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TABLE OF CONTENT

ACRONYMS	4
WHAT IS THE STATE OF THE RIVER REPORT?	6
Why Should We Care?	7
Contributors to this Book	8
River Heritage - How Sungai Bernam	
Got Its Name	11
ABOUT THE RIVER BASIN	13
Location	14
Tributaries	14
Major Towns and Administrative Bodies	15
Main Uses of the River	17
Distinctive Features of the Basin	18
A Major Agriculture Hub	18
North Selangor Peat Swamp Forest	19
Sungai Dusun Wildlife Reserve and	10
Conversation Centre	19
Sungai Faken Firelly Conservation Area Sungai Karang Forest Reserve Hornbill	20
Observatory Centre	20
Homestav	20
Land Use	21
MAP OF SUNGAI BERNAM BASIN	24
STATE OF SUNGAI BERNAM 2012-2015	27
How Is Our River Doing?	28
Considerations For Future Planning	29
Need a Platform for Joint River	
Stewardship	29
Clear Inter-Jurisdictional Boundaries	30
Clearer Guidelines, Procedures	
and Manuals	31
Challenges Faced by Enforcing Agencies	
on Illegal Occupation of Land	32
Mangrove Degradation by Aquaculture	33
Effluents from Livestock Breeding	34
Impact of Mixed Development	35
Need to Control Future Land Clearing	36



RESOURCES IN THE RIVER BASIN

37

River Basin Planning and Management	38
Changes to the Environmental	
Quality Act 1974	38
Changes in the State Water	
Supply Structure	38
Regulation of Water Services	39
Regulation of Sewage Services	40
Monitoring of Water Resources	42
Subsidiary Legislation	43
Water Resources and Supply	44
Surface Water	44
Water Intake at Bernam River Headwork	45
Zones of Contribution of Surface Water	46
Groundwater	47
Rainfall Patterns	49
Water Level and Flow	50
Water Consumption and Abstraction	51
Water Abstraction by Water Intake Point	51
Water Quality at the Intakes	52
Irrigation Demand	54
Estimated Water Balance	55
Non-Revenue Water	56
Water Quality	57
New Function within SYABAS:	
River Surveillance and Investigation	57
Review of Existing Effluent	
Discharge Regulations	58
Water Qualityy Within Sungai Bernam	58
	61
River Ecology	62
Fauna	62
Flora	64
Mangrove Forests	65

RIVER-RELATED ACTIVITIES AND			
River-Related Activities and			
Sources of Pollution	68		
Sewage	68		
Industry	71		
Solid Waste	71		
Sand Mining	76		
Development and Earthworks	76		
Alteration of Resources	77		
Agriculture Activities	80		
Livestock Farming	83		
Aquaculture and Fishery	87		
Wet Markets/Restaurant/			
Food Outlets	94		
Recreation	95		
IMPACT OF POLLUTION AND OTHER HUMAN ACTIVITIES	97		
Water Borne Diseases	98		
Water Supply Disruption	100		
Ecological Destruction	101		
Flooding	103		
Aquaculture and Commercial Fishing	108		
IMPACT OF CLIMATE CHANGE	109		
APPENDICES	113		
Appendix A - Water Quality Index	114		
Appendix B - Effluent Standard	115		
Appendix C - Potential Sources of			
Raw Water	116		
Appendix D - List of Parameters and			
Limits of Discharge	117		
Appendix E - Contributors	118		
Appendix F - Photo Credits	120		



ACRONYMS

BCDDDEEFG

BASS	Konsortium Aliran Bekalan Air Selangor Selatan Sdn. Bhd.
РММ	Agensi Pengkuatkuasaan Maritim Malaysia /
	Maritime Enforcement Agency Malaysia
SEAN	Association of South East Asian Nations
OD	Biochemical oxygen demand
OD	Chemical oxygen demand
AF	Dissolved air flotation
OA	Jabatan Pertanian / Department of Agriculture
OF	Jabatan Perikanan / Department of Fisheries
IA	Environment impact assessment
PU	Economic Planning Unit
RIM	Forest Research Institute Malaysia
PT	Gross pollutant trap
ADA	Integrated Agricultural Development Area
60	International Standard Organisation
VK	Indah Water Konsortium Sdn. Bhd.
AS	Jabatan Alam Sekitar / Department of Environment
KNS	Jabatan Kesihatan Negeri Selangor /
	Selangor State Department of Health
кт	Jabatan Kerajaan Tempatan /
	Department of Local Government
KPTG	Jabatan Ketua Pengarah Tanah dan Galian /
KR	Jabatan Kerja Raya / Public Works Department
LM	Jabatan Laut Malaysia / Marine Department Malaysia
MG	Jabatan Mineral dan Geosains /
	Department of Mineral and Geoscience
PBD	Jabatan Perancangan Bandar dan Desa /
	Department of Town and Country Planning
PNS	Jabatan Perhutanan Negeri Selangor /
	Selangor Forestry Department
PP	Jabatan Perkhidmatan Pembetungan/
	Sewerage Services Department
PS	Jabatan Pengairan dan Saliran /
	Department of Irrigation and Drainage
PSPN	Jabatan Pengurusan Sisa Pepejal Negara /
	Department of National Solid Waste Management
PV	Jabatan Perkhidmatan Veterinar /
	Department of Veterinary Services
UPEM	Jabatan Ukur dan Pemetaan Malaysia /
	Department of Measurement and Maps Malaysia
КМ	Kementerian Kesihatan Negara / Ministry of Health
eTTHA	Kementerian Tenaga, Teknologi Hijau dan Air /
	Ministry of Energy, Green Technology and Water
PI	Key performance index

LKIM	l embaga Kemajuan Ikan Malaysia /
	Malaysian Fisheries Development Authority
LLM	Lembaca Lebuhrava Malavsia / Malavsian Highway Authority
LUAS	Lembaga Urus Air Selangor/Selangor Waters Management Authority
MARDI	Institut Pervelidikan Dan Kemainan Pertanian Malaysia /
	Malaysian Agricultural Research Development Industry
MCM	
MDSB	Mailis Daerah Sabak Bernam/Sabak Bernam District Council
MDTM	Mailis Daerah Tanjong Malim/Tanjong Malim District Council
MLD	Million litres per day
MNS	Malavsia Nature Society
MOA	Kementerian Petanian dan Industri Asas Tani Malavsia /
	Ministry of Agriculture and Agro-Based Industries
MyGAP	Malaysian Good Agricultural Practices
NÁHRIM	National Hydraulic Research Institute Malaysia
NGO	Non-governmental organisation
NH ³ -N	Ammoniacal nitrogen
NTU	Nephelometric turbidity unit
PAAB	Pengurusan Aset Air Berhad
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 Certificate
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
WIP	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



Ç,

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 a 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 problemsolving among agencies towards a future where the coming generations can continue to enjoy the beauty and bounty of our rivers.



Sungai Bernam as source of water for irrigation and wildlife



Diversity of plant species along Sungai Bernam

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 the state of Selangor. And because Sungai Bernam is a river that straddles two states, input came from agencies in Perak as well.

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.



RIVER HERITAGE

From a *river serving* as a boundary divider between *two states...* ...to a *Major Source* of irrigation water for a thriving *agriculture hub*

How Sungai Bernam Got Its Name

According to folklore, the origin of the name Sabak Bernam came from six brothers or close friends who explored up the river, cutting down a massive tree that had been blocking the river. Because they were known as 'sahabat berenam' (six friends), the river was named after them.

Another story says that six noblemen from Aceh and Sumatra fled to Malaya to escape a war. They traversed the river and settled by the river bank to rest. To prepare a meal, they made a pit of fire in the sand. This cooking pit is called a 'sabak' in the native language of the travellers. Because there were six in the party, from then onwards the place became known as Sabak Bernenam and the river which they traversed came be be known as Sungai Bernam.



ABOUT THE RIVER BASIN

ABOUT THE RIVER BASIN



Location



The Sungai Bernam basin originates from the mountainous areas of the Main Range bordering the state of Pahang and flows in an approximately east-west direction for about 200 kilometres before discharging into the Straits of Melaka, occupying a total basin area of about 3,335 square kilometres. The river basin straddles the states of Perak and Selangor, with the river course of Sungai Bernam demarcating the boundary of the two states. About 65% of the basin lies in the state of Perak to the north of the river.

Tributaries

The river has eight main tributaries, which are Sungai Slim, Sungai Behrang, Sungai Bernam, Sungai Terolak, Sungai Telau, Sungai Dusun, Sungai Erong, and Sungai Chawang.





JPM is an agency that provided statistical services and conducts census of the population

NEW:

A new district called Mualim is slated to be established in early 2016 as the eleventh district and as a new state constituency. It had been part of Batang Padang district. Occupying an area of 93,435 hectares, the new district will include the current sub-district of Tanjong Malim, located in the south Batang Padang district. After proclamation by the Sultan of Perak, the district will encompass three mukims, which is Slim, West Ulu Bernam and East Ulu Bernam.

The district will include towns in Slim River and Tanjong Malim such as Tanjong Malim, Slim, and Proton City. It has been given the name *Mualim*, the Arabic word for "teacher" in recognition of the Sultan Idris Education University in the proposed district, which has produced many teachers since the colonial era.

DISTRICT	ADMINISTRATIVE BODIES
Hulu Selangor Batang Padang Mualim	Majlis Daerah Tanjong Malim
Hilir Perak	Majlis Perbandaran Teluk Intan
Sabak Bernam	Majlis Daerah Sabak Bernam

Source: LUAS 2012





Main Uses of the River

The river water is primarily used for agricultural, industrial and residential consumption while also serving as an important transportation and communication medium for the residents within the basin. The river delta area provides a refuge for seafaring fishermen. Meanwhile, sand mining and aquaculture activities have rapidly become two major economic activities in the Sungai Bernam Basin.



Water supply

Irrigation (direct abstraction from river) and some public consumption

Ecosystem

The river supports both rich aquatic and terrestrial life in the basin notably at the Northwest Selangor Peat Swamp Forest and the Sungai Dusun Wildlife Sanctuary

Tourism/Recreation

Attractions within the basin include fishing, water sports, and river cruises. These attractions are found primarily along the middle section of the basin to the river delta. Growing interest in the recreation and tourism has led to the setup of recreational areas at Sungai Bil, Sungai Inki and Sungai Bugis

Sand Mining

A viable economic activity in the river basin

Aquaculture

Three types of aquaculture are present in the basin: brackish water, fresh water and ornamental fish culture

Navigation Ø

Inland navigation includes river crossing, sand barging, recreational fishing and commercial harbour activities

Distinctive Features of the Basin



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

A Major Agriculture Hub

Integrated Agricultural Development Area (IADA) in Northwest Selangor covers an area of 18,638 hectares of agricultural area that includes Kuala Selangor and Sabak Bernam. The area near the coast, from Sabak Bernam to Tanjung Karang, is the rice bowl of Selangor and is one of the most productive rice-growing areas in the country. In 2011, the average yield was 5.5 tonne hectares.

The IADA in Northwest Selangor consists of eight areas: Sawah Sempadan, Sungai Burong, Sekinchan, Sungai Leman, Pasir Panjang, Sungai Nipah, Panchang Bedena, and Bagan Terap. The area for the paddy area contains a river, a drainage system, and rural roads. The total paddy irrigated area is 18,980 hectares, with additional 625 hectares being used for drainage. There are roughly 10,300 paddy farmers.

North Selangor Peat Swamp Forest

The North Selangor Peat Swamp Forest encompasses 73,592 hectares in Northwest Selangor, comprising Sungai Karang Forest Reserve (50,106 hectares) to the north and Raja Musa Forest Reserve (23,486 hectares) to the south.

This is the largest remaining peat swamp forest on the west coast of Peninsular Malayia and is critical for biodiversity conservation, water resource management, and carbon storage. The forest is home to large mammals such as leopards, tapirs, and Malayan sun bears as well as more than 100 species of fish. Both the Raja Musa and Sungai Karang forest reserves are managed by the Selangor State Forestry Department.

Sungai Dusun Wildlife Reserve and Conservation Centre

SELANGOR

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



The Sungai Dusun Wildlife Reserve was established in 1964 under the Selangor State Government. With an area of 4,330 hectares, this area was the first to be reserved to protect the Sumateran rhinos. It is located about 120 kilometres to the north of Kuala Lumpur. Within the reserve, there is an ex-situ breeding centre for wildlife species called the Sungai Dusun Wildlife Conservation Centre. Originally built in 2000 to preserve the Sumatran Rhinoceros, it has since included conservation of the Cipan Rhinoceros, Malayan Gharial, Malayan Porcupine, and Slow Loris Hornbill.

Selangor Peat Swamp Forests



Pusat Pemerhatian Enggang di Hutan Simpan Sungai Karang, Sabak Bernam



Sungai Pakeh Firefly Conservation Area

Located in Sungai Panjang, this location provides a more remote refuge for fireflies that inhabit the brackish waters of Selangor.

Sungai Karang Forest Reserve Hornbill Observatory Centre

The Hornbill Observation Centre in Sungai Karang Forest Reserve is an area where numerous types of hornbills can be seen. The most sighted Hornbills are the Rhinoceros Hornbill, Black Hornbill, and the Oriental Hornbill. If a visitor is lucky, the Busty Crested Hornbill has also made its appearance here. Apart from these exotic species, visitors can also see other birds such as the Green Bellied Malkoha, Chestnut Malkoha, Dollarbird, Long-tailed Parakeet, and many others inhabiting this swamp forest.

Homestays

The Sungai Bernam basin is home to many interesting sites for recreation and explorations in biodiversity. Starting with the hills on the east side of the basin, there are numerous waterfalls, resorts, and picnic areas for nature lovers and enthusiasts, including the Inki Recreation Park, Kalumpang Resort, and the Sungai Bil recreation area. At the west end of the basin towards the sea, there are beaches and homestays and the Kelong Paradise.



Land Use

The Sungai Bernam basin comprises forest. agriculture (including animal husbandry, aquaculture, oil palm and rubber cultivation; built-up areas (residential, commercial, industrial, mixed development, institutions. mining, sand mining, and quarries); and water bodies consisting of rivers, lakes, and ponds.

In the **district of Batang Padang**, the highest land use is forest area at 49.10%, followed by agriculture area at 33.50%. The built-up area and water bodies are 4.50% and 3% respectively.

The **district of Hulu Selangor** has 48% forest cover. The area is known for its natural tourist attraction sites such as the Sungai Inki Recreation Area and Kerling Hot Springs. The agriculture area, which occupy 36.10% of the land, is near the mountains. The built-up area is located upstream of the river and has a land use area of 12.10%, while the water bodies area comprises 3.80% of the district.

In the **district of Hilir Perak**, the largest land use is agriculture at 96.93%, which consists of mainly oil palm plantations. The forest area is at 2.30%, followed by built-up and water body areas, each of each are less than 1%.



JPBD is a town planning agency that plans, controls, and coordinates development, land use, and land conservation Agriculture areas occupy the largest land use in the **district of Sabak Bernam** at 55.20%, consisting of coconut farms and rice paddies. The land use for the forest area is 39.90%, located downstream of the river. Built-up areas occupy little land at 4.80% and water bodies even less, lower than 1%.



Land use within the Sungai Bernam basin Source: Report of Master Plan Study on Flood Mitigation and River Management for Sungai Bernam Basin



Land use map within the Sungai Bernam Basin (Selangor side) Source: Local Plan Hilir Perak and Batang Padang, Jabatan Perancang Bandar dan Desa



Land use map within the Sungai Bernam Basin (Perak Side) Source: Local Plan Hilir Perak and Batang Padang, Jabatan Perancang Bandar dan Desa

MAP OF SUNGAI BERNAM BASIN









STATE OF SUNGAI BERNAM 2012 - 2015

Currently Sungai Bernam is not heavily affected by many human activities. As water supply is provided by other rivers in both Selangor and Perak, demand for Sungai Bernam water comes mainly from agricultural needs. There is sufficient water to cater to the various needs, and the river is not water stressed.

However, as shown in the current and projected land use maps, more development in the areas bordering the river is expected to grow. This will have an impact on the health of the river, and agencies on both sides of the river have highlighted several issues that require joint cooperation and collaboration to protect and maintain the health of Sungai Bertam through sustainable stewardship.

This section focuses on issues that have been recommended by stakeholders to be addressed by the states of Selangor and Perak for a coordinated approach to sustainable growth of the river basin.

How Is Our River Doing?



The indicator used to measure 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 did not meet expectations and are of "highest concern."

RIVER BASIN	STATE	WQI				
		2011	2012	2013	2014	2015
Bernam	Perak/Selangor	89	87	90	91	88

- **Conclusion:** Sungai Bernam is a relatively clean river, with an overall water quality index of 89, which ranks it as a Class II river.
- **Food for thought:** As the river basin is still pristine, it has been suggested by stakeholders to brand the Sungai Bernam Basin as a model catchment with best management practices and measures to maintain the high water quality of its waters.

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).



Considerations For Future Planning

The following section covers major issues and suggestions highlighted by stakeholders in both Selangor and Perak states for better joint management of the river basin. Many of the government agencies and organisations interviewed for the preparation of this report indicated a willingness to work collaboratively to maintain the high water quality and environment of the river basin resources.



Need a Platform for Joint River Stewardship

Sungai Bernam is the biggest river in the country that is *inter-jurisdictional*, meaning that the river has a shared boundary. It is shared by two states, namely Selangor and Perak. There are other rivers throughout the country that are inter-jurisdictional such as Sungai Kesang (near Muar, Johor) and Sungai Muda (Kedah), although the interface of the shared boundary is much smaller. The term 'inter-jurisdictional river' should not be confused with *transboundary* river, where the river runs through two or more states.



JUPEM serves as a government adviser in the field of surveying and mapping as well as conducting measurement and mapping works



Water is a state matter and as such, rivers fall under the jurisdiction of the state. However, in the case of inter-jurisdictional rivers, the Federal Government can intervene if the states sharing the river boundaries cannot agree on a resolution when problems arise. This is mandated in the Federal Constitution, in the Ninth Schedule.

Currently, there is no platform for inter-jurisdictional management of Sungai Bernam between Selangor and Perak. However, LUAS is in talks with Jabatan Pengairan dan Saliran (JPS) Perak for setting up an integrated river basin management (IRBM) framework to be implemented by the two states. With major developments coming up in Perak in Proton City and Tanjong Malim, integrated river basin management is expected to play a very important role towards sustainable economic and urban growth in the river basin.

Clear Inter-jurisdictional Boundaries

The land areas along the river have not yet been gazetted although there are plans to engage in gazetting Sungai Bernam (after the river areas of Daerah Gombak have been completed). However, there is some level of ambiguity in determining what land parcel belongs to whom. Agencies such as Jabatan Ukur dan Pemetaan (JUPEM) Perak and Selangor have not yet demarcated the land belonging to each respective state. The question arises as to whether the states follow the river course as boundaries, or whether there is a need to demarcate the boundary.

There is current no committee or inter-jurisdictional coordinating body governing and coordinating activities along Sungai Bernam. However, discussions with various district and land offices have revealed that they would be willing to work cooperatively for the sustainable growth of the river and the river basin.



For joint coordination and management of Sungai Bernam, there needs to be a clear definition and delineation of river-related boundaries and authorities of power. From the viewpoint of agencies such as the district and land offices, they feel that there are conflicting and overlapping delineations of boundaries and authorities along the river. For example, LUAS mandates that there be a clearance of no activities from the centre of the river to the shoreline. But the question arises as to whether this is universally accepted by other agencies. It was felt that JPS has one set of guidelines, while LUAS has another.

Another example of the ambiguity in guidelines is the erecting of jetties: do they have to extend from the shoreline to the middle of the river, or can it extend as far as the other side? A land office added that they were in the process of gazetting a jetty near Sekinchan, south of the Sungai Bernam. However, as there is no differentiation in the size of the jetty, big jetties—which should be levied at a higher rate—were paying the same rate as the smaller jetties, which should be paying a lower rate. These and other on-the-ground conundrums plague river and land managers. As implementing agencies, district and land offices wish to have one clear set of definitions, guidelines, and delineations to be adopted and universally applied.

A suggestion was to come up with a manual, guideline or standard that consolidates all the existing guidelines for uniform implementation. These guidelines would cover all aspects of river usage and management, from boundary delineation to standardisation of river assets to even disposal of cremated ashes, as pointed out by one district office. There are plans for future works on Sungai Bernam by JPS Perak. Works on river deltas along the coast of Perak are underway, although none are have started inland work along the river pending resolution of boundary demarcation issues.

Challenges Faced by Enforcing Agencies on Illegal Occupation of Land



One of the issues raised by district and land offices was the challenge in enforcing more control over development on riverine land. There are occupants living within the river reserves (normally extending 50 metres out from the shoreline of the river) who, because they are occupying the land illegally, have not been granted a temporary occupation license or TOL. Because there is no TOL and land offices therefore have no grounds to monitor them, the development cannot be controlled.

In the past, the development were simple structures; now authorities are seeing bungalows being built on river reserves. To combat this growing issue of illegal occupation on riverine land, the land and district offices have expressed the need to work in close cooperation with LUAS (on the Selangor side) to expedite the resolution of this issue.

Mangrove Degradation by Aquaculture Activities

According to some agencies, aquaculture has been not only been encroaching on mangrove forests, but replacing the mangrove trees with aquaculture ponds. Some aquaculture operators have adopted the practice of taking more land than permitted by the authorities. Cases have occurred where aquaculture businesses have been approved for a fixed number of acres, but in actuality have expanded to occupy more acreage. There is a need for more control over aquaculture sites and operations.

There have been replanting projects with Jabatan Perhutanan in conjunction with non-governmental organisations such as the Global Environment Centre as well as communities, but they need to be carried out more regularly to combat any further mangrove forest degradation.



Effluents from Livestock Breeding



There are a number of chicken farms along the river stretch. Some of them discharge directly into the tributaries that feed into Sungai Bernam. One such case involves a chicken farm that discharges wastewater into Sungai Bernam near Kampung Telok Raja, Behrang.

Authorities have responded to reports of a smell emanating from the premises and have found that it not only did not follow proper procedures before releasing water into the river, but that it was illegal. They have taken action against the farm owner. This and other such cases makes it imperative that farm operators must treat the animal wastewater first before discharging into any water body.
Impact of Mixed Development



There are a number of ongoing and upcoming mixed development in the upper reaches of the river basin. Hulu Selangor is undergoing extensive development, while Proton City and Taman Bernam are two townships that are slated for major development. While this is economically attractive, more attention needs to be given to sustainable development for the protection of water resources within the upper catchment area. In this area there are forest reserves and rubber tree plantations.

District authorities are worried about the clearing activities there that may affect the upstream water quality as well as concerned that river reserves are being encroached. As it is in the upper areas of the Sungai Bernam basin, these activities need to be monitored and controlled.

Need to Control Future Land Clearing



Land clearing and cutting down of trees in the forest have not yet become a major concern within this basin. However, authorities in the upper catchment area point out the need to continue to control forest cutting for future sustainable growth. Proper planning and adherence to procedures will ensure that large-scale developments in the upper catchment area will not compromise the water quality and the ecosystem of the basin.

ESOURCES IN THE RIVER BASIN



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



Lembaga Air Perak is a corporate body established under the Perak Water Board Enactment 1988 for the purpose of providing water supply services in the state of Perak



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

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.

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 consider environmental factors in all stages of planning, construction and operations 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 considering 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 requires 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

Within the state of Perak, water supply is managed by Lembaga Air Perak (LAP) and there are no significant changes to the institutional structure. However in Selangor, 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, ABASS Konsortium Sdn. Bhd., Konsortium Air Selangor

Berhad and potentially SPLASH Sdn. Bhd—as well as water supplier SYABAS Sdn. Bhd. would fall under the umbrella of Pengurusan Air Selangor Sdn. Bhd., which in turn is overseen by the 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 and asset owner Pengurusan Aset Air Berhad 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.



2015 State Water Industry Structure

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

Regulation of Water Services

Suruhanjaya Perkhidmatan Air Negara (SPAN) is the regulator and enforcement agency of water and sewerage services. It conducts investigation and brings



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 treatement plants along Sungai



Konsortium ABASS Sdn Bhd operates and maintains the Sungai Semenyih Scheme



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 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 have to 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 the Jabatan Perkhidmatan Pembetungan and Jabatan Bekalan Air, 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.



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.



SEWERAGE – 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 population equivalent (PE). Moreover, the plants that are constructed do not follow standardised design plans.



DISCOURAGE DEVELOPERS FROM BUILDING THEIR OWN PLANTS

As there is a trend for centralisation of sewage treatment plants (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.



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

Monitoring of Water Resources

A number of agencies monitor water resources and water quality throughout the river basin. Within Perak, water resources—in particular water quality—is monitored by Jabatan Alam Sekitar Perak and LAP. Within Selangor, Lembaga Urus Air Selangor (LUAS) is a major 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. River water quality is also monitored by other agencies and organisations such as water concessionaires, water distributors, Jabatan Alam Sekitar Selangor, 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 on the basis of incoming complaints or reports. To become more proactive by enlarging its scope of responsibilities, the Emission or Discharge of Pollutants (State of Selangor 2012 was gazetted in 2012. The proposed list of activities that were expanded is shown below. With an expanded scope, LUAS can better regulate errant end-users of water resources.

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

Source: LUAS 2011

Subsidiary Legislation

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, and 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 area at Mukim Kapar in the district of Klang. The regulation places restrictions on building structures and carrying out 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 the state of Selangor. It protects Klang Gates Dam, Sunagi Batu Dam, Sungai Langat Dam, Sungai Selangor Dam, Sungai Semenyih Dam, Sungai Tinggi Dam, and Tasik Subang Dam.



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

Water Resources and Supply

Surface Water

The rivers in the Sungai Bernam basin provide water supply for consumption and irrigation. The bodies involved in water resources development are JPS and Bahagian Pengairan dan Saliran Pertanian (BPSP) of Kementerian Pertanian dan Asas Tani for irrigation, while for potable water, the bodies are LAP, Pengurusan Air Selangor Sdn. Bhd., PNSB, and Taliworks Construction Sdn. Bhd. As water resource development hinges on the availability of surface water, these bodies are dependent on the sufficiency of flows under drought conditions for their operations. In this basin, there is no dam to store or regulate flow. There are presently nine water intakes for potable water supply located within the basin.



NO.	INTAKE	DESIGN CAPACITY (MLD)	RAW WATER SOURCE	STATE	USE
1	Kalumpang	6.7	Sg. Inki	Selangor	Water supply
2	Kg. Sungai Selisik	1.6	Sg. Bernam	Selangor	Water supply
3	Sg. Dusun	1.3	Sg. Dusun	Selangor	Water supply
4	Bernam River Headwork	65.6	Sg. Bernam	Selangor	Water supply
5	Bernam River Headwork	1,788.0	Sg. Bernam	Selangor	Irrigation
6	Bagan Terap Pump House	404.4	Sg. Bernam	Selangor	Irrigation
7	Sg. Gelinting	50.0	Sg. Gelinting	Perak	Water supply
8	Sg. Trolak	8.5	Sg. Terolak	Perak	Water supply
9	Sg. Behrang	34.0	Sg. Behrang	Perak	Water supply

List of water intakes within the Sungai Bernam basin Source: PNSB and LAP

Water Intake at Bernam River Headwork



The main source of water supply for the Tanjung Karang granary areas of 19,359 hectares is Sungai Bernam. Water is diverted the Bernam River Headworks and the Bagan Terap Pump House to irrigate the paddy areas, which are located outside the basin area.

Intake Point at Sungai Bernam Headwork



Bernam River Headworks is a water treatment plant and intake point to irrigate paddy areas within the Tanjung Karang Granary area.



Zones of Contribution of Surface Water

It is important to look at surface water resource 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.



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. Since there is no dams in Sungai Bernam basin, there is no effective zone in this basin

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 area of semi-effective zone has the smallest capacity among others zone which is 1,263.38 km², about 48.56% 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 discharge to the sea. The capacity area of non-effective zone has the largest capacity compared to other zones, about 51.44% (1,338.26 km²) of the total basin area.

Zoning allows water resources 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.



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



JABATAN MINERAL & GEOSAINS MALAYSIA

JMG is an agency that provides technical advisory services and expertise in minerals, geosciences, mining and quarries 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 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 for groundwater is 5 sen/m³ for industry and 1 sen/m³ for public use. For personal consumption, water users are given a free allocation of water in accordance to section 45 of the LUAS Enactment.





Rainfall Patterns

There are 12 rainfall stations in the Sungai Bernam basin that are monitored by JPS Malaysia. From 1971 to 2015, the average annual rainfall in the basin fell within the range of 1,500–2,600 millimetres whereby the water level upstream is higher than the level downstream.



Annual rainfall shown in Isohyet Map within the Sg. Bernam basin

An analysis of the average monthly rainfall from 2012–2015 shows that the rainfall depth was higher at the end of the year compared to the beginning of the year. The highest annual rainfall was 346.51 millimetres during November 2012, with the next highest in November 2015 at 308.44 millimetres. During February 2014, 13.72 millimetres is recorded as the lowest annual rainfall depth because of the effects of the El Nino phenomenon.



Graph average monthly rainfall within the Sungai Bernam basin Source: JPS 2015

The El Nino phenomenon has had a significant negative impact throughout the state of Selangor although less so in Perak. It has not similarly affected Perak as it has more water resources and less water demand as compared to Selangor.



Water Level and Flow

For the period 2012 to 2025, the water level and flow patterns for Sungai Bernam are higher during the monsoon season (November to February) than other times of the year.

Water Consumption and Abstraction

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/m³, while water for public utility, including domestic supply, is RM0.01/m³.

WATER ABSTRACTION	RATES
Commercial	RM 0.05/m ³
Water Supply	RM 0.01/m ³

In 2015, there were five water intake points to abstract surface water from within the basin. SYABAS is the distributor of potable water to the consumer.

All water intake on the Selangor side of Sungai Bernam is operated by PNSB. In 2012, the amount of raw water abstracted from rivers was 40.35 MLD. The amount of abstraction shows a steady annual increase to 58.05 MLD in 2013, 72.85 MLD in 2014, and 77.40 MLD in 2015.

Water Quality at the Intakes



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 water treatment plants every two hours.

WATER INTAKE	DESIGN PRODUCTION (CAPACITY 2012 2013 201		ION (MLC 2014)) 2015	
Kalumpang	6.7	6.7	5.58	6.97	7.34
Kg. Sungai Selisik	1.6	1.6	1.95	2.37	2.42
Bernam River Headwork (Old)	65.6	65.6	25.53	38.93	40.02
Bernam River Headwork (New)	65.6	65.6	23.18	23.18	26.28
Sungai Dusun	1.3	1.3	1.11	1.39	1.35
TOTAL		40.35	58.05	72.85	77.41

Production at water intake within the Sungai Bernam basin on the Selangor side Source: PNSB

In Perak, all water intake is operated under LAP. In 2012, the amount of raw water abstracted from rivers was 167.85 MLD. The amount is increasing annually, to 179.40 MLD in 2013 and 196.75 MLD in 2014.

WATER INTAKE	OPERATED	Р	RODUCT))
(DISTRICT)	BY	2012	2013	2014	2015
Batang Padang	Lembaga Air Perak	79.17	87.87	103.34	-
Hilir Perak	Lembaga Air Perak	88.68	91.53	93.41	-
TOTAL		167.85	179.40	196.75	-

Production at water intake within the Sungai Bernam basin on the Perak side Source: Laporan Tahunan Lembaga Air Perak 2015



Total Abstraction of Surface Water by State (MLD)

In a comparison of total abstraction of surface water between the states of Selangor and Perak from 2012 to 2015, Perak is shown to be the bigger abstractor of surface water than Selangor. In Perak, the point of least abstraction is in 2012, although the abstraction volume has been increasing in the years since then. Selangor also shows a similar pattern of increasing abstraction volume for the period extending until 2015.

Irrigation Demand

Water for irrigation within the basin is abstracted at the Bernam River Headwork. It provides irrigation water to Sungai Tengi to control the river flow, which must be sufficiently distributed to the paddy fields along Tanjung Karang on the Selangor side, outside of the basin area.



Bernam River Headwork pumping water into Sungai Tengi and into the irrigation canals along Tanjung Karang

In the table showing irrigation demand in 2010 and its projection until 2050, it can be seen that irrigation demand will is projected to decrease over the next four decades.

MONTH	IRRIGATION DEMAND (MLD)				
	2010	2020	2030	2040	2050
Jan	1355.62	1232.93	1043.71	969.41	902.88
Feb	750.82	682.56	577.15	536.54	500.26
Mar	1840.32	1672.70	1416.10	1315.87	1226.02
Apr	2651.62	2411.42	2040.77	1896.48	1766.88
May	3292.70	2993.76	2534.11	2354.40	2193.70
Jun	2801.95	2547.94	2156.54	2003.62	1866.24
Jul	1549.15	1409.18	1192.32	1107.65	1032.48
Aug	678.24	616.03	521.86	484.70	451.87
Sep	1701.22	1546.56	1308.96	1216.51	1133.57
Oct	2130.62	1937.09	1639.87	1523.23	1419.55
Nov	2601.50	2365.63	2001.89	1860.19	1733.18
Dec	2130.62	1937.09	1639.87	1523.23	1419.55
Ave	1957.03	1779.41	1506.10	1399.32	1303.85



ITEM	TOTAL	UNIT
Catchment Area	3,335	km²
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 2,423sq km	2,401	MCM/Year
Average Runoff	6,579	MLD
Utilization for Water Supply (Perak)	196	MLD
Utilization for Water Supply (Selangor)	77	MLD
Utilization for Irrigation (2015)	1,870	MLD
Balance	4,436	MLD

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 in 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 Bernam Basin is 2.15 m and 0.72 m respectively. However, the river abstraction from intakes and irrigation need to be counted into the remaining water balance. For the Sungai Bernam Basin, the utilisation for water supply at water intakes Perak and Selangor are 196 MLD and 77 MLD, while the utilisation for irrigation is 1,870 MLD. The remaining water balance after considering the water utilisation for water supply and irrigation is 4,436 MLD. This surplus presentlyflows into the sea. With proper water source development, this potential reserve may be tapped for future use.

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

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

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 km of piping made from older asbestoscement 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.As of end 2015, only 1,200 km 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. The 84 hotspots 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. JAS' main functions are to conduct enforcement on point source pollution and audit and monitoring. Water quality sampling is done regularly by a third party. Within the Sungai Bernam basin, there are five JAS monitoring stations along the rivers and tributaries for water quality from Tanjong Malim to Teluk Bintang.

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 water treatment plants test every two hours.

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 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 enforcement support of infractions by offending parties. These new roles were added during the restructuring of the water services sector in Selangor in 2014 and 2015.



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

Review of Existing Effluent Discharge Regulations

LUAS is currently in the process of reviewing the existing Emissions or Discharge of Pollutants (Selangor) 2012. It would review the limits of parameters for 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 Bernam

Based on the water quality data at water supply intake points at the Sungai Bernam Head Works, Sungai Kalumpang, Sungai Selidik, and Sungai Dusun, Sungai Bernam on the whole is considered clean with a water quality index (WQI) ranging above 80. As shown in the WQI chart, there is not much variation in the water quality from year 2010 to 2015.



Water Quality Index (WQI) at Water Intakes (Sungai Bernam)

The main and tributaries river are coloured according to their classes where all rivers— Sungai Bernam, Sungai Inki, Sungai Slim, and Sungai Trolak—are classified as clean.

SUNGAI	LOCATION	STATION CATEGORY
Bernam	Pekan Tanjong Malim	AMBIENT
Slim	Jambatan Gantung Kg. Slim	AMBIENT
Trolak	Jambatan Sg. Terolak	AMBIENT
Slim	Jambatan Kg. Balun	AMBIENT
Inki	Jambatan Berhampiran UPSI Tg. Malim	AMBIENT



DISCHARGE OF EFFLUENTS

Incidents of discharge of effluents from palm oil factories are suspected to occur in the Hilir Perak area, particularly during times of heavy rainfall and during the night, but these are non-point forms of pollution and thus cannot be pinpointed to specific facilities. Discharges are released in batches, not continuously. If effluents were released continuously, it would be easier to detect the sources. Catching offenders would require officers being at the right place at the right time. JAS can only take action when a complaint or reports come in from the field or when an offense is discovered during its scheduled monitoring, which take place every three months.



ISSII

PESTICIDE CONTAMINANTS

According to Selangor and Perak agencies, the biggest contaminants in the river are pesticides due to agricultural activities, siltation from sand-dredging and land clearing, and wastewater from livestock farming. Sand-dredging is becoming an issue in the upper catchment area.

Action Taken: JAS has introduced some new regulations in 2015. One is the 2015 Regulation for Scheduled Waste, which is an upgrade from the 1989 regulation. In addition, a revision of the EIA was released in 2015.

One of the fundamental changes in the new EIA is the requirement of an EIA of any new development in environmentally sensitive areas over 20 hectares instead of the customary 50 hectares. In terms of the impact of the new EIA on river quality, two new prescribed activities have been added. Effluents from oil palm and rubber processing plants shall now be more tightly controlled. This shall impact the oil palm processing plants along Sungai Bernam, which numbers seven in total.

Other actions that JAS Perak is proposing is tighter controls on oil palm plantations and mixed development. They are pushing to put this in the prescribed activities of the EIA. This positive action would impact such activities in Batang Padang and its tributaries, which flow into Sungai Bernam. And finally, for more environmental control in the coastal area, shipyard activities shall be included. This shall control the level of pollution caused by waste or used oil as well as oil sludges produced during operation.

RIVER ECOLOGY



Jabatan PERHILITAN coordinates enforcement on the protect-tion of wildlife throughout Peninsular Malaysia

River Ecology

Of all the flora and fauna lifeforms present in the Sungai Bernam basin, those most prominently studied and discussed are the peat swamp forests along the river and the protected species of large mammals. Although studies on phyloplankton and fish in the river have been conducted by universities, the ecological concern in this river basin is not so much about the presence of pollutants but the protection of unique species found in this basin, which if not actively protected, will disappear from the land and waters of Selangor.

Fauna

River basins, with their abundance of natural water resources, are necessary for wildlife. The Sungai Bernam basin is home and sanctuary to several mammal species that require protection from illegal poaching and excessive hunting. These mega fauna, known as the "Big 5" are the Sumatran Rhinoceros, Asian Elephants, Malayan Tiger, Seladang, and Wild Tapir. According to Jabatan PERHILITAN, the last sighting of a Big 5 mammal was an elephant in 1991.

There are a few wildlife reserves and wildlife rescue centres in Sungai Tengi, including the Sungai Dusun Conservation Centre, the Hornbill Conservation Centre, and Sungai Pakeh Firefly Park.

All these animals are protected under the Selangor State Government and are featured in a program, such as the National Elephant Conservation Action Plan or the "Sayang My Tapir Selangor" campaign, which posts road signs along roads to encourage motorist to reduce their speed. In 2015, five tapirs were hit and killed by speeding vehicles. Tapirs (*tapirus indicas*) are now the official animal of the state, and public awareness campaigns is expected to start in 2016. Campaigns shall be featured in Taman Botani Negara Shah Alam, Hutan Simpan Bukit Cheraka, and Sungai Dusun.

To monitor the population count, there is a biodiversity list which keeps track of five species every 10 years. An Inventori Hidupan Liar, carried out by Jabatan PERHILITAN Selangor, is done every five years. One of the limitations that the department faces is that it can only carry out enforcement in wildlife reserves; anything outside is beyond their jurisdiction.

Some of the megafauna that is protected within sanctuaries in Sabak Bernam.



HUMAN-ANIMAL CONFLICT

Urban development encroaches into wildlife habitat, thus blurring the boundary between humans and wildlife, sometimes with negative consequences. The presence of macaques at housing developments is an indicator of urban sprawl, resulting in wildlife living at the fringes of the forest near the urban boundary.

Plain Pouched Hornbill

Malayan Tapir

Flora

Areas classified as having ecological importance include the North Selangor Peat Swamp Forest, which is very rich in biodiversity. The protection of such environments is important as it provides and supports the rich biodiversity present there.

Both Raja Musa and Sungai Karang forest reserves are part of the North Selangor Peat Swamp Forest. In the southeast corner of the Raja Musa



Forest Reserve, an area was cleared for agriculture in the the late 1990s by illegal settlers. While the encroachers have been evicted in 2008 and the crops destroyed, the forest has been slow to regenerate.

Raja Musa Forest Reserve has been designated as a pilot site for the ASEAN Peatland Forests Project, run by the non-governmental organisation Global Environment Centre and Jabatan Perhutanan, which aims to rehabilitate damaged areas, secure the forest boundaries, and protect the area from further damage.

DISCHARGE OF EFFLUENTS

Sometimes local planners do not follow the National Physical Plan. On paper, reserve areas are maintained, but in actuality the reserves are overridden to make way for new developments. There must be a limit on the land area that can be overridden.

Mangrove Forests



Mangrove at Sabak Bernam (Sungai Air Tawar) Source: Mustaqiim Mohd Abidin

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-km 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, Sabak Bernam has 1,448.0 hectares.

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



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 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. However, with aquaculture encroachment and other human activities, stretches of mangroves along Sungai Bernam are becoming degraded.



RIVER-RELATED ACTIVITIES AND SOURCES OF POLLUTION



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



JABATAN PERKHIDMATAN PEMBENTINGAN 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

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 Perkhidmatan Pembetungan (JPP) became the regulatory body. In 2008, 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 as 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 services are something that 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.

The Sungai Bernam basin has two zones of sewage treatment plants (STPs). The total population equivalent within the basin is 24,991 PE.

The types of STPs found along the basin are:

- Imhoff tank
- Communal septic tank
- Extended aeration
- Oxidation ditch
- Network pumping station

- Trickling filter solid contact
- Intermediate demand extended aeration
- Active bio
- Oxidation pond
- Aerated lagoon
- Sequencing batch reactor

CATCHMENT	ZONE	TOTAL(PE)
SUNGAI BERNAM	GSB	12,649
	GUS	12,342
Sub Total		24,991

Total PE within the Sungai Bernam basin Source: IWK

In general, no problems with existing sewerage lines were reported in the Sungai Bernam basin. However, with new mixed developments taking place in the Proton City and Tanjong Malim area, sewerage disposal should be controlled to avoid being a problem in the future. In spite of ongoing efforts, IWK still faces challenges in managing sewerage services throughout the country.



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.



STPs ARE OWNED BY JPP, IWK ARE ONLY OPERATORS

According to IWK, many people are not aware of this. As a result, IWK is often blamed when anything negative regarding sewage is reported.



DILUTION FACTOR NOT TAKEN INTO ACCOUNT DURING DRY SEASON

Readings give uncharacteristically high concentrations.



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)

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. Insufficient sewerage services arise when developers increase the plot ratio of new developments. As a result, 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 to the ease of doing business in Malaysia. There needs to be more concerted efforts for the widespread use of centralised plants for investors to tap into.

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. Such practices are deemed illegal, but old houses and homes, especially in rural areas, still continue to use it. There is not enough enforcement by local authorities.

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.



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.




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

In Selangor, industrial activities are seen around the Sekinchan and Hulu Selangor area. On both sides of the river, there have been reports of effluents being discharged into the river during heavy rain and in the darkness of night.

Solid Waste

Until 2011, solid waste collection and transportation in Selangor 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 Malaysia), 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. The table shows which local authority is servicing each district in Selangor.

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 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
- 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		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



In the Sungai Bernam basin, there is one landfill, which is located at Pancang Bendena near Sungai Besar.

It is located south of Sungai Bernam and it is closer to the ocean than it is to the river. It does not impact Sungai Bernam. In the upstream area of the river basin, there is a landfill at Kampung Penderas, but it is close to Sungai Slim and does not affect Sungai Bernam.

To the knowledge of the authorities there, there are no illegal landfills in the vicinity. 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.



Jetty at Bagan Parit Baru at Sabak Bernam Source: The Star Online

Sand Mining

There are sand mining activities in the Tanjong Malim area as well as the midsection areas on the Perak side of the river. While those that are licensed can be monitored and controlled, there have been reports of illegal sites. However, enforcement has been difficult as operators have left the premises by the time the authorities arrive at the site.

Development and Earthworks

Any changes to water resources or new developments are done in consultation among the local governments and relevant state agencies. For major projects impacting water resources, the state's investment arm, Invest Selangor, gives approval, with recommendations by Air Selangor.

An example was the proposed construction of a major port in Sabak Bernam, which was not approved due to the potential impact in the area from land reclamation activities. Proposed works and projects are reviewed and approved in terms of the benefit they bring to the local economy. Under the laws of Air Selangor, permanent structures along the river banks are not permissible, but Penampang Bagan Parit Baru was approved because of the economic boost to the local fishermen. In the past, jetties were temporary structures but current structures are made of concrete and more permanent. Hence, all jetties, including private ones, must get approval from LUAS. A proposed development is a jetty for ferries is at Hutan Melintang near Sungai Selendang. It is located on a private estate land, but there are plans to create a navigation corridor along this stretch of river. There is also a request for approval to engage in a shipbuilding dock along Sungai Bernam. A hydraulic study has been submitted for review by the relevant agencies.



PROPER PROCEDURES OF SAND WASHING AND SAND MINING BEING FOLLOWED

There are some sand washing and sand mining activities along the river, most notably along the stretch west of Kuala Slim. They are legal activities, but authorities are not sure whether proper sand washing and mining procedures prescribed by Jabatan Mineral dan Geosains are being observed. Cases of bund breaking and bank erosion are also being reported by JPS.



Alteration of Resources

Alteration of resources along Sungai Bernam consists predominantly of changes in the river alignment, either natural or manmade. Along the river, there are a number of oxbow bypasses and canals.

Changes in River Alignment

An oxbow lake is a U-shaped body of water that forms when a wide meander from the main stem of a river is cut off, creating a free-standing body of water. This landform is so named for its distinctive curved shape, resembling thebowpin of an oxbow. There are many oxbow lakes, a lot on Perak territory. Some of these have formed 20 years ago, but maps do not reflect this.

There are also 'shortcuts' built along the river to enable access to water for purposes of industry or agriculture. One of these is a diversion created just below the Bernam Headworks, which is a canal to divert water from Sungai Bernam to the agricultural areas on the Selangor side of the river.



Diversion of River Water into Canals

Almost all of the land use in the Sabak Bernam district is agricultural. As the rice bowl in the northwestern region of the country, there are rice paddies bordering the Selangor side of Sungai Bernam.

However, water supplied from the river was insufficient to meet the agricultural demand and a canal was built to divert water from Sungai Bernam to Sungai Tenggi and along a canal that runs along the southern perimeter of the paddy fields. This is known as the Tanjung Karang Irrigation Scheme.

During times of low rainfall, the canal was not sufficient to supply the fields near Padang Terap and thus a pump station was built to channel water from Sungai Bernam at the other end of the IADA territory. The pump station of late has been plagued by muddy water from upstream due to sandwashing activities.

Source: 'Simulation of Future Daily Rainfall Scenario using Stochastic Rainfall Generator', Dlamini et al., Universiti Putra Malaysia

Significant River Works

Significant works within the Sungai Bernam basin involved flood mitigation, upgrading drainage and river management programs.

FLOOD MITIGATION

Hulu Selangor District

Flood mitigation project at Sungai Bernam

Sabak Bernam District

Flood mitigation project at area of Sungai Panjang, Sabak Bernam

UPGRADING DRAINAGE

Sabak Bernam District

Upgrading of main drainage system project at peninsular of Sungai Bernam

RIVER MANAGEMENT PROGRAMED

Along Sungai Bernam

Reserves of Sungai Bernam

List of significant river works within the Sungai Bernam basin Source: JPS 2015



DOA is an agency that encourages and monitors agricultural activities



PPPNP is a Perak agency that encourages and promotes agrobased activities in the state

Agricultural Activities

Agricultural land held by large holding entities such as estates and plantations comprise 29% of the Sungai Bernam basin. Most of this land is used for oil palm and rubber cultivation. While some of this is privately owned, others are held by the Federal Land Development Authority (FELDA) and cooperatives. There are two FELDA plantations in the basin on the Selangor side--Soeharto and Gedangsa--while six others are located in Perak.

These holdings are concentrated in the middle and lower sections of the basin. The area of Hutan Melintang is the largest among this group, at 58%. Similarly, the lower basin areas are also dominated by large holding entities.

Small holding agriculture is characterised by a wide range of crops and land use profiles. Crop types vary from rubber and oil palm plantation to coconuts, paddy, and bananas to fruit orchards.

The State of Perak actively encourages more participation of small holding enterprises and farmers into agro-based activities. Perbadanan Pembangunan Pertanian Negeri Perak (PPPNP) is a state agency dedicated to promoting and stimulating the growth of agro-based industries within the state. Its activities consist of assisting individual farmers, organisations, companies, and agencies to enhance agricultural development.

Some of its focus areas is the development of implementing Ladang Rakyat, Ladang Untuk Rakyat and Ladang Pahlawan projects in order to increase the number of entrepreneurs in the agriculture sector. In the Hilir Perak area along Sungai Bernam, PPPNP provides financial and other forms of support for lowincome farmers to plant oil palm at the Hilir Perak Estate.

A breakdown of agricultural land use in Selangor for the year 2012 shows that palm oil and rubber occupied 199,805 ha (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 ha 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.

TYPE OF	COVERAGE AREA (HECTARE)				VARIATION		
CROPS	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

Good Practices

Jabatan Pertanian provides awareness and education on good farming practices to farmers through an incentive program called Malaysian Good Agriculture Practice (MyGAP). Introduced in 2010, MyGAP is 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 in order 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.



INSUFFICIENT WATER FOR IRRIGATION

There is insufficient water for irrigation, especially in the rice fields along Sungai Bernam. This occurs mostly in the dry season, from February to May. T o compensate, water is being drawn from neighbouring peat forests, the Raja Musa and Sungai Karang Forest Reserves. However, water from these forests is acidic due to high levels of decaying organic matter and hence reacts negatively with fertilisers, rendering the nutrients unusable for crops. In turn, farmers often apply more fertilisers, unaware that this has adverse effects of increased nutrient overload during runoff events. Additionally, water drawn from peat forests are not monitored and has no limits.

FERTILIS This is relat

FERTILISER / CHEMICAL RUN-OFF

This is related to the issue above. Current legal regulations cover 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.



ALGAE BLOOMS

Overloading of nitrogen and phosphorous levels in rivers from excessive nutrients promote sudden growths of cyanobacteria which produces harmful toxins into 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.



EFFECTS OF CLIMATE CHANGE

Farmers and authorities are reporting extreme dry and wet weather as well as rain events that are more severe than before. This has been observed within the past five years. DOA report a 20% to 30% loss in value of production. To mitigate the negative effects of drought on crop production, there has been research done by the Malaysian Agricultural Research and Development Institute (MARDI) on aerobic rice, which has a far less water consumption as compared to conventional paddy rice. However, the yield is lower than the conventional rice. Thus, aerobic rice is not yet feasible to replace conventional paddy rice.



Jabatan Perkhidmatan Veterinar is an agency for animal disease control, inspects livestock farms and processing plants, controls production of livestock, livestock products and animal feed

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 livestocks are licensed.

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

Perangkaan Ternakan Tahun 2014 Source: Jabatan Perkhidmatan Veterinar Selangor

In the Sabak Bernam within the Sungai Bernam basin, most of the farms are for rearing cattle and goats. Beef cattle have the highest number of farms (197), followed by goats (118). Other livestock such as sheep and chicken trail behind.

However, in terms of population, poultry are the most numerous. Broiler chicken are the highest at 1,021,550, followed and broiler quail at 15,720 and free-range chicken at 14,901.

Number of farms and population of livestock in Sabak Bernam Source: Department of Veterinary Services, Annual Report 2014

DISTRICT	Sabak I	Bernam
Livestock Type	Farm	Population
Buffalo beef	-	-
Dairy buffalo	-	-
Beef cattle	197	3,055
Dairy cattle	1	564
Heifer	-	-
Goat	118	2,305
Dairy goat	1	5
Sheep	16	301
Swine / Pigs	-	-
Deer	-	-
Horse	-	-
Rabbit	4	587
Broiler chicken	12	1,021,550
Egg laying chicken	1	100
Breeding chicken	-	-
Free-range chicken	60	14,901
Turkey	4	400
Broiler quail	10	15,720
Egg laying quail	-	-
Broiler duck	5	360
Egg laying duck	9	4,810
Ostrich	-	-
TOTAL	438	1,064,658

Swine Livestock

There are no pig farms in the Sungai Bernam basin. Currently, all pig farms have been concentrated in Kuala Langat, where they can be more easily monitored and regulated.

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 must follow local authority zoning. Any application for big-scale poultry farming must get approval from relevant agencies such as district and land offices, JPBD, local authorities, and LUAS and follow local authority zone. Upon approval, Jabatan Perkhidmatan Veterinar (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 are 170 cow and buffalo farms in Selangor. They are not licensed by JPV. The method of raising cows are free-range grazing, although this practice gives rise to some issues, as explained further in this section. 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.



DIRECT DISCHARGE FROM SWINE AND POULTRY FARMS

There have been reports of direct discharge from swine farms over the past years. 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. By and large, poultry rearing does 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 colour in the river, LUAS had made it mandatory to request farmers to have treatment ponds on their farm premises.



Aquaculture and Fishery

Jabatan Perikanan (DOF) Negeri Selangor 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 Regulation.

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.

Both DOF Selangor and Perak'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.



Jabatan Perikanan is an agency that develops and manages the national fishery industry

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, Sepang and Gombak	111
Sg. Selangor	Kuala Selangor, Hulu Selangor Gombak	221
Sg. Bernam	Sabak Bernam and Hulu Selangor	108
Sg. Klang	Klang, Petaling, Kuala Langat Sepang and Gombak	160

Number of aquaculture farms by river basin Source: Jabatan Perikanan 2016

Total Landing

TYPES DISTRICT		LANDING	S (METRIC	TONNES)
		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 (2016)

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 2016 was 377 metric tonnes.

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

Diminishing Species

PARTICIPATING DISTRICTS	TOTAL RELEASE OF FRY (METRIC TONNES)	SPECIES
Kuala Selangor	30,000	Udang galah
Hulu Selangor	182,500	Lampam
Kuala Langat	38,000	Lampam
Hulu Selangor	24,000	Lampam
Hulu Selangor	30,000	Patin
Kuala Langat	4,000	Patin and baung
Kuala Selangor	51,000	Udang galah
Shah Alam	5,000	Patin
Sabak Bernam	10,000	Baung
Kuala Selangor	7,000	Baung

Volume of fish fries released in Selangor waters Source: DOF 2016 Some of the river fish species were found to be dwindling in population in Selangor, and these are gourami (temakang), carp, barb or sliver sharkminnow (terbul), hampala barb (sebarau). beardless barb (temperas), bulu barb (tenggalan), champion, and eels.

To counteract this trend, a DOF program called Program Pelepasan Benih Ikan Sungai was initiated to preserve inland fishery species. As of 2016, a total of 392,500 metric tonnes of fry was released into the rivers of Selangor.





Lembaga Kemajuan Ikan Malaysia is an agency that provides assistance to local fishermen through financial incentives, skills development and technology improvement

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 (2017)

Jetties for Cockles

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	
А	Sampan/outboard engines	Traditional
В	Inboard engine below 25 GRT	Purse seine or trawler
B1	Inboard engine below 40 GRT	Purse seine or trawler
С	Inboard engine below 70 GRT	Purse seine or trawler
C2	Inboard engine 70 and above	Purse seine or trawler
	*CBT arread rate to page 2	DOE Colonnan

*GRT = gross rate tonnage

Source: DOF Selangor

Promotion of Good Practices

In 2015, the Ministry of Agriculture 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 Skim Amalan Akuakultur Baik (SAAB) industry requirements. MyGAP is mainly targeted to the prawn industry, and there are seven registered with LUAS for emission 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. In the Sungai Besar district, there were 51 beneficiaries; in Hulu Selangor 19 beneficiaries; and in Kuala Selangor, 26 beneficiaries.



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.



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 nland fish to the public.

ENCROACHMENT OF ACTIVITIES ONTO AQUACULTURE LAND

In Sabak Bernam, land for agricultural and aquaculture activities is being taken for other uses. This results in degradation of water quality and lower yield. For example, along various stretches of Sungai Bernam, sand mining activities are affecting fish culture yields. To address this, LUAS under the directive of UPEN is coming up with a Pelan Pembangunan Pertanian Selangor, which focuses on land use and production.



IMPACTS OF CLIMATE CHANGE

DOF Selangor says that 2012 to 2015 has 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 due to flooding. Other states such as Pahang were affected, where a large population of fish in caged culture perished due to rising water temperature.



DIFFICULTY OF MYGAP ADOPTION BY AQUACULTURE OPERATORS

MyGap promotion to aquaculture operators has been difficult primarily due to 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.



NEED FOR BETTER COORDINATION AND COMMUNICATION AMONG AGENCIES

DOF has been restructured such that enforcement now falls under another agency called the Agensi Pengkuatkuasaan 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 various levels, communication and coordination becomes important to address linkages and maintain coherence in policy making and program designs.



AQUACULTURE REPLACES MANGROVE AND CUT BACK ON THE MANGROVE FORESTS

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. In Sabak Bernam, authorities have taken action by closing down or forcing the relocation of some ponds but as they are on private land, enforcement is difficult. TNB has cut off electricity supply to errant or illegal operations but such actions have legal implications and are difficult to enforce.

Pesticide and fertiliserare also known to be discharged into the river at Hilir Perak. This occurs all on privately owned land .

Wet Markets / Restaurants / Food Outlets

By and large, wet markets in the major towns on the Perak side of Sungai Bernam do not have grease traps, although this has not raised any issues.



Recreation

There are a number of parks and animal sanctuaries along Sungai Bernam, such as the Sungai Dusun Wildlife Centre, the Hornbill Conservation Centre, Sungai Pakeh Firefly Conservation Area, and Inki Recreational Park. Towards the coast, there are many homestays to enjoy the view of green, lush expanse of paddy fields.

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

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, and 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 wastewater

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 water treatment plants 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 protozoas are parasites that live in the intestine and cause persistent diarrhoea in children and 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 Selangor every four months on a district by district basis. These tests are usually taken near the water intakes or at river confluences. 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 water treatment plants 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



Jabatan Kesihatan Negeri Selangor is a government agency that safeguards public health and monitors the environment for factors that impact human health



Water Supply Disruption

Compared to other river basins throughout the state, the Sungai Bernam basin did not experience many water disruptions for the period 2012 to 2015.

WATER INTAKE POINT	WATER DISRUPTION (HOUR)			
	2012	2013	2014	2015
Kalumpang	-	-	-	-
Sg. Selisik	43.5	-	-	18.5
Bernam River Headwork (Old)	-	20.0	28.8	-
Bernam River Headwork (New)	-	-	28.8	-
Sg. Dusun	-	-	-	-
Total	43.5	20.0	57.6	18.5

Water Disruption at water intake point within Sungai Bernam Catchment Source: PNSB

From 2012-2015, there were four incidents of water disruptions within the basin.

- In 2012, Sungai Selisik intake ceased operations for nearly 44 hours operations due to high amount of ammonia and manganese
- In 2013, Sabak Bernam experienced a 20-hour water disruption to repair a leaking pipe channeling treated water from the Bernam River Headworks water treatment plant to the area. The locations affected were Kampung Parit 13 to 17, Belia 1 and Belia 2, Bagan Terap, Taman Padu Permai, Taman Nirwana, Taman Berkat, Kampung Nelayan, Parit 2 to Parit 6 Barat, Kampung Sekendi, Jalan Taman Pusara, Taman Gemilang, Jalan Raja Chulan, and Kampung Naidu.
- In 2014, the each Bernam River Headwork intakes (old and new) experienced shutdowns for 28.8 hours due to oil spillage. This year had the longest duration in shutdown time, about 57.6 hours.
- In 2015, the Sungai Selisek intake had to shut down its operation for almost 19 hours due to high amount of ammonia level. This year had the shortest shutdown duration period so far.

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, the State Economic Planning Unit 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



North Selangor Peat Swamp Forest

Source: Buffer Zone Management Plan for North Selangor Peat Swamp Forest 2014, Selangor State Government, Jabatan Perhutanan, GEC and APFP-SEApeat

Approximately 30% of Selangor is forested, with the Northwest Peat Swamp Forest occupying a large section of it. It is a vast tract of land in Sabak Bernam covering about 80,000 hectares. It has a unique ecosystem consisting of acidic stagnant water and peat from organic material from 10,000 years ago. One of the benefits of a peat swamp forest is its role as a carbon sink.

Carbon sink	One of the largest storage of carbon in the world, impacting global warming
Regulates flood	Has hydrological value. Peat absorbs ten times more than its weight.
Acts as reservoir	A permanent water source. In Tanjung Karang, rice paddy fields are planted 5 times over 2 years. The source of the water for the padi is the peat swamp
Biological value	Within the past few years, five new species of aquarium fish were discovered
Biodiversity	Tapir, Black Panther, Sun Bear (Harimau Kampong), Long- Snouted Gar, and Hornbills



Jabatan Perhutanan is the agency for sustainbly managing and developing the forest resources and optimising their constributions to national socioeconomic development

There has been a moratorium on logging from five years ago that was imposed by the Selangor State Government. However, there is drainage of swamp area due to irrigation and other uses. The result is that peat drains and becomes susceptible to burning.

In 2014, a Buffer Zone Management Plan for the North Selangor Peat Swamp Forest was prepared by Jabatan Perhutanan Negeri Selangor (JPNS) and a nongovernmental organisation, Global Environmental Centre, for the Selangor State Government under the auspices of the ASEAN Peatland Forest Project. In the plan, one of causes cited for the degradation of the peat swamp forest was the encroachment of human activities such as mining, plantations, drainage projects having a negative impact on the forest in the form of reduced hydrology, fire, subsidence and loss of peat.

It was observed that many of the fires in the peat swamp forests were deliberately started as part of illegal land development activities, primarily for oil palm. Also, construction of canals/drainage in peat soil areas for agriculture without adequate water management (over drainage), caused the water to drain out of the peat layer, with the result that the peat becomes dry and highly combustible. One of the interesting uses of the peat forest is to use it as an undergroundwater hydrant in dried peat.

Causes of Peatland Degradation

Fire	Started as part of illegal land development activities, primarily for oil palm
Canal/drainage construction	Construction of canals/drainage in peat soil areas for agriculture without adequate water management (over drainage) caused the water to drain out of the peat layer, with the result that the peat became dry and highly combustible



Mangroves face a similar 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.

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.

Thus far, in the period of reporting (2012-2015) the basin has been spared of major floods, except for the December 1, 2014 event when 187 residents had to be evacuated. On November 30, 2012, there was a flood warning issued when the level of Sungai Bernam at the SKC Bridge in Hulu Selangor reached 18.61 metres, although it did not completely breach the river banks.

DATE	AREA AFFECTED	RELOCATION CENTRE/ NO. OF HOUSES AFFECTED
Dec 1, 2014	Hulu Bernam Selatan, Kampung Sungai Kerian, Kampung Hassan, Hulu Bernam Utara, Kampung Lalang, Kampung Gesir Tengah, Kampung Sri Pagi and Kampung Nilam	177 people at the Geo Kosmo National Service Training Centre; 10 at SK Hulu Bernam



In general, there are many settlements located in low-lying areas in the basin that are prone to floods. As shown in the map, flooding mostly occurs at Hulu Selangor.



On the Perak side, the Tanjong Malim and Behrang areas are known to be flood-prone. There is a sense of urgency in mitigating floods at Tanjong Malim, as it has been designated as Youth City, a project that involves waterfront development and beautification works. It is planned to start in 2017. Hence there is a flood mitigation project under the Federal Government and managed under Rancangan Tebatan Banjir in the amount of RM5 million scheduled at Tanjong Malim.

On the Selangor side, Kampung Kuala Slim is also known to experience floods on occasion. It is the area where the two rivers—Sungai Slim and Sungai Bernam—meet. Another area prone to flooding is Kampung Selisik near the Hulu Selangor district. Flooding occurs yearly, and the half of the village closest to the river is always affected.

Urban areas normally face flash floods arising from undersized drainage and/or lack of their maintenance. Drains may become undersized due to increases in urbanised areas that contribute to additional flood flows which overwhelm drains that are not upgraded. On the other hand, poorly maintained drains may experience sedimentation that reduced the carrying capacity and made worse by getting choked up with garbage.



Rainfall Trends

In Selangor, data from 61 rainfall stations are compiled by JPS 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 at Selangor State Source: JPS 2015

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 the state of Selangor.

This implies that human activities are highly vulnerable to such changes of rainfall trend, and it clearly show that climate change is happening in the state.


Flooding at Kampung Bagan Nakoda Omar Source: JPS 2015

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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 Sabak Bernam, cockle farmers filed reports of water full of pesticides affecting their cockle population, presumably from the nearby paddy fields. All along the stretch of coastline from Sabak Bernam to Kuala Selangor, the main aquaculture farms are cockle. In Kuala Langat, it is shrimp.
- 2 In 2015, a sanitary landfill in Sungai Sembilang, Kuala Selangor leaching heavy metals affected the cockle population there.

In these cases, local authorities and relevant agencies say that communication among LUAS, JAS, and the reporting agencies is important. Because 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.

As a result of polluted water around the aquaculture sites, the cockle population has dropped by as much as 70%. This has economic impact as Selangor is the biggest producer of cockle and spat (cockle seedlings) in the country. In Sabak Bernam, Kuala Selangor and even Kuala Langat, cockle breeding is a big industry. In particular, the number of spatfall landing has reduced. Perak also is a large producer of cockle and spat, and is neck-to-neck with Selangor in cockle production. While Selangor produces more spat than Perak, water quality for both states is important.

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 are anecdotal observations made by officers in technical agencies. To verify the impact of climate change in Malaysia, specifically Selangor, Institut Penyelidikan Hidraulik Kebangsaan 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 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 the Malaysian Stormwater Manual (MSMA).
- When planning for new developments, planners must not only consider past rainfall history in the development area, but also projections.
- As climate change affects water resources, NAHRIM suggests that LUAS incorporate climate change impacts and measures in their long-term planning of water resources.

APPENDICES

Appendix A. Water Quality Index

Since 2001, the Department of Environment or Jabatan Alam Sekitar (JAS) has been conducting 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(NH3-N), total suspended solids (TSS), and pH.

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

WQI Class	Range	Water Usage Description
1	<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)	рН	BOD	COD	SS	NH ³ -N	NO ³ -N	Р	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	Stan	dard
			А	В
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
	рH	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	Ammoniacal Nitrogen (NH ₃ -N)	5 mg/l
in ponds or cages	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	Ammoniacal Nitrogen (NH ₃ -N)	5 mg/l
in ponds	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	Total Suspended Solid (TSS)	100 mg/l
earthworks	Oil and grease	10 mg/l
Livestock other than pigs	Ammoniacal Nitrogen (NH ₃ -N)	
	Biochemical Oxygen Demand	200 mg/l
	(BOD5) at 20°C	
	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	50 mg/l
	(BOD5) at 20°C	
	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

Appendix E. Contributors

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Mangrove forest	Global Environment Centre	32
Sg. Selangor Dam		43
Water background		57
River ecology		61
Sungai Karang Peat Swam Forest	Jabatan Pengairan dan Saliran	64
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Water ripples	Jacqui Thurlow-Lippisch	89
Mangrove		93
Wet market		94
Children splashing	Ooi Li Ling	95
Peat swamp forest		101
Mangrove forests		103
Rescue boat		103
Shrimp and fish		108

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