ability to store carbon through sequestration. The **South Langat Peat Swamp Forest** consists of virgin jungle reserve combined with degraded and regenerating trees. Not only does this forest have high value timber species such as *Koompasia malaccensis* (kempas), *Shoreateysmanniana* (light red meranti), *Tetramerista glabra* (entuyut ortuyot), and *Gonystylus bancanus* (ramin), they are also valuable as sites for potential forest carbon sinks. Towards the lower Sungai Langat basin near the river mouth, paragliders on **Bukit Jugra** can admire the view where the Sungai Langat finally meets the ocean.



Land Use

There are five districts in the Sungai Langat basin, and each has different land uses. Land use is categorised into four areas: forest; agriculture (including animal husbandry, aquaculture, oil palm and rubber cultivation); built-up (residential, commercial, industrial, mixed development, institutions, mining, sand mining, quarries) and water bodies comprising rivers, lakes and ponds.

Within the district of **Hulu Langat**, the major land use in the area upstream of the river basin is forest cover at 45.63%. With scenic features such as natural waterfalls located at Gabai along Sungai Congkak, the area is a tourism and recreational attraction. The next biggest land use is built-up area at 29.42% and agriculture at 24.64%. Water bodies have the least land use in this district.

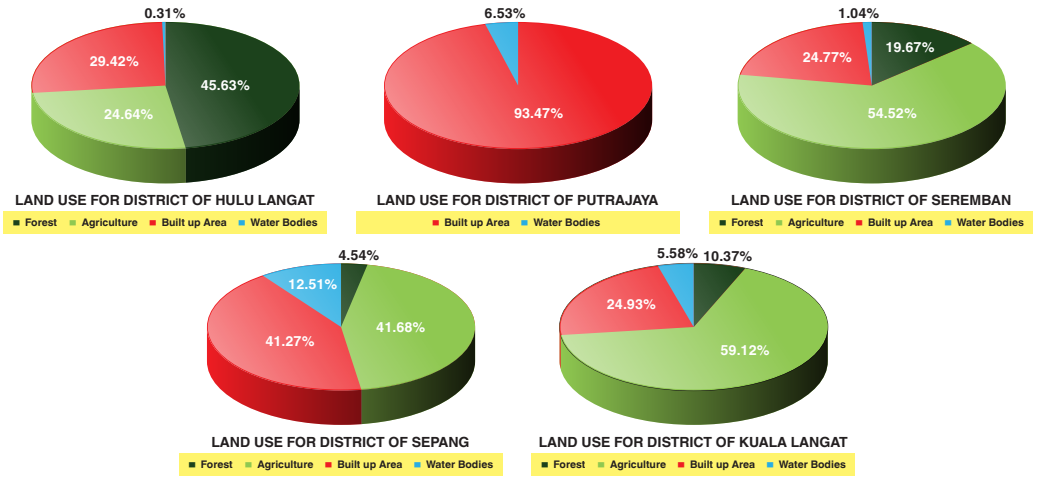
In the district of **Putrajaya**, the land consists only of built-up and water bodies. The built-up area occupies 93.47% of the land, which accommodates Putrajaya as the federal administrative centre with government buildings such as Jabatan Perdana Menteri and Jabatan Alam Sekitar as well as other facilities such as the Putrajaya International Convention Centre (PICC), Alamanda Putrajaya Shopping Centre and Putra Mosque. Due to their unique architecture and vast park-like layout of the precincts, these buildings are also tourist attractions. Even the remaining land use, water bodies at 6.53%, is used for tourism purposes: Putrajaya Lake and Putrajaya Wetlands Park draws tourists locally as well as abroad.

***JPBD** is a town planning agency that plans, controls, and coordinate development, land use, and land conservation*

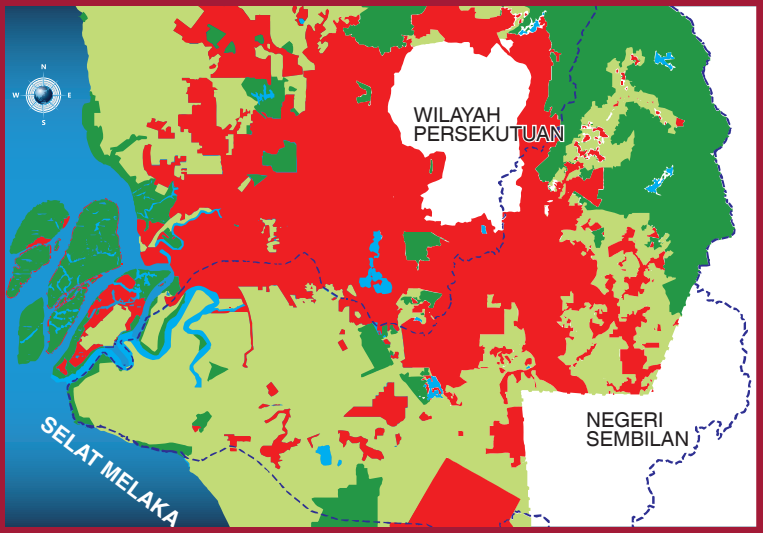
Twenty percent of the Sungai Langat basin lies in the neighbouring state of Negeri Sembilan. The biggest land use within the **Seremban District** is agriculture at 54.52%, while the built-up area covers 24.77% and is mostly located at the border with Selangor. At the west region of the district, 19.67% is forest area while the remaining land use is taken up by water bodies.

The biggest land use area in the **district of Sepang** is agriculture at 41.68% and the built-up area is slightly less at 41.27%. Water bodies is next at 12.51%, which is the highest among the other district. Last is forest area at 4.54%, which has the least land use in the river basin.

Within the **district of Kuala Langat**, the largest area of land use is agriculture at 59.12%, which has the highest land use among the districts. Next is the built-up area at 24.93%, followed by forest area at 10.37%. The smallest area in the district is 5.58%, which is occupied by water bodies.



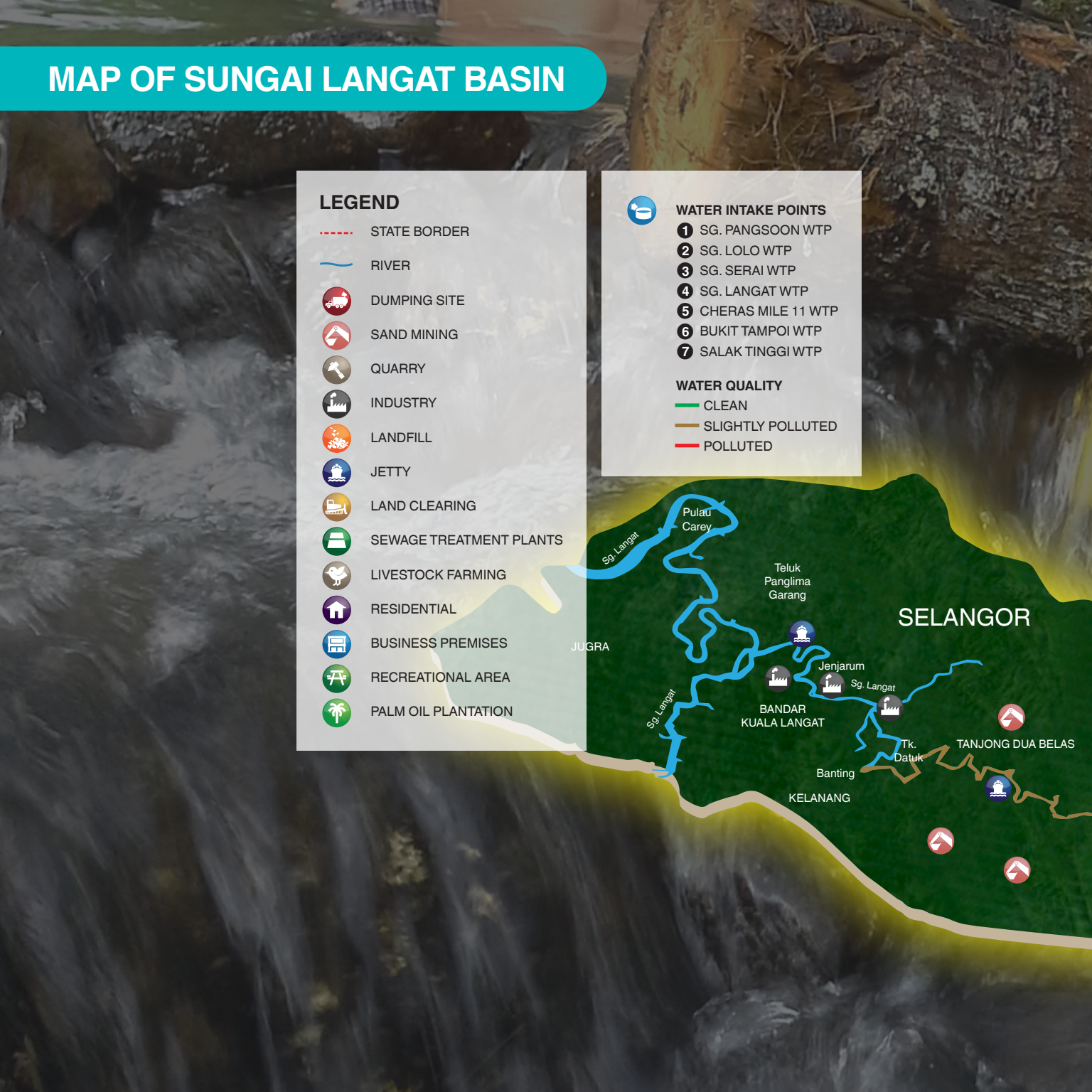
Land use within the Sungai Langat basin
Source: JPBD 2015



Land use within the Sungai Langat Basin
Source: JPBD 2015

Map of the Sungai Langat basin
Source: JPBD 2015

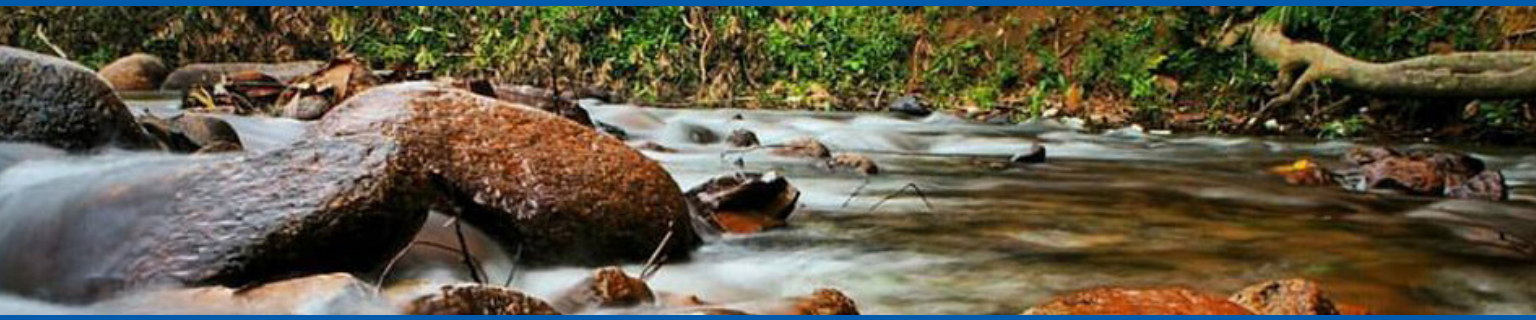
MAP OF SUNGAI LANGAT BASIN



Source: SYABAS EIS 2011 and LUAS

STATE OF **SUNGAI LANGAT 2012 - 2015**

How Is Our River Doing?



A measure of river health is the water quality index (WQI). WQI summarises and presents water-quality data in an easily understandable format. It is a number ranging from 1 to 100; a higher number indicates better water quality. In general, stations scoring 80 and above met expectations for water quality and are of 'lowest concern', scores 40 to 80 indicate 'moderate concern', and water quality at stations with scores below 40 do not meet expectations and are of 'highest concern'.

RIVER BASIN	STATE	WQI				
		2011	2012	2013	2014	2015
Langat	Selangor	77	84	84	82	84

Conclusion: Sungai Langat is a relatively clean river, with an overall water quality index of 82.2, which ranks it as a Class II river.

KEY FOR INDICATORS

The key for the indicators is shown below. The direction of the triangles show whether the trend is increasing, decreasing, or no change. The colour of the triangle indicates whether the trend is positive, negative, or neutral (neither good nor bad).

TREND

▲ Increasing ◆ No Significant Change ▼ Decreasing

IMPACT/EFFECT

■ Positive ■ Neutral ■ Negative

Main Issues in 2012-2015

The following section covers key issues and suggestions highlighted by stakeholders for joint problem resolution because issues usually require the actions of more than one department or agency. There are more issues and challenges raised in various chapters and sections throughout this report, but some issues that were common to all and highlighted by numerous stakeholder agencies are consolidated in this section.

Preventing Prevent Fires in Peat Forests

Peat swamp forests are forests that are characterised by the accumulation of partially decomposed organic matter under waterlogged conditions to form carbon-rich soil called peat. When peat dries out, it becomes highly susceptible to oxidization and peat fires. This is turn contributes to carbon emission and global warming.

The Kuala Langat North Forest Reserve is such a forest. In recent years, this forest reserve has been coming under increasing pressure by surrounding development and large portions have been impacted by fire. In 2014, more than 350 hectares of the forest was burned during the dry season.

Measures have been carried out to prevent the recurrence of fires. Jabatan Mineral dan Geosains (JMG) advises that when sand mining, care must be given to peat areas to ensure that they do not dry out. There are six TubeWells in Kuala Langat Utara and three in Kuala Langat Selatan. During the dry season, the pumps are activated into the drainage system. There are also check dams belonging to Jabatan Pengairan dan Salian to control the water going into the peat layer by raising the water level in vulnerable areas.

Jabatan Perhutanan Negeri Selangor has a watchtower in the vicinity to monitor for fires. This is to detect any fires in peat forests. There is also an air pollution index monitoring system called Infrastruktur Pengawal Kebakaran Hutan Gambar under Jabatan Alam Sekitar.

Effluents from Sand Mining Flowing into the River

Several operators, including water intake operators, have reported high levels of turbidity in the river, to the extent that it has disrupted water intake operations. This happens when sand mining activities are not properly controlled and monitored. A sand mining site must follow a mining scheme, which is a layout of the mining operations and the methods that will be used. A typical mining scheme consists of tailing, operations office, siltation pond, spillway and stockpile. Different mining coverage has a different layout configurations. It also describes how deep the operator will dig and what methods will be employed, be it hydraulics, dry cell, dredging, or open cast. Most importantly, it specifies the buffer between any water bodies and the site. Unfortunately, not all mining operations follow the mining scheme that was submitted to the authorities for approval.

Direct Discharge from Swine and Poultry Farms

There have been incidents whereby discharge from livestock farms (specifically, pig farms) have affected coastal mangroves negatively. This has directly resulted in loss of coastal mangroves in areas such as Tanjung Sepat. Good practices mandate that swine farms have three treatment ponds to treat the wastewater before discharging into the river, although not all follow this practice.

There have also been reports of odour emanating from integrated swine breeding facilities where there is a concentrated population of pigs.

Prawn Aquaculture Replaces Mangrove and Cuts Back on Mangrove Forests

Within the prawn aquaculture industry, enterprises are encroaching on mangrove forests and thus must be controlled. In just three days, broad swaths of mangroves can be cut down and wiped out. Aquaculture operators are given approval by the authorities for a fixed number of acres, but in practice take up more acres than permitted. There have been replanting projects by Jabatan Perhutanan, but they are not sustained regularly.

Another problem arises when the shrimp ponds are cleaned out. Authorities say they do not know what is inside the ponds or the discharges that are released into the environment. Shrimp wastewater can have adverse effects to receiving waters due to its high concentrations of total suspended solids (TSS), total nitrogen (TN), and total phosphorus (TP).

ESOURCES IN THE **RIVER BASIN**

JABATAN PENGAIRAN DAN SALIRAN MALAYSIA

***JPS** is the government agency responsible for river basin management and costal zones, water resource management and hydrology, and flood management*

***NRE** is responsible for natural resources management, conservation and management of environment and shelters, and management of land survey and mapping administration*

Water Resources in the River Basin

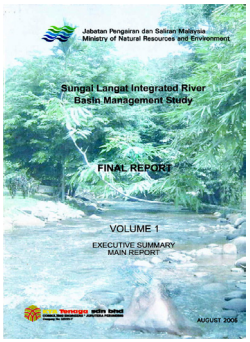
River Basin Planning and Management

Activities, resources, and assets within the river basin are managed by a number of government bodies at both state and federal levels.

Integrated River Basin Management

In 2005, an Integrated River Basin Management Study commissioned by Jabatan Pengairan dan Saliran (JPS) was carried out for the Sungai Langat basin. It combines the various uses, issues, and opportunities into a single action plan that extends until 2020.

Main Issues and Action Plans for Sungai Langat Basin



Sg. Langat 2005, JPS

- Prevent water quality degradation
- Manage water demand and supply
- Mitigate the frequency of floods
- Reduce frequency of flooding
- Rehabilitate eroding river banks
- Manage river sand abstraction
- Enhance river-related sites for recreation and tourism
- Enhance navigational use of the river channel

Source: Study on Integrated River Basin Management Plan for Sg. Langat 2005, JPS

Changes to the Environmental Quality Act 1974

In 2015, amendments to the Environmental Quality Act 1974 were initiated and tabled by Kementerian Sumber Asli dan Alam Sekitar (NRE). These amendments introduced a new order called the 'Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015' as part of the government's preventive strategy in ensuring all development

projects would take into account environmental factors in all stages of planning, construction, and operation based on the environmental impact assessment (EIA) procedures.

The EIAs mandated in the new order is expected to help the authorities make informed decisions on development projects by taking into account its impact on the environment, as well as control measures that need to be done.

When the new order is gazetted and comes into force in 2016, it will among others, reduce the area of the development projects that require the EIA procedures from 50 hectares to 20 hectares. These changes shall have an impact on all activities within the river basins, from agriculture to fisheries to forestry, industries, mining, and other activities in other industries and sectors.

Changes in the State Water Supply Structure

In 2015, the Selangor State Government acquired control over all water abstraction and distribution operators in the state. Under the new water supply structure, all water concessionaires—Puncak Niaga Sdn. Bhd. (PNSB), Konsortium Aliran Bekalan Air Selangor Sdn. Bhd. (ABASS), Konsortium Air Selangor Berhad (KASB) and potentially Syarikat Pengeluar Air Sungai Selngor Sdn. Bhd. (SPLASH)—as well as water supplier Syarikat Bekalan Air Selangor Sdn. Bhd. (SYABAS) would fall under the umbrella of Pengurusan Air Selangor Sdn. Bhd., which in turn is overseen by state-run company, Kumpulan Darul Ehsan Berhad. With this move, the water supply structure no longer has any federal links; it is all owned and run by the State of Selangor. Only the regulatory body, Suruhanjaya Perkhidmatan Air Negara (SPAN), and water asset owner Pengurusan Aset Air Berhad (PAAB) would remain as federal links to the Selangor water structure. However, all water sector bodies in the state are still bound by the terms of the Water Service Industry Act (WSIA) 2006, a federal enactment.

Puncak Niaga Sdn Bhd *is one of water treatment operators in the state. It has 29 plants and 49% of treated water to five million agricultural and industrial end-users*

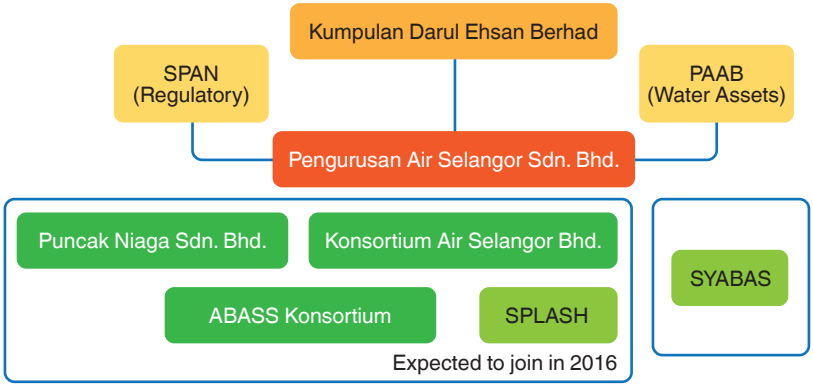
Konsortium ABASS Sdn Bhd *operates and maintains the Sungai Semenyih Scheme*

Konsortium Air Selangor Berhad *operates and maintains the Sungai Labu water treatment plant*

Syarikat Pengeluar Air Sungai Selangor *operates and maintains SSP1 and SSP3 water intake and treatment plants along Sungai Selangor*

***SPAN** is a government commission that regulates water supply and sewerage services*

***PAAB** is the water asset management company for the nation's water industry*



2015 State Water Industry Structure

Under this framework, the Sungai Klang and Sungai Langat basins are covered by PNSB while Sungai Selangor is covered by SPLASH. SPLASH is slated to come under the umbrella of Air Selangor next year.

Regulation of Water Services

SPAN is the regulator and enforcement agency of water and sewerage services. It conducts investigation and brings those who breach the law to court. It enforces the Water Services Industry Act (WSIA) 2006, which dictates the water industry and tariff structure and gives SPAN the authority to prosecute illegal tappers and unlicensed contractors.

With WSIA, SPAN can register and regulate a wide range of service providers such as water concessionaires, developers, plant and parts suppliers, and any other registered suppliers, as well as pipe work companies, including plumbers. This means that any activities between raw water source to consumer water meters need to go through SPAN, which in effect is the regulator and enforcer of water supply and sewerage services. To maintain

the license from SPAN, service providers must submit three years of performance records and meet key performance indices for ten years. There is a distinction in that the term 'authorisation to operate' is not the same as a full-fledged license.

SPAN also enforces the EQA (Environmental Quality Act) for treatment of raw water, distribution, collection, treatment of wastewater and discharge into waterways.

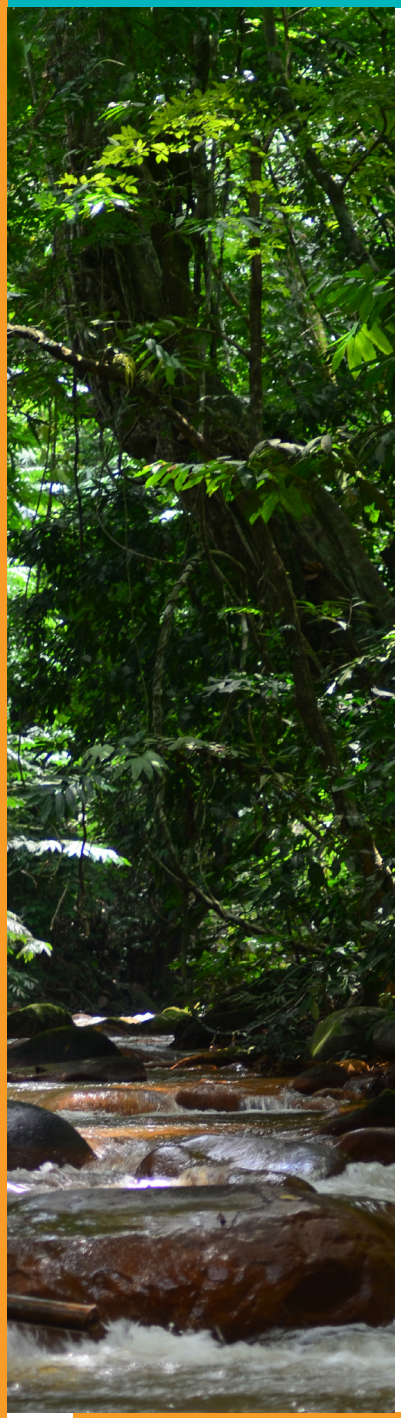
Water-related assets such as pipes and plants fall under the purview of a federal agency called Pengurusan Aset Air Berhad (PAAB). PAAB assists new service companies in getting started up by renting assets to these companies until they can self-sustain the operating costs of the assets. The assets are owned by PAAB. After 45 years, the assets can be owned by the state. The main difference between SPAN and PAAB is that water services are managed by SPAN, while physical assets, facilities, and works are managed by PAAB. As such, PAAB oversees agencies such as Jabatan Perkhidmatan Pembetungan (JPP) and Jabatan Bekalan Air (JBA), which manage and carry out the physical water projects.

Regulation of Sewage Services

The structure of the sewerage industry remains the same as before, although it will eventually likewise undergo a similar restructuring like the water services industry.

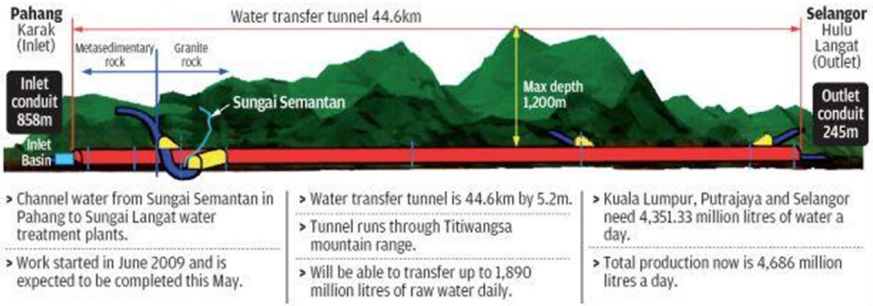
Ensuring Water Supply

One of SPAN's focuses is to ensure that there is sufficient water even in times of drought. To this end, there are three mitigation works undertaken by SPAN, one of them being the transfer of water from Sungai Semantan in Pahang to Sungai Langat. In 2014, a pipeline was built from Sungai Sementan to direct water to the Langat 2 water treatment plant (WTP), which did not materialise. Instead, the pipeline was extended to Sungai



Langat around Cheras Batu 11. In times of drought or water shortage, water would be drawn from Pahang. The water from Pahang currently supplies to areas in the Langat area. In the meantime, the Langat 2 plant has been approved for construction. Groundbreaking has already started, and the plant is scheduled to be completed in 2019. The water supplied from Sungai Semantan is expected to meet water supply demands up until the year 2030.

Pahang-Selangor Raw Water Transfer Project



Pahang-Selangor Raw Water Transfer Project graphic
Source: SYABAS, KeTTHA and The Star 2014

One of the issues of the water transfer is the water quality from Sungai Semantan, which is polluted. To address this problem, the State of Selangor uses water from Operasi Pengepaman Air Kolam Alternatif (OPAK) scheme to dilute the level of pollution coming into Sungai Langat.

River Basin Monitoring

The Selangor State Government maintains close surveillance on the state of the river basins by calling the Mesyuarat Jawatankuasa Pengurusan Lembangan Sungai dan Pantai once a month or every two to three months. Starting in 2014, LUAS, local authorities, district offices, and other relevant stakeholders meet to report on incidents and cases within their jurisdictional area and update on happenings. The meeting is chaired by the State Secretary.

Monitoring of Water Resources

A number of agencies monitor water resources and water quality throughout the river basin. One of them is LUAS, the water resources management body that monitors and enforces control over human activities for the management of water resources, river basins, water bodies, groundwater, and coastal waters in the State of Selangor. Water quality of rivers is also monitored by other agencies and organisations, JAS, and Jabatan Kesihatan Negeri Selangor. Through LUAS, information is shared so that any issues or problems arising can be handled effectively and expeditiously.

Currently, LUAS addresses violations mainly based on incoming complaints or reports. To become more proactive through its scope of responsibilities, the Emission or Discharge of Pollutants (State of Selangor) 2012 was gazetted in 2012. The list of activities that were expanded is shown below. With an expanded scope, LUAS can better regulate errant end-users of water resources.

***LUAS** is a state agency for regulating and managing all water resources in Selangor*

Subsidiary Legislation

ACTIVITY	LUAS' EXPANDED SCOPE
Freshwater aquaculture in ponds or cages	Operating breeding area of 50 hectares or above
Marine shrimp aquaculture in ponds	Operating breeding area of 10 hectares
Development and earthworks	For areas less than 50 hectares
Livestock other than pigs	Chicken, ducks, geese, turkeys, guinea fowl, guinea, pigeon, ostrich, emu, cows, goats and other livestock in number of 20,000 or more
Swine livestock	All farms regardless of the number
Pets	Activities involving 20 cats or dogs
Mining-related activities	Any type of sand mining, soil and other irrespective of the quantity (mining or quarry) in areas less than 200 hectares

The State of Selangor has passed several laws between 2009 and 2011 relating to the management of the river basin.

In 2009, the **Port Klang Coastal Strategy Implementation Plan** was gazetted for implementation. The Plan, which was prepared by LUAS and approved by the State of Selangor in 2007, delineates actions to address water pollution, destruction of habitat, solid waste, health, over-exploitation of natural resources, erosion, and sedimentation.

In 2010, the **Notification of Charges for Diversion of Water from Any Water Source 2010,** was ratified, allowing LUAS to prescribe a rate for the diversion of water for electricity generation.

In the same year, a regulation called the **Zone of Protection (Declared Area and Restriction) Notification 2010** was gazetted to protect part of the wetland area, river reserve and environmentally sensitive coastal areas at Mukim Kapar in the district of Klang. The regulation places restrictions on the building of structures and carrying out of works, application or storage of chemicals, alteration of existing land contours, clearing or harvesting of vegetation, and discharges of any effluent or waste.

Another 2010 regulation, **Zone of Protection (Declared Area and Restriction) (No. 2)** Notification 2010 protects and reserves water resources and their environment in the catchment area for dams within Selangor. It protects Klang Gates Dam, Sungai Batu Dam, Sungai Langat Dam, Sungai Selangor Dam, Semenyih Dam, Sungai Tinggi Dam, and Tasik Subang Dam.

Enforcement on Government Land

Land and district offices have the authority to ensure proper compliance for all government land. Any enforcement on violations on government land falls under the land and district offices. Thus, privately-owned structures on government land, such as on river reserves, can be demolished or acquired through buy-back. Buy-back occurs on land under old grants, when rivers were part of the private owners' land. Under the new grant, rivers are not included in private grants and reserve land by the rivers belong to JPS.

GETTING STATES TO MIGRATE TO PAAB

Some states such as Terengganu and Pahang are still not under the PAAB scheme. The physical works of water industry such as pipe system upgrading or water facility building are costly, and the advantages of being under PAAB is the provision of funds to engage in these costly works. There are regulatory meetings to ensure that certain conditions are met and KPIs are attained such as production, quality, and compliance.

LACK OF STANDARDISATION OF TREATMENT PLANTS AMONG DEVELOPMENT PROJECTS

Not all treatment plants follow uniform design specifications. There are requirements and guidelines, such as the requirement of a treatment plant if a development is more than 30 PE. Moreover, the plants that are constructed do not always follow standardised design plans.

DISCOURAGE DEVELOPERS FROM BUILDING THEIR OWN PLANTS

As there is a trend for centralisation of STPs, developers are encouraged not to build their own stand-alone plants on their development lot. Instead, they are encouraged to pay a contribution levy towards the construction and maintenance of a centralised STP which is shared by several parcel owners on a larger scale.

Water Resources and Supply

Surface Water

Sungai Langat is the main source of water supply for Putrajaya, Sepang, Kajang, and Kuala Langat. It also supplies water to other areas such as the Federal Territory of Kuala Lumpur, Shah Alam, Klang, Petaling Jaya, Keramat, Wangsa Maju, and Kelang Lama. The water is supplied to the population for daily, commercial, agricultural, and industrial consumption.

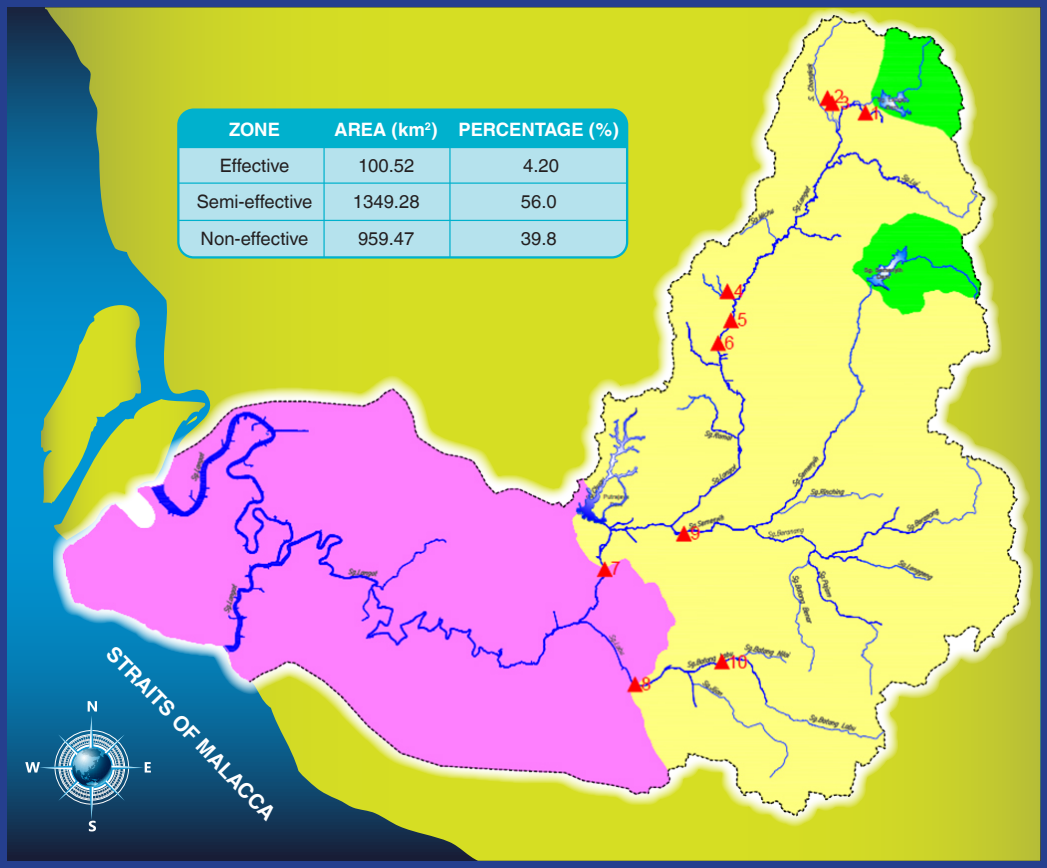
A total of eight water intake points are operated by PNSB while two water intake points are operated by ABASS and KASB within the Sungai Langat basin.

NO	INTAKE	OPERATOR	RAW WATER SOURCE	DESIGN CAPACITY (MLD)
1	Sg. Pangsoon	PNSB	Sg. Pangsoon	1.8
2	Sg. Lolo (Old)	PNSB	Sg. Lolo	2.9
3	Sg. Lolo (New)	PNSB	Sg. Lolo	2.9
4	Sg. Serai	PNSB	Sg. Serai	0.9
5	Sg. Langat	PNSB	Sg. Langat	386.0
6	Cheras Mile 11	PNSB	Sg. Langat	27.0
7	Bukit Tampoi	PNSB	Sg. Langat	31.5
8	Salak Tinggi	PNSB	Sg. Labu	10.8
9	Sg. Semenyih	ABASS	Sg. Semenyih	545.0
10	Sg. Labu	KASB	Sg. Labu	105.0

Water intakes within the Sungai Langat basin
Source: PNSB 2016

Zones of Contribution of Surface Water

It is important to look at surface water resources contribution by zones. Through zonation, water resources managers can see where the water consumption and storage is concentrated within the river basin and can plan for mitigation measures when unexpected occurrences, such as drought conditions or widespread pollution, arise.



ZONE	AREA (km²)	PERCENTAGE (%)
Effective	100.52	4.20
Semi-effective	1349.28	56.0
Non-effective	959.47	39.8

SUNGAI LANGAT DAM

Catchment:
54 km²

Dam area:
2.5 km²

Capacity:
37,480 ML

Yield:
477 MLD

Type:
Earth embankment

The **effective zone** (shown as the green area on the map) is where water from rainfall is fully captured and stored in the dam reservoirs up to the reservoir capacity. The upper reaches of Sungai Langat Basin has two dams—Sungai Langat Dam and Sungai Semenyih Dam. Putrajaya Dam is excluded from the effective zone as its purpose was to create the Putrajaya Lake and does not service the rest of the basin. The effective zone is the area of least capacity within the basin at 4.2% or 100.52 square kilometres.

The **semi-effective zone** (shown as yellow) is where surface water from rainfall contributes to the river flow without any benefit of major storage. This zone contributes to the abstraction for public water supply and other uses. Without storage, part of the river flow discharges to the sea even after abstraction. The semi-effective zone has the largest capacity among the other zones in the basin. At 1,349.28 square kilometres, it comprises 56% of the total area of basin.

The third zone is the **non-effective zone** (shown as purple), which covers catchment that is not contributing to any abstraction for public water supply or major irrigation. Any flow contribution from this zone mostly discharges to the sea. The capacity area of the non-effective zone is slightly larger than the effective zone at 959.47 square kilometres or 39.8% of the total basin area.

Zoning allows water resource managers to see how much of the river water, which can be captured and stored for contingencies, is underutilised and flows out to the sea.

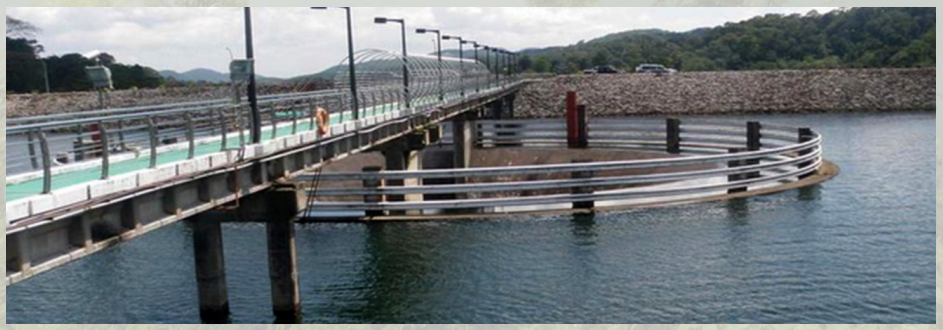
Water Reservoirs

There are two dams used as water supply, **Sungai Langat Dam** and **Sungai Semenyih Dam**, which are managed by PNSB. There is another dam, Putrajaya Dam, but it is used for recreation and water sports and does not contribute to the overall water supply.

Built in 1979, the Sungai Langat Dam is located within a forest reserve upstream of Sungai Langat at Batu 24, with a catchment area of 41.1 square kilometres. During drought season, this dam serves as a regulating reservoir that augments the flow at the Sungai Langat water treatment plant intake at Batu 10, about 14 miles downstream of the dam.

The Sungai Semenyih Dam, which is within a forest reserve upstream of Sungai Semenyih, has a catchment area of 56.7 square kilometres. The dam was constructed in 1984. An augmentation scheme for Sungai Semenyih was later constructed to provide additional raw water supply at the Semenyih water treatment plant intake from a cluster of abandoned mining ponds in the vicinity.

Sungai Langat Dam



Sungai Semenyih Dam

SUNGAI SEMENYIH DAM

Catchment:
41 km²

Dam area:
2 km²

Capacity:
59,071 ML

Yield:
545 MLD

Type:
Earthfill

***UPEN** is the economic planning arm for the State of Selangor*

***JMG** is an agency that provides technical advisory services and expertise in minerals, geosciences, mining and quarries*

Actions Taken for Water Security

Dam operators submit daily reports on dam conditions such as the dam water level and release volume. When the dam condition reaches critical drought levels, Unit Perancangan Ekonomi Negeri (UPEN) calls operators and LUAS to initiate standard operating procedures and decision making. If there is not enough water during drought, drawdown from the balancing reservoir is carried out.

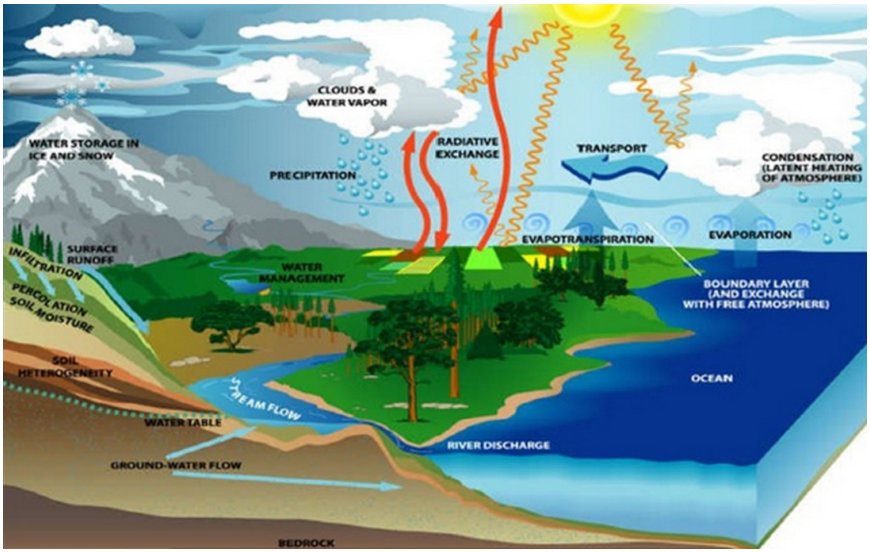
There is also a water transfer scheme from Sungai Semantan directly into Sungai Langat. When water in Sungai Langat Dam goes down to a certain level, it triggers the Penyaluran Air Mentah Selangor (PAMPS), which has a capacity of 300 MLD, to direct water from Sungai Semantan into Sungai Langat.

Groundwater

Groundwater is defined as 'water under the ground surface that fills spaces between sand grains, in rock crevices and in solution openings'. LUAS refers to groundwater as 'subsurface water that occurs beneath the water table in soils and geologic formations'. It is abstracted via wells, boreholes or any similar work sunk into underground strata, excavation into underground strata, or designated groundwater.

All groundwater abstraction in Selangor is regulated by LUAS. Users must get a license from LUAS pending technical comments from Jabatan Mineral dan Geosains (JMG), which serves as a technical advisor. It is LUAS' role to ensure that abstraction is properly managed, while JMG advises on the volume and method in which the abstraction is done. If the volume of abstraction exceeds 1 MGD (million gallons per day or 4.5 MLD), an EIA is required and reviewed by JMG for groundwater modelling. This is necessary as there are four wells in Selangor, two wells for Spritzer in the Selangor River basin and two wells for Champs Water in the Klang River

basin. Groundwater abstraction is 5 sen/m^3 for industry and 1 sen/m^3 for public utility. For personal consumption, water users are given a free allocation of water in accordance to section 45 of the LUAS Enactment.

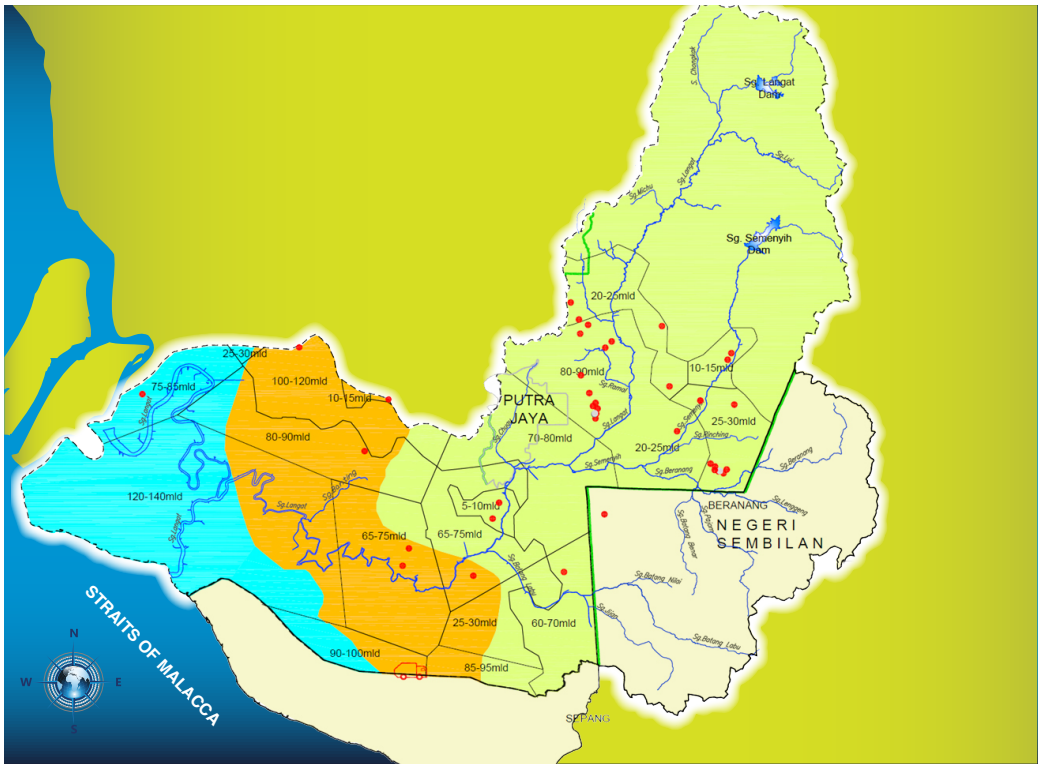


Hydrological cycle showing groundwater flow

Available Groundwater Resources

The Sungai Langat basin has three groundwater zones which are fresh, brackish and salty. A total of 61.34% from the catchment in the groundwater zone is a freshwater zone located upstream, followed by brackish and salty zones at 21.44% and 17.22% respectively.

The freshwater zone is at risk of becoming contaminated due to an existing landfill that is located at Dengkil near KLIA. Based on the available groundwater resources, the maximum rate available is 120–140 MLD, which is downstream of Sungai Selangor at Kuala Langat, and the range for the rest of the zone is between 5-120 MLD.



Groundwater zone and availability within the Sungai Langat Basin
Source: Laporan Kajian Kebolehdapatan sumber Air Bumi Negeri Selangor Untuk LUAS

Lakes and Ex-Mining Ponds

There are 26 lakes and ex-mining ponds in the basin, out of which eight have been identified as alternative water resources. Among these, one pond is located in Hulu Langat, five in Kuala Langat, and two in Sepang.

DISTRICT	NAME OF POND	LOCATION	HECTARE (HA)
Hulu Langat	Bekas lombong Kg. Sg. Kembong	Beranang	90.00
	Kolam Kg. Sg. Sementa	Beranang	30.00
	Kolam Kg. Pasir	Semenyih	15.00
	Kolam Sg. Batangsi	Hulu Langat	30.00
	Kolam KISDAR/KUIS	Bangi	40.00
	Kolam Teratak Tekala	Hulu Semenyih	30.00
	Kolam hadapan UKM	Bangi	9.00
	Bekas lombong	Bukit Mahkota	90.00
	Kolam takungan Sg. Chua	Kajang	17.00
	Kolam tepi tol	Bangi	25.00
	Kolam Country Height	-	-
Sepang	KT. Seri Kenangi	-	9.80
	KT Kg. Baru Dengkil	Dengkil	9.80
	KT Tepi Sg. Langat	Nam Tak	29.60
	Sg. Langat	Kuala Sg. Labu	10.00
	Kolam takungan tepi Sg. Langat	Ampar Tenang	10.00
	Kolam takungan Kolam PUAS	Janda Kalim	101.30
	Kolam takungan tepi Sg. Semenyih	Kg. Sg. Buah	49.40
Kuala Langat	Lombong pasir	Labohan Dagang/ Brooklands	500.00
	Lombong Bukit Cheding	Kuala Langat	500.00
	Paya Indah Wetland	Dengkil	-
	Lombong Agrotek Ace	Olak Lempit	180.00
	Tasik bersebelahan Agrotek	Olak Lempit	250.00
	Tasik bersebelahan Agrotek	Olak Lempit	40.00
	Lombong	-	30.00
	Kolam Bekas Lombong	Saujana Putra	100.00
		TOTAL	**2,195.90**

List of ex-mining ponds within the Sungai Langat Basin
Source: LUAS 2015

Ensuring Continued Water Supply

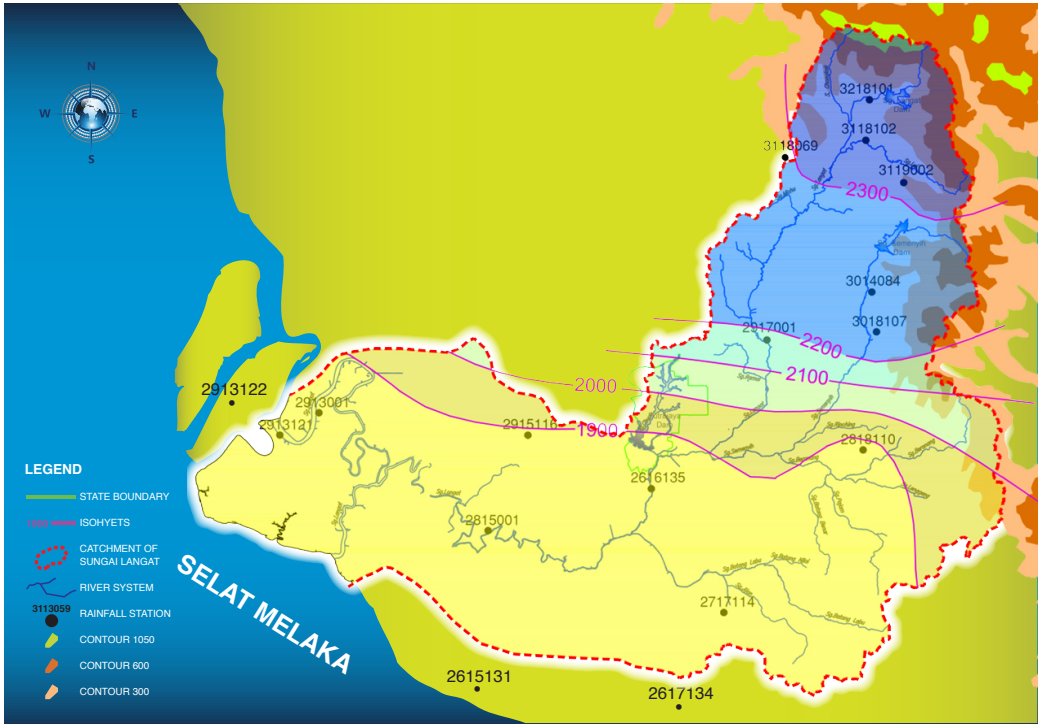
UPEN has proposed a new water supply scheme known as the Labohan Dagang Project, which will develop raw water source and intake facilities, a WTP with a design capacity of 150 MLD, and a selection of trunk mains of treated water pipeline route.

The proposed treatment plant is strategically located to serve the areas in the Kuala Langat district, particularly Banting, Teluk Panglima Garang, Bukit Tampoi, and surrounding areas that are currently experiencing unsatisfied water demands. It is expected that with the new scheme, the issues of water shortage will be resolved, which will also cater to the outstanding water application demand from surrounding development plans. The construction of this plant has just started, and it is expected to be completed in mid-2018.

Project Labohan Dagang
Source: UPEN Selangor

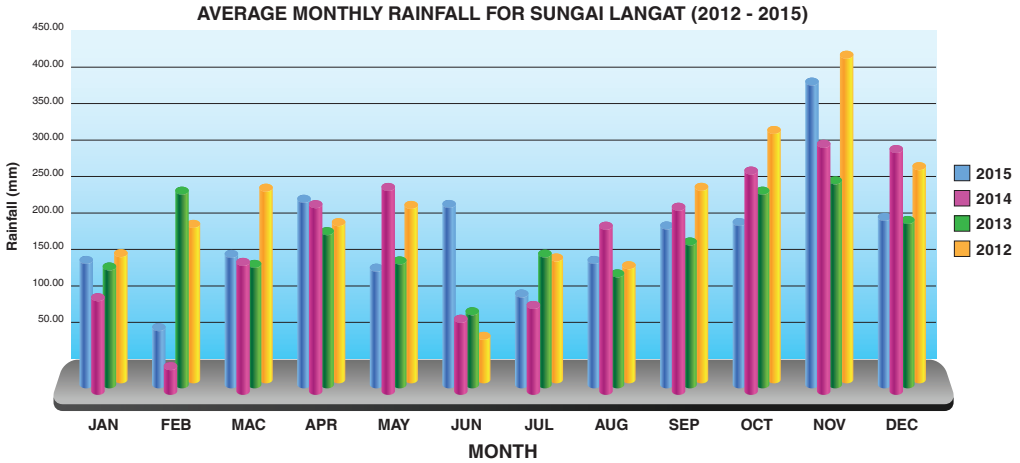
Rainfall Patterns

There are 17 rainfall stations in the Sungai Langat basin that are monitored by JPS. The average monthly rainfall is shown in the column graph, while annual rainfall is depicted in the isohyet map. From 1971–2015, the average annual rainfall in the Sungai Langat basin fell within the range of 1,900–2,300 millimetres where the water level at the upstream section of the basin was higher than the downstream.



Isohyet map for the Sungai Langat basin

Based on analysis of the average monthly rainfall from 2012–2015, the rainfall depth was higher at the end of the year compared to the earlier part of the year. The highest annual rainfall was 419.76 millimetres during November 2015, followed by November 2012 at 378.48 millimetres. The lowest was in February 2014 at 18.45 millimetres due to the effects of the El Nino phenomenon.

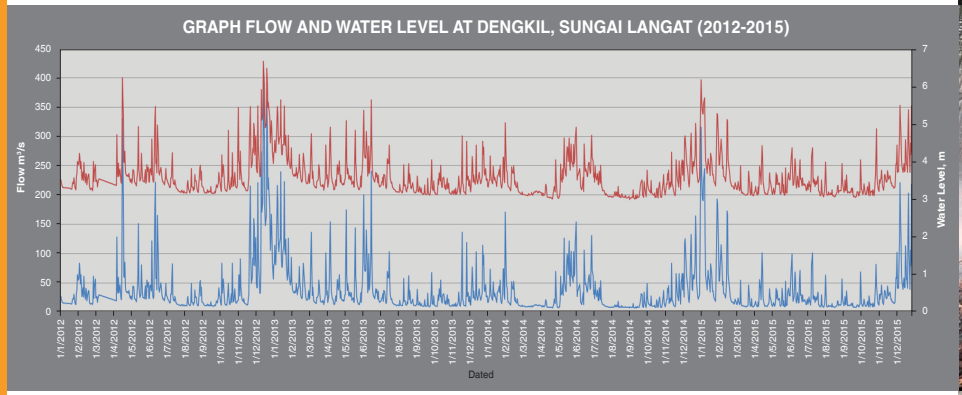


Average monthly rainfall within the Sungai Langat basin
Source: JPS 2015

El Nino has had a negative impact on almost all industry sectors within Selangor. The lack of rainfall and increase in average air temperature caused the water level in the dam to drop. The most significant impact of the phenomenon has been the burning of the peat swamp forest, which occurred several times at Kuala Langat due to lack of water content in the peat soil. In addition, due to the low volume of rainfall, there was no dilution in the river and the ammonia level increased. This affected the operation of WTPs at Batu 11 and Bukit Tampoi, which needed to be shut down every year, especially during drought periods.

Water Level and Flow

The water level and flow patterns for Sungai Langat from the end of 2012 to 2015 shows that generally both displayed a trend that correlates with monsoon seasons over the years. The pattern depicts higher values during the monsoon seasons (November to February) in Selangor.



Graph Flow and Water Level
Source: JPS

Water Abstraction

Abstraction from Surface Water

Water Abstraction by Water Intake Point

In Selangor, approval from LUAS is required before water can be abstracted. LUAS carries out monitoring and enforcement to ensure that premises and factories that abstract ground and surface water resources are registered with LUAS. This is to ensure that all the conditions

stipulated in the license are complied with by the water abstractor. The ultimate goal is to control the use of water in a holistic and integrated manner. LUAS imposes a charge for water abstracted from all water resources. Revenues from abstraction go towards the conservation of water resources and environment. Water abstracted for commercial use is RM0.05/m^3, while water for public utility, including domestic supply, is RM0.01/m^3.

WATER ABSTRACTION	RATES
Commercial	RM 0.05/m^3
Public Utility	RM 0.01/m^3

Within the basin, there are ten water intake points that abstracted surface water. SYABAS is the distributor of potable water to the consumer. All water intakes are operated by PNSB, ABASS, and KASB. In 2012, the amount of raw water abstracted from rivers was 1,250.7 MLD. The amount decreased to 1,247.8 MLD in 2013, followed by 1,349.7 MLD in 2014, and increased slightly in 2015 to 1,357.3 MLD.

WATER INTAKE POINT	DESIGN CAPACITY	PRODUCTION (MLD)			
		2012	2013	2014	2015
Sg. Pangsoon	1.8	3.85	4.16	4.58	4.31
Sg. Lolo (Old)	2.9	1.92	1.26	1.24	3.72
Sg. Lolo (New)	2.9	2.88	2.45	3.01	2.75
Sg. Serai	0.9	1.26	1.08	1.52	1.82
Sg. Langat	386	462.98	402.64	486.43	492.56
Cheras Mile 11	27	27.49	22.68	22.19	26.43
Bukit Tampoi	31.5	34.15	32.21	32.30	33.52
Salak Tinggi	10.8	4.93	4.36	4.71	4.41
Sg. Semenyih	545	670.81	677.71	692.75	680.16
Sg. Labu	105	40.47	99.24	101.01	107.60
TOTAL	**1,113.80**	**1,250.74**	**1,247.79**	**1,349.74**	1,357.28

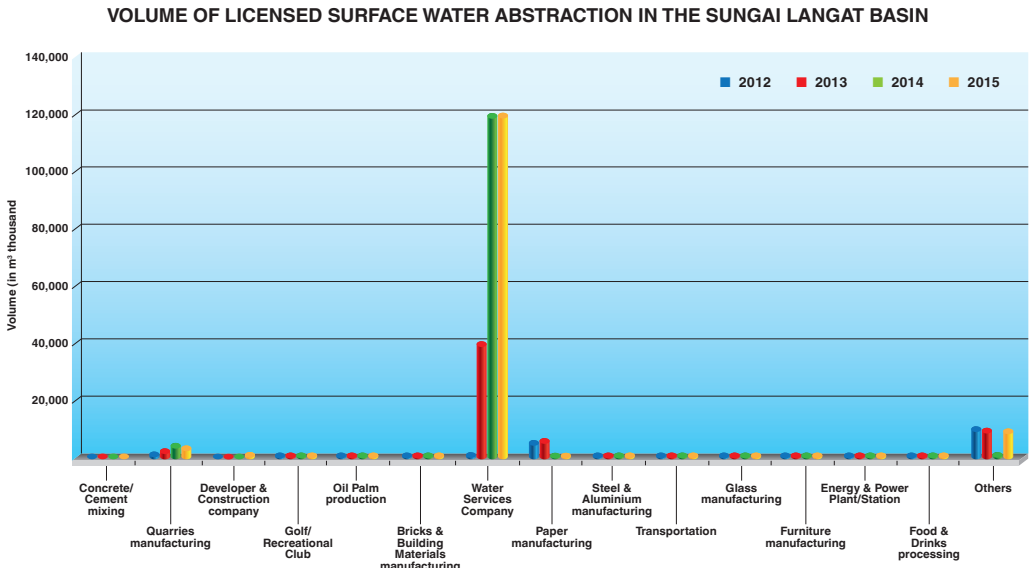
Production at water intake within the Sungai Langat Basin
Source: PNSB

In terms of abstraction volume, the highest was at Sungai Langat and Sungai Semenyih. The least abstracted volume among the ten water intake points was at Sungai Serai, due to its low design capacity.

Water Abstraction by Industry

The volume of licensed abstraction of surface water in the Sungai Langat basin has changed over the past few years. The biggest abstractors are the water service companies (281 MCM), followed by quarries (10.7 MCM), others industries (10.1 MCM in 2012), and paper manufacturing (5.7 MCM in 2013).

The lowest abstractor of surface water amongst the industry sectors are the development and construction companies at 2,000 cubic metres. Based on abstraction of surface water data by LUAS, the highest volume of abstraction was in 2015 with 134.6 MCM and the least volume was in 2013 at 58.5 MCM.



Surface water abstraction within the Sungai Langat basin
Source: LUAS 2015

Abstraction from Groundwater

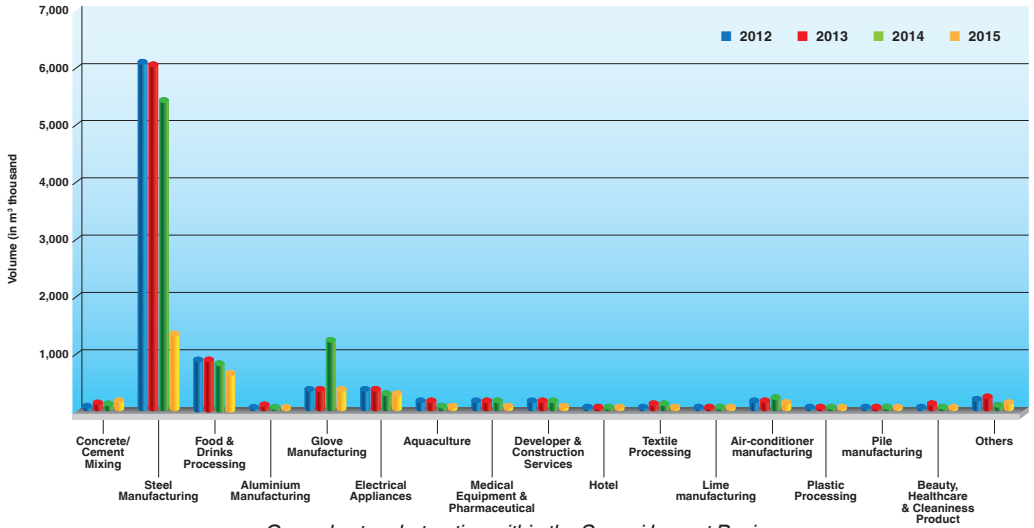
From 2012 to 2015, the steel manufacturing sector was the biggest user of groundwater within the basin at 6.1 MCM in 2012, 6.1 MCM in 2013, and 5.4 MCM in 2014. In 2015, abstraction dipped to 1.5 MCM.

This is followed by the food and drink processing sector at 3.2 MCM. The glove manufacturing sector saw a major increase to 898,813 cubic metres during the 2013-2014 period. Other significant activities were food and drinks processing (3.2 MCM), electrical appliances (1.2 MCM) and manufacturing of air-conditioner (816,541 cubic metres).

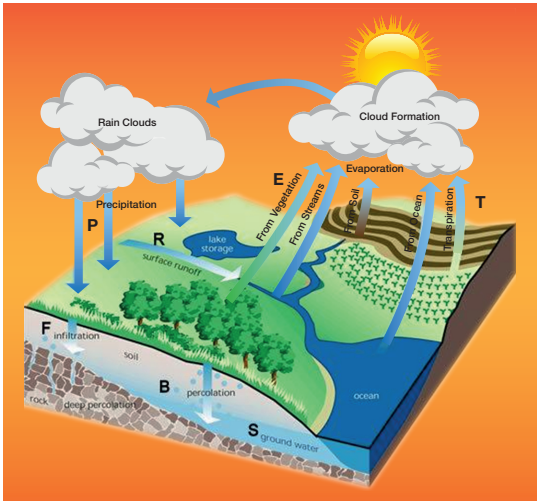
In 2015, the total volume of groundwater abstraction decreased, with only 3.2 MCM abstracted by consumers.

Every three months, PNSB appoints a contractor to test and monitor the water quality at the intakes for all river basins. It tests for 14 parameters. For dams, water quality will be tested every quarter year, while WTPs are tested every two hours.

VOLUME OF LICENCED GROUNDWATER ABSTRACTION IN THE SUNGAI LANGAT BASIN



Groundwater abstraction within the Sungai Langat Basin
Source: LUAS 2015



Estimated Water Balance

A water balance from the hydrological cycle perspective is defined as 'the amount of water entering and leaving a control space during a specific time period'. In general, rainfall is the main input of the system, which upon reaching the ground, will undergo a process of evapotranspiration and seepage to the ground. The remaining volume will travel overland and into the rivers in the form of surface runoff. After deducting the amount abstracted for water supply and irrigation, the balance will discharge to the sea. The amount discharged to the sea in general can be considered as the unused potential reserve that can be capitalised provided there is adequate infrastructure to harvest the resource.

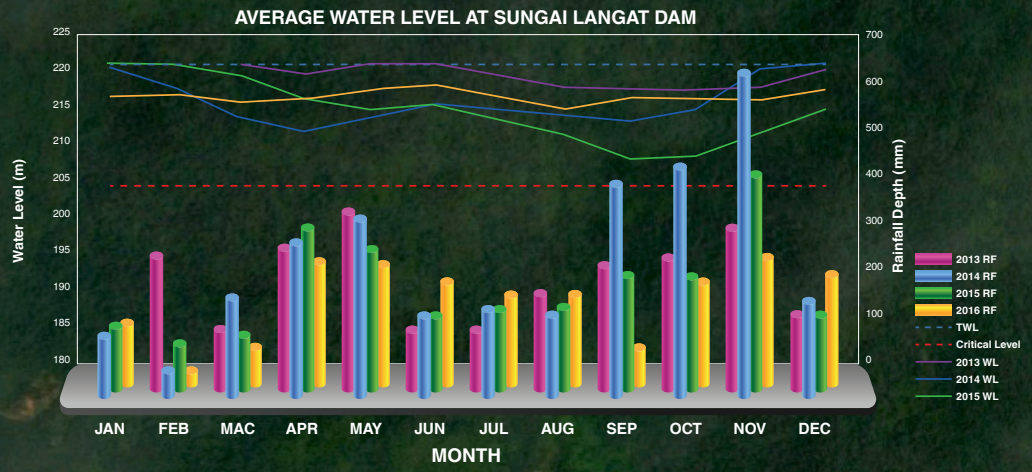
The total annual depth of rainfall and runoff at Sungai Langat basin is 2.15 metres and 0.72 metres respectively. The total depth of runoff is the subtraction depth of annual rainfall, evapotranspiration and seepage to ground. Therefore, the total depth of runoff for the basin with area of 2,423 square kilometres is 1,745 MCM/year or 4,780 MLD.

However, the river abstraction from industries and intakes need to be counted into the remaining water balance. For the Sungai Langat basin, the utilisation for water supply at water intakes and industries are 1,357 MLD and 368 MLD. The remaining water balance after consideration of the water utilisation for water supply is 3,055 MLD. This surplus presently flows into the sea. With proper water source development, this potential reserve may be tapped for future use.

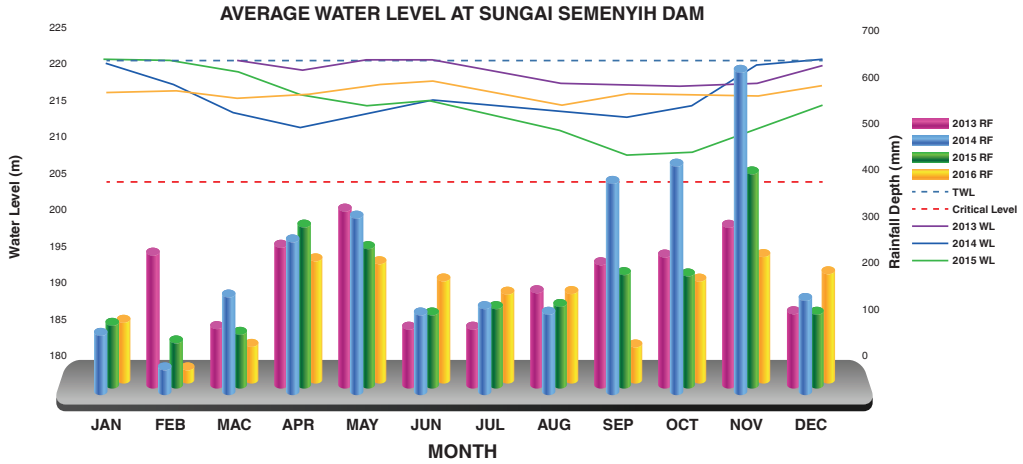
ITEM	TOTAL	UNIT
Catchment area	2,423	km^2
Annual rainfall	2.15	m
Annual evapotranspiration	1.28	m
Annual seepage to ground	0.15	m
Annual runoff	0.72	m
Total runoff over 2,423 sq km	1,745	MCM / Year
Average runoff	4,780	MLD
Utilisation for water supply (Water intake)	1357	MLD
Utilisation for water supply (Industry)	368	MLD
Balance	**3,055**	**MLD**

Water Level at Dams

There are two dams for water supply, the Sungai Langat Dam and Sungai Semenyih Dam, which are managed by PNSB. The graph below shows the average water level for both dams. The top water level and critical level for the Sungai Langat Dam are 220.96 metres and 204.21 metres respectively. The highest and lowest water level is during December 2014 at 221.09 metres and September 2015 at 208.05 metres. In 2015, the water level showed a steady drop from the month of January until October. In general, the drought season occurs from the month of February until April and continues from July until August.



For the Sungai Semenyih Dam, the top water level and critical level are 111 metres and 95.64 metres respectively. The highest water level was in April 2013 (111.08 metres) while the lowest was in September 2014 (104.5 metres). In the middle of each year, the water level drops from the month of June until October. Generally, the drought season occurs from February until April and continues from July until August. The water level for both dams does not cross the critical water level (red line), which means that the dam has enough storage of water supply.

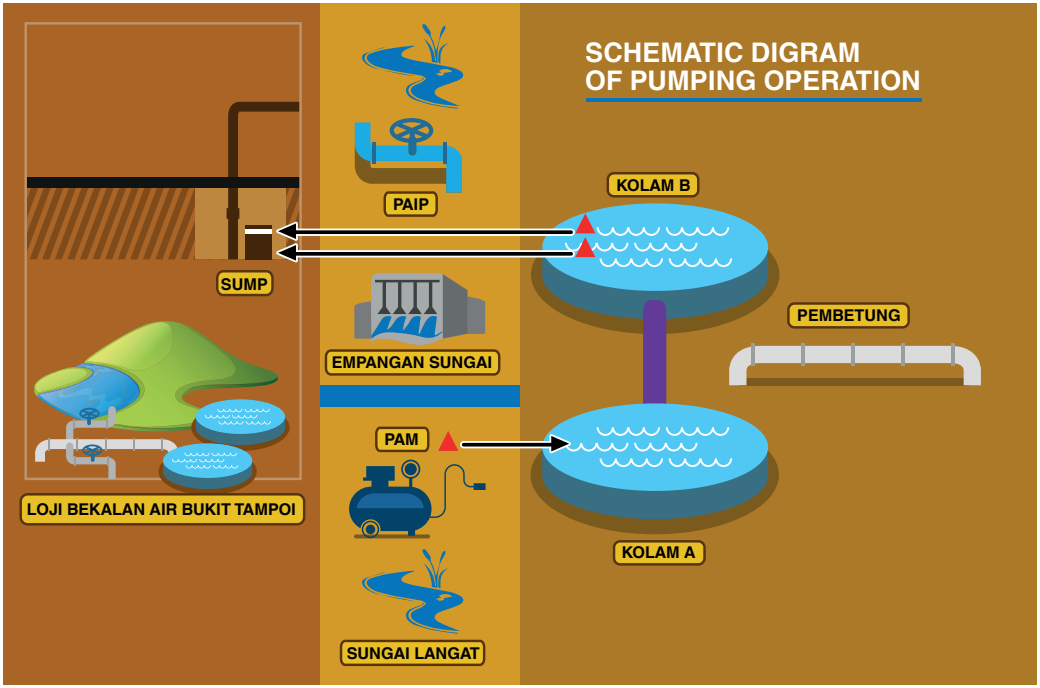


Abstraction from Lakes and Ex-Mining Ponds

Orang Asli Bukit Tampoi Pond is an alternative source during water supply shortages caused by operational shutdowns at the Bukit Tampoi WTP during the drought season. Shutdowns were caused by high levels of ammonia in the river water due to a drop in the rate of dilution in the river. This in turn was caused by low river water level due to lack of rainfall in the catchment area.

There are two ponds that will be used in the area of Warta Orang Asli Bukit Tampoi, which is located beside Sungai Langat near the Bukit Tampoi WTP. The estimated volume of Pond A is 37,500 cubic metres while Pond B is 20,000 cubic metres. The use of pond A

and pond B as alternative water resources will help mitigate the problem of water crisis, especially during the drought season, by reducing the levels of ammonia concentration.



Sungai Langat Water Pumping Operation into pond and to the intake plant

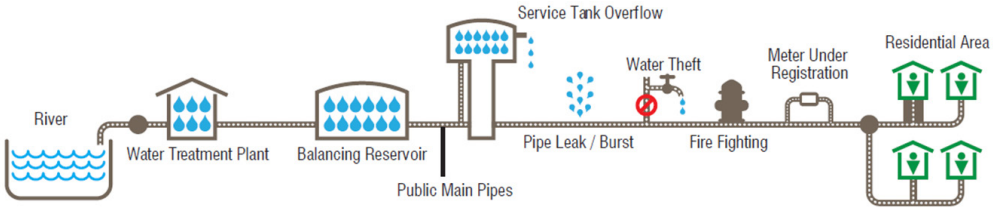
The purpose of the water pumping operation at the Bukit Tampoi Pond is to provide an alternative source of water to avoid plant shutdowns. This is done by ensuring that the water that flows in the WTP has a low levels of ammonia and is in compliance with the standards on raw water, which is not more than 1.5 mg/l.

There are sewers between ponds to channel water from Pond A to Pond B. The water quality will be tested every two hours by the LUAS Unit Management and Environmental Laboratory to ensure that the Orang Asli Bukit Tampoi Pond contains a low level of ammonia to be channelled to the Bukit Tampoi WTP.

Non-Revenue Water

Non-revenue water, or NRW, is the proportion of treated water that is lost before reaching the consumer. It is a major source of losses for water distribution companies. Elements contributing to NRW are service tank overflow, leaking or burst pipes, water theft, and tampered meters.

Elements Contributing to NRW



Source: Malaysia Water Guide 2011

NRW	
2008	34%
2009 - 2011	32%
2015	35%

As at 2015, Selangor's NRW stands at 35%, which costs the state up to RM400 million a year in losses. The main source of the losses are leakages or bursting of pipes within the network of nearly 6,000 kilometres of piping made from older asbestos-cement material. A large portion of this piping is over 30 years old, resulting in burst pipes that disrupt the end user's water supply and contribute to the high NRW losses in Selangor. At the end of 2015, only 1,200 kilometres of piping had been replaced throughout Selangor and the accompanying Federal Territories.

To address this issue, the Selangor Government is introducing a plan to cut down the total losses in treated water from the current 35% to 25% by 2025. Eight-four hotspots in Selangor and Kuala Lumpur have been identified, and a year-on-year staged replacement programme is expected to start in late 2015. Efforts to address this issue is not new—SPAN has been monitoring NRW since January 2008—and NRW is a key performance indicator, or KPI, for all water distribution operators.

Water Quality

Jabatan Alam Sekitar (JAS) Selangor continuously monitors the quality of river water, marine water and groundwater to detect and quickly address any changes in the environment that may have a negative impact on humans as well as the environment. Within the Sungai Langat basin, there are 12 JAS monitoring stations along the rivers and tributaries for water quality.

Water quality index, known as WQI, indicates how polluted is the water in a river. It is a weighted average of various pollutants, called parameters, to make it easier to classify the river according to quality levels. The quality levels fall into one of three categories, which are clean (81-100), slightly polluted (60-80), and polluted (0-59).

Every three months, PNSB appoints a contractor to test and monitor the water quality at the intakes for all river basins. It tests for 14 parameters. For dams, water quality will be tested every quarter while WTPs every two hours.

***JAS** is an environmental protection agency that monitors and regulates air quality, river, groundwater and marine water quality, noise pollution and climate change*

New Function Within SYABAS: River Surveillance and Investigation

In light of recent water disruptions due to indiscriminate and severe river water pollution, Selangor's treated water distributor SYABAS has revamped its former environmental monitoring function to a more active water quality sampling and monitoring unit, which now includes a river surveillance unit. It monitors two groupings of major catchments, which are Sungai Selangor/Sungai Bernam and Sungai Langat/Sungai Klang. In addition to its role of monitoring, it now has added investigation and facilitates towards enforcement of infractions by offending parties. These new roles were added during the restructuring of the water services sector in Selangor in 2014 and 2015.

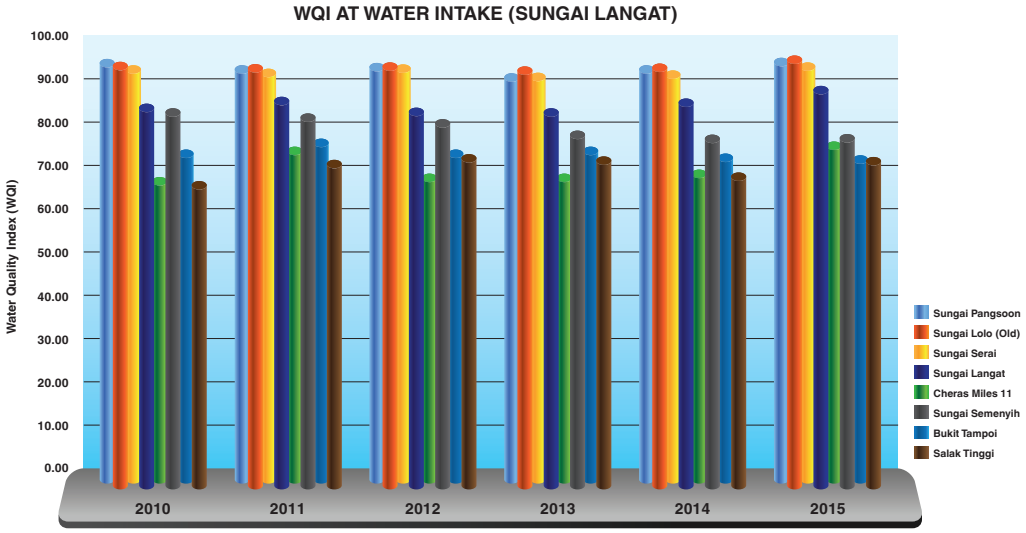
The rationale for this new setup is to enable fast action in times of water quality-related emergencies. It is part of a multi-agency task force that involves LUAS, JAS, land and district offices, local authorities and any relevant parties. In inter-boundary cases, the state department also participates. Success of this setup and program also hinges on the respective states' acknowledgement that a water quality crisis is developing when emergencies occur. Thus, a change in mindset and a constant state of readiness is necessary for timely and effective reaction to emergencies.

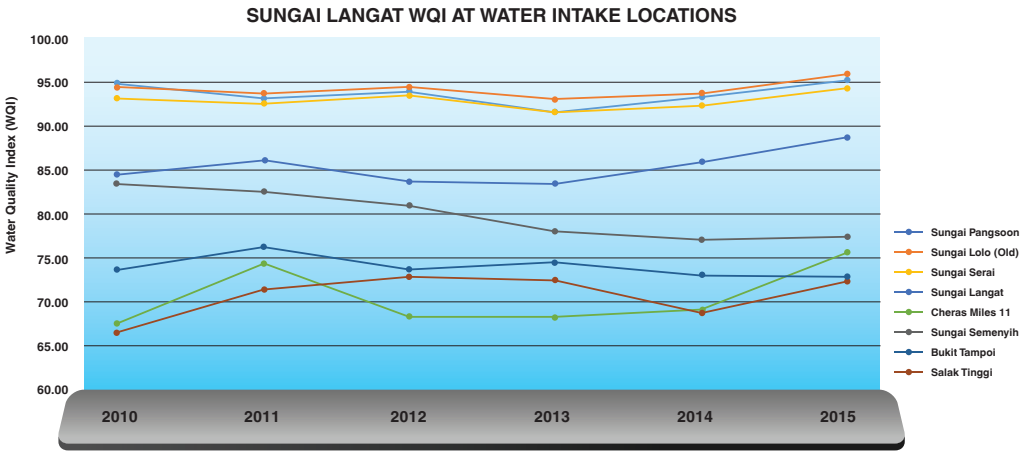
New Addition to the Effluent Guidelines

LUAS is currently in the process of reviewing the existing Peraturan Kemasukan dan Pelepasan Bahan Pencemar (Selangor) 2012 or Emissions or Discharge of Pollutants (Selangor) 2012. It will review the limit for parameters of each of the seven activities covered in this regulation. The seven activities are sand mining and quarry, earthwork, pig farming, animal husbandry excluding swine, freshwater aquaculture, marine prawn aquaculture, and pets.

Water Quality Within Sungai Langat

Water quality data for Sungai Langat was collected from nine water supply intake points which covers Sungai Pangsoon, Sungai Lolo, Sungai Serai, and Sungai Semenyih. For Sungai Langat, data is available for the intakes located at the Sungai Langat WTP, Cheras Batu 11, Batu Tampoi, and Salak Tinggi. Based on JAS data, four rivers are considered clean with WQI above 85. These rivers are Sungai Lolo, Sungai Pangsoon, Sungai Serai, and Sungai Langat upstream of BatuTampoi. The other rivers have WQI between 84 to 66.5 in the year 2010. In 2015, the lowest WQI rose to 72, indicating some improvement.


WQI AT WATER INTAKE (SUNGAI LANGAT)
Water Quality Index (WQI)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
2010
2011
2012
2013
2014
2015
Sungai Pangsoon
Sungai Lolo (Old)
Sungai Serai
Sungai Langat
Cheras Miles 11
Sungai Semenyih
Bukit Tampoi
Salak Tinggi


SUNGAI LANGAT WQI AT WATER INTAKE LOCATIONS
Water Quality Index (WQI)
100.00
95.00
90.00
85.00
80.00
75.00
70.00
65.00
60.00
2010
2011
2012
2013
2014
2015
Sungai Pangsoon
Sungai Lolo (Old)
Sungai Serai
Sungai Langat
Cheras Miles 11
Sungai Semenyih
Bukit Tampoi
Salak Tinggi

In the map below, the main river and its tributaries are coloured according to their classes where only Sungai Lui, Sungai Semenyih, Sungai Chua, and Sungai Jijan are classified as clean rivers. While for slightly polluted rivers, there are Sungai Langat, Sungai Pajam, Sungai Batang Nilai, and Sungai Anak Chua. There are no rivers or tributaries that are classified as polluted in the basin.

River water quality within the Sungai Langat Basin
Source: Jabatan Alam Sekitar


RIVER **ECOLOGY**

River Ecology

Wetlands

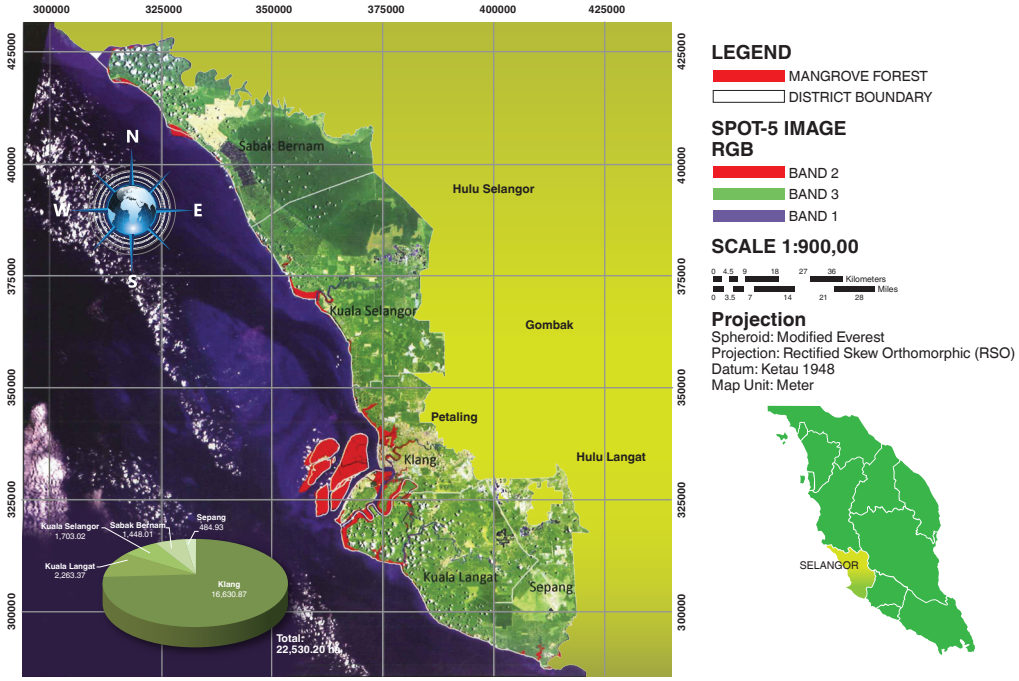
The Paya Indah Wetlands in Dengkil, Selangor, which has been closed since February 2005, is now open to the public. The 450-hectare sanctuary is filled with 210 species of residential and migratory birds and 26 species of mammals, including four Nile hippos. It is the site of conservation and research while offering recreational activities such as angling, boating, cycling, and nature walks.



Peat Swamp Forest

Peat swamp forests are a unique ecosystem unlike any other ecosystem. It is characterised by the accumulation of organic matter (peat) derived from dead and decaying plant materials in water saturated condition. In nature, peat swamp forests represent a unique wetlands ecosystem that supports highly specialized species, thus a very important for the conservation of biological diversity and storing freshwater resources. It also serves as carbon sink; having the ability to sequester and store atmospheric carbon for thousands of years.

The peat layer of the South Kuala Langat Peat Swamp Forest overlays with a soft (and equally deep) mud layer that can only be found in a marine or mangrove area. This indicates that the forest is part of a larger coastal peatland that was once formed in between of river basins along the Selangor coast and plays an important role in flood mitigation and regulation within the state.



FRIM is a premier institution in tropical forestry research and a full fledged statutory body governed by the Malaysian Forestry Research and Development Board (MFRDB) under the Ministry of Primary Industries

Mangrove Forests

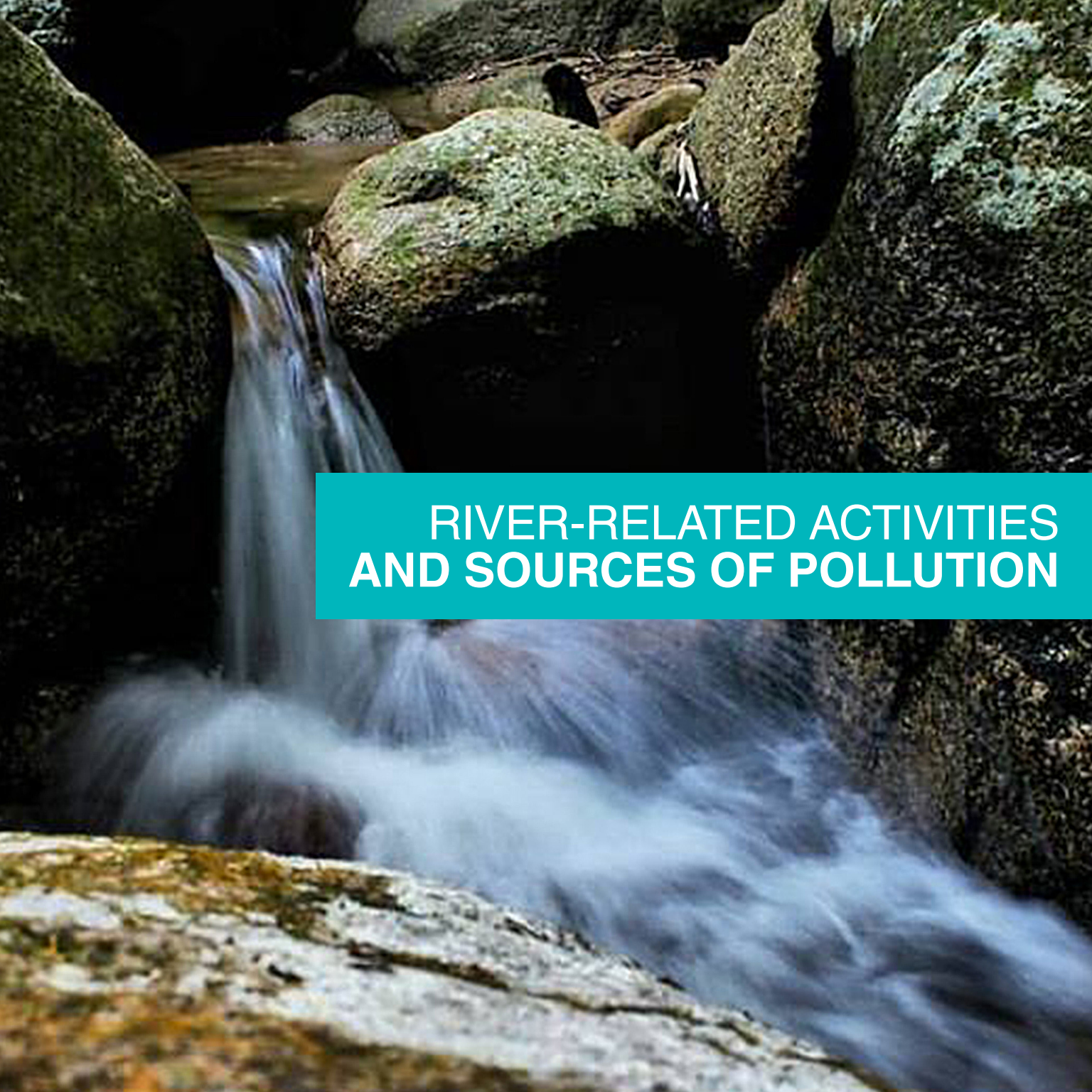
Selangor is one of the states in Peninsular Malaysia that still have large extents of mangroves after Perak and Johor. Situated in the central west region of the Peninsula, Selangor has a 90-metre coastline starting from the mouth of Sungai Bernam in the north to the mouth of Sungai Sepang down south. Out of the 22,530.20 hectares of mangrove forest in Selangor, Kuala Langat has 2,263.37 hectares or 10%.

The mangrove forest is an important habitat for aquatic and terrestrial fauna. It is an important breeding ground that provides food and shelter for many tropical commercial fish species, crabs, prawns and other marine animals.

Some ecosystem functions provided by mangroves include:

- Protection from strong winds and waves
- Soil stabilisation and erosion protection
- Nutrient retention and water quality improvement through filtration of sediments and pollutants
- Flood mitigation
- Sequestration of carbon dioxide
- Protection of associated marine ecosystems

In addition, mangroves also directly contribute to the livelihood of the nearby people. Traditional and indigenous coastal populations have found sustenance from mangroves, collecting products and goods in a sustainable manner for hundreds or even thousands of years, including firewood, medicine, fibres and dyes, food, charcoal and construction material.



RIVER-RELATED ACTIVITIES **AND SOURCES OF POLLUTION**

River-Related Activities and Sources of Pollution

Sewage

The company managing the country's sewerage services is Indah Water Konsortium (IWK), which took over operation of the service from the local authorities in 1993, and Jabatan Pembetungan Paip (JPP) became the regulatory body. In 2008, Suruhanjaya Perkhidmatan Air Negara (SPAN) took over the regulatory role and became executor and enforcer of policies created by Kementerian Tenaga, Teknologi Hijau dan Air (KeTTHA). IWK was relegated to operator of facilities and certifying body of designs of facilities in new developments. JPP regulates physical works of sewerage systems.

Faced with the challenge of maintaining over 8,000 plants, IWK is currently in the process of rationalisation to ease the task of maintenance.

The Federal Government funds IWK as tariffs alone cannot sustain it. Collection of tariffs from home dwellers remain a challenge as public awareness of the importance of sewerage services remains low. The general perception is that water is a necessity for the people whereas sewerage service is something people take for granted. To address this issue, a joint billing structure is being proposed whereby sewerage services will be billed together with the water services.

***IWK** is the national sewerage company providing sewerage services, operating and maintaining public sewage treatment plants and sewerage pipelines*

***JPP** is the government department that provides sewerage pipeline services*

***KeTTHA** is the ministry for ensuring availability, reliability and affordability of energy and water services, and to promote green technology for green economy and green living*

There are seven zones of STPs within the Sungai Langat basin. The total population equivalent at Sungai Langat Basin is 1,797,529 PE. The types of STPs found within the basin are:

- Communal septic tank
- Extended aeration
- Oxidation ditch
- Intermediate demand extended aeration
- Sequencing batch reactor
- Hi-Kleen
- Activated sludge

In line with IWK's push towards centralisation of plants, there is a study currently being carried out to build a pond for a centralised sewage treatment plant. In spite of ongoing efforts, IWK still faces challenges in managing sewerage services throughout the country.

CATCHMENT	ZONE	TOTAL(PE)
SG. LANGAT	AMA	4,465
	GKL	70,408
	GSG	182,562
	HLT	756,909
	KLR	12,394
	KXG	214,094
	WPJ	556,697
Sub Total		**1,797,529**

Total Population Equivalent (PE) within the Sungai Langat Catchment
Source: IWK

ISSUE 01

DIFFERENCES IN EFFLUENT STANDARDS BETWEEN JAS, IWK AND LUAS

Although the STPs are compliant to JAS standards, LUAS uses different parameters, and hence IWK STPs are considered as non-compliant. A gap in standards exists between JAS and LUAS.

ISSUE 02

STPS ARE OWNED BY JPP, IWK ARE ONLY OPERATORS

According to IWK, many people are not aware that JPP are the owners of the STPs. As a result, IWK is often blamed when anything negative regarding sewage is reported.

ISSUE 03

DILUTION FACTOR NOT TAKEN INTO ACCOUNT DURING DRY SEASON

Readings give uncharacteristically high concentrations.

ISSUE 04

LACK OF MAINTENANCE OF INDIVIDUAL SEPTIC TANKS AND COMMUNAL TANKS

Tanks on private property fall under the responsibility of the respective homeowners. IWK will only provide services up to the main line.

ISSUE 05

GAPS APPEAR WHEN AUTHORITIES' APPROVALS OF DEVELOPMENTS ARE NOT SYNCED WITH STP PLANNING ACROSS THE BASIN

Infrastructure should drive development and not the other way around. This is due to developers increasing the plot ratio of new developments. Hence STPs are often unable to handle the volume of sewage when the plants are operational. The World Bank Report cites existing infrastructure under IWK as an obstruction in the ease of doing business in Malaysia. There is a need for more concerted efforts for the widespread use of centralised plants for investors to tap into.

ISSUE 06

POUR FLUSH

It is direct discharge of sewage into river without any sort of filter or treatment. It is a primitive system which is still commonly but dangerously practiced in rural areas in particular. Deemed illegal but old houses and homes especially in rural areas still continue to use it. Not enforced by local authorities.

ISSUE 07

PLANT CAPACITY DESIGN ISSUE

Plant design does not accommodate illegal connections (e.g. non-registered sewage discharge, toxic waste disposal).

ISSUE 08

MAINTENANCE AND PUBLIC AWARENESS ISSUE

The public needs to know what can and cannot enter sewerage systems. Clogging often happens, hence incurring extra costs for the repair of pipes. Oil and grease are major contributors to pipe clogging.

ISSUE 09

NON-PAYMENT OF SEWAGE SERVICE TARIFFS

The Federal Government funds IWK as tariffs alone cannot sustain them. Unlike water, which is considered a necessity for subsistence, sewerage services are something people take for granted. IWK is currently in the process of being restructured. This will result in joint billing whereby sewerage services will be billed.

Illegal factories along Sungai Semenyih and Sungai Langat

Industry

According to district offices, there are no major industries near the river in the district of Kuala Langat. There are some industries close to the river in Mukim Telok Panglima Garang consisting of boat construction, warehouses, sand storage, lumber mills, office furniture factories, sand processing plants, plaster board, rubber glove manufacturing, storehouses and jetties, steel manufacturing plants and in Mukim Tanjung Dua Belas, metal workshops.

However, there are also a number of unlicensed factories in Banting, Kota Seri Langat, Jenjarom, Telok Panglima Garang, and Telok Mengkuang along the river. These comprise wood processing plants, storage and jetties, office furniture factories, brick factory, used battery processing plant, concrete chair factory, gate manufacturing factory, billboard production companies, and storage containers.

Most of the pollution comes from the upper reaches from the district of Hulu Langat, where there are factories and industries. Turbidity is commonly a problem due to sand mining activities, and there are industrial effluents flowing from Kajang.

***JPSPN** is a federal government agency dedicated to the management of solid waste*

Other potential sources of pollution are cow and sheep farms in Dengkil, villages that produce domestic waste at Sepang, and from Cyberjaya to Puchong, there are factories, especially around the Putra Perdana area. Areas that have experienced problems are Sierra 16 along Sungai Rasa and effluents that flow from Sungai Merab to Desa Putra into the rivers around Sepang. Because of this, the district offices in this basin are thinking of proposing a gate.

Overall, the water quality status in Kuala Langat has not reached critical level and the WTP at Sepang is still able to process the current pollution load in the river.

Solid Waste

Until 2011, solid waste collection and transportation was managed and carried out under Jabatan Pengurusan Sisa Pepejal Negara (JPSPN), which integrated solid waste management system at the national level. It was established under the Solid Waste and Public Cleansing Management Act 2007 (Act 672). The Act empowered the Federal Government to take over the management of solid waste and public cleansing from the local authorities throughout Peninsular Malaysia and the Federal Territories of Putrajaya and Labuan.

Another entity, Solid Waste Management and Public Cleansing Corporation (SWCorp), was established to complement and implement the National Solid Waste Management Policy. In Selangor, the contractor carrying out the solid waste disposal services was Alam Flora.

In 2012, the responsibilities of solid waste management, implementation, and enforcement was reinstated to the Selangor State Government, which meant that local governments were now charged with the task of solid waste management. All nine districts in Selangor now manages the collection, and solid waste transport is handled by the local authorities.

DISTRICT	OVERVIEW OF SOLID WASTE COLLECTION
Sabak Bernam	Local authority: Majlis Daerah Sabak Bernam Daily load estimate : 90 tonnes/day Landfill location : Sungai Besar, Sabak Bernam
Kuala Selangor	Local authority: Majlis Daerah Kuala Selangor Daily load estimate: 170 tonnes/day Landfill location: Jeram, Kuala Selangor
Hulu Selangor	Local authority: Majlis Daerah Hulu Selangor Daily load estimate: 170 tonnes/day Landfill location: 1. Sungai Sabai, Kalumpang 2. Bukit Beruntung
Gombak	Local authority: 1) Majlis Perbandaran Ampang Jaya 2. Majlis Pembandaran Selayang Daily load estimate: 600 tonnes/day Landfill location: 1. MPS – Bukit Tagar,Hulu Selangor 2. MPAJ-Jeram, Kuala Selangor
Hulu Langat	Local authority: Majlis Perbandaran Kajang Daily load estimate: 1000 tonnes/day Landfill location: Refuse Derived Fuel (RDF) plant owned by Recycle Energy Sdn Bhd at Semenyih
Petaling	Local authority: 1. Majlis Bandaraya Shah Alam 2. Majlis Pembandaran Subang Jaya 3. Majlis Bandaraya Petaling Jaya Daily load estimate: 1. MBSA : 480 tonnes/day 2. MPSJ : 500 tonnes/day 3. MBPJ : 400 tonnes/day Landfill location: Jeram, Kuala Selangor Note: Approximately 85% of the solid waste is sent to the transfer station at Section 21, Shah Alam for processing before being sent to the Jeram landfill
Klang	Local authority: Majlis Perbandaran Klang Daily load estimate: 700 tonnes/day Landfill location: Jeram, Kuala Selangor
Kuala Langat	Local authority: Majlis Daerah Kuala Langat Daily load estimate: 190 tonnes/day Landfill location: Tanjung Dua Belas, Kuala Langat
Sepang	Local authority: Majlis Perbandaran Sepang Daily load estimate: 180 tonnes/day Landfill location: Tanjung Dua Belas, Kuala Langat

Current Solid Waste And Collection Management System 2012
Source: Laporan Tinjauan: Kajian Rancangan Struktur Negeri Selangor 2035, B13: Sisa Pepejal

There are eight landfills in Selangor:

- The sanitary landfill in Bukit Tagar handles solid waste from Kuala Lumpur.
- The Majlis Bandaraya Shah Alam, Majlis Bandaraya Petaling Jaya and Majlis Perbandaran Subang Jaya are serviced by a transfer station at Section 21, Shah Alam that compresses the solid waste before sending it to a landfill in Jeram, Kuala Selangor.
- The Majlis Daerah Kuala Langat is served by the South Kuala Langat landfill near Bandar Sri Ehsan, which is northwest of KLIA. It is located in a reserved forest area, although it is a distance away from the river.
- Solid waste under the Majlis Perbandaran Kajang is disposed of through a Refuse Derived Fuel (RDF) plant owned by Recycle Energy Sdn Bhd. The system processes solid waste to generate electricity from the energy created during the combustion of separated waste.

LOCAL AUTHORITY	LANDFILL SITES	SIZE (ACRES)	OPERATOR
Majlis Daerah Sabak Bernam	Sungai Besar Landfill	10	Majlis Daerah Sabak Bernam
Majlis Daerah Kuala Selangor	Jeram Sanitary Landfill	160	Worldwide Landfill Sdn. Bhd.
Majlis Daerah Hulu Selangor	Sungai Sabai, Kalumpang Landfill Bukit Beruntung Landfill	20 20	Majlis Daerah Hulu Selangor
Majlis Perbandaran Selayang	Bukit Tagar Sanitary Landfill	700	KUB-Berjaya Enviro
Majlis Perbandaran Ampang Jaya	Jeram Sanitary Landfill	160	Worldwide Landfill Sdn. Bhd.
Majlis Perbandaran Kajang	Solid Waste Recovery Centre (RDF Plant), Semenyih	160	Recycle Energy Sdn. Bhd.
Majlis Perbandaran Subang Jaya	Transfer Station @ Sec 21, Shah Alam ➔ Jeram Sanitary Landfill	160	Worldwide Landfill Sdn. Bhd.
Majlis Bandaraya Shah Alam	Transfer Station @ Sec 21, Shah Alam ➔ Jeram Sanitary Landfill	-	Worldwide Landfill Sdn. Bhd.
Majlis Bandaraya Petaling Jaya	Transfer Station @ Sec 21, Shah Alam ➔ Jeram Sanitary Landfill	160	Worldwide Landfill Sdn. Bhd.
Majlis Perbandaran Klang	Jeram Sanitary Landfill	160	Worldwide Landfill Sdn. Bhd.
Majlis Daerah Kuala Langat	Tanjung Dua Belas, Sanitary Landfill	160	Worldwide Landfill Sdn. Bhd.
Majlis Perbandaran Sepang	Tanjung Dua Belas, Sanitary Landfill	160	Worldwide Landfill Sdn. Bhd.

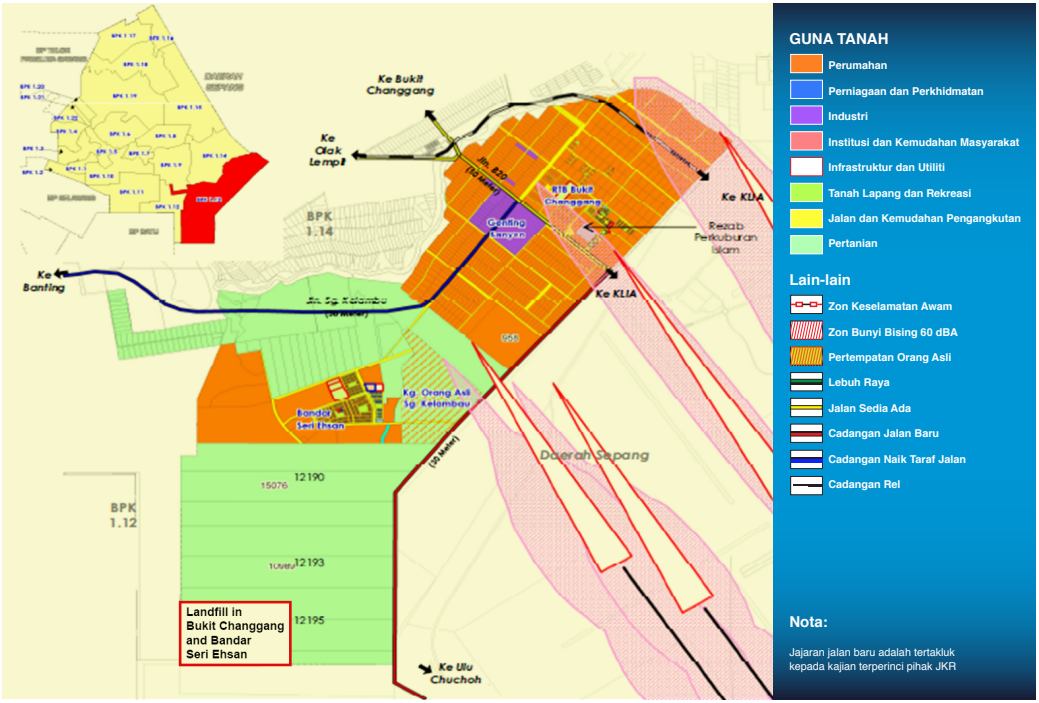
Disposal centres by district and operator 2012
Source: Laporan Tinjauan: Kajian Rancangan Struktur Negeri Selangor 2035, B13: Sisa Pepejal

Landfills throughout Selangor
Source: Laporan Tinjauan: Kajian Rancangan Struktur Negeri Selangor 2035, B13: Sisa Pepejal

Non-sanitary landfills allow leachates to seep into the ground, and thus must be must be monitored to ensure that leachate does not infiltrate into nearby waterways. This is especially so as the location of these landfills upstream of water intakes raise the concern of potential river contamination.

In 2015, the three district—Hulu Langat, Kuala Langat, and Sepang—generated a combined volume of 1,437 tonnes of solid waste per day. This amounts to 30% of the state's daily total. According to JPBD Selangor, the rate of solid waste generated per person is 0.8 kg/capita/day. The current state total is 4,924 tonnes per year and is expected to reach 7,200 tonnes by 2035.

YEAR	2010	2015	2020	2025	2030	2035
District	Waste Generated					
Sabak Bernam	85	95	110	134	166	180
Kuala Selangor	168	189	215	244	273	295
Hulu Selangor	158	179	220	262	306	331
Gombak	546	615	754	902	1,017	1,102
Hulu Langat	925	1,043	1,145	1,243	1,330	1,440
Petaling	1,450	1,634	1,673	1,761	1,869	2,023
Klang	689	776	859	914	951	1,030
Kuala Langat	180	203	259	299	339	367
Sepang	169	191	270	335	339	432
Total	**4,370**	**4,925**	**5,505**	**6,094**	**6,590**	**7,200**



ISSUE

MALODOUR COMING FROM TANJUNG DUA BELAS LANDFILL

This is not an issue affecting the river, but there has been complaints and reports of bad odour emanating from the landfill

Sand Mining and Quarries

Sand Mining

Approval and Structure of Sand Mining

There are 33 sand mining sites and 12 quarries in Hulu Langat. Generally, quarries in Selangor are operated by large companies that normally carry out proper operational procedures. District and land offices ensure that operators have applied for permits to move rocks and quarry debris from one location of the mining scheme to another. Thus, each transport lorry must have a docket, which is given after paying royalty to the state.

Sand mining has more local players, although there is one large company that parcels out sites among smaller players. Although there are illegal operators, especially along the rivers, a number of these are reported by the head of the village or community who are concerned about their environment.

Sand mining is approved by Pejabat Tanah dan Galian Selangor, and applicants must follow the mining scheme stipulated in the State Mineral Enactment (SME). Permits are

given on a 2-month basis, but this depends on the mineral deposit. JAS allows use of chemical bentonite for sand mining.

The method of operation for sand mining is approved by JMG, while sandwashing is approved by JPS and LUAS. The sand mining and sandwashing industry is structured such that a coalition of operators work through one major operator. There are no individual operators. Sandwashing is usually carried out upstream of the river basin, to maximize the river flow. Sand mining is a downstream activity.

Sand Mining Activities in Sungai Langat

In terms of major sand mining projects, recently a permit was given out to a concessionaire in two parcels: Permit 1, which is ongoing, covers the 7.1 kilometres stretch of the river from the boundary of Sepang (Bukit Changgang) to Labohan Dagang. Permit 2 which covers the stretch from Labohan Dagang to Jambatan Telok Datok has yet to commence.

Another sand mine location is near the Paya Indah Wetlands, where there are old mining pits which have been converted for sand mining.

Some sand mining sites need monitoring to mitigate any potential problems. At a site near Sungai Labu and Sungai Langat, JPS had requested the operator to leave a buffer of 50 metres between the site and the river. As extra precaution, JPS installed a bund by the river. In 2015 the bund broke, spilling out large amounts of sand into the river and causing heavy turbidity. The bund has since been rectified, but JPS is taking precautions as high flow from heavy rains may trigger another bund failure.

Due to dwindling supply of sand, sand mining industry out at sea has begun. Storage of such sand are located at four sites at Segenting. It is a growing industry, but authorities worry that environmental problems may arise due to the high salt content in the salt harvested from sea.

As inland mining cannot keep up with the country's demand for sand, offshore sand mining is becoming more prevalent. Concessionaires approved by Jabatan Ketua Pengarah Tanah dan Galian (JKPTG) under NRE extract sand from the federal area of the channel in the Straits of Melaka. JMG monitors the offshore operators together with Agensi

Pengkuatkuasaan Maritim Malaysia (APMM), Jabatan Laut Malaysia, LUAS, and the land offices. Extracted sand from the sea is then stockpiled along the coast. Currently, there are four sites of stockpiling, one of them at Seganting, near Pulau Carey. However, the sand is not suitable for construction because of its salt content. In Lukut, Negeri Sembilan, offshore sand is used for land reclamation projects.

Quarries

All quarry works must be approved by JMG. Quarry operators must follow established procedures, especially for blasting (there is a stipulation that a JMG officer has to be present onsite during blasting operations). In Sungai Langat, quarries can go as deep as 70 metres for alluvium deposits.

Effluents must follow JAS and LUAS regulations. The stipulation became more stringent after the Twin Ridge landmark case in 2013 when the opening up of a quarry in a forest reserve in Semenyih near Sungai Langat caused massive pollution of the river, with high levels of turbidity, aluminium and nitrate in the water. But it was the heavy presence of granite debris in the river that caused the treatment plant to close down.

After this, a buffer of 500 cubic metres from the quarry face was enforced. Enforcement is done together with Pejabat Tanah dan Galian, but it is based on reports or complaints and monitoring is not done on a regular basis.

ISSUE 01

EROSION ALONG RIVER EMBANKMENT

There are cases reported on erosion problems within the river basin. One such location is located along Sungai Labu, where sand mining operators dug out the bund and berm. Operators are not following the standard operating procedures for carrying out sand mining activities set up by JMG and JPS. Also, there is poor standing supervision to ensure that proper procedures are being carried out. This should be addressed as the cost of rectifying the problems caused by sand mining activities is more than the value of the sale of the sand.

■ **Suggestions:** Best management practices, ISO, standing supervision

ISSUE 02

COMPLAINTS FROM RESIDENTS THAT OPERATORS ARE NOT FOLLOWING PROCEDURES

According to authorities, quarry rehabilitation is merely a best management practice, not a guideline. They also point out that sometimes the quarry was there first, and houses came later, as in the case of Putra Heights.

ISSUE 03

EFFLUENTS FROM SAND MINING FLOWING INTO THE RIVER

This happens when sand mining projects are not properly controlled and monitored. A sand mining site must follow a mining scheme, which is a layout of the mining operations and the methods that will be used. A typical mining scheme consists of tailing, operations office, siltation pond, spillway and stockpile. Different coverage has a different layout configurations. It also describes how deep the operator will dig and what methods will be employed: hydraulics, dry cell, dredging, or open cast. Most importantly, there must be a buffer between any water bodies and the site.

■ **Action:** There is a committee under LUAS for emergency response to river pollution, which is the Jawatankuasa Kecemasan Pencemaran Sumber Air (Committee on Water Pollution Emergencies), which comprises many agencies such as JAS, JPS, JMG, local authorities and others.

ISSUE 04

NEED TO CONTROL WATER MOVEMENT TO PROTECT THE PEAT FORESTS

In the Sungai Langat Basin, there is the South Langat Peat Swamp Forest. In order to monitor it, modeling should be carried out to control water movement. The soil of the peat forests is largely made up of homogens with high transivity that allows water to flow at 7,000 cubic metres per day. This means that water from peat forests can find their way into sand mine pits. To prevent groundwater intrusion into the pit, a clay bund is installed as the digging goes deeper. During this time, monitoring of the groundwater is important. The objective of having proper monitoring is to protect the aquifer regime in terms of quantity and quality. Starting from a few years ago, all large-scale sand mining project proposals are now required to have modelling and an EIA. Smaller projects must produce an environmental management plan.

ISSUE 05

NEED DATA FOR SIMULATION, MODELING AND INVESTIGATION

When sand mining, operators must take measures to ensure that peat areas do not dry out. This applies in particular to Kuala Langat. There has not been a recent combustion of forest, although in April 2016 there have been some cases. There are six TubeWells in Kuala Langat Utara and three in Kuala Langat Selatan. During the dry season, the pumps are activated into the drainage system. Check dams installed by JPS control the water level that will go into the peat layer as well as raise the water level when needed. There is also a watchtower under JPNSto monitor for fires. This is to prevent fires in peat forests. There is a system called Infrastructur Pengawal Kebakaran Hutan Gambar,led by JASas this agency also monitors the air pollution index.

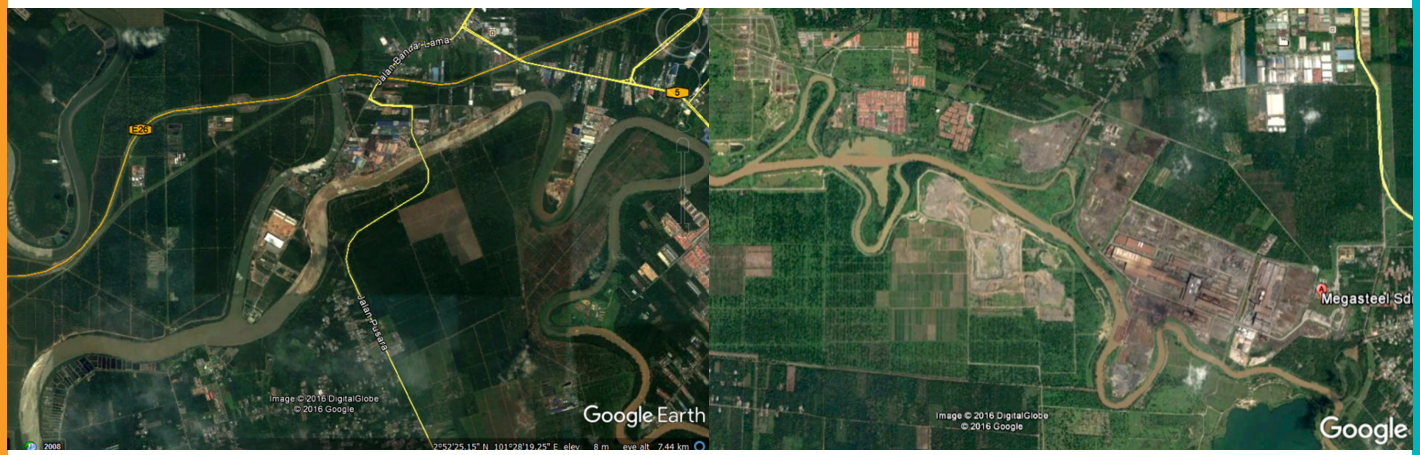
Development and Earthworks

Development should be more controlled by local authorities, especially during earthworks when earth and silt is likely to seep into the rivers. Best management practices, such as silt traps, should be carried out. EIAs have been completed for some of these developments, but the implementation does not always follow the prescribed measures in the assessments. Authorities have also emphasised the need to control the river quality from upstream areas to prevent heavy sedimentation from earthworks and development activities.

There is an illegal project in Banting called Tadom Hills Resorts, which has taken orang asli land and developed without permits from the local and district authorities. The authorities are concerned about the safety and environmental integrity of the premises, including the quality of water bodies on the land.

Alteration of Resources

JPS is carrying out a resurvey of Sungai Langat, which will be submitted to the district and land office for gazetting. With the new survey, planning for river improvement works can commence. The survey has already started from the Sungai Klang boundary. Some works have already been carried out, such as river straightening works at tight bends along the river where it turns sharply at Teluk Datuk near Sungai Manggis.



At Olak Lempit in Mukim Tanjung Dua Belas, a river shortcut was made for Megasteel Sdn. Bhd., an integrated steel mill that produces flat steel products. A commercial jetty has also been constructed at this stretch. Both works were undertaken to facilitate navigation and operations of Megasteel barges.

Significant River Works

Significant river works within the Sungai Langat basin involved flood mitigation, upgrading drainage, river management program, and upgrading pond and lakes.

1.0	**FLOOD MITIGATION**
1.1	**District of Hulu Langat**
1.1.1	Flood mitigation project at Sungai Rinching, Mukim Beranang
1.1.2	Flood mitigation project at Sg. Sompo
1.1.3	Flood mitigation project at Sg. Serai Phase 1
1.1.4	Flood mitigation project at Kg. Sg. Jeluh Phase 2
1.1.5	Flood mitigation project at Sg. Ramal Phase 3
1.1.6	Flood mitigation project at Kuala Sg. Sering, Mukim Cheras
1.1.7	Upgrading of riverbank project at Sg. Balak, Mukim Kajang
1.1.8	Scheme of flood prevention at Sg. Sekamat, Mukim Cheras
1.1.9	Flood mitigation scheme at Sg. Bangi, Mukim Semenyih
1.1.10	Flood mitigation scheme at Sg. Sering, Mukim Cheras
1.2	**DISTRICT OF KUALA LANGAT**
1.2.1	Flood mitigation project at Pekan Banting
1.2.2	Flood mitigation project at Pekan Sg. Jarom
1.2.3	Flood mitigation project at Pekan Morib
2.0	**UPGRADING DRAINAGE**
2.1	**District of Kuala Langat**
2.1.1	Upgrading of drainage system project at Jugra
2.1.2	Upgrading of drainage system project at Sijangkang
2.1.3	Upgrading of drainage system project at Pekan Telok Panglima Garang
2.2	**DISTRICT OF HULU LANGAT**
2.2.1	Upgrading of drainage system project at Kg. Sg. Kantan
2.2.2	Upgrading of drainage system project at Kg. Sg. Jernih
2.2.3	Upgrading of drainage system project at Jalan Semenyih
2.2.4	Upgrading of drainage system project at Kg. Teras Jernang
2.2.5	Upgrading of drainage system project at Kg. Baru Balakong
2.2.6	Upgrading of drainage system project at Kg. Sentosa
2.2.7	Upgrading of drainage system project at Pekan Broga
2.2.8	Upgrading of drainage system project at Country Height
2.3	**DISTRICT OF SEPANG**
2.3.1	Upgrading of drainage system project at Sg. Salak
2.3.2	Upgrading of drainage system project at Revolusi Hijau
2.3.3	Upgrading of drainage system project at Rehabilitation Centre, Dengkil
2.3.4	Upgrading of main drainage system project at Sg. Padang Kerbau

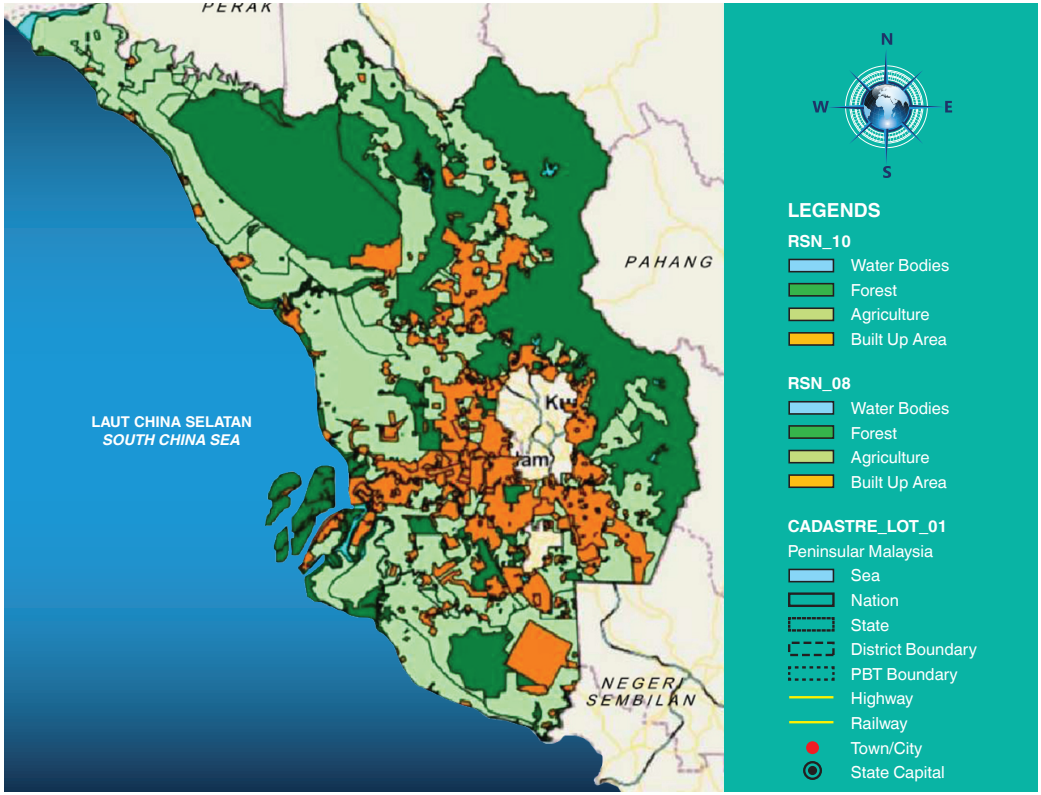
***DOA** is an agency that encourages and monitors agricultural activities*

3.0	**RIVER MANAGEMENT PROGRAME**
3.1	Reserve management of Sg. Langat
4.0	**UPGRADING POND AND LAKES**
4.1	Upgrading of highway PLUS (1) detention pond and related works at Kg. Abu Bakar Baginda, Dengkil, Sepang
4.2	Upgrading of highway PLUS (2) detention pond and related works at Kg. Abu Bakar Baginda, Dengkil, Sepang
4.3	Upgrading of detention pond 1 and related works at Kg. Sg. Merab, Dengkil, Sepang
4.4	Upgrading of detention pond 3 and related works at Kg. Sg. Merab, Dengkil, Sepang

List of significant river works within Sungai Langat Basin
Source: JPS Selangor

Agricultural Activities

There are 43,000 registered farmers in Selangor. On average, there is a ratio of one farmer per two hectares of land. In Selangor, agriculture occupies approximately 298,000 hectares of land (37% of total land in Selangor) and contributes about 1.7% to the state GDP. Agriculture activities are carried out in various scales and production efficiency by entities ranging from large companies orestates to small holders and government corporations.



A breakdown of agricultural land use in Selangor for the year 2012 shows that palm oil and rubber occupied 199,805 hectares (67% of the total agriculture area), but these farms generally do not draw water from water bodies except for nursery irrigation. The biggest water use in the farming sector is irrigation for paddy planting in the Northwest Selangor IADA which occupies 18,610 hectares of land and uses about 700 MCM of water per year. Faced with limited water resources, increasing demand for potable water supply is deepening the conflict for water allocation between the farming community and other users of river water.

TYPES OF CROPS	COVERAGE AREA (HECTARES)						VARIATION
	2012	2015	2020	2020	2030	2035	
Oil Palm	168,239	165,833	163,427	161,021	158,615	156,206	12,033 (7.2%)
Rubber	31,566	30,460	29,354	28,248	27,142	26,033	5,533 (17.5%)
Paddy	18,610	18,610	18,610	18,610	18,610	18,610	0 (0)
Other crops	79,613	77,241	74,869	72,497	70,125	67,752	11,861 (14.9%)
Wasteland	520	416	312	208	104	0	520 (100%)
Total	**298,548**	**292,560**	**286,572**	**280,584**	**274,596**	**268,601**	**29,947 (10%)**

Projection of agricultural land based on type of crops in Selangor (2012 – 2035)
Source: Kajian Semula Rancangan Struktur Negeri Selangor, 2020

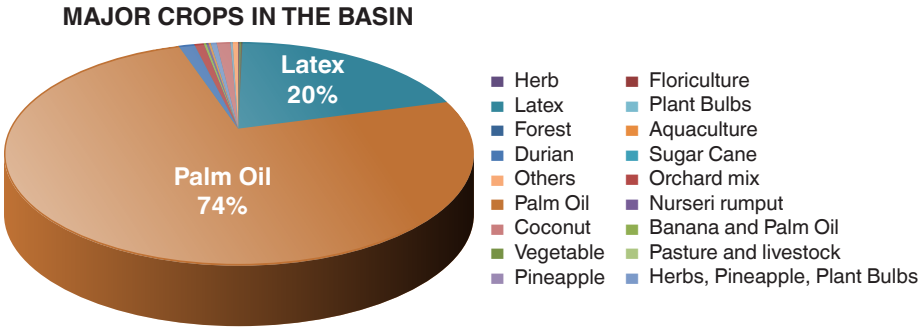
In the Sungai Langat basin, agriculture takes up a large percentage of the basin's land at 60,000 hectares. Commercial plantations for palm oil and rubber as well as fruit and vegetable farming dot the landscape along Sungai Langat and its subcatchments, Sungai Semenyih and Sungai Labu.

The predominant crop types in the basin were palm oil at 74% and latex at 20%.

MAJOR CROPS IN THE BASIN			
Palm Oil	Latex	Durian	Banana
Mixed orchards	Plant bulbs	Herbs	Sugar cane
Pineapple	Coconut	Vegetables	Cultivated grass

Source: Jabatan Pertanian 2012

There are also many other crop types that were cultivated such as jackfruit, rambutan and longan; however, they tended to belong to individual owners on small plots of land. In the pie chart, they constitute the thin slivers of the pie.



Common crops grown in the Sungai Langat basin
Source: Jabatan Pertanian 2011

Good Practices

Jabatan Pertanian (DOA) provides awareness and education on good farming practices to farmers through an incentive program called Malaysian Good Agriculture Practices (MyGAP). Introduced in 2010, MyGAP promotes incentives for good agricultural practices. Farmers who comply will be awarded a certificate of good practices, which is globally recognised. This is significant because target market countries, such as the European Union and Japan, require the certificate before accepting Malaysian agricultural imports into their countries.

Currently, there are 500 farmers who have the certification. However, most farmers do not follow or pursue such promoted practices. Farmers cannot be forced to comply with these guidelines, although to be a legal operation, they must register their farming enterprises with the district and land office.

Regulation

There are currently efforts to further regulate the pesticide industry. A Pesticide Act is in the process of being drafted. However, the revision is only for enforcement on the supply side and defining and regulating the types and classes. There is no monitoring on the use of the pesticides and fertilisers by the end-users and how much they can discharge into the rivers.

Issue 01

FERTILISER OR CHEMICAL RUN-OFF

Current legal regulations covers only the fertiliser industry on the supply side and not the end-users. DOA has guidelines that limit and schedule the amount of pesticides or fertilisers that can be used, but has no power for enforcement. Local authorities have reported seeing changes in the colour of the river water when there are large amounts of chemical runoff into the river.

Issue 02

ALGAE BLOOMS

Overloading of nitrogen and phosphorous levels in rivers from excessive nutrients promote sudden growths of cyanobacteria which produces harmful toxins in the water. When the blooms die off, a deoxygenizing process takes place due to the sudden die off of mass cyanobacteria. Large and frequent blooms will destroy entire aquatic ecosystems leading to regional “dead zones” especially at river deltas where the nutrients are concentrated from all over the river basin.

Livestock Farming

In Selangor, there are three enactments regulating the livestock industry, starting with the Undang-Undang Pendaftaran Lembu Kerbau 1971. The swine sector later saw its own enactment, as did the poultry sector. The enactment for bovine livestock focuses more on nuisance caused by livestock rather than on regulatory matters. Unlike other states, Selangor's enactment does not focus on registration of bovine livestock, and as such, does not address current issues, and is weakly enforced. On the other hand, enactment on the poultry and swine sectors deal with registration and health issues. At this moment, poultry and swine livestock are licensed.

***JPV** is an agency for animal disease control, inspects livestock farms and processing plants, controls production of livestock, livestock products and animal feed*

Livestock Population

In Selangor, the population of livestock consists predominantly of poultry. Poultry comprise broilers, hens, Baka breed and free-range chicken. In terms of population, there were 8 million broilers and 10.3 million hens. Pigs came next at 273,630 followed by goats at 23,536. Beefing cattle came next at 18,409 and dairy cows are last at 6,098.

The Sungai Langat basin has the largest population of pigs in Selangor. Swine breeding in Selangor is now concentrated in the western part of the Sungai Langat basin, following a series of swine epidemics that broke out in the late 1990s including the Nipah epidemic that resulted in the culling of almost a million pigs. Having them concentrated into a single area made for better monitoring, management and facility as well as centralisation services.

TYPE OF LIVESTOCK	2009	2014	% DIFFERENCE
Beefing cow/Buffalo	28,056	18,409	-34.30
Dairy cows	6,297	6,098	-3.10
Sheep/Goats	46,324	23,536	-49.10
Broilers (chicken and duck)	7,696,920	8,013,569	+4.10
Hen (chicken and duck)	4,649,400	10,285,211	+121.20
Pigs	254,141	273,630	+7.60

Figures of livestock in Selangor 2014
Source: Department of Veterinary Services Selangor

In Hulu Langat and Kuala Langat, livestock breeding are clustered by animal type. In Hulu Langat, the most number of farms are those for beef cattle and goats with a population of 2,125 and 3,315 respectively. In Kuala Langat, pig farms occupy the highest number at 128 with a population of 273,630. Sepang sees less livestock breeding, with 48 farms for beef cattle with a population of 1,002 and 29 farms for goats with 1,502 heads.

Sungai Langat Basin

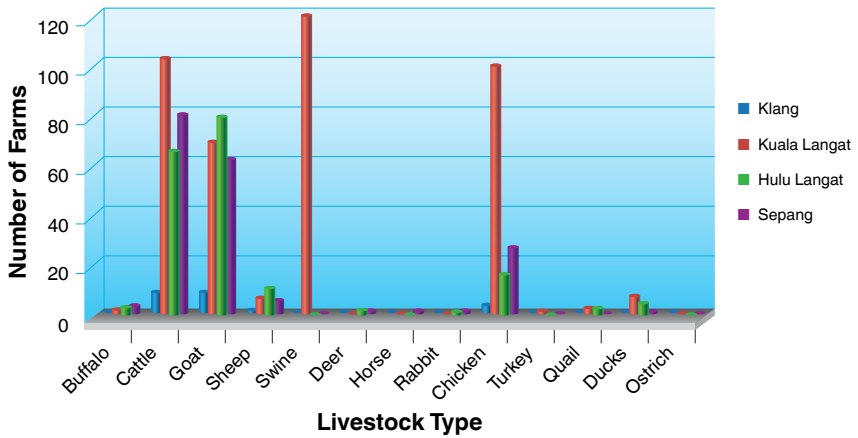
The poultry industry is concentrated with a few farms with large populations in Hulu Langat, while there are more smaller-scale farming operations in Kuala Langat and Sepang.

DISTRICT	HULU LANGAT		KUALA LANGAT		SEPANG	
Livestock Type	**Farm**	**Population**	**Farm**	**Population**	**Farm**	**Population**
Buffalo beef	6	71	1	11	-	-
Dairy buffalo	4	923	-	-	-	-
Beef cattle	84	2,125	25	1,273	48	1,002
Dairy cattle	16	766	4	154	14	578
Heifer	17	628	-	-	3	93
Goat	81	3,315	12	637	29	1,502
Dairy goat	2	72	2	29	1	23
Sheep	19	1,437	4	431	4	239
Swine / Pigs	-	-	128	273,630	-	-
Deer	3	61	-	-	1	5
Horse	-	-	-	-	-	-
Rabbit	1	30,000	-	-	-	-
Broiler chicken	3	388,000	80	2,344,040	22	852,739
Egg laying chicken	2	300,040	6	256,000	-	-
Breeding chicken	2	503,200	-	-	1	3,000
Free-range chicken	6	2,451	14	12,366	1	2,000
Turkey	-	-	1	200	-	-
Broiler quail	1	2,000	2	127,00	1	390
Egg laying quail	-	-	1	80,000	-	-
Broiler duck	-	-	1	20	-	-
Egg laying duck	1	33	2	713	-	-
Ostrich	1	200	-	-	-	-
Total	**249**	**1,235,322**	**283**	**2,982,204**	**125**	**861,571**

Number of farms and population of livestock in the Sungai Langat basin
Source: Department of Veterinary Services, Annual Report 2014

To give an indication of the physical distribution of the farm locations by districts, the farms were plotted according to districts of Klang, Kuala Langat, Hulu Langat, and Sepang. In Langat, the farms are located towards Bukit Chilling. It should be noted that as only a small part of the Klang administrative district falls under the Sungai Langat basin, a rough estimate of 10% was considered in calculating the number of farms. There is an abbatoir at Sungai Manggis for cows and chicken.

NUMBER OF FARMS BY DISTRICTS AND LIVESTOCK TYPE



The bar chart shows that although cattle and goat farms were the biggest in terms of numbers, their distribution was widespread among the four districts. With other livestock such as swine or chicken, the farms tended to be concentrated in the Kuala Langat district.

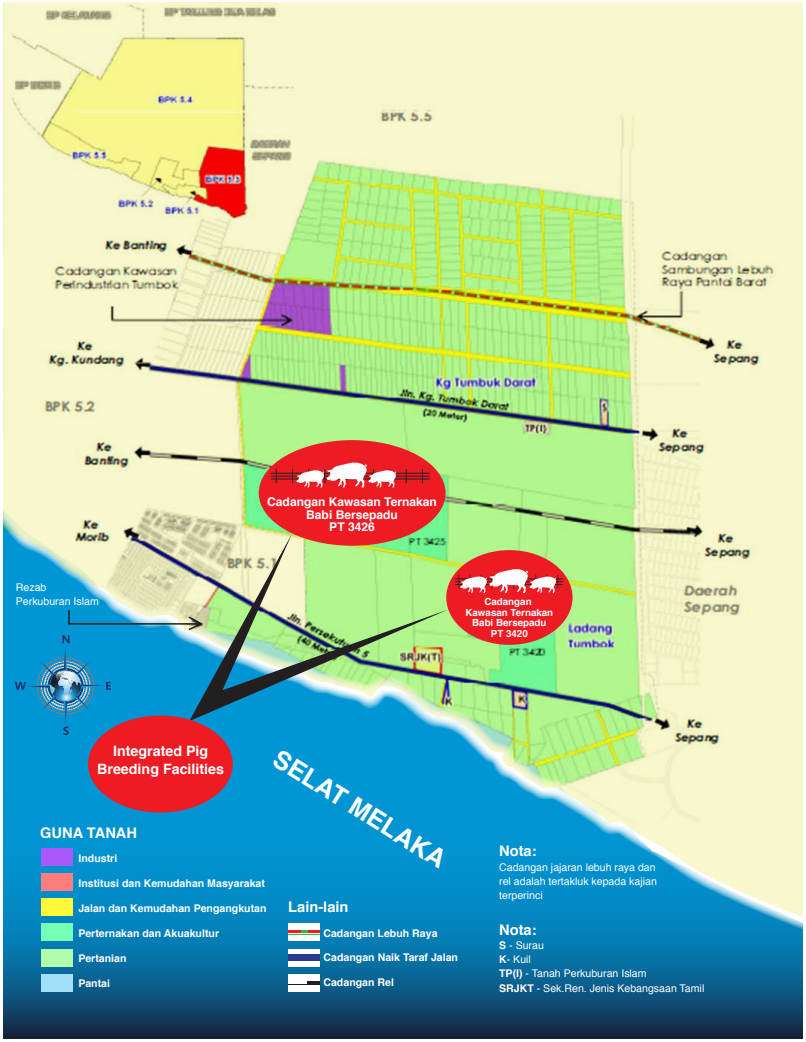
In the Hulu Langat districts, cattle and buffalo farms are located in the Bangi area while in the Sepang district, the majority of livestock farms are concentrated in Jenderam, Hulu Dengkil, and Kampung Labu Lanjut. Some of these farms have wastewater treatment ponds, but a majority of them do not.

Swine Livestock

Following the Nipah virus outbreak in 1998, there was a relocation exercise to migrate pig farms to a centralised location in Kuala Langat district. They are now located along the coastline between Pantai Morib and Bagan Lalang as well as further inland along Sungai Langat. As of 2015, there were a total of 125 pig farms, most of them private and small-scale. This centralised area is called a 'modern pig farm'.

There are a number of swine farms at Batu Laut, including four farms in Banting and another four in Kanchong. There are also a number of farms along the coast at Tanjung Sepat and Tumbuk, and four at the border of Sepang. Unfortunately, the sultan's palace is located in proximity to the farms and there have been reports from the palace. Odours from a livestock feed plant in the Kanchong area led to complaints and eventually the shutdown of the plant.

Also compounding the problem of swine farm locations are plans to promote the area for tourism such as the Gold Coast Morib. Hence, there are plans to move some of the farms elsewhere. However, there has been resistance from farmers who have been there for three to four generations since their relocation. Thus authorities suggest that relocation of pig farms be well-coordinated and not cause undue financial hardships to the owners. There is a quota for swine population, which is derived using an estimate called "standing population" (the figure for the estimate equals the number of sows; the total population is



Source: Majlis Daerah Kuala Langat

tenfold as the average litter has ten pokers, or harvest-ready pigs). The quota is 250,000 pigs for the entire state of Selangor. Each farm has its own quota as set by Jabatan Perkhidmatan Veterinar (JPV).

Poultry Livestock

The area with the biggest poultry population is Kuala Langat, followed by Kuala Selangor, then the rest are small-scale operations, with Petaling having the least number of poultry population. There is no quota set for the poultry sector, but it follows local authority zoning. Any application for big-scale poultry farming must get approval from relevant agencies such as the land and district offices, JPBD, local authorities, and LUAS and follow local authority zone. Upon approval, JPV will issue a license. For smaller scale operations with less than 500 birds, it is considered subsistence farming and there is no need for licensing.

Bovine Livestock

As of 2013, there were 222 cow and buffalo farms in Selangor. They are not licensed by JPV. The method of raising cows is free-range grazing, although this practice gives rise to some issues of trespassing on private property and destroying cultivated patches of vegetation. There are guidelines provided by JPV for good husbandry practices.

Good Practices

JPV promotes Good Animal Husbandry Practices, a worldwide standard for animal husbandry that was developed by the World Organisation for Animal Health. It covers all aspects of animal husbandry such as infrastructure, drainage, waste management, effluent management, shelter, health, and biosecurity. Abbatoirs are regulated under federal law, which has many requirements. Some of the challenges faced by JPV is that not all famers follow the guidelines that have been prepared by the agency. However, awareness and education activities by the agency is ongoing.

Issue 01

DIRECT DISCHARGE FROM SWINE AND POULTRY FARMS

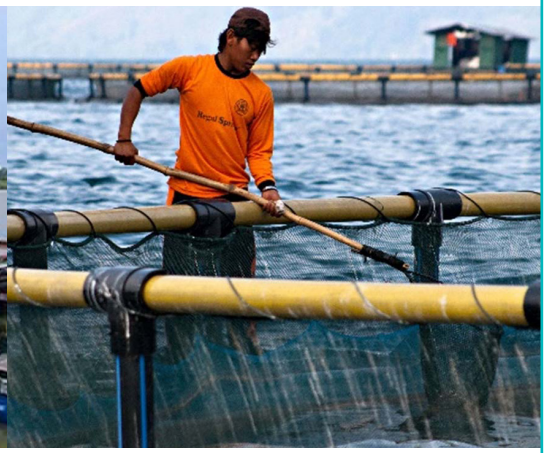
There has been incidents whereby discharge of solid waste from livestock farms (mainly pig farms) have affected coastal mangroves negatively. It has resulted in loss of coastal mangroves at Tanjung Sepat. Good practices mandate that swine farms have three treatment ponds to treat the waste water before discharging into the river, although not all follow this practice. By and large, poultry rearing do not use as much water as swine. As such there has been no requirements for treatment ponds in the past. However, after receiving complaints of odour and dark water in the river, LUAS had made it mandatory to request farmers to have treatment ponds on their farm premises.

Issue 02

POLLUTION OF RIVER WATER AND ODOUR EMANATING FROM THE INTEGRATED SWINE BREEDING FACILITIES

Discharge from such facilities have been the main source of pollution for Sungai Tumbok, Sungai Titi and Sungai Sepat.

Aquaculture and Fishery



***DOF** is an agency that develops and manages the national fishery industry*

Jabatan Perikanan Negeri Selangor (DOF) is the agency that regulates and monitors aquaculture and marine fishery. DOF Selangor's functions comprise registration and licensing of aquaculture operators and fishing vessels, data collection and inventory. DOF responds to reports or complaints from the public on aquaculture activities by conducting investigations with JAS or with LUAS, which is backed by the Emissions or Discharge of Pollutants (Selangor) 2012 Enactment.

Currently, DOF regulates marine aquaculture and marine fishery. This means that licenses for marine aquaculture are compulsory and must be registered with DOF. For marine fishery, licenses are determined by vessel size and the type of fishing gear and equipment onboard.

There is no law yet for inland aquaculture, and registration for aquaculture licenses is still on voluntary basis. An act to give power to DOF for regulating inland aquaculture is in the works and expected to be out next year. Likewise, an enactment to give DOF the power to enforce the rules and regulations tied

to inland fishermen is expected to be passed next year. The Kaedah-Kaedah Peraturan Perikanan Darat was drafted at the federal level in 2015, but not yet accepted at the state level.

Selangor DOF's jurisdiction extends out three nautical miles from the low tide line. Any waters beyond that falls under federal law. As DOF Selangor is a representation at the state level of a federal agency, it enforces both state and federal law in coastal waters.

Aquaculture

Currently, there are about 614 inland aquaculture businesses registered under DOF in Selangor. However, the number of total or unregistered farms is unknown. Out of the registered businesses, 80% are small-scale operations. The rest are larger commercial entities, which make up 20 to 30% of production yield. In Selangor, the aquaculture business is mostly made up of cockle breeding, occupying an area of 4,850 hectares. The district of Sabak Bernam has the most cockle breeding farms (53), while Kuala Selangor district has 29 and Klang district has seven.

RIVER BASIN	DISTRICT	NO. OF AQUACULTURE FARMS
Sg. Langat	Kuala Langat	111
	Sepang	
	Gombak	
Sg. Selangor	Kuala Selangor	221
	Hulu Selangor	
	Gombak	
Sg. Bernam	Sabak Bernam	108
	Hulu Selangor	
Sg. Klang	Klang	160
	Petaling	
	Kuala Langat	
	Sepang	
	Gombak	

Number of aquaculture farms by river basin
Source: Jabatan Perikanan 2015

Total Landings

TYPES	DISTRICT	LANDINGS (METRIC TONNE)		
		2012	2013	2014
Cockles	Klang, Kuala Selangor, Sabak Bernam	5,895.56	5,200.75	3,377.92
Marine Prawn	Kuala Langat, Kuala Selangor, Sabak Bernam, Sepang	5,895.56	5,200.75	3,377.92
Caged Marine Fish	Klang, Sabak Bernam	3,113.19	2,444.96	967.97
Freshwater Fish	All districts	14,856.91	16,114.45	7,773.03

Note: Data for 2014 is up until July
Source: DOF website (2015)

Fishery

Captured fishery refers to marine fishing, while inland fishery refers to fishing in the rivers and ponds. In terms of yield and production, the captured fishery industry comprises commercial enterprises while inland fishery consists of small-time fishermen who fish for their own consumption. The size of the inland fishery industry is smaller than that of marine fishery, at a ratio of 2:5. The volume of inland fishery landings in 2015 was 377 metric tonnes.

Some of the fish species caught in the Sungai Langat basin are perch (sepat), helicopter catfish (tapah), catfish, knifefish or chitala (belida), snakehead, giant freshwater prawns, minnow (seluang), spotted catfish (lundu), tilapia, gourami (kaloi), and river carp, among others.


Perch


Helicopter Catfish


Belida


Snakehead


Giant Freshwater Prawns


Minnow


Gourami


Black Tilapia

Diminishing Species

Some of the river fish species population were found to be dwindling in Selangor, and these are gourami (temakang), carp, barb or sliver sharkminnow (terbul), hampala barb (sebarau), beardless barb (temperas), bulu barb (tenggalan), and eels.

To counteract this trend, a DOF program called Program Pelepasan Benih Ikan Sungai was initiated to preserve inland fishery species. As of 2015, a total of 392,500 metric tonnes of fry was released into the rivers of Selangor.

PARTICIPATING DISTRICTS	TOTAL RELEASE OF FRY (METRIC TONNES)	SPECIES
Kuala Selangor	30,000	Freshwater prawn
Hulu Selangor	182,500	Java or goldfoil barb
Kuala Langat	38,000	Java or goldfoil barb
Hulu Selangor	24,000	Java or goldfoil barb
Hulu Selangor	30,000	Pangas catfish
Kuala Langat	4,000	Pangas catfish/Asian redtail catfish
Kuala Selangor	51,000	Freshwater prawn
Shah Alam	5,000	Pangas catfish
Sabak Bernam	10,000	Asian redtail catfish
Kuala Selangor	7,000	Asian redtail catfish

Volume of fish fry released in Selangor waters
Source: DOF 2015

Jetties

DOF does not own any jetties, either inland or marine, although it does have some for cockle landings.

NO.	YEAR	COST	NO. OF JETTIES	LOCATION / DISTRICT
1	2009	-	4	Sementa/Klang Tok Muda/Klang Sg. Semilang/Kuala Selangor Sg. Buloh/Kuala Selangor
2	2010	RM909,190.20	3	Bagan Tengkorak/Kuala Selangor Pasir Panjang/Sabak Bernam

Source: JPV website (2015)

Lembaga Kemajuan Ikan Malaysia (LKIM) and LUAS are the agencies in charge of the jetties. However, it is the DOF that specifies zones in marine waters where vessels are allowed to enter.

ZONE	VESSEL TYPE	GEAR
A	Sampan/outboard engines	Traditional
B	Inboard engine below 25 GRT	Purse seine or trawler
B1	Inboard engine below 40 GRT	Purse seine or trawler
C	Inboard engine below 70 GRT	Purse seine or trawler
C2	Inboard engine 70 GRT and above	Purse seine or trawler

**GRT = gross rate tonnage*
Source: DOF Selangor and Perak

Promotion of Good Practices

In 2015, Kementerian Pertanian dan Industri Asas Tani Malaysia (MOA) introduced the Malaysian Good Agricultural Practices (MyGAP) program, which provides certification for exporting goods in the agriculture, veterinary, and aquaculture sectors. MyGAP ensures good and sustainable practices through strict and stringent requirements. In Selangor, there are only seven aquaculture businesses with MyGAP certification, most of them larger-scale aquaculture enterprises. The certification allows them to export to key markets such as the United States, the United Kingdom, and the European Union, which require the certification. An example of a good practice advocated by DOF is a treatment pond for each aquaculture site where wastewater from the pond will be directed into the treatment pond before being released back into the river. This is necessary to prevent high levels of BOD from polluting the river.

In the aquaculture sector, MyGAP is an extension of DOF's already existing Skim Pensijilan Ladang Akuakultur (SPLAM) and Sijil Amalan Akuakultur Baik (SAAB) industry requirements. MyGAP is mainly targeted to the prawn industry, and there are seven registered with LUAS for emissions and discharge control. The reasons cited for not more participation by the smaller-scale operators is that MyGAP is strict and costly to implement. In addition, DOF Selangor provides a subsistence allowance of RM200 per person to assist inland fishermen.

LKIM

***LKIM** is an agency that provides assistance to local fishermen through financial incentives, skills development and technology improvement*

ISSUE 01

NEED TO REVIEW LICENSING PROCEDURES AND RATE FOR AQUACULTURE TOL

Since 2014, some aquaculture activities such as caged culture are required to get a temporary occupancy license (TOL). This is a requirement by the district and land office before DOF can issue licenses to aquaculture operators. However, this created a situation for caged culture operators who had started operating before 2014 to be fined by the district and land office for not having a TOL. This is currently being worked out, but operators have resisted the TOL imposition, saying it is too costly for them.

ISSUE 02

WATER CHARGES IMPOSED ON AQUACULTURE PROJECTS

In 2012, an act to charge aquaculture operators on water abstraction was passed, and the practice was put into effect in 2015. This created a problem for operators when notices and summons were issued for non-payment as they said they were not informed and made aware of the new law and practice. They also pointed out the need for a scale of water rates, as their use of water was different from that of other water businesses, such as mineral water industry. For the mineral water sector, water is the end-product whereas water for aquaculture was an operational necessity. The imposition of the standard flat rate for commercial water made it difficult for aquaculture operators to stay in business.

ISSUE 03

CHALLENGES TO SELANGOR FISHERY PRODUCTION DUE TO VARIOUS MARKET FACTORS

Captured fishery still comprises 70% of the state's total catch, but Selangor is ranked 5th in production amongst Malaysia's states in 2015. Land for aquaculture activities is costly, and with rising operational costs, fish from Perak is being sold in Selangor markets as they are cheaper than fish from Selangor itself. At the same time, the consumer demand for marine fish is greater than that for freshwater fish. Low consumer perception of freshwater fish such as tilapia gives rise to increased demand for captured fishery products. DOF Selangor is looking for ways to rebrand inland fish to the general public.

ISSUE 04

AQUACULTURE AFFECTED BY POLLUTION

Aquaculture farms are affected by pollution from various sources. In 2015, an aquaculture farm in Hulu Langat was affected by polluted water from a factory further upstream.

ISSUE 05

IMPACTS OF CLIMATE CHANGE

DOF Selangor says that the past three years, from 2012 to 2015, have not been good for aquaculture, citing extreme heat and flooding as a result of El Nino. In Sepang, flooding caused the loss of many aquaculture products. Other states such as Pahang were affected, where a large population of fish in caged culture perished due to rising water temperature.

ISSUE 06

DIFFICULTY OF MYGAP ADOPTION BY AQUACULTURE OPERATORS

MyGAP promotion to aquaculture operators has been difficult primarily due to the stringent regulations, the cost of compliance, and additional paperwork. Agencies suggest the issuance of SAAB, a lower level of certification, to get more registration numbers first, then gradually promote the MyGAP certification.

ISSUE 07

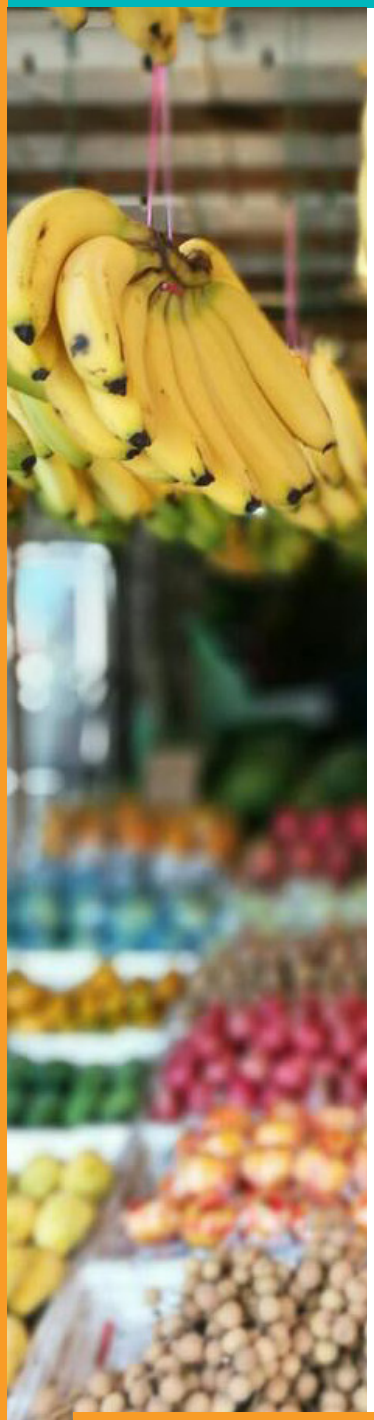
NEED FOR BETTER COORDINATION AND COMMUNICATION AMONG AGENCIES

DOF has been restructured such that enforcement now falls under another agency called the Agensi Penguatkuasaan Maritim Malaysia (APMM). In addition, as a federal agency implemented at the state level, DOF Selangor saw that much of the communication and decision making tends to be centralised at the top and does not trickle down to the state level. With DOF functions being relegated to different organisations and implemented at different levels, communication and coordination becomes important to address linkages and maintain coherence in policy making and program designs.

ISSUE 08

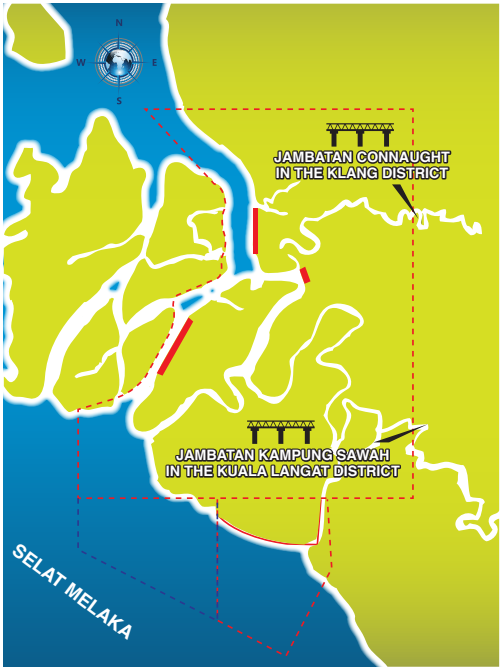
PRAWN AQUACULTURE REPLACES MANGROVE AND CUT BACK ON THE MANGROVE FORESTS

Prawn aquaculture enterprises are encroaching on mangrove forests and thus must be controlled. In just three days, broad swaths of mangroves can be cut down and wiped out. Operators get approval for a fixed number of acres, but in practice take up more acres than permitted. There have been replanting projects with JPNS, but they are not sustained regularly. Another problem arises when the shrimp ponds are cleaned out. Authorities do not know what is inside the ponds and these discharges are being released into the environment. Shrimp wastewater can have adverse effects to receiving waters due to their high concentrations of TSS, TN, and TP.



Wet Markets / Restaurants / Food Outlets

Grease traps are integrated into the licenses, hence local authorities and district offices claim there are no problems of significant pollution from direct discharge of waste water from restaurants and wet markets.



Map of Port Limit in the Sungai Langat and Sungai Klang basins
Source : LUAS 2011

Navigation

There are policies and procedures in navigating rivers. The Federal Authority Act, Ninth Schedule stipulates the authority and responsibilities and policies regarding transport and navigation of state rivers. These policies and procedures are to safeguard personal and public safety as well as protect natural water resources. As coastal waters and river waters share common issues, LUAS coordinates with Port Klang Authority and the Marine Department Malaysia or Jabatan Laut Malaysia (JLM).

Along the coast there is an area called the Port Limit, which designates the area reserved by the JLM and the Port Klang Authority. The Port Limit covers the area starting from the Kapar Power Station above Sungai Kapar Besar at the north and extends down to the mouth of Sungai Langat to the south. Geographically, the port limit falls under two catchments, Sungai Klang and Sungai Langat basins.

In terms of river management, LUAS' scope falls outside the boundaries of the port limit (demarcated in dotted lines on the map). At the eastern border of the port limit is Kampung Sawah in the district of Kuala Langat. Anything east of this point is considered 'inland navigation' while all water-related activities west of the point falls under Port Authority or JLM.

However, land activities within the port limit falls under LUAS, and thus all alteration activities must procure written approval from LUAS. LUAS' authority extends to water resources 5.5 kilometres or 3 nautical miles offshore, although the international navigation lane within the Port Limit is off-limits to LUAS.

An enactment enables LUAS to license and regulate vessels operating in river waters, and as such LUAS oversees the issuance of vessels licenses, collection of navigation fees, coordination of vessel traffic, monitoring and conducting vessel checks as well as enforcing navigation regulations.

In terms of navigation activity, Sungai Langat has become a busy place. There are a number of shipyards south of the river, requiring vessels to transport iron scraps and other commodities upstream. One of the major navigation activities involves Megasteel Sdn. Bhd., which was given a license in 2006 to transport 2,000 metric tonnes of scrap metal using barges up Sungai Langat to its jetty at Olak Lempit. The Megasteel plant supplies steel to the key industries in the state, thus providing economic benefit. However, in so doing, its operations had to be regulated by LUAS to ensure that environmental degradation of the waterways does not occur and to ensure navigation safety.

***JLM** is the marine agency that monitors public jetties, ensures navigation safety and regulates maritime activities and technology improvement*

Port Klang Authority (PKA) is a government agency of Malaysia that facilitates, regulates and owns the country's most important port, Port Klang

Recreation

In the upper basin areas, there are many scenic sites for picnics, swimming, and recreational activities such as Sungai Pangsun, Sungai Gabai Waterfalls, Sungai Tekala Waterfalls, and Sungai Batangsi Waterfalls.

One of the concerns of district authorities is for riverside resort owners to improve or upgrade water treatment and sanitation at recreational areas so that river water is not contaminated for tourists and river users. Riverside resort owners must also ensure that they have a proper septic tank for wastewater and not discharge directly into the river or into unlined pits that leach contaminants into the recreational waters.

IMPACT OF POLLUTION
AND OTHER HUMAN ACTIVITIES

***JKNS** is a government agency that safeguards public health and monitors the environment for factors that impact human health*

Impact of Pollution

Water Borne Diseases

River pollution can have negative impact on human health, in the form of water-borne diseases such as cholera and acute gastroenteritis. It can cause skin diseases while constant exposure to heavy metals in the water will give rise to respiratory problems and nervous system failures.

Types of common water-borne diseases are typhoid, leptospirosis, salmonella, and E. coli.

DISEASE	EFFECTS	CAUSE
Typhoid	Abdominal pain, diarrhoea, cramps, high fever	Salmonella in contaminated water
Leptospirosis	Flu-like symptoms with stiffness of neck. Can lead to meningitis and liver and kidney disease	Direct contact through animals such as rodents or contact with contaminated water
E-coli infection	Nausea, vomiting, cramps, diarrhoea. Can lead to kidney failure, anemia and dehydration	E. coli bacteria in waste water

Source: JKNS

The most common sources of pollutants are:

Common Sources of Pollution

Leachate from landfills	Contain heavy metals and agriculture wastes such as pesticides
Sewage	Wastewater that flow directly into the river
Industrial effluents	From textile, furniture, and latex factories
Illegal sand mining and land use	Contributes to higher turbidity of the river water
Agricultural activities	Fertilisers
Aquaculture and animal husbandry	Waste from animals directly flowing into the river

Source: JKNS 2012

Although WTPs handle most pollutants, there are some bacteria that cannot be eradicated by standard water treatment. It has been found that protozoans such as Cryptosproridium and Giardia are resistant to chlorine, the chemical used to treat pollutants. These protozoans are parasites that live in the intestine and cause persistent diarrhoea in children as well as nausea and fatigue. However, this depends on the treatment process, such as the dose of chlorine, coagulant, media filter, and water pH.

Currently, the Engineering Services Unit under Jabatan Kesihatan Negeri Selangor (JKNS) is in the process of drafting a bill called the Safe Drinking Water Act which is now being tabled in Parliament. This Act and the Water Safety Plan (WSP) are initiatives to improve the quality of drinking water and subsequently, the quality of human health.

Untreated sewage poses a threat to public health since it contains pathogenic bacteria and viruses that cause deadly diseases such as cholera, typhoid, and hepatitis A. A sanitary survey is carried out by JKNS every four months on a district-by-district basis. These tests are usually taken near the water intakes or at confluences of rivers. It tests for various parameters. If there are any signs of contamination in the test results, JKNS will test the upstream rivers.

Since 2000, JKNS' Engineering Services Unit has been conducting sanitary surveys, which is routine monitoring of water quality from the water intake to the WTPs and up to the reticulation system. The surveys are conducted systematically district by district. If there is a water quality violation, JKNS will conduct investigation together with the treatment plant operator and water supplier. JKNS also conducts an immediate investigation upon receiving a report on the quality of drinking water.

One of the measures that JKNS has taken is to inform the public through hazard warning notice boards describing the risk of infection and preventive actions to be taken.

A JKNS billboard warning swimmers of the risks of communicable diseases in the river
Source: JKNS 2011

***JKNS** is a government agency that safeguards public health and monitors the environment for factors that impact human health*

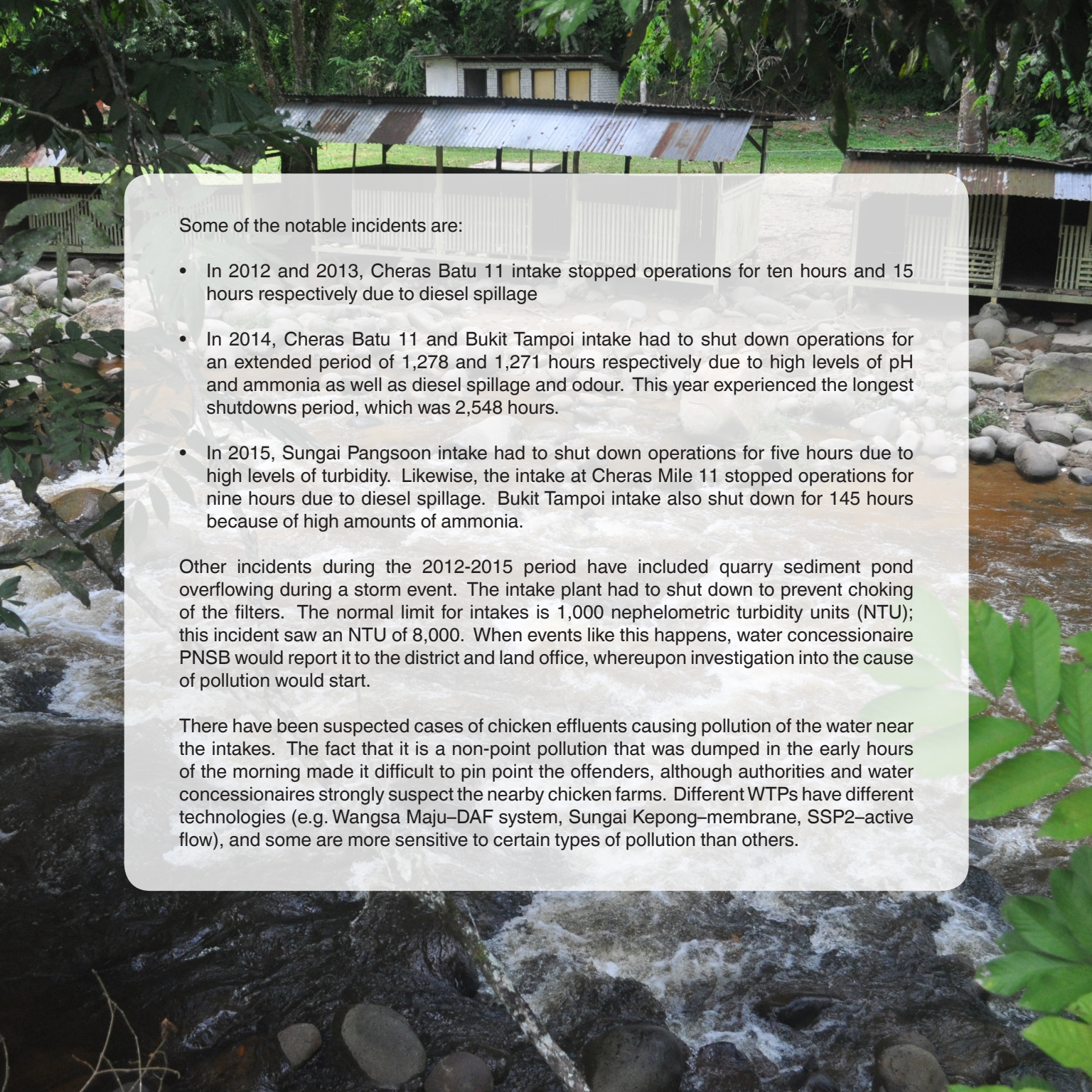
Water Supply Disruption

From 2012 until 2015, WTPs within the Sungai Langat basin experienced shutdowns for extended periods of time due to water disruptions. In most cases, the causes of the water disruptions were due to high levels of turbidity from loading of silt during heavy rainfall. In one case, shutdown was triggered by diesel spillage from a skidded lorry.

It was noted that during the period from 2012 until 2014 the number of water disruptions increased while in 2015, the number fell drastically. The table below shows that WTPs at Sungai Lolo (old and new), Sungai Serai, Sungai Langat, Salak Tinggi, Sungai Semenyih, and Sungai Labu did not experienced any water disruptions between 2012 and 2015.

WATER INTAKE POINT	WATER DISRUPTION (HOUR)			
	2012	2013	2014	2015
Sg. Pangsoon	-	-	-	5.25
Sg. Lolo (Old)	-	-	-	-
Sg. Lolo (New)	-	-	-	-
Sg. Serai	-	-	-	-
Sg. Langat	-	-	-	-
Cheras Mile 11	9.75	14.92	1,277.67	9.25
Bukit Tampoi	-	-	1,270.75	145
Salak Tinggi	-	-	-	-
Sg. Semenyih	-	-	-	-
Sg. Labu	-	-	-	-
Total	**9.8**	**14.9**	**2,548.4**	**159.5**

Water disruption at water intake points within the Sungai Langat basin
Source: PNSB



Some of the notable incidents are:

- In 2012 and 2013, Cheras Batu 11 intake stopped operations for ten hours and 15 hours respectively due to diesel spillage

- In 2014, Cheras Batu 11 and Bukit Tampoi intake had to shut down operations for an extended period of 1,278 and 1,271 hours respectively due to high levels of pH and ammonia as well as diesel spillage and odour. This year experienced the longest shutdowns period, which was 2,548 hours.

- In 2015, Sungai Pangsoon intake had to shut down operations for five hours due to high levels of turbidity. Likewise, the intake at Cheras Mile 11 stopped operations for nine hours due to diesel spillage. Bukit Tampoi intake also shut down for 145 hours because of high amounts of ammonia.

Other incidents during the 2012-2015 period have included quarry sediment pond overflowing during a storm event. The intake plant had to shut down to prevent choking of the filters. The normal limit for intakes is 1,000 nephelometric turbidity units (NTU); this incident saw an NTU of 8,000. When events like this happens, water concessionaire PNSB would report it to the district and land office, whereupon investigation into the cause of pollution would start.

There have been suspected cases of chicken effluents causing pollution of the water near the intakes. The fact that it is a non-point pollution that was dumped in the early hours of the morning made it difficult to pin point the offenders, although authorities and water concessionaires strongly suspect the nearby chicken farms. Different WTPs have different technologies (e.g. Wangsa Maju–DAF system, Sungai Kepong–membrane, SSP2–active flow), and some are more sensitive to certain types of pollution than others.

***JPNS** manages, plans, protects and develops the Permanent Forest Reserve in accordance with national policies*

***FRIM** manages, plans, protects and develops the Permanent Forest Reserve in accordance with national policies*

***MNS** manages, plans, protects and develops the Permanent Forest Reserve in accordance with national policies*

PERHILITAN manages, plans, protects and develops the Permanent Forest Reserve in accordance with national policies

Water concessionaires also cite that the effects of El Nino bring upon drought conditions caused by lack of rainfall. When the dam reaches critical drought conditions, UPEN calls operators and LUAS for actions to take. If there is not enough water during drought, one of the first actions taken is to draw down from the balancing reservoir. For more serious or extended cases, alternative water source solutions at each river basins are deployed.

Ecological Destruction

Peat Swamp Forests

Peat forests become sensitive when manmade activities disturb the ecosystem that sustains them. According to Forest Research Institute Malaysia (FRIM), a common human factor is deforestation of adjacent land and the subsequent draining of water from the peat swamp. The draining is exacerbated by canals built by logging and agricultural operators for the purpose of channelling water into agriculture land. During dry season when there is no water, the channels act as conduit for the peat swamp water that drain into these channels. When the trees of the peat swamp forests themselves are cut down, evaporation hastens the drying process. Thus, maintaining canopy of vegetation over peat land and providing adequate buffers between the peat forests and the manmade development is crucial to prevent peat swamp forest degradation.

JMG Selangor states that protection of peat swamp forests should be ensured by not only engaging land owners and developers in replanting activities, but also by carrying out a study on the hydrology of the general area prior to opening up land for development. This involves the joint coordination of land offices and JPBD to have sustainable policies on buffer zones and hydrological processes.

The survival of the South Kuala Langat Peat Swamp Forest in Selangor State came under threat in 2011 when a state agriculture body made a proposal to acquire the whole of Kuala Langat South Forest Reserve (6,908 hectares) for an oil palm plantation. With objections from JPNS and Jabatan Perlindungan Hidupan Liar dan Taman Negara (PERHILITAN) together with NGOs such as the Global Environment Centre (GEC) and the Malaysian Nature Society (MNS), a rapid environmental assessment was carried out. It was spearheaded by JPNS, with GEC assessing the peat soil, potential carbon storage of the peat swamp forest, and options for rehabilitation.

It was found that the peat layer of South Kuala Langat was overlaid with a soft (and equally deep) mud layer, which can only be found in marine or mangrove areas. This indicated that the swamp forest was part of a larger coastal peatland that was once formed in between river basins along the Selangor coast, and has been playing an important role in flood mitigation within the state.

Suggestion: Ensure protection of peat swamp forests by not only engaging in replanting activities, but also conduct a study on the hydrology of the general area before opening up land for development. This involves the joint coordination of land offices and JPBD to have sustainable policies on buffer zones and hydrological processes.

Mangroves

Mangroves face a problem of coordination among state government agencies. In addressing problems associated with flooding or coastal erosion, technical agencies sometimes introduce structural solutions that degrade mangrove colonies, such as wave breakers that deprive mangroves of salty water that is conducive to their ecosystem. In Tanjung Sepat by the coastline, mangrove forests have died because of effluents by pig farms, which are concentrated there.

Flooding

Flood-Prone Locations

Owing to heavy rainfall events typical of the Malaysian climate, floods are persistent occurrences that wreak damage on properties, result in loss of lives and incur great inconveniences to the public. Major floods occur mainly due to heavy rainfall resulting in flows exceeding the carrying capacity of the rivers and cause flood waters to overflow from the river into the low laying areas.

By many accounts, floods are a common occurrence in the Hulu Langat area. In 2012, the months of March and September saw heavy rainfall that caused the evacuation of hundreds of residents living along the stretch from Batu 11 to Batu 18. In September, people living along Taman Sungai Segamat were hard hit. This resulted in the Federal Government providing RM7.5 million for short-term flood mitigation measures.

The year 2013 was a catastrophic year of floods for four states, including Selangor, although it was not as heavily affected as the other three states Terengganu, Kelantan and Perak. In Selangor, 15 people were evacuated to a relief centre in Sepang.

In 2015, a flood event occurred on December 13 to 15, which was caused by three hours of heavy rain with an estimated return period of 42 ARI. According to the residents, the last terrible flood was at the end of 1970 and also in 1995.

DATE	AREA AFFECTED	RELOCATION CENTRE/ NO. OF HOUSES AFFECTED	DETAIL
March 7-9, 2012	Batu 12, 13, 14 Taman Indah Jaya, Kg. Rantau Panjang, Kg. Semungkis, Kg. Jawa	1,000 evacuated to 7 evacuation centres	-
March 15, 2012	Batu 11, 14 and 18. Sungai Serai in Hulu Langat	3,000 residents affected. 661 people evacuated to SK Sungai Serai	-
Sept 4, 2012	Taman Sungai Segamat	41 houses damaged	Heavy downpour, obstructed water flow in Sg. Segamat
Dec. 13, 2015	Kampung Chinchang, Sepang	15 families were evacuated to a relocation centre	3 hours of heavy rain resulted in flash floods
	Kampung Lembah Paya, Sepang	172 people from 42 families	-
	Taman Gemilang, Dengkil	23 families	-
	Kampung Salak Tengah, Sepang	29 familities	-
	Kampung Baru Salak Tinggi, Sepang	21 families	-

There is an increasing trend in the amount of monthly rainfall. The trend line shows that the maximum amount of monthly rainfall has increased by a factor of 0.1648 for each year in Selangor.

This implies that the human activities are highly vulnerable to such changes in rainfall trend, and it clearly shows that climate change is happening in the state. There are 36 flood-prone areas within the Sungai Langat basin, which includes Taman Indah Jaya, Batu 14; Kampung Batu 14, Hulu Langat; Kampung Batu 20 Sungai Lui, and Kampung Batu 16 Dusun Tua.

Majlis Perbandaran Kajang has two flood-prone areas, namely Sungai Segamat and Country Heights. Also affected are Dusun Tua, Taman Sri Nanding, and Kampung Sungai Serai, among others.

Flooding areas in 2012-2015 within the Sungai Langat basin
Source: JPS

Flooding at Kg Sungai Ramal Dalam
Source: JPS

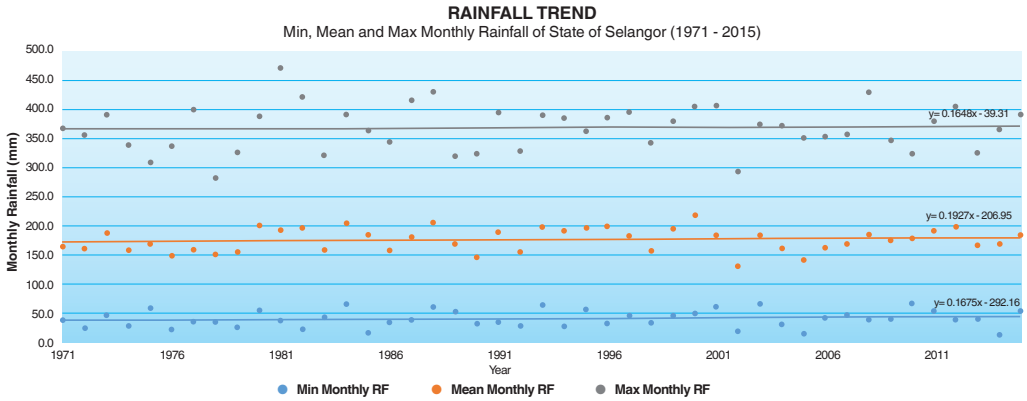
Flooding at Bandar Banting
Source: JPS

In view of the flood problems, the government is implementing several flood mitigation projects.

PROJECT	IMPLEMENTING AGENCY	STATUS	REMARK
Flood Mitigration Project Sungai Langat Phase 2	JPS Malaysia	Construction started in 2013 and due to complete in 2017	Construction of bunds along Sg. Langat from Dengkil to Bt Tampoi
Deepening of tributary of Sungai Langat	JPS Selangor	-	-
Upgrading of main drain	Majlis Perbandaran Ulu Langat	-	Consultant appointed in 2011
Diversion of water flow into Sungai Ramai Dalam	-	Proposed in 2012	-
Deepening of Sungai Langat	JPS	Proposed in 2012	-
Drainage plan review (under the Marris grants)	-	Proposed in 2012	-
Upgrading of bridges along Sungai Serai, including the sewerage and drainage systems	-	Proposed in 2012	-
RM7.5 million package: Bridge on a major route RM3.5 million Two culverts RM1 million Relocation of utilities RM3 million	-	Short term measures approved by the PM	-
Long term measure RM15 million 6-hectare Sungai Serai retention pond	-	Expected to be built in 2 years	-

Rainfall Trends

In Selangor, data from 61 rainfall stations are compiled at Bahagian Saliran dan Air Hujan, JPS Ampang to analyse rainfall trends in the state. The analysis is based on monthly data from 1971–2015, and it can be categorised into three plots, which are minimum, average and maximum. The graph shows that every year the data has a positive correlation coefficient and the slope of the regression line is positive.



Rainfall Trend within the state of Selangor
Source: JPS Ampang

Aquaculture and Commercial Fishing

Aquaculture and fish are sensitive to changes in the river water environment, and there have been cases of entire populations along stretches of rivers being affected.

1	In 2015, all the fish in a pond in Hulu Langat suddenly died. An investigation carried out by JAS and LUAS found the cause was effluents from a nearby factory that had contaminated the pond.
2	In Kuala Langat, aquaculture operators also complained about effluents from activities in Tanjong Malim affecting their yield.

Cases of affected aquaculture projects within the basin
Source: JPS Ampang

In these cases, local authorities and relevant agencies say that communication among LUAS, JAS and the reporting agencies is important. Because reporting agencies on the ground act on complaints by the public, they need to know the causes and particulars of the case so that they can report back to the inquiring party.


IMPACT OF
CLIMATE CHANGE

***NAHRIM** is a national reference centre, research body, and consultancy in water and environmental domains*

Impact of Climate Change

In discussions with various agencies throughout Selangor, several mentioned experiencing the impact of climate change. Seasonal monsoon patterns were changing, and more extreme conditions were being experienced for rainfall and droughts. These were anecdotal observations made by officers in technical agencies such as water concessionaires, who noticed changes in patterns of drought occurrences purportedly caused by changes in the climate.

To verify the impact of climate change in Malaysia, specifically Selangor, the National Hydraulic Research Institute Malaysia (NAHRIM) weighs in on this issue.

In 2014, NAHRIM carried out an Impact Assessment Study of Climate Change, which included impacts on the river basins. Two river basins in Selangor were studied: Sungai Selangor and Sungai Klang. It covered changes in rainfall, evapotranspiration, and assessment of water availability. As climate change is a gradual process, it runs scenarios in 30-year slices.

In the same year, it also completed the climate change modelling for Peninsular Malaysia. Called the Regional Hydro Climate Model, it is based on three global climate models and presents four scenarios: worst case, two middle cases, and best case. **Studies have shown that the phenomenon of El Nino, which exacerbates drought conditions and normally occurs every eight to nine years, occurs more frequently now at every three to four years.** La Nina, which brings heavy rainfall and flooding, still follows local monsoon seasons, but the situation may change as global climate conditions plays on local conditions.

In reviewing the possible case scenarios, NAHRIM suggests several adaptation measures to be undertaken:

- Ensure that new urban developments have built-in climate change mitigation measures. This calls for a holistic approach that includes non-structural as well as structural measures.

- Encourage low-impact development. Low impact means development that encompasses good stormwater management. We already have guidelines for low impact development in the form of Malaysian Stormwater Manual (MSMA).

- When planning for new developments, planners must not only consider past rainfall history in the development area, but also projection

- As climate change affects water resources, NAHRIM suggests that LUAS incorporates climate change impacts and measures in their long term planning of water resources.

APPENDICES

Appendices

Appendix A. Water Quality Index

Since 2001, Jabatan Alam Sekitar (JAS) has been conducting a water quality monitoring programme to detect changes in river water quality and to identify sources of pollution. JAS collects water samples at regular intervals from designated stations to determine physical, chemical and biological characteristics.

The WQI serves as a basis for environmental assessment, whereby categorisation and designation of classes according to beneficial usage as stipulated in the National Water Quality Standards for Malaysia (NWQS).

The WQI is calculated based on six parameters, which are dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), ammoniacal nitrogen (NH_3-N), total suspended solids (TSS), and pH.

WQI	STATUS
>80	Clean
60-80	Slightly polluted
<60	Polluted

WQI Class	Range	Water Usage Description
I	<92.7	Conservation of natural environment
		Water supply I – practically no treatment needed (except disinfection or boiling only)
		Fishery I – very sensitive aquatic species
II	76.5 – 92.7	Water supply II – conventional treatment required
		Fishery II – sensitive aquatic species
		Recreational use with body contact
III	51.9-76.5	Water supply III – extensive treatment required
		Fishery III – common, of economic value and tolerant species
IV	31.0-51.9	Irrigation only
V	<31.0	Water unsuitable for any of the above uses

Appendix B. Effluent Standard

Until 2008, effluent discharges were stipulated under the Environmental Quality Act 1974 and the Environmental Quality (Sewage and Industrial Effluent) Regulations 1979.

In 2009, revisions were introduced by Kementerian Sumber Asli dan Alam Sekitar, resulting in two sets of regulations—the Environmental Quality (Sewage) Regulations 2009 (EQSR) and the Environmental Quality (Industrial Effluent) Regulations 2009.

Standard	Temp	(C)	pH	BOD	COD	SS	NH_3-N	NO_3-N	P	O&G
Category 1 (Rivers)										
Standard A	40	6.0-9.0	20	120	50	10	20	5	5	
Standard B	40	5.5-9.0	50	200	100	20	50	10	10	
Category 1 (Lakes)										
Standard A	40	6.0-9.0	20	120	50	5	10	5	5	
Standard B	40	5.5-9.0	50	200	100	5	10	10	10	
Category 2										
Standard A	n/a	n/a	20	120	50	50	n/a	n/a	20	
Standard B	n/a	n/a	50	200	100	50	n/a	n/a	20	
Category 3										
CST (STD A & B)	n/a	n/a	200	n/a	180	n/a	n/a	n/a	n/a	
IT (STD A & B)	n/a	n/a	175	n/a	150	100	n/a	n/a	n/a	
OP (STD A & B)	n/a	n/a	120	360	150	70	n/a	n/a	n/a	
AL (STD A & B)	n/a	n/a	100	300	120	80	n/a	n/a	n/a	
MP (STD A)	n/a	n/a	60	180	100	60	n/a	n/a	20	
MP (STD B)	n/a	n/a	60	240	120	60	n/a	n/a	20	

No.	Parameter	Unit	Standard	
			A	B
1.	Temperature	°C	40	40
2.	pH Value	-	6.0-9.0	5.5-9.0
3.	BOD5 at 20°C	mg/l	20	50
4	COD	mg/l	50	100
5	Suspended Solids	mg/l	50	100
6	Mercury	mg/l	0.005	0.05
7	Cadmium	mg/l	0.01	0.02
8	Chromium, Hexavalent	mg/l	0.05	0.05

9	Arsenic	mg/l	0.05	0.10
10	Cyanide	mg/l	0.05	0.10
11	Lead	mg/l	0.10	0.5
12	Chromium, Trivalent	mg/l	0.20	1.0
13	Copper	mg/l	0.20	1.0
14	Manganese	mg/l	0.20	1.0
15	Nickel	mg/l	0.20	1.0
16	Tin	mg/l	0.20	1.0
17	Zinc	mg/l	1.0	1.0
18	Boron	mg/l	1.0	4.0
19	Iron (Fe)	mg/l	1.0	5.0
20	Phenol	mg/l	0.001	1.0
21	Free Chlorine	mg/l	1.0	2.0
22	Sulphide	mg/l	0.50	0.50
23	Oil and Grease	mg/l	Not detectable	10.0

Appendix C. Potential Sources of Raw Water

Shows the categories of pollution found in river water and how they are measured. Possible sources of pollution are listed.

Group	Parameter	General Potential Sources
Microbiological	Total Coliform	Sewage effluent – residential and livestock farming
Physical	Turbidity	Earthworks, sand mining, heavy rainfall
	Color	Industrial effluent, mining pools, swamps
	pH	Industrial effluents, swamps
Inorganic	BOD	Agriculture, natural vegetation, leachate, waste disposal, livestock farming, industrial effluents, earthworks, swamps
	COD	Agriculture, natural vegetation, leachate, waste disposal, livestock farming, industrial effluents, earthworks, swamps
	Ammonia	Domestic waste, industrial effluent, leachate, sewage effluent
	Total nitrogen	Agriculture, natural vegetation
Iron & Manganese	Industrial effluent, earthworks	
Heavy Metals		Industrial effluent, earthworks
Pesticides		Agriculture, recreation

Appendix D. List of Parameters and Limits of Discharge

Activity	Parameter	Limit for Discharge
Freshwater aquaculture in ponds or cages	Ammoniacal Nitrogen (NH_3-N)	5 mg/l
	Biochemical Oxygen Demand (BOD5) at 20°C	50 mg/l
	Total Suspended Solid (TSS)	100 mg/l
	Nitrogen Nitrogen (TN)	10 mg/
	Phosphorus (TP)	1 mg/l
Marine shrimp aquaculture in ponds	Ammoniacal Nitrogen (NH_3-N)	5 mg/l
	Biochemical Oxygen Demand (BOD5) at 20°C	50 mg/l
	Total Suspended Solid (TSS)	100 mg/l
	Nitrogen Nitrogen (TN)	10 mg/l
	Phosphorus (TP)	1 mg/l
Development and earthworks	Total Suspended Solid (TSS)	100 mg/l
	Oil and grease	10 mg/l
Livestock other than pigs	Ammoniacal Nitrogen (NH_3-N)	
	Biochemical Oxygen Demand (BOD5) at 20°C	200 mg/l
	Chemical Oxygen Demand (COD)	500 mg/l
	Total Suspended Solid (TSS)	500 mg/l
Swine livestock	Ammoniacal Nitrogen (NH_3-N)	200 mg/l
	Biochemical Oxygen Demand (BOD5) at 20°C	50 mg/l
	Chemical Oxygen Demand (COD)	500 mg/l
	Total Suspended Solid (TSS)	100 mg/l
Pets	Ammoniacal Nitrogen (NH_3-N)	300 mg/l
	Biochemical Oxygen Demand (BOD5) at 20°C	50 mg/l
	Chemical Oxygen Demand (COD)	500 mg/l
	Total Suspended Solid (TSS)	250 mg/l
Mining and related activities	Total Suspended Solids (TSS)	50 mg/l
	Oil and grease	1 mg/l

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