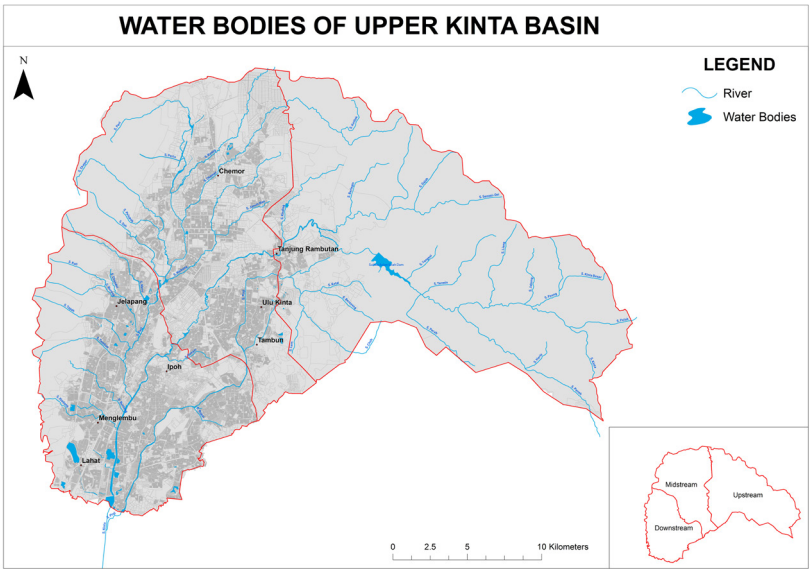
UPPER KINTA BASIN ENVIRONMENTAL ASSESSMENT REPORT



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CHAPTER 1: INTRODUCTION 1-1

1.1 BACKGROUND

Integrated Management of Kinta River Basin for community and ecosystem services through active community and stakeholder participation is a project initiated by Global Environment Centre (GEC). The project is funded by Yayasan Hasanah and is being implemented over a duration of 36 months, from May 2018 to April 2021. The project aspires to bring together the governing agencies, local communities, and private sectors in a bottom-up integrated approach to managing and conserving the forest and rivers in the Upper Kinta Basin (UKB), and to streamline the forest and riverine habitat conservation into development planning and policies. In this project, the local community is seen as a critical component of managing water resources as a soft-path management instrument.

The prime interest of the project is the Upper Kinta Basin in Perak. The Kinta River, which forms the Kinta Valley, is bounded by the Main Range to the east and the Keledang Range to the west. The Kinta river which flows from Gunung Korbu in Ulu Kinta at an altitude of around 2000 m above the sea level is 110 km long with the catchment area of 2,540 km^2. The Kinta River is an important water supply source to Ipoh inhabitants and its surrounding areas. The river basin has high biodiversity and is rapidly urbanizing. The state capital visions itself as a sustainable, dynamic, and excellent city by 2020. However, just as other fast-paced developing cities in Malaysia, it is a constant battle balancing urban growth, economic development, and protecting environmentally sensitive areas. A Basin-wide approach is an appropriate unit for integrated management. A basin-level perspective allows addressing the linkages between water resources management and the management of land and other related resources effectively. The importance of water resource conservation should be recognized at the highest level of decision-making as well as at the grassroots level.

This project through one of the key output, Upper Kinta Basin Management Strategy (UKBMaS) also supports the Perak State Structural Plan 2040 (*Rancangan Struktur Negeri Perak 2040*, RSN) under the Planning Policy item 23: Strengthening/empowering the role of community in caring for the environment. Moreover, the project also supports Malaysia's efforts in achieving the 2030 sustainable development goals (SDGs). Six out of the 17 SDGs goals are addressed within the project, which are:

- SDG 6 - Ensure availability and sustainable management of water and sanitation for all
- SDG 8 - Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
- SDG 11- Make cities and human settlements inclusive, safe, resilient and sustainable
- SDG 12 - Ensure sustainable consumption and production patterns
- SDG 13 - Take urgent action to combat climate change and its impacts
- SDG 15 - Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Under the project objective 2, a number of activities will be implemented to encourage responsible river usage, water consumption and waste management through community engagement. This supports the SDG 6 targets to improve water quality by reducing pollution, increase water-use efficiency, implement integrated water resources management, and to protect and restore water-related ecosystems by 2030. The proposed activities will be focused on supporting and strengthening the participation of local communities in improving water and sanitation management. Similarly, under SDG 11 and 12, the target for education environmental impacts will be focused on efficient use of natural resources and waste management including chemicals and food.

The public awareness programmes were designed to incorporate the SDG 12 and 13 by aiming to ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature, and to improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning, respectively. This project also intends to encourage entrepreneurship and job creation through supporting the Orang Asli community to establish small-scale nursery as part of tree planting initiative, providing small-scale skill training and supporting the community-based initiatives such as hiking tour guiding and nature-based tourism. This is directly within the SDG 8 goal, where one of the key implementations is to devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products by 2030. In summary, the UKBMaS initiatives at the state-level, supports the SDG 15 targets which includes to promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally, and secondly to integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts by 2020.

1.2 OBJECTIVES

The main goal of the Upper Kinta Integrated River Basin Management is to conserve forests and riverine habitats in the Upper Kinta River Basin to support the Central Forest Spine initiative (CFS) through cross-sector partnership and community empowerment.

The project aims to achieve its goal through two objectives, which are:

1. To develop and adopt a strategy for forest and water resource management of the upper Kinta basin; and
2. To establish communities engagement to address issues regarding forest management and river protection

The outcome of this project will be the empowerment of the stakeholders especially Orang Asli and the urban/peri-urban communities on the forest and water resources monitoring and protection, and the implementation and adoption of the monitoring framework as defined in the UKBMaS by all relevant stakeholders. A number of key activities as tabulated in **Table 1.1** are proposed under the respective objectives to accomplish the above-stated outcomes:

Table 1.1: Project key activities

Objective	Key Activities
1) To develop and adopt a strategy for forest and water resource management of the upper Kinta basin	1.1 Diagnostic assessment of the UKB (as described in this report)
	1.2 Stakeholder workshops and consultation on basin management
	1.3 Establishment of project working group
	1.4 Develop the UKBMaS for implementation
	1.5 Promote strategy to key stakeholders for adoption
	1.6 Develop a financing mechanism for the strategy implementation
2) To establish communities engagement to address issues regarding forest management and river protection	2.1 Establishment of a platform for community engagement through capacity building
	2.2 Orang Asli engagement in forest protection and rehabilitation
	2.3 Urban and peri-urban river livelihood and pollution prevention activities
	2.4 Environmental education and outreach

1.2.1 Target beneficiaries

There are four groups of beneficiaries targeted for the project which has been divided based on their distribution area within the project site. Essentially, the target beneficiaries are the key users of the water resources and the ecosystem services provided by the forest and riverine biodiversity in the project area as tabulated in **Table 1.2**.

Table 1.2: Target beneficiaries (communities) and the corresponding ecosystem services

Beneficiary	Ecosystem services
Orang Asli communities.	• Water supply • Livelihood
Peri-urban and urban communities	• Water supply • Amenity value
Stakeholders such as government agencies and private organizations	• Economic value • Amenity value
Downstream users of the river (outside project area)	• Amenity value

In addition to the communities, respective governing agencies responsible for river and catchment management, forest management, pollution control, and local planning and coordination are also the beneficiaries of this project as they share similar interests.

1.3 BASELINE STUDY

Managing water resource systems are directly and indirectly affected by the interaction of numerous human-related drivers of change such as:

- Governance (e.g. institution, legal framework);
- Demography (e.g. population growth, gender, urbanization);
- Land use (e.g. agriculture, urbanization, deforestation, pavement);
- Social conditions (e.g. education, culture, poverty);
- Technology (e.g. water use technologies, information technology);
- Economy (e.g. industrialization, globalization); and
- Climate change and variability – uncertain driver

This diagnostic assessment and data collection, conducted from May – November 2018, provides information to support in achieving the intended outcome of the project through active community and stakeholder participation. The assessment details out the demographic breakdown of the population, current land use, condition of the upper Kinta River and its main tributaries, community perception, and potential sources of pollution within the project area. This baseline reports the summary of the understanding and appreciation of the current state of affairs and stakeholder viewpoint within the project area.

This diagnostic assessment is essential to guide the development of the Upper Kinta Basin Management Strategy (UKBMaS) and the design of the community engagement programmes. It will also form the basis for subsequent monitoring and review, post-implementation of the results of the stakeholder engagement programmes. The UKBMas expected to be used as guidance and reference for relevant agencies and communities to ensure that the natural resources, particularly the forest and riverine habitat, is protected and sustained for the future.

1.3.1 Format of this report

The report is divided into six chapters describing different aspects of the diagnostic assessment. In addition to this introductory chapter, this report describes the following chapters:

Chapter 2: Upper Kinta Basin – This chapter provides information on the project area, including the demography and current land use.

Chapter 3: Pollution Source Inventory – This chapter outlines the sources of pollution in the project area, water quality study which describes the water quality status of rivers within the project area. In addition, this chapter will also provide information on the health and conditions of the water bodies, through the bio indicator studies focusing on macroinvertebrates.

Chapter 4: Stakeholder Perception Survey – This chapter describes the findings and results of the interviews and questionnaires carried out to assess the awareness level regarding forests, rivers and water resource, willingness to participate in the outreach programs and their current practices, if any, on environmental management.

Chapter 5: Linkages to Central Forest Spine – This chapter links the UKB to the Central Forest Spine as an ecological corridor, highlighting the issues and challenges.

Chapter 6: Overall Conclusion – This provides all the pertinent findings from the diagnostic assessment along with recommendations for the design stage.

CHAPTER 2: UPPER KINTA BASIN 2-1

2.1 PROJECT AREA

The project focuses on the upper reach of the Kinta River (hereafter referred to as Upper Kinta Basin). The Upper Kinta basin (UKB) covers an approximate area of 69,736 hectares[1], encompasses Chemor to the north, Lahat to the south, and other major towns such as Ipoh, Tanjung Rambutan, Jelapang, Tambun and Ulu Kinta. The UKB lies entirely in Mukim (sub district) Ulu Kinta in the Kinta district. The Ulu Kinta sub district is divided into Chemor, Ipoh, Lahat, and Tanjung Rambutan, administered by the *Pejabat Daerah dan Tanah Ipoh*. The project area is within the local authoritative administration of the *Majlis Bandaraya Ipoh* (MBI).

For the purpose of this project, the UKB area is divided into three main zones to facilitate project planning, designing and implementation as shown in **Figure 2.1**. The zones, identified as upstream, midstream, and downstream, represent the different regions of the Upper Kinta River that is within the project area.

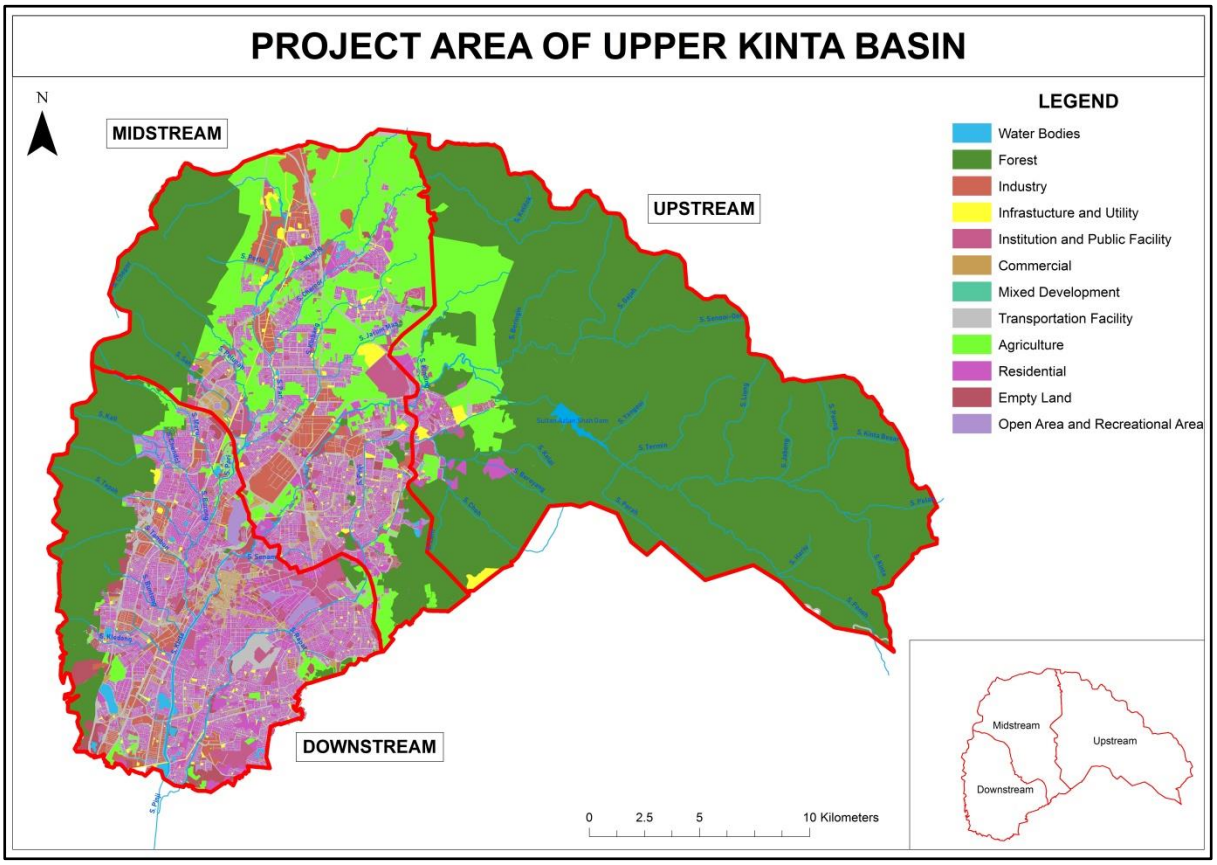


Figure 2.1: UKB project area

i. **Upstream:** Represents the upper portion of the Kinta River, to the east of the project area. The topography is hilly and mountainous with elevation ranging from

[1] *Jabatan Perancangan Bandar dan Desa* Perak, 2017

approximately 175 m above sea level (masl) to the highest peak at Yong Belar Mountain on the Main Range, at 2181 masl[2,3].

ii. Midstream: Represents the middle portion of the upper Kinta River, which includes a portion of the Pari and Pinji basin. The midstream section begins from the towns fringing the green areas in upstream, namely Chemor, Tanjung Rambutan, and Ulu Kinta, towards the North-South Expressway that bisects UKB. The elevation in the valley ranges from approximately 50 masl at the Kinta River bank, to Peninjau Mountain 1058 masl on the Keledang Range to the west, and 938 masl at Juang Mountain to the east[2,3].

iii. Downstream: Represents the lower portion of the upper Kinta River, where Ipoh town is located. The Kinta River separates Ipoh old town and new town. The topography of the downstream zone is generally higher on the range to the west, gradually decreasing towards the floodplain, and then slightly increases to the east. The elevation ranges from approximately 808 masl at the peak of Keledang Mountain to 30 masl near the Kinta River bank at the UKB boundary[2,3].

2.2 METHODOLOGY

The methodologies for undertaking the assessment of Upper Kinta Basin are as follows:

i. Land use and demographics assessment of Upper Kinta Basin – analyzed based on the satellite image analysis, secondary data collection, and field verification.
   - Site survey along Sungai Kinta basin especially after Sultan Azlan Shah Dam down to Orang Asli community, peri-urban and urban site.
   - Google Earth Mapping.
   - Secondary data from PLAN

ii. Pollution mapping and water quality monitoring – focuses on erosion/land clearance in upper basin and around settlements. The methods used for pollution mapping and water quality monitoring will be through:
   - Site survey along the upper Sg. Kinta
   - Google Earth Mapping
   - Secondary data of Water Quality Data from the Department of Irrigation and Drainage Perak & Kinta, Department of Environment as well as Lembaga Air Perak
   - Selected Water Quality Sampling/Analysis by project team; in-situ parameters and accredited lab Water Quality Analysis – APHA means Standard Methods for the Examination of Water & Wastewater, 21st Edition, 2005; American Public Health Association (APHA), American Water Works Association (AWWA) & Water Environment Federation (WEF).

     Biological Monitoring – provides accumulative assessment of environmental performance by integrating over the long-term effects of all sources of

[2] *Jabatan Ukur dan Pemetaan Malaysia,* 1986
[3] Google Earth Pro

environmental pressure involving land use and changes to water quantity and quality.

iii. Stakeholder Engagement: Organize briefing and consultation meetings with key relevant stakeholders.
- Organize individual and group consultation with key stakeholders like Department of Irrigation and Drainage Perak/Kinta; Lembaga Air Perak, Department of Forestry Perak and Department of Environment Perak.

2.3 SECONDARY DATA ANALYSIS

2.3.1 Climate

The project site experiences abundance sunshine and typical equatorial climate, humid with high temperature all year round. The mean annual humidity ranges from 63% to 99% with the lowest usually recorded in February and the highest usually recorded between October to November. In general, the climate within UKB is hot and wet with the seasons relatively defined as tabulated in **Table 2.1**. The daily temperature generally varies between 23°C and 32°C, where low air temperature occurs from December to January and the highest air temperature usually occurs from April to May. The annual rainfall ranges between 2,000 mm to 2,400mm.[4]

Table 2.1 The annual seasonal climate period within the project area

Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov
North–East Monsoon			Transitional period			South-West Monsoon			Transitional period		

The project site is sheltered from the Northeast monsoon, hence receives limited rain during this season. In contrast, the Southwest monsoon, from May to July, accumulates moderate rainfall. The peak of rainfall occurs from April to May and August to October during the transition period between the monsoons. Major floods generally occur between the months of July to December. In some events, occasional spills over the mountain range during the Northeast monsoon cause floods in November and December.[4]

2.3.2 Geology and soil type

UKB is located in the Western Tin Belt of Peninsular Malaysia and composed of Devonian sedimentary rocks of limestone. The floodplain soils range from well-drained levee soils to poorly drained heavy clays and peat soils in very poorly drained areas. Most soils are suitable for a wide range of crops. The terrain is flat to gently undulating has a general alluvial landscape that is underlain by unconsolidated to semi-consolidated sediments of variable thicknesses deposited during the Quarternary age in a variety of environmental settings. The mountain ranges are entirely of sedimentary rocks, mainly of fine-grained sandstone with interbedded shales, mudstones and minor siltstones probably of Carbo-Permian Age.[4]

[4] Sungai Perak IRBM Study, 2010

2.3.3 Water supply

Kinta River is one of the main tributaries of Perak River, flows from Mount Korbu at Ulu Kinta, Tanjung Rambutan to Perak River. Its main function is for water supply. Three (3) main rivers that flow through UKB are Kinta River and its two (2) tributaries: Pari River and Pinji River. Pari River confluences with Kinta River near Menglembu, while Pinji River meets Kinta River after the UKB boundary site. **Figure 2.2** shows the water body within UKB project site.

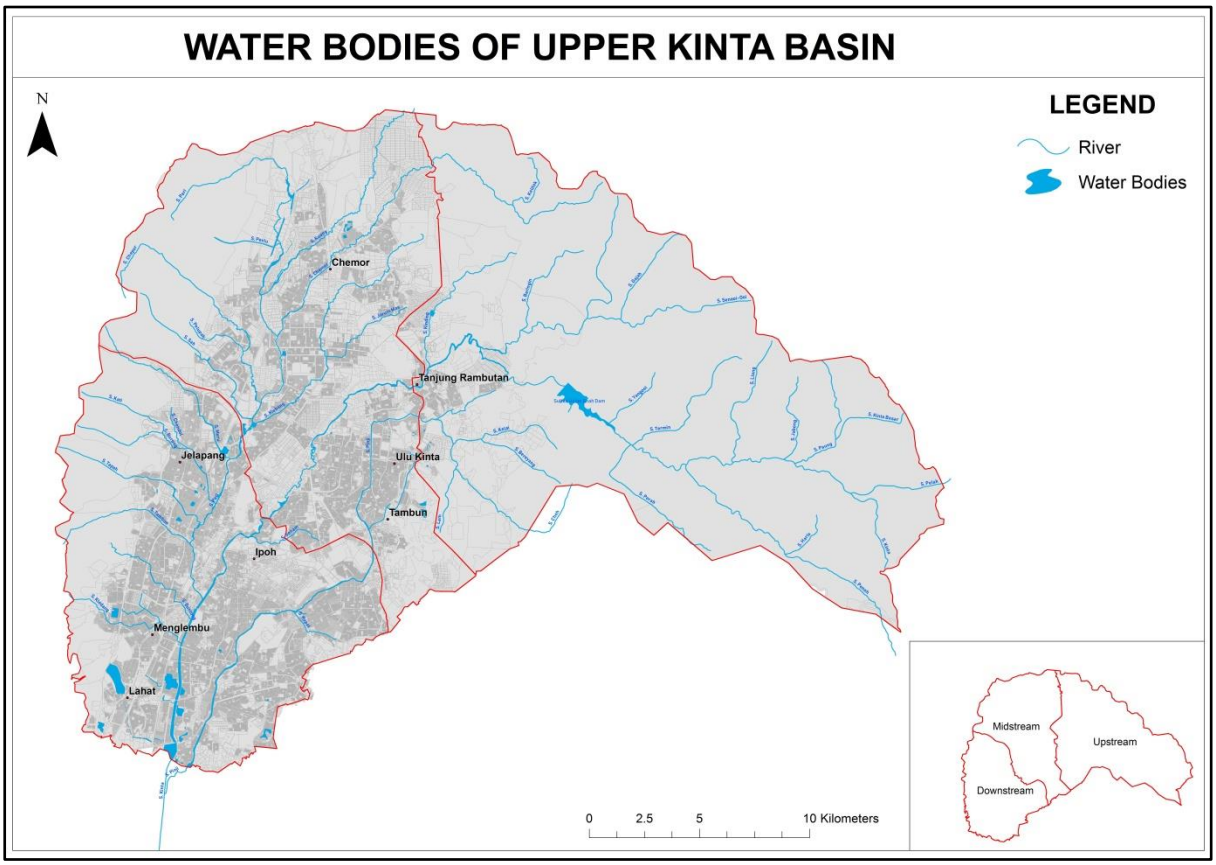


Figure 2.2: Water bodies of Upper Kinta Basin

Sultan Azlan Shah Dam is the first in the country that adopted the roller compacted concrete construction technique, where its construction period started in 1997 and was officiated on August 2, 2007. The dam was the last phase of the Greater Ipoh Water Supply II Scheme under Lembaga Air Perak (LAP). The RM253 million dam can produce 639 million litres of water per day and is expected to meet demand in the Kinta Valley up to 2020. It was constructed in order to raise the water supply of Perak by 25%. It is aimed to increase water output for the Kinta district (including Ipoh city) from 136 million litres daily (MLD) to 639 MLD to cater for 350,000 consumers.

The two main issues faced by the LAP to date are due the sedimentation and limited water stored during the dry season. The issues on the sedimentation at the Sultan Azlan Shah Dam currently were addressed via excavation of the sedimentation from the dam to maintain the water storage volume in the dam. The observed sedimentation at the dam is made up of

a variety of materials, including fine particles of silt and clay and larger particles of sand and gravel. The excavation processes take place in three (3) stages at the check dam. Three (3) check dams were constructed before the Sultan Azlan Shah Dam by the LAP to control sedimentation. This area is an active erosion environment because of the erodible material in the stream and check dams[5]. Check dams are commonly used to stabilize sedimentation, reduce the water velocity, limit catchment erosion, and increase the reservoir storage capacity of a dam.

The Kinta River is the main water source of the municipal water pipeline to the urban and peri-urban areas within UKB, enabled by LAP. LAP operates the Sultan Azlan Shah Dam and the two water treatment facilities that provide water supply to different parts of UKB; the Sungai Kinta Water Treatment Plant (WTP) and Ulu Kinta WTP. Only these two WTP are dam regulated in the Kinta district, while the rest are by the run of river scheme. The Sungai Kinta WTP is the second largest WTP in the district with a design capacity of 227 millions litres per day (MLD) (**Table 2.2**). **Table 2.3** shows the rivers contributing to the dam reservoir. The major demand points are from the town areas of Ipoh, Kampar and Tapah[4]. Based on historical data of water consumption in Ipoh (**Table 2.4**), the demand for water is expected to increase with increasing population in the future, thus depleting unregulated available water.

Table 2.2: Existing WTPs within UKB

Water treatment plant	Water sources	Forest reserve	Design capacity (MLD)
Ulu Kinta	Kinta river	Bukit Kinta	136.38
Sungai Kinta	Kinta river	Bukit Kinta	227.30

Source: Lembaga Air Perak, 2013

Table 2.3: Sultan Azlan Shah Dam catchment

Main River	Tributaries	Tributaries
Kinta	Pipit Dempak Raga Pelak Garing	
	Karok	Kejok, Mentak, Teng Wek
	Terok	
	Kinta Besar	Paung
	Jahang	
	Gerok	Senoh
	Liang Tamong Sempak	
	Penoh	Jenalik, Betek, Hariu, Chemor, Gesa Pok Wok, Buluh, Sheppiet, Tampoi
	Changoi	

[5] LAP, 2014

	Termin Perah	
	Yangooi	

Source: Lembaga Air Perak, 2017

Table 2.4: Water consumption for Ipoh

Year	Water supply to Ipoh (m^3)	Total water consumption in Ipoh (m^3)
2012	130,912,256.00	98,980,428.00
2013	137,386,394.00	100,615,459.00
2014	140,637,591.00	103,058,639.00
2015	141,164,357.00	103,934,278.00
2016	145,033,761.00	109,404,559.00
2017	130,481,853.00	98,622,167.00

Source: Lembaga Air Perak, 2017

2.3.4 Demography

The population is one of the main drivers of water consumption. Aside from consumption for survival, health and well-being, the economic activities and development that grows alongside population lead to impacts on natural resources within UKB. Therefore, knowledge on the current and future population is essential for resources planning and management. The demographic information of UKB is obtained from secondary data by Lembaga Air Perak, Population and Housing Census of Malaysia (2010), Jabatan Kemajuan Orang Asli Malaysia (JAKOA), and Pejabat Daerah dan Tanah Ipoh.

(1) Population

The population density of Kinta district is 432 persons per square kilometer. The majority of its population is of Chinese ethnicity (44%) followed Bumiputera, made up of Malay (38%) and indigenous community (Orang Asli) (0.6%), Indian (14.1%), and non-Malaysian citizen (3%). The estimated total population within UKB in 2010 was 653,838 with a population density of approximately 938 persons per squared kilometers[6]. The number is contributed by the high population density in Ipoh, being one of the largest cities in Malaysia. The population breakdown according to ethnicity within UKB is tabulated in **Table 2.5**. Most of the residents within UKB are concentrated in clusters in Menglembu, Buntong, Tasek, Ampang, Bercham and Pasir Puteh, making the area of Ipoh larger than any other town around the edge of the city. **Figure 2.3** shows the distribution of community settlement within the UKB area. The map shows that the distributions of people are along the river for both the Orang Asli and others. The map also shows that higher population is concentrated within the urban area which have more economic outcome for the people.

[6] Population and Housing Census of Malaysia, 2010

Table 2.5: Total population by ethnic groups within UKB

Area	Malaysian Citizen							Non-Malaysian Citizen	Total
	Bumiputera			Chinese	Indian	Others	Total		
	Malay	Other	Total						
Chemor	477	3	**480**	1,016	323	12	**1,831**	23	**1,854**
Jelapang	172	12	**184**	3,169	483	11	**3,847**	51	**3,898**
Lahat	8	N/A	**8**	284	81	N/A	**373**	25	**398**
Ipoh	126,419	2,137	**128,556**	226,853	67,745	1,173	**424,327**	9,877	**434,204**
Tambun	375	1	**376**	264	78	3	**721**	38	**759**
Tg.Rambutan	3,254	19	**3,273**	902	2,494	18	**6,687**	153	**6,840**
Other areas	118,066	1,548	**119,614**	54,982	21,234	339	**196,169**	9,716	**205,885**
Total	**248,771**	**3,720**	**252,491**	**287,470**	**92,438**	**1,556**	**633,955**	**19,883**	**653,838**

Source: Population and Housing Census of Malaysia, 2010

There are six Orang Asli villages; Kg. Chadak, Kg. Makmur, Kg. Tonggang, Kg. Sg Suluh, Kg. Sg. Choh and Kg. Sg. Baduk within UKB (**Table 2.6**). All these villages are located either along Kinta River or Seno-oi River. All the villages are managed by Jabatan Kemajuan Orang Asli Malaysia (JAKOA) Batu Gajah under a plan called Rancangan Penempatan Semula Orang Asli Ulu Kinta. The easiest village to access is Kampung Chadak and Kampung Tonggang. Kampung Sg Suloh is about 2km away from Kg Chadak and the access road started from Kg Chadak. Kampung Sg Suloh can also be accessed from Kampung Tonggang via 2km road. Kampung Makmur located about 4km away from Kg Chadak on winding hilly road.

The Temiar and Semai tribe were found within the site with most of the Temiar tribe located within Kampung Chadak, Makmur, Tonggang, and Sg. Suluh whereas the Semai[7] were found in Kg Sg. Choh. The main Kg Makmur is made up of five villages that were relocated during the construction of the Sultan Azlan Shah Dam.

Some of the initial discussion and consultation with the Orang Asli communities indicate the followings:

- Kampung Chadak is the only village that is located directly along the Kinta River.
- Kampung Makmur, Kampung Sg. Suloh and Kampung Tonggang are situated within sub-basin of Senoi-oi River.
- The Kampung Chadak community cannot use the Kinta River flowing adjacent to the village for their water supply or fishing activities due to high siltation effect.
- Kampung Chadak's drinking water supply comes from another tributary known as Tongyang River. Whereas drinking water for Kampung Makmur is from Senoi-oi River and Kampung Sg. Suloh from Suloh River.

[7] Sungai Kinta Dam EIA (1998)

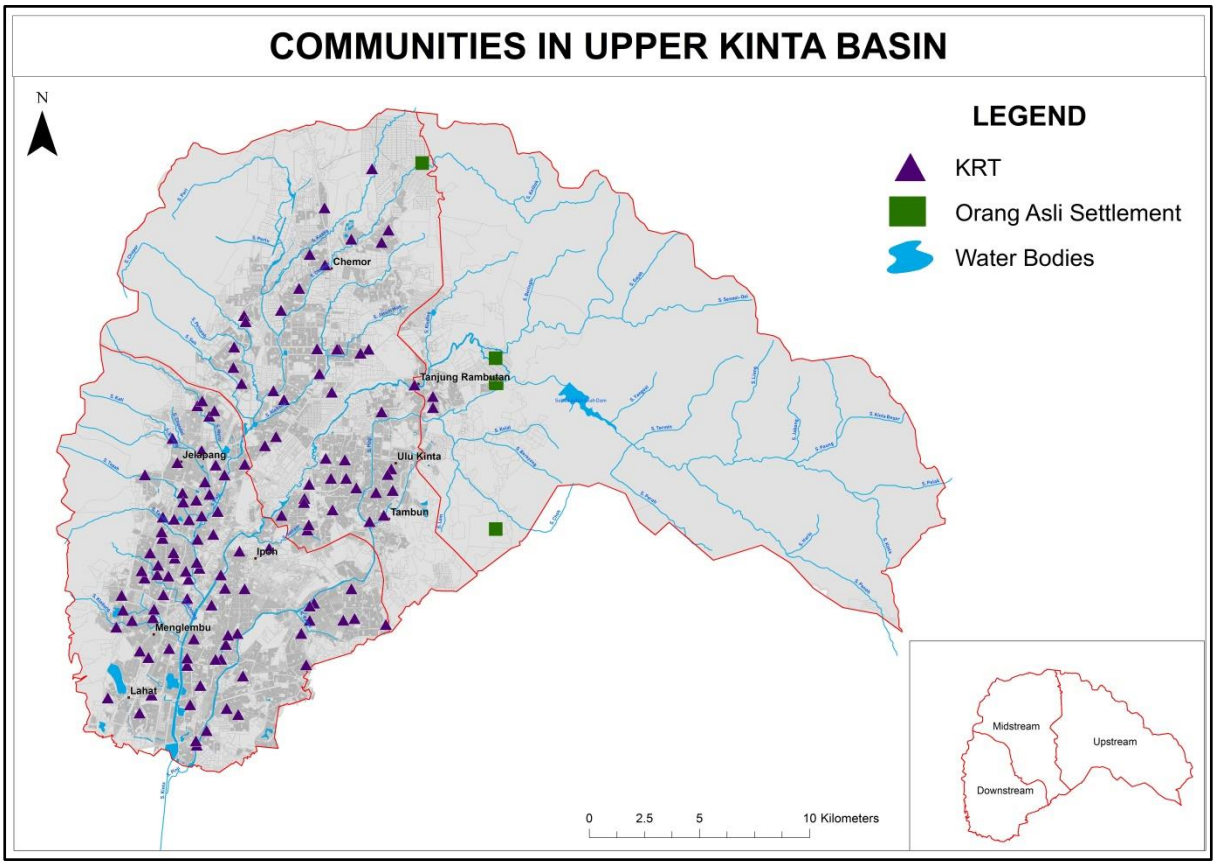


Figure 2.3: The communities in Upper Kinta Basin

Table 2.6: Orang Asli community within UKB

Village name	Number of residents	Average household	Public facility				Utilities	
			Community hall	Primary school	Pre-school	Prayer room	Water	Electric
Kg. Chadak	474	4	Yes	No	Yes	Yes	Gravity	Yes
Kg. Makmur	625	2	Yes	No	Yes	Yes	Gravity	Yes
Kg. Tonggang	372	4	Yes	Yes	Yes	Yes	Gravity	Yes
Kg. Sg Suloh	167	3	No	No	No	Yes	Gravity	Yes
Kg. Sg. Choh	163	3	Yes	No	No	Yes	Gravity	Yes
Kg. Sg. Baduk	125	3	No	No	No	Yes	Gravity	Yes

Source: JAKOA, 2014

(2) Projected population

The Kinta district population projection is shown in **Table 2.7**. The projections, exhibit an increasing trend to 2050. On average, it is expected that the population in Kinta district will increase by approximately 33% in 2050.

Table 2.7: Population projections (in thousands) under high, medium and low variant assumptions for Kinta district

	2020	2030	2040	2050
High	999	1126	1211	1291
Medium	973.6	1020.2	1064.9	1090.3
Low	879.6	928.2	965.9	987

Source: Population and Housing Census of Malaysia, 2010

(3) Urbanization

Peninsular Malaysia experienced rapid urbanization over the past decades whereby the proportion of people staying in urban areas increased from 28.7% in 1970 to 65% in 2000. UKB is considered highly urbanized with relatively 90% of the population living in urban areas. Based on the data available for Kinta district, at the current rate of growth, UKB is expected to be fully urbanized in 2040 (**Table 2.8**)[8].

Table 2.8: Projected urbanization level in Kinta district 2020-2050

Year	2020	2030	2040	2050
Percentage	93	96	100	100

2.3.5 Land use assessment

Land use and water resources are inseparable. The current land use and practices can affect the quantity and quality of water resources. The change in land use impact on water resources, for example through changes in catchment yields, infiltration rates, dissolved organic carbon and nutrient transfers. The significance of this land use assessment is to identify and document the current land use within UKB as a basis for subsequent monitoring references and review.

The 2017 land use database from the Jabatan Perancangan Bandar dan Desa Negeri Perak (PLAN) was used as the main reference for the land use assessment. The land use databases shared are in the editable shapefile format (*.shp*) for the entire Kinta district. For the purpose of the project, only the land uses within the Mukim Ulu Kinta were maintained, cropping out the rest of the district. This step was carried out using the ArcGIS version 10.3. Minor modifications were done on areas with no information identified by empty spots on the map. The land uses in these areas were corrected to match the neighboring land uses, cross-validated with Google satellite imagery and on-site verification.

[8] Population and Housing Census of Malaysia, 2000

2.4 LAND USE WITHIN UKB

The total area of UKB is 69,832 ha. Overall, the largest land use type within UKB is forest, which is more than half of the total size of UKB (52.1 %). Second largest is agriculture covering an area of 9,377.2 ha, followed by residential (7,158.6 ha) and transport facility (7,090.4 ha). The main land use(s) are shown in **Table 2.9** and the land use map of UKB is in **Figure 2.4**.

Table 2.9: Breakdown of land uses within UKB area according to the zones: upstream, midstream, and downstream

	Upstream		Midstream		Downstream		Total		
Type of Land Use	**Unit**	**Area (ha)**	**Unit**	**Area (ha)**	**Unit**	**Area (ha)**	**Unit**	**Area (ha)**	**%**
Water Bodies	77	64	179	245	465	545	721	853	1
Forest	300	26841	260	5259	309	4277	869	36,377	52
Industry	0	0	2189	1,491	6016	841	8,205	2,331	3
Infrastructure and Utility	132	156	1173	502	1210	231	2,515	888	1
Institution and Public Facility	83	1210	696	879	1082	1173	1861	2181	3
Commercial	238	9	10336	449	13673	500	24,247	958	1
Mixed Development	0	0	3	2	4	0	7	2	0
Transportation Facility	20	275	448	3066	245	3752	713	7090	10
Agriculture	1240	2418	5100	6275	3213	684	9553	9377	13
Residential	4169	405	103769	2657	141502	4097	249440	7159	10
Empty Land	2206	61	3230	268	5683	841	11119	1170	2
Open Area and Recreational Area	146	31	1564	530	1982	884	3692	1445	2
Total	**8611**	**30389**	**128947**	**21621**	**175384**	**17822**	**312942**	**69832**	**100**

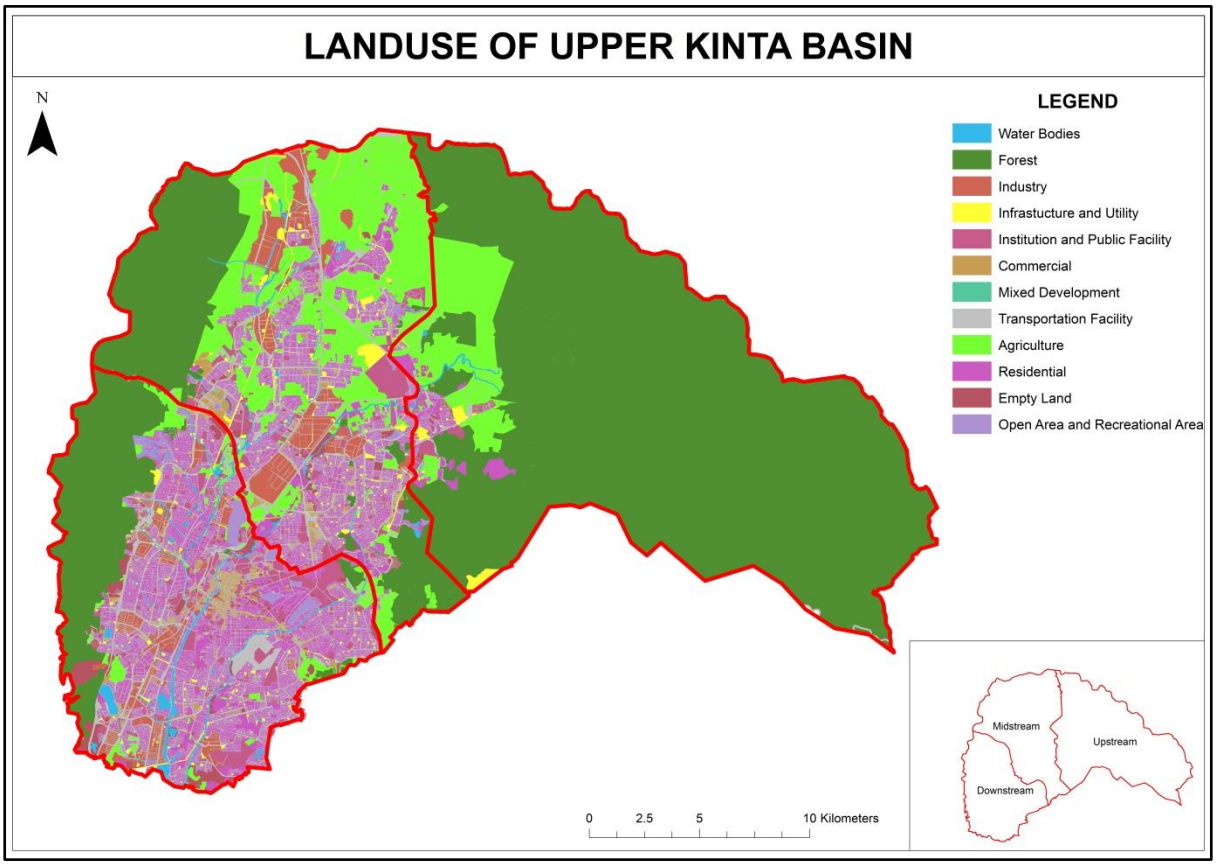


Figure 2.4: Land use of Upper Kinta Basin

2.4.1 Forest

The total area recorded within UKB as forest is 36,377 ha with 73.8% of it is within upstream, followed by the downstream (4,2767 ha) and the lowest at the midstream (5,259 ha). Within this land use, Bukit Kinta on the Main Range and Keledang Range, is Environmentally Sensitive Areas (ESA) in Perak where else Hutan Simpan Kekal Bukit Kinta covers an area of more than 65,000 ha. This forest reserve is managed by Perak State Forestry Department through Kinta District Forest Officer Office. The permanent forest reserve status was given to this area on 29th August 1930 with gazette number 6158. The highest point is in Mount Korbu which more than 3000 meter above sea level and it is the second highest mountain in the Peninsula of Malaysia after Mount Tahan. The department has taken the necessary steps to gazette almost the entire forest area at Bukit Kinta (green area to the east of UKB) and a small portion of forestland at Keledang Saiong as a 'Water Catchment Area'. A number of high conservation value (HCV) species are found in the UKB area such as the Resak abdulrahman and Gerutu Pasir Daun Besar.

2.4.2 Agriculture

The total area of land use within UKB for agriculture is 13.4% of total land or 9377.2 ha. Most of the agriculture activities are carried out at the midstream with total area of 6275.4 ha with only 2417.9 ha at upstream. The main agricultural activities includes the fruit farms (28.5 ha), rubber plantations (1.7 ha), coconut trees plantations (0.4 ha), palm oil plantations (276.7 ha), mixed agriculture (256 ha) and others (685 ha). Almost 85% of the agricultural land within UKB is not cultivated. There are 20 aquaculture activities carried out within UKB covers 44.1 ha. **Figure 2.5** shows the figure of agricultural and aquaculture activities carried out within UKB which privately owned and in small scale.

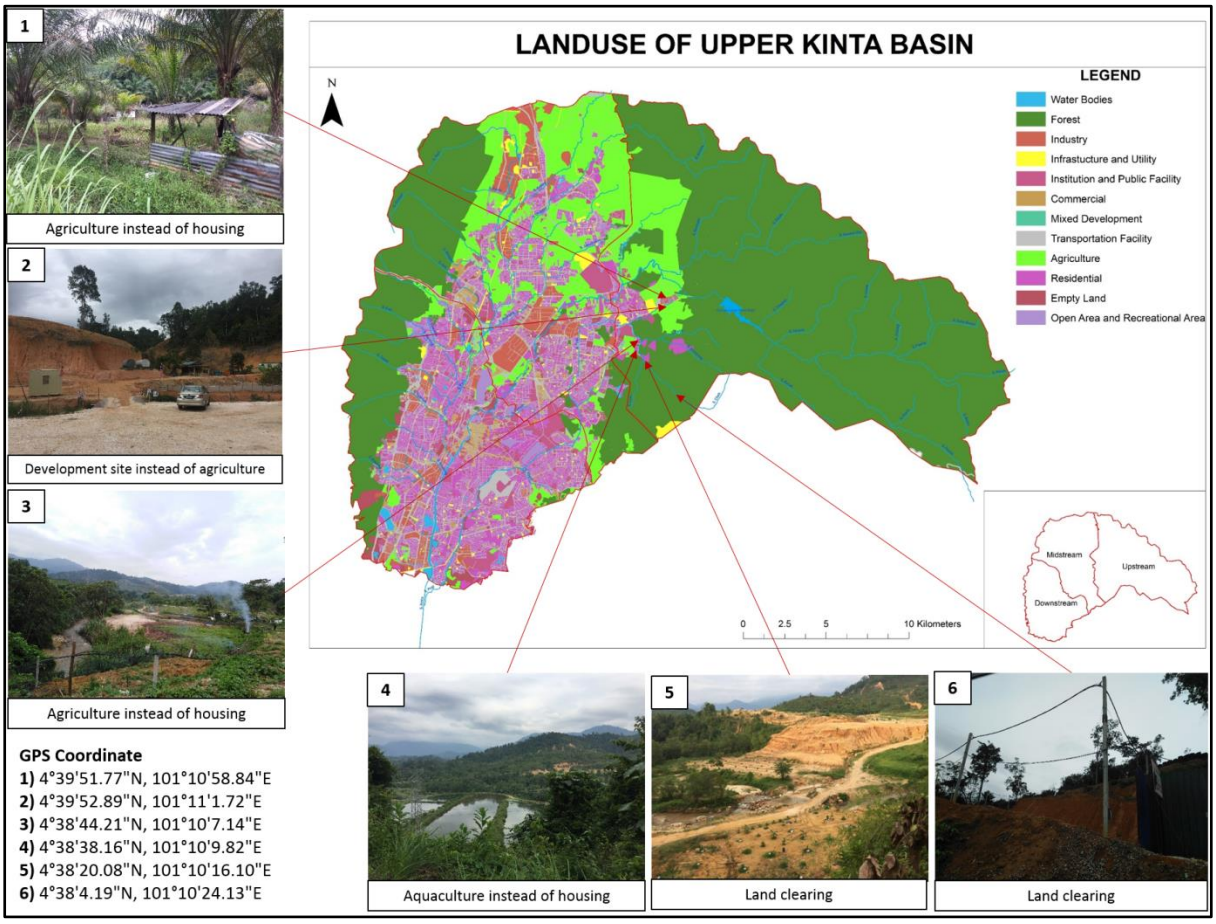


Figure 2.5: Agriculture and aquaculture activities within UKB

2.4.3 Residential and transportation facility

The residential area is highly populated at the downstream at 141,502 units (4097 ha) and the less dense population is at the upstream with only 4169 unit that covered 405 ha. The total area covered by residential units is 10.3% of the total land use within UKB. For the transportation facilities, the midstream shows the highest quantity at 448 facilities and area covered is 3064 ha. The lowest is at the upstream (20 facilities) with the area covered up to 275 ha.

2.4.4 Industries

The overall land use for the industrial units within UKB is 2331.4 ha which include heavy industries (259.3 ha), special industries (283.5 ha), small and medium industries (1733.3 ha) and mining/quarries (55.2 ha). Downstream of UKB is concentrated with industries (6016 unit) with an area cover of 840.7 ha followed by midstream; 1490.7 ha (2189 unit). There are eight (8) main industrial zones within UKB focusing on manufacturing industries such as iron and steel, food industries, rubber and electronic and computer industries. The **Table 2.10** shows the industrial zones within UKB together with the types of industries and adjacent river. Aside from the manufacturing industries within UKB, there are three quarries, operated by Cabaran Quarry (near to Pari River) and Lafarge Cement in Chemor, and Tasek Cement in Tasek (adjacent to Kinta River). Main industrial areas within UKB are as pointed in **Figure 2.6.**

Table 2.10: Industrial zones within UKB

Industrial zone	Types of industries	Adjacent River
IGB Industrial Zone	Electronics and computer Iron and steel Textile Cement Rubber Printing	Klebang, Kinta
Tasek Industrial Zone	Cement Iron and steel Rubber Timber and wood-based Electronic	Kinta
Bercham Industrial Zone	Tyre Iron and steel Food Metal Wood based Plastic	Kinta
Bukit Merah Industrial Zone	Ore processing Radioactive compound Chemical Iron and steel Food	Serokai
Jelapang Industrial Zone	Food Robber Wood-based Iron and steel Electronics and computer Textile Wood-based Marble Plastic	Tapah

Menglembu industrial Zone	Iron and steel Textile Plastic Food Tyre	Kledang, Kinta
Silibin Industrial Zone	Plastic Iron and steel Food Pottery Electronics and computer Wood-based	Tambun
Zarib Industrial Zon	Food Plastic Toiletries	Pinji

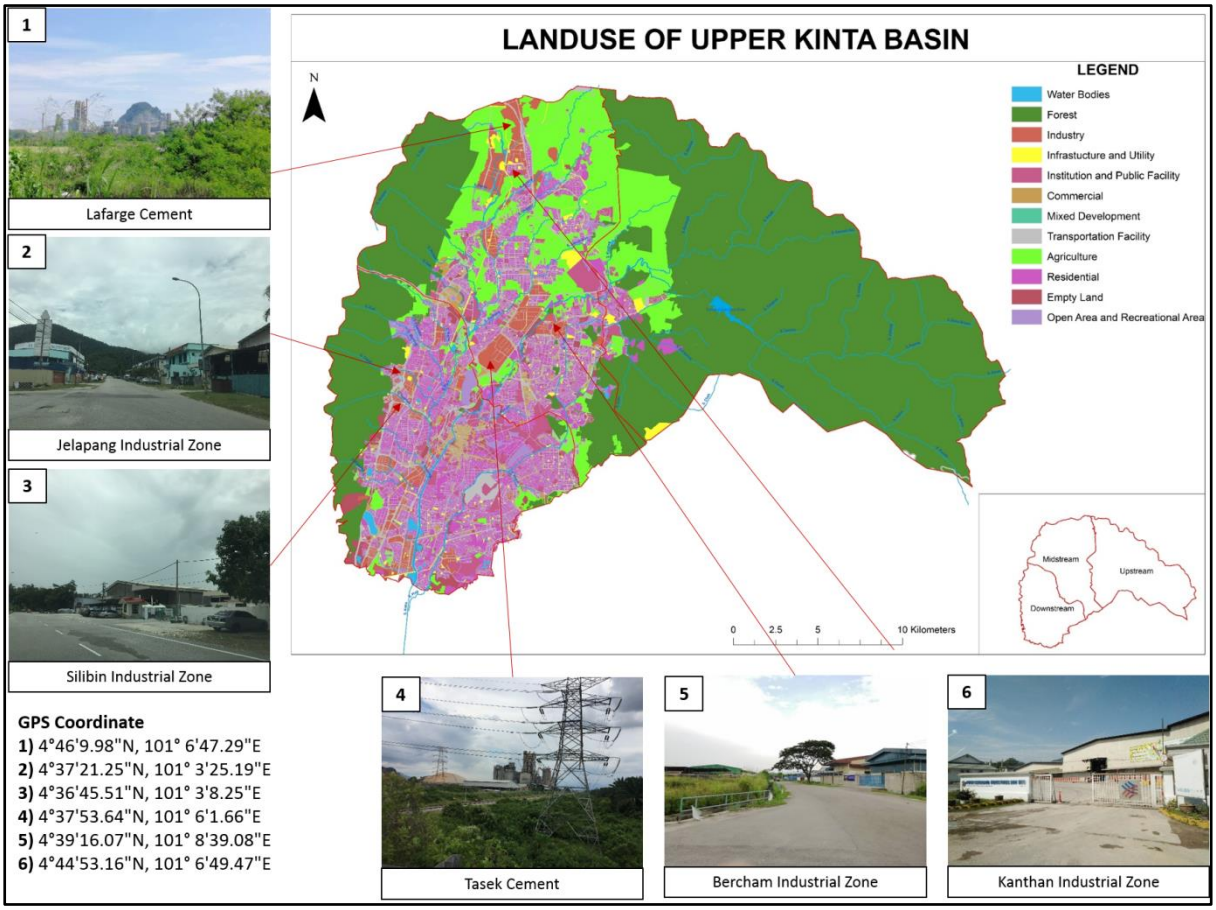


Figure 2.6: Main industrial areas within UKB

2.4.5 Waterbody

The overall water bodies at UKB are recorded at 721 water bodies with the overall land use are 853.4 ha or 1.2% of total area within UKB. Most of lake and ex-mining pond were found scattered at the downstream of the UKB, within the Ipoh Town. Ipoh Town is one of the main mining areas, leaving behind ex-mining ponds turned into an aquaculture or recreational lake/pond. The highest water bodies recorded are at the downstream with 465 water bodies covered up to 544.7 ha. The lowest water bodies recorded are at the upstream with only 77 water bodies with total area covered at 63.8 ha. **Table 2.11** tabulated the different types of water bodies recorded within upstream, midstream and downstream of UKB site. Some of the ex-mining sites are secured within the forest reserve area where 14 former mining pools 6km south of Batu Gajah covers 395 ha located within the Ulu Kinta Forest Reserve and around seven (7) hot spring pools are located within the Tambun Lost World Hotspring. Observations along the Kinta River visit are as in **Figure 2.7**.

Table 2.11: Breakdown of waterbodies within UKB

Water Bodies	Upstream		Midstream		Downstream		Total		
	Unit	Area (ha)	Unit	Area (ha)	Unit	Area (ha)	Unit	Area (ha)	%
River	5	55	79	197	211	338	295	591	1
Lake/Pond	71	8	65	21	230	93	366	122	0
Recreational Lake	0	0	3	5	11	40	14	45	0
Others	1	1	1	0	4	2	6	3	0
Mining/Ex-mining Pond	0	0	31	197	9	72	40	270	0
Water Bodies	77	64	179	245	465	545	721	853	1

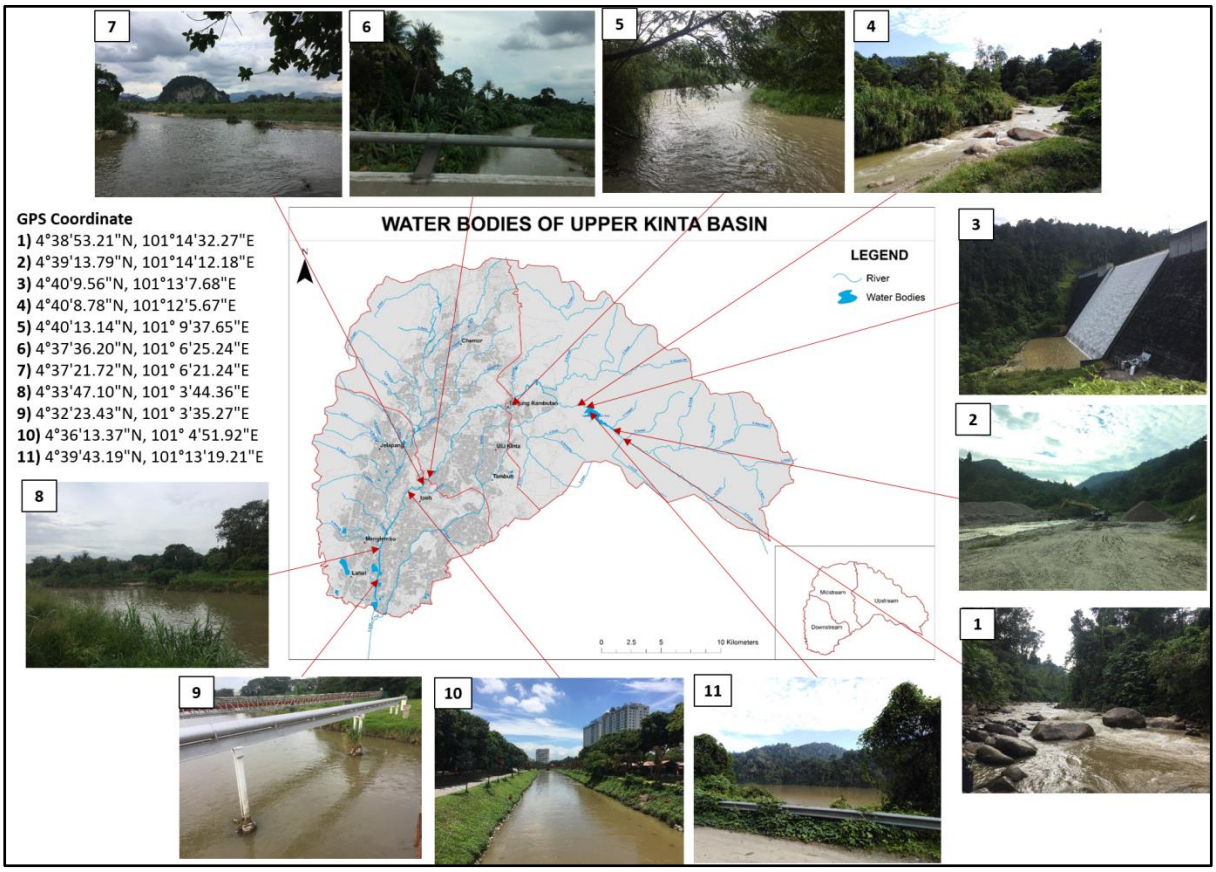


Figure 2.7: Observations along Kinta River

2.4.6 Others

Most of the infrastructure and utilities are located at the downstream with the area covered at 230.5 ha followed by the midstream with 1173 infrastructure (502.2 ha) with the overall land use at 888.4 ha (1.3%). The highest institutional and public facilities are provided at the downstream which is the urban area with 1082 facilities (1172.6 ha). The upstream shows the lowest facilities at only 83 unit that covered 129.6 ha of the land used. For commercial purpose, the downstream recorded the highest quantity with 13,673 (500.2 ha) and the lowest is at the upstream which covered the area up to 8.7 ha. The recreational area covers 2.1% a total land use within UKB area with the highest areas (883.6 ha) are at the downstream with only 146 units within upstream.

Overall 1.7% total land use within UKB is recorded as empty land recorded with highest empty land recorded is at the downstream with 840.9 ha with the lowest empty land is recorded at the upstream with 61.1 ha.

2.5 LAND USE AND WATER BODIES

The land use along the vicinity of the water bodies within the watershed has great impacts on the water quality of rivers. The water quality of the water bodies will degrade due to the changes in the land cover patterns due to human activities. The impacts of pollution within the developed area or ongoing development site are more alarming compared to rural. Changes in the land cover and land management practices have been regarded as the key influencing factors behind the alteration of the hydrological system, which will lead to the change in runoff as well as the water quality. Sanitation and hygiene issues related to water bodies are important to be addressed spirally at the upstream and midstream where the residential areas are scattered especially at Chemor on their own/family lands where the sewerage tanks are buried underground. Moreover, in certain area villages, the discharge of the sullage or the sewerage might end up polluting the river from upstream if proper education and guidance not given to the communities.

CHAPTER 3: POLLUTION SOURCE RAPID INVENTORY 3-1

3.1 INTRODUCTION

The pollution source rapid inventory study included three elements - a pollution source inventory, a water quality study and a bio-indicator study. Pollution source inventory helps to identify possible issues that affecting the UKB. It is important as visual observation of point source pollution enables the design of preventive measures as well as to identify the stakeholders that need to be engaged.

There are two types of river pollution; point and non-point sources pollution. Point source discharge pollutants at specific locations through pipelines or sewers into the surface water. This includes the visible pollution factors as sewage treatment plants, manufacturing and industries, wet markets, squatters and many others. Non-point source defined as diffused sources as surface runoff which carries the natural and human made pollutants as excessive fertilizers, pesticides from residential and agriculture, oil and grease from urban runoffs, as well as sediments, erosion from land clearance and development along and depositing them to the nearby water bodies. In general, the increase in the percentage of developed land and urbanization usually associated with a high concentration of waterborne pollutants.

On the other hand, water quality and biological monitoring will help us to identify the impacts of both point source as well as non-point source pollution. A river basin is an interconnected system of main river course and its tributaries (Viera et al., 2012) and it serves as the major source of water resources for domestic, industrial and agricultural practices as well the transportation mode at remote areas. As such, poor management of river systems will result in deteriorating water quality, frequent flash floods, water shortage due to high pollutant concentration and sedimentation. This, in turn, will have a negative impact on the economy, social, economic and health of that particular area and/or country. The protection, preservation and monitoring of the rivers cannot be diminished nor understated so that the importance, value and benefits of the river can be fully realized and any river problems can be prevented. The focus of water quality study in Upper Kinta River basin (UKB) is to know the current condition of the rivers section within Upper Kinta Basin.

Knowledge on the health status of aquatic ecosystems and the value of the potential services that they can provide, allows optimal and sustainable use of the available resources (Constanza et al., 1997). Some aquatic organisms, due to their inherent traits and characteristics, will react to changes and degradation of their habitat. They can be used as an indicator species of any changes to their environment. Some known organisms have limitation towards nutrients and dissolved oxygen concentration in the water. Hence, the presence of organisms living within habitat with such limitation indicates that these organisms are resistant and able to survive within that range of conditions. Hence, biological water quality monitoring for this study is done to know the health of UKB that is suitable for aquatic life as well as to classify UKB according to biological water quality status.

The output will enable the project working group to design appropriate best management practices to address the problems concentrating on the major river pollution within UKB.

3.2 METHODOLOGY

The methodologies used for the three different aspects as explained below:

3.2.1 Pollution source inventory

The preparation of the pollution source inventory involves a number of processes. The first step was a desktop land use analysis of the project area to map the location of different land use (as described in Chapter 2) and recognize the land use to prioritize in terms of the possible pollution area as well as its impact to the nearest waterbody. Relevant research, secondary data and existing information from relevant agencies were reviewed to augment into the inventory. Then, field visits and periodical site assessments were conducted from May 2018 to October 2018 to verify and validate the information. The rivers near the possible pollution sources were observed.

3.2.2 Water quality study

There were two (2) main sub-method used for this aspect. Firstly, secondary data was collected from relevant agencies on existing water quality monitoring. Secondly, GEC team has identified ten (10) stations within UKB to study the current water quality status.

3.2.2.1 Secondary data collection

Existing water quality monitoring information by relevant agencies was collected and analyzed. The water quality data received from three (3) main agencies which are Department of Environment (DOE) Perak, Department of Irrigation and Drainage (DID), Perak and Lembaga Air Perak (LAP). DOE Perak has 14 stations within Kinta River Basin with eight (8) of the stations are within UKB. **Figure 3.1** shows the DOE's sampling stations within UKB. DID Perak also monitor the Kinta River water quality. However, the agency only monitors the main Kinta River. It has a total of nine (9) stations located on Kinta River and all of them within UKB (**Figure 3.2**). Besides this, LAP has two (2) water treatment plants (WTP) that receive raw water supply from Sultan Azlan Shah Dam, located within UKB (**Figure 3.3**).

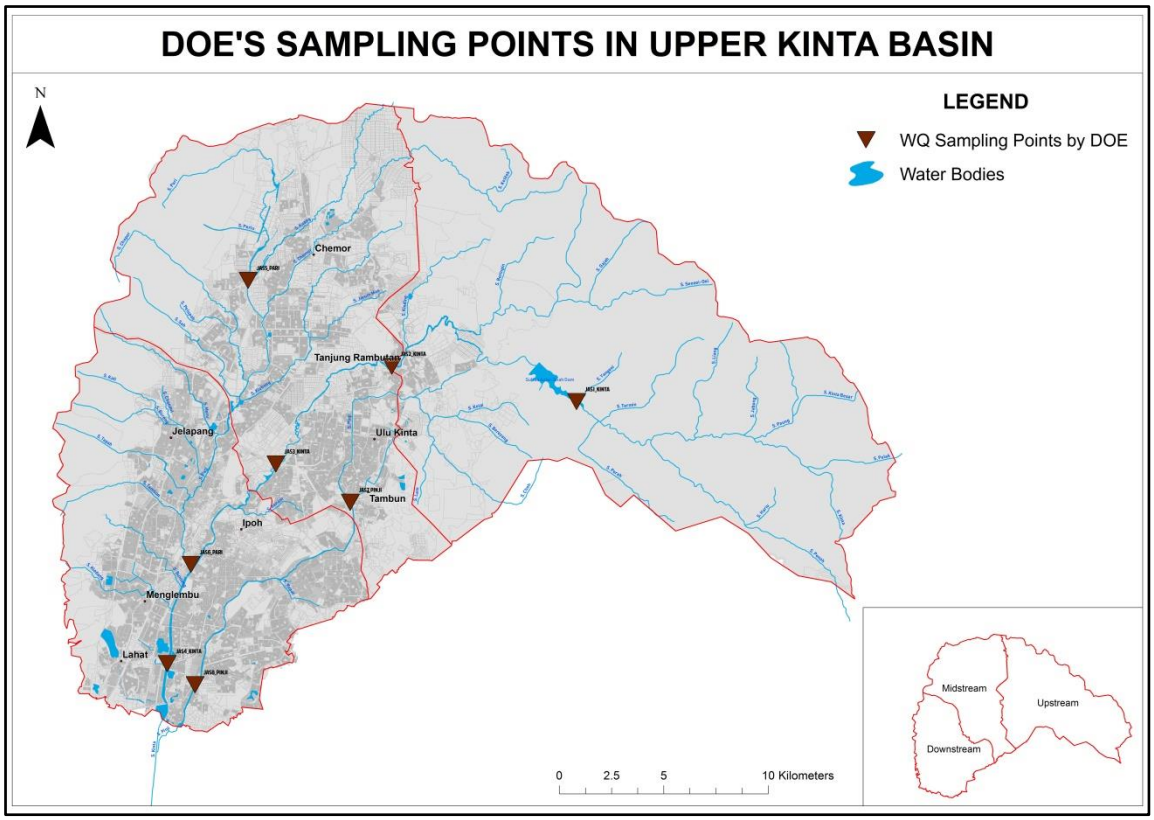


Figure 3.1: DOE Perak's water quality sampling points within UKB

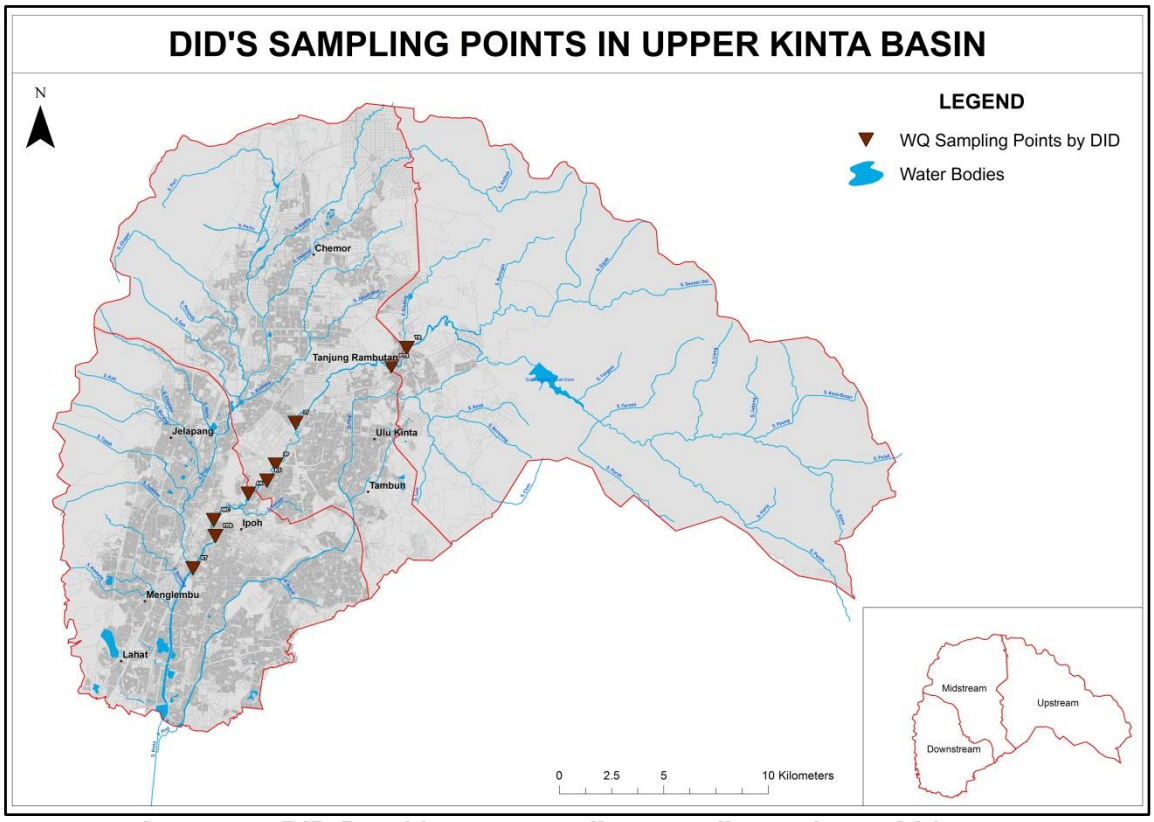


Figure 3.2: DID Perak's water quality sampling points within UKB

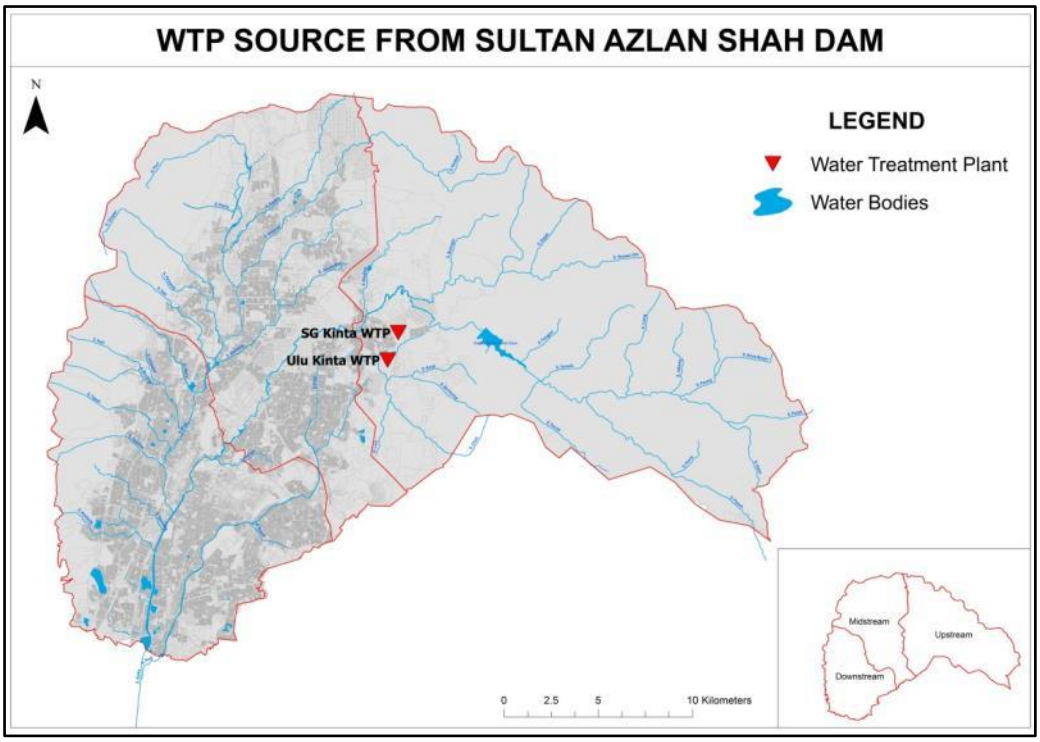


Figure 3.3: WTP's sourced by Sultan Azlan Shah Dam

3.2.2.2 Sampling by GEC team

Ten (10) sampling station (**Figure 3.4**) selected for this study within UKB to assess the current water quality status. Within the ten stations, eight (8) stations are identified to study the current water quality of the UKB and serve as baseline data. In additional, two (2) sites before and after the observed key development activity within UKB site was selected to identify the impact of the development to monitor the impact of pollution within the site. The site justification is as per **Table 3.1**. The water sampling was conducted on 21st and 22nd October 2018 from 0800 hours to 1700 hours. Water sample was collected through the grab sampling method (**Figure 3.5**). Water quality parameters measured through both in-situ (**Figure 3.6**) and ex-situ method. For ex-situ measurement, water samples were sent to KenEp Laboratories (M) Sdn. Bhd, which is accredited by Malaysian Accreditation Council under the Malaysian Laboratory Accreditation Scheme. Water quality parameters involved (**Table 3.2**) analyzed according to the standard methods recommended by APHA 2005 and MN Method.

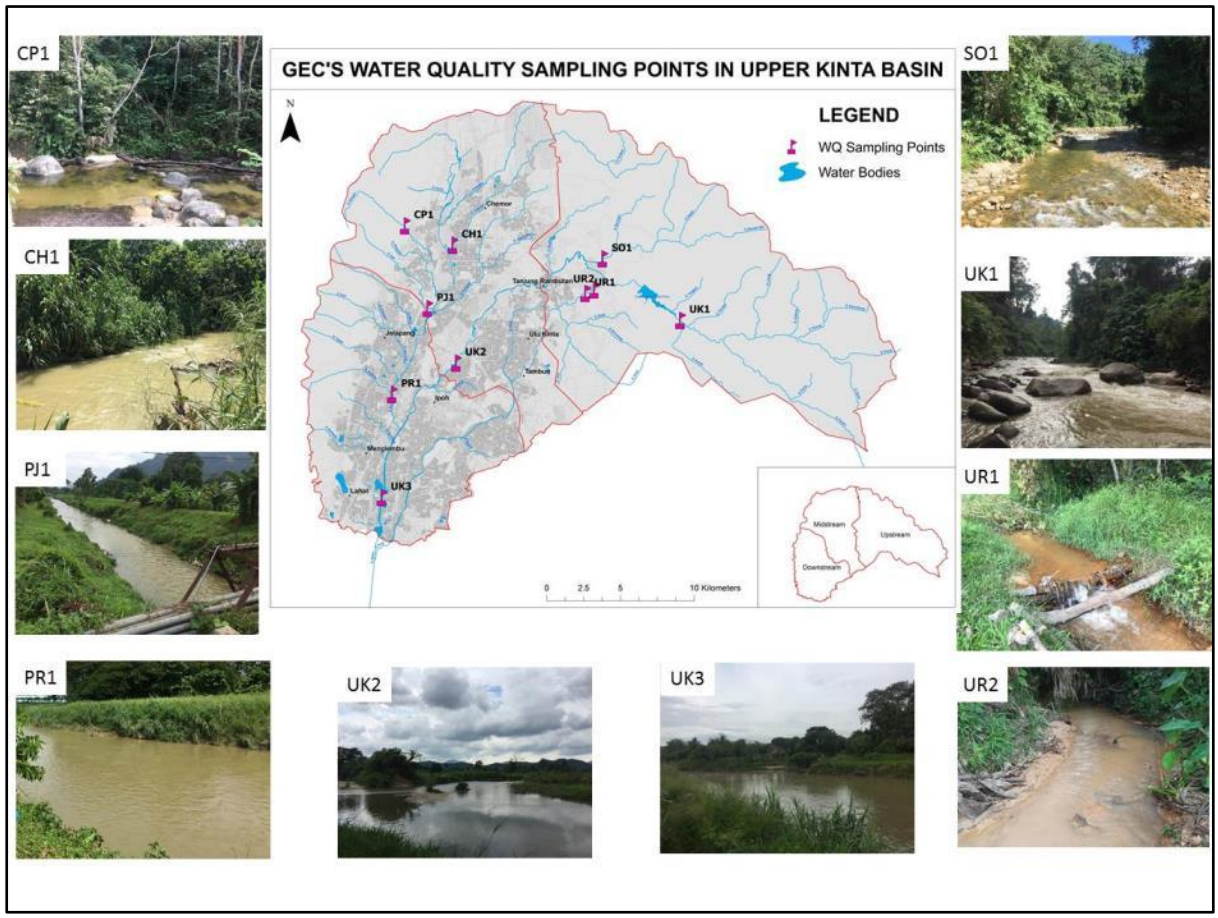


Figure 3.4: GEC's water quality sampling points

Table 3.1: Water quality stations, length and GPS coordinates of the river

UKB Region	River	Station	GPS Coordinates	Site Justification
Upstream	Kinta	UK1	4°38'53.39"N 101°14'32.17"E	• Close to source of Kinta River • Impact of activities upstream of dam • Water quality upstream of dam
	Senoi-oi	SO1	4°41'9.07"N 101°11'41.46"E	• Important tributary • Effect of activities of Orang Asli villagers
	Unnamed river	UR1	4°40'0.57"N 101°11'23.10"E	• Sampling point before the key ongoing development activity within UKB
	Unnamed river	UR2	4°39'52.92"N 101°11'3.40"E	• Sampling point after the key ongoing development activity within UKB

Midstream	Chepor	CP1	4°42'22.13"N 101° 4'26.51"E	• Tributary of Pari River basin • Source as well as place for recreational activities
	Chemor	CH1	4°41'39.41"N 101° 6'11.51"E	• Upstream of Pari river basin • Located in industrial area
	Pinji	PJ1	4°36'34.75"N 101° 8'19.51"E	• Among the key tributaries of UKB • Located in commercial area especially restaurants
	Kinta	UK2	4°37'19.62"N 101° 6'18.99"E	• Located on main Kinta River • Surrounded by commercial area
Downstream	Pari	PR1	4°36'10.61"N 101° 3'57.93"E	• Key sub-basin of UKB • Effect of residential area
	Kinta	KT1	4°32'23.43"N 101° 3'35.27"E	• Last point/region within UKB • Effect of residential area and commercial area

Figure 3.5: Collection of water sample using grab sampling method

Figure 3.6: In-situ sampling

Table 3.2: Water quality parameters analysis

Characteristics	Parameters	Unit	Method used
Physico-chemical	pH	-	In-situ
	DO	mg/L	In-situ
	Turbidity	NTU	APHA 2130 B, 2005
	Total Suspended Solids	mg/L	APHA 2540 D, 2005
	Ammoniacal Nitrogen	mg/L	MN Method 91805
	Biochemical Oxygen Demand	mg/L	APHA 5210 B, 2005 MN Method 985822
	Chemical Oxygen Demand	mg/L	APHA 5220 D, 2005 MN Method 985026
Microbiological	Faecal Coliform	MPN/100mL	APHA 9222 D, 2005.

3.2.3 Biological water quality study

Biological water quality monitoring utilizes the presence of biological indicator as a water quality indicator. Among the communities that are considered as bio-indicator of water quality, the most commonly used are benthic macroinvertebrate (Bonada et al., 2006). For this study, a total of six (6) sampling sites were chosen to assess biological water quality status of UKB (**Figure 3.7**). Five (5) of the sampling stations are same as the water quality sampling stations (UK1, UK2, UK3, CP1, SO1) and the other one at downstream is pointed differently at Senam River (SN1) which is tributary of Kinta River due to site accessibility factor. The geographical coordinate of each sampling station is detailed in **Table 3.3**.

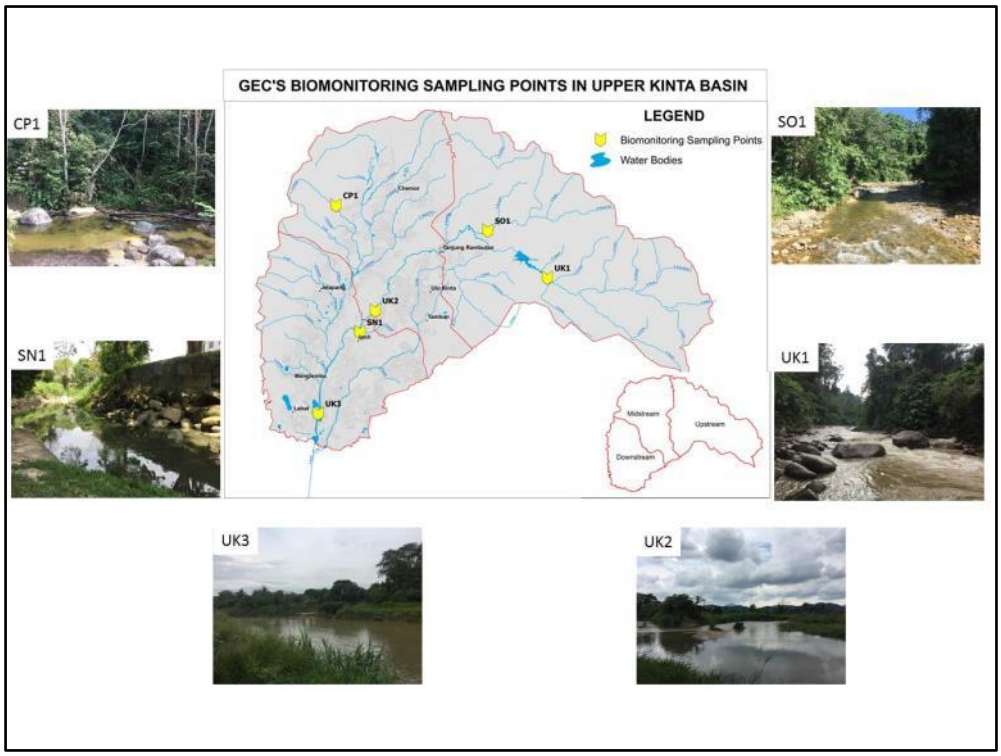


Figure 3.7: GEC's biomonitoring sampling points within UKB

Table 3.3: Geographical location for biomonitoring study

River	Station	Coordinates
Kinta	UK1	4°38'53.39"N 101°14'32.17"E
Senoi-oi	SO1	4°41'9.07"N 101°11'41.46"E
Kinta	UK2	4°37'19.62"N 101° 6'18.99"E
Chepor	CP1	4°42'22.13"N 101° 4'26.51"E
Kinta	UK3	4°32'23.43"N 101° 3'35.27"E
Senam	SN1	4°36'17.55"N 101° 5'34.91"E

3.3 RESULTS & DISCUSSIONS

3.3.1 Pollution source inventory

a) Secondary data analysis

The overall pollution source inventory was carried out based on secondary data as well as through site surveys. The secondary data of pollution source from various source and reports was analyzed based on three regions within UKB, upstream midstream and downstream. The major causes of pollution in the Kinta River Basin are industrial discharge, improper sewage treatment, residential discharge, sand mining, land development and soil erosion (Kalithasan 2008).

Based on the Study on Pollution Prevention and Water Quality Improvement at Sungai Kinta, Perak, by Department of Irrigation (DID) Malaysia in 2010, the possible source of pollution

within the UKB is identified mainly from three main categories: non-plantation, plantation, and developed area. Based on the report, a total of 4,884 ha of plantation activities mainly rubber, palm oil and crop cultivation could be possible cause of river pollution. Based on local council, a total 9,650 ha of developed area also reported as possible pollution sources from residential and roads. The last category, which is non-plantation, is made up of a number of land uses; animal farms, aquaculture, business, fields, industrial, planned industrial, infrastructure or services, institution, landfill, mining, service facilities, sewage treatment plant, and transportation.

Table 3.4, 3.5, and 3.6 highlights the summary plantation, developed, and non-plantation areas at the upper Kinta River and its main tributaries.

Table 3.4: Plantation areas by catchment

River	Rubber area (ha)	Palm oil area (ha)	Crops area (ha)	Total area (ha)
Kuang	80	883	1	892
Chemor	100	164	0.1	264.1
Pari	10	938	0.14	948.1
Jarun Mas	377	179	3	559
Chepor	0.1	493	0.1	493.2
Sah	0.03	239	-	239
Kinta	6	501	0.01	507
Meru	0.02	3	-	3
Pinji	92	696	0.02	788
Kledang	4	10	-	14
Serokai	3	62	-	65
Johan	32	53	27	112
			Total:	4884.5

Source: Study on Pollution Prevention and Water Quality Improvement at Sungai Kinta, Perak, by DID Malaysia, 2010

Table 3.5: Developed areas by catchment

River	Residential area (ha)	Road area (ha)	Total area (ha)
Kuang	152	90	242
Chemor	204	172	376
Pari	159	252	411
Jarun Mas	226	305	531
Chepor	32	54	86
Sah	2	89	91
Kinta	1,033	1,052	2,085
Meru	97	173	270
Pinji	186	144	330
Kledang	164	149	313
Serokai	115	150	265
Johan	2,211	1,480	3,691
		Total:	9,650

Source: Study on Pollution Prevention and Water Quality Improvement at Sungai Kinta, Perak, by DID Malaysia, 2010

Table 3.6: Summary of possible pollution sources other than plantation and development

Types of pollution by land use	River														
	Kuang	Chemor	Pari	Jarum Mas	Chepor	Sah	Kinta	Meru	Kati	Tapah	Tambun	Pinji	Kledang	Serokai	Johan
Animal farms	4	5	10	5			2					1	1		1
Aquaculture			1				1			1		2			
Business	15	7	145	70	2	6	512	15	19	57	82	490	173	15	145
Fields							3					3			
Industrial			10	24			97	6	5	31	49	25	8	12	15
Industrial (planned)	1		44	32			142	5	15	90	117	79	127	14	185
Infrastructure/ services				2		1	6					3	2		1
Institution			16	10	1		50	5	5	5	2	55	6	1	2
Landfill							1								
Mining				1			1			1		1			
Service facilities			1				1						1		
STP	14	8	20	20	2	1	77	5	1	4	18	203	23	5	23
Transportation			1			2	2					1			
Total	34	20	248	164	5	10	895	36	45	189	268	863	341	47	372

Source: Study on Pollution Prevention and Water Quality Improvement at Sungai Kinta, Perak, by DID Malaysia, 2010

b) Assessment of upstream of UKB

The Sungai Kinta River basin system has six (6) main tributaries as Termin River, Changor River, Penoh River, Sempak River, Tamong River and Liang River. However there are more than 12 secondary sub-tributaries and 13 tertiary sub-tributaries flowing from Mount Korbu and the Ulu Kinta Water Catchment Forest Reserve (**Figure 3.8**). The contributing factor for high sedimentation at the upper Kinta River is originates from one of these tributaries. As illustrated in **Figure 3.9,** all the identified tributaries are located deep inside the forest reserve area, further from other land use activities.

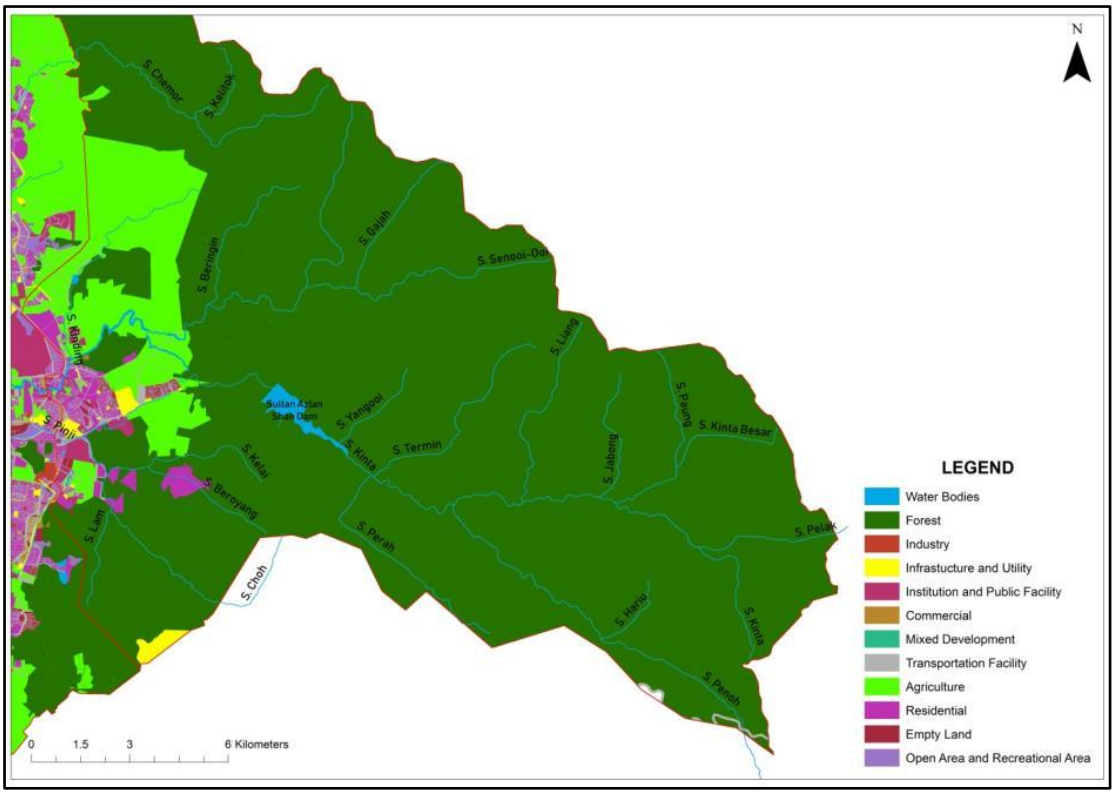


Figure 3.8: Kinta River main and sub-tributaries forming the water catchment of Upper Kinta

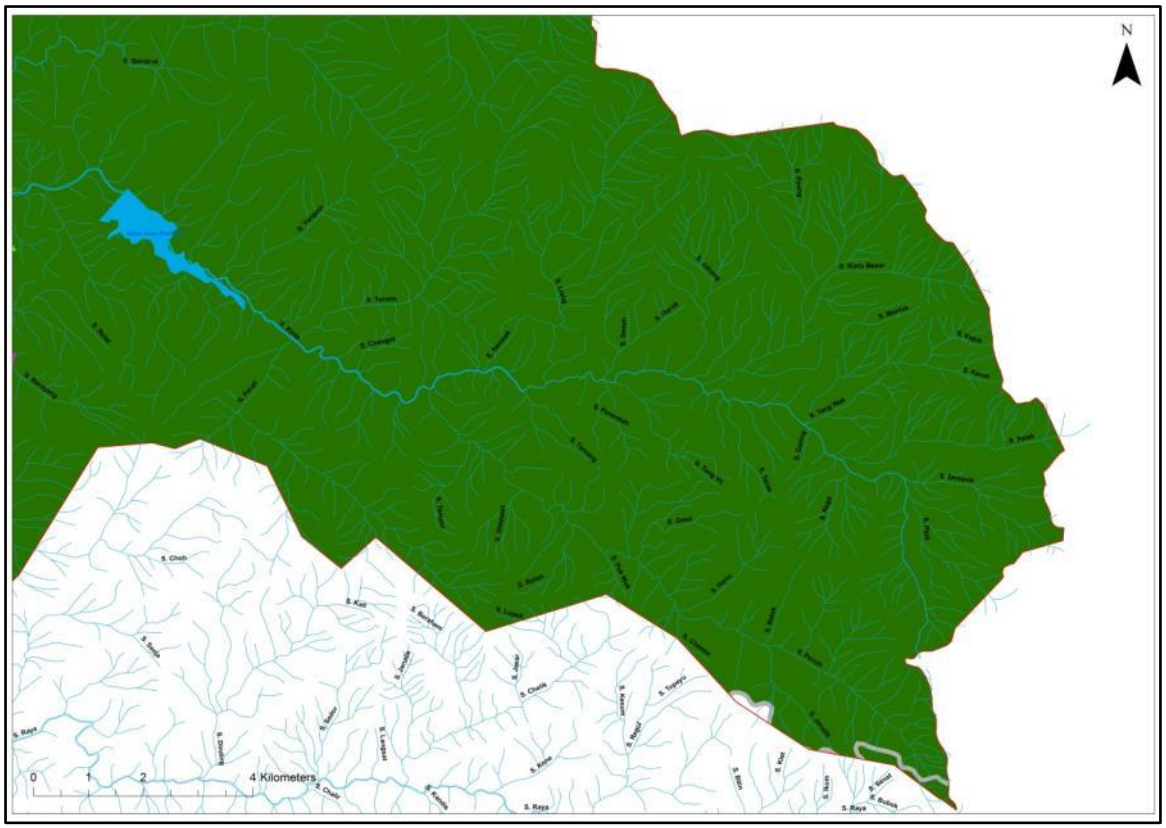


Figure 3.9: Tributaries located inside the green sketch inside the forest reserve area as informed by The Perak Forestry Department

As classified as forest reserve and moreover water catchment forest area, no development, logging or any form of activities can take place within this area. Moreover the catchment of Kinta River above the water intake weir is steep and mountainous. The ridge along the head of the catchment forms part of the watershed of the main range (Titiwangsa Range). From the satellite image, no large scale land use activities or landslide detected at or near the majority of the main or sub tributaries (**Figure 3.10**).

Figure 3.10: Satellite map of upstream portion of at Upper Kinta Basin

However when the image was focused more towards the tributary closest to the Simpang Pulai-CH Route A181, erosion and some landslide issues can be noticed as shown below **(Figure 3.11).**

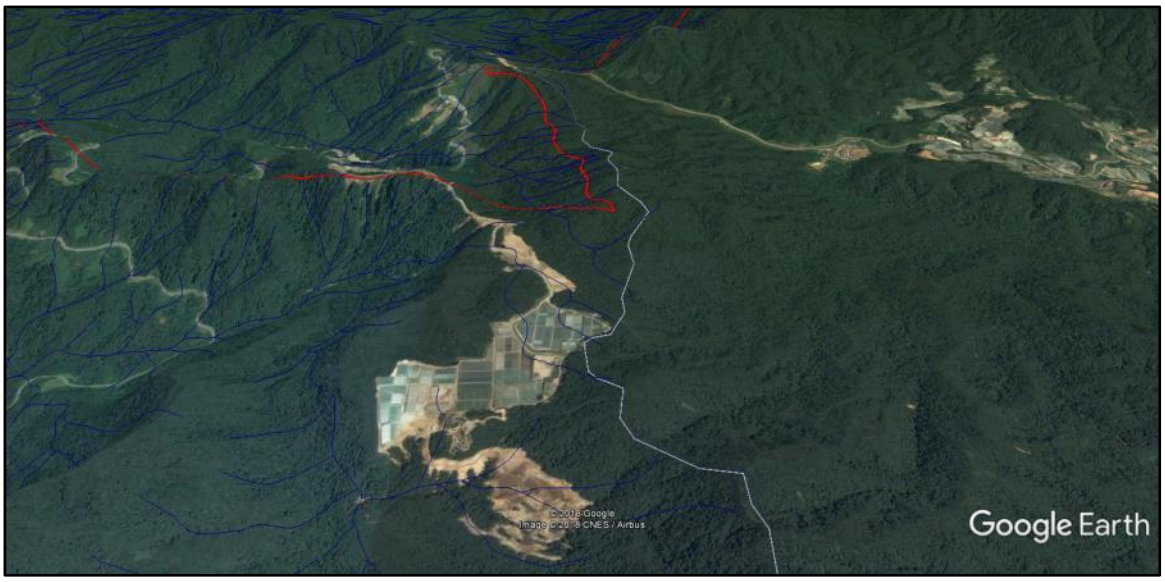


Figure 3.11: Satellite map indicating land clearance and landslides

A site visit was conducted along the Simpang Pulai-CH Route A181 to locate the number of landslide occurred at the range as well as to identify the route to access the tributary that

have caused the massive erosion. The image below **(Figure 3.12)** shows some of the land opening and landslides along the route.

Figure 3.12: Landslide and the clearance along the route through the UKB

The major landslide detected at Km 44-46 were identified and verified as the main cause of the high sedimentation of the alluvium at the Sultan Azlan Shah Dam. The contributing factor significant to the landslide is known as the northern earth flow, movement of the plates of the Gunung Pass. The area affected is the western hillside of the Gunung Pass ridge; where the eroded landslides were washed down to the Penoh River during heavy downpour. The deeply-incised Penoh River is located 600 m below into the valley densely forested and generally steeper than 30°, leading down from the Gunung Pass which has an elevation of 1587 m above the sea level. Satellite image**, Figure 3.13** shows the location of the landslide and the sub-tributaries flowing from the ridge going down to Penoh River.

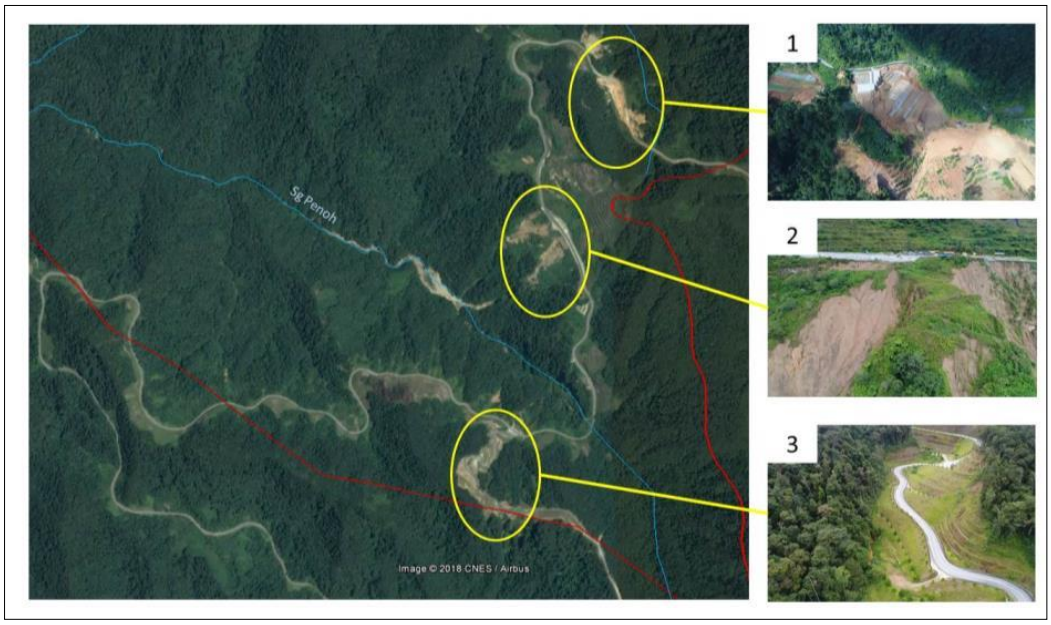


Figure 3.13: Satellite image and drone photo of the landslide and the erosion ending up into the Penoh River feeding into the Kinta River (Sultan Azlan Shah Dam) as in November 2018

i) Erosion in the upper catchment

In terms of the upstream of the UKB, one of the key issues is hill cutting and erosion which can lead to sedimentation of the river channel and siltation of the water supply dam. Site visits were undertaken to various points in the upper catchment between January to November 2018. This section also draws on earlier assessments undertaken by GEC of the catchment including partnership with Institute Darul Ridzuan (IDR) in 2013 and further surveys undertaken in 2018 in conjunction with the state government. The following were found to be the key sources of siltation in the upstream area:

i. Landslide at KM 44-46 Simpang Pulai to Cameron Highland highway
ii. Highland Agriculture/Agro Tourism project in Ulu Kinta/Sg Raia catchment Perak

i. Landslide at KM 44-46 Simpang Pulai to Cameron Highland Highway

The landslide at km 44-46 Simpang Pulai to Cameron Highland started in 2003 following hillside excavation at the terrain along the highway which starting 1997. According to the study conducted by Andres Malone Ltd in 2007, movement occurred at roadside when the slope was cut in the vicinity of chainage 23+900 during the roadworks (**Figure 3.14a**). The slope was cut back to a flatter angle but due to the persistent instability, more extensive slope flattening was undertaken in response until the works reached the ridgeline, 200 m to 260 m above the road. This lead to the gross movements which occurred in the cut in September 2013 (**Figure 3.14b**) with the formation of a main scarp and associated disruption and the displaced mass has since moved continuously. This is later known as the Northern Earthflow where the main scarp of the failure extends to the north into unexcavated ground in the more weathered part of the slope where natural hillside valley existed and has now extended to road level.

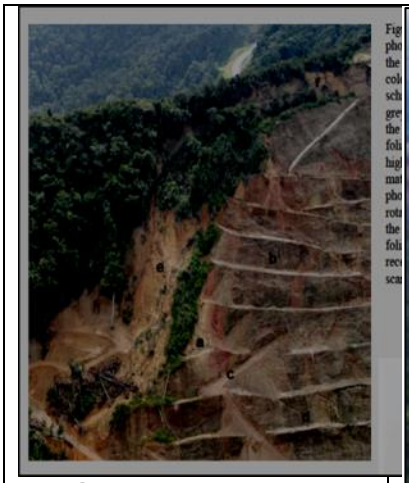


Figure 3.14a: Stope cutting along highway route (extracted from the Landslide Study at CH23+800 Simpang Pulai – Lojing Highway Malaysia Report submitted by Andres Malone Ltd (May 2007)

Figure 3.14b: Erosion at slope as of 2013 (extracted from GEC - IDR Report - 2014)

The Malaysian Public Works Department (PWD) Kuala Lumpur has classified the landside at Section 44 (Km44) and Section 46 (Km46) of Simpang Pulai-Lojing Road (FT185) as a critical area.

Figure 3.15: Status of the landslide area along Simpang Pulai-Cameron Highland as of November 2018

Figure 3.15 shows the stretch of the Simpang Pulai – Cameron Highland CH44 landslide area as of November 2018. In order to mitigate the continuous impact of the landslide, the federal government allocated RM34 million to repair two slopes along the Simpang Pulai-Kampung Raja road leading to Cameron Highlands in 2015-2017. Two (2) companies were appointed to carry out the slope strengthening works at Km44 (JJM Integrated Sdn Bhd) and Km46 (Jati Estetika Sdn Bhd). The project at Km44 focused on a piled embankment to withstand erosion (**Figure 3.16**). Reinforced concrete landslide shed was built to enable any landslip to slide over the shed and fall beyond it. This would protect road users. The shed will also acts as a retaining wall[1].

Figure 3.16: Mitigation measures – piled embankment undertaken to reduce the impact of landslide

[1] https://www.malaymail.com/s/907623/rm34m-to-repair-cameron-highlands-slopes

Although mitigation measures were undertaken to address the issue, continuous slope failure keeps on taking place as highlighted in **Figure 3.17**. This is caused by multiple geological factors and complex. The structure of the rocks along the slopes is unstable and weak because due to weathering, structure and geology. In addition to landslides along the Simpang Pulai – Cameron Highland stretch, two other incident happened this year, i.e. mudflow as the retaining wall collapse due to continuous rain sent a river of mud flowing down the hillslope[2] and six orang asli houses were destroyed after earth fissures measuring 1.2 m wide at Kampung Pawong, near Simpang Pulai[3].

Landslide in 2017 (31 January 2017[4])

Landslide in 2016 (16 July 2016[5])

Mud flood in 2018 (26 September 2018)

Earth fissures in 2018, October 23, 2018

Figure 3.17: Examples of landslides during the last two years

[2] https://www.thestar.com.my/news/nation/2018/09/28/dept-simpang-pulaicamerons-road-safe/#GohoStBQDcyvsA5F.99flowing

[3] https://www.thestar.com.my/news/nation/2018/10/24/earth-fissures-damage-six-orang-asli-houses-near-simpang-pulai/#h7LGv3uwV8BoRi1W.99

[4] http://english.astroawani.com/malaysia-videos/laluan-simpang-pulai-cameron-highlands-selamat-digunakan-141363
http://english.astroawani.com/malaysia-videos/laluan-simpang-pulai-cameron-highland-selamat-digunakan-120257

[5] http://www.utusan.com.my/berita/nasional/jalan-simpang-pulai-cameron-highlands-selamat-digunakan-1.354061

As a result of the continuous erosion of the highway slope large amounts of sediment are washed downstream choking the bed of the Penoh River and being washed downstream to the dam (**Figure 3.18**).

Figure 3.18: The sediment in the bed of the Penoh River in November 2018 below the eroding highway slope

ii. Highland Agriculture/Agro Tourism project in Ulu Kinta/Sg Raia catchment Perak

Land opening at the highland for agro-tourism also contributes to significant siltation and high sedimentation which ends up in the dam. During the 2013 study, the development of agriculture (Agrotourism) (Collecting, Processing and Packaging Center by Agroto Business (M) Sdn Bhd Agroto) on Lot PT24507, and the road and vegetable farm on PT 245072 Mukim Ulu Kinta, PT23157 Mukim Sg Raia was causing a lot of issues and contributed to the sediment runoff at the dam as in **Figure 3.19**. Although during the current site visit, it was observed that the project area is now covered with cover crop a patch of landslide was observed. The drainage of storm water from the uphill to the downhill where the water flows through or absorbed by the ground was identified as the contributing factor and need to be addressed to avoid unforeseen landslides. **Figure 3.20** shows the current condition of the site. The images indicates the mitigation undertaken and current landslide issues within the site (**Figure 3.21**)

Figure 3.19: Dumping of the soils along the slope and uncomplete discharge point into the slope towards the water catchment area in 2013

Figure 3.20: The site in November 2018 after mitigation being undertaken

Figure 3.21: Two patches of slope erosion on either side of the Agroto Sdn Bhd store which shows the flow of the water from the drainage from the agro tourism site flowing contributing to slope erosion in the Kinta Catchment

During the site visit, land opening was observed and some activities were seen focusing on the agro farming and agro tourism at an upper portion of the site (at GPS coordinate 4.601013; 101.345473 – **Figure 3.22**). This land clearing is in the adjacent Raia River catchment which also is classified in the National Physical Plan as an Environmentally Sensitive Area (ESA) Class 1 as it is a proposed dam catchment and it needs to be totally protected. High sedimentation during this project period will end up into the catchment. In addition to land clearance, once the site is ready for agro farming and tourism, there are possible that issues related to pesticide and fungicide will pose direct threat to the water body. Runoff from both the Agroto Business (M) Sdn Bhd and the upcoming of agro farming and agro tourism at (GPS coordinate 4.601013; 101.345473) will end up into the Kinta River.

Figure 3.22: Current land clearance activities for agro tourism within adjacent Raia River catchment area (linked to access road on main Punoh/Kinta River catchment

As mention earlier, one of the main concerns of the pollution source at upstream area relies mainly of the agro farming and tourism at the hilly slopes. The usage of fertilizers for the vegetables and plants in the farm will eventually end up into the catchment in form of runoff; as no holding pond noticed there to stop the fertilizers from entering the water bodies

ii) Small scale land development

There are three (3) Orang Asli settlements; Kampong Pawong, Kampung Chiduk and Kampung Jantung Baru along the river stretch downhill from the landslide stretch (but in the adjacent catchment of Raia River) which will be affected significantly from the activities upstream (**Figure 3.23**). The settlements are located very near to the river as they community depend mainly on the river and the natural resources for their livelihood. Moreover, Orang Asli also has orchard and small land opening for agriculture for livelihood.

Figure 3.23: Kampong Pawong, Kampung Chiduk and Kampung Jantung Baru settlement and the land use within the settlement

The plantation and orchard belonging to the Orang Asli upstream of the Sultan Azlan Shah Dam were also highlighted as the possible contributing factor if no proper mitigation taken or monitor accordingly. **Figure 3.24** shows some of the Orang Asli's durian orchard and oil palm as well the rubber plantation at the upstream.

Figure 3.24: The plantation area within the Orang Asli settlement

iii) Sultan Azlan Shah Dam

Beside orang asli, LAP is another main beneficiary of the Kinta River which acts as source of drinking water. These upstream activities have a direct impact on river and deteriorating the quality of the raw water at the Sultan Azlan Shah Dam. Sultan Azlan Shah Dam constructed period starting in 1997 and was officiated in August 2, 2007. The RM253 million dam can produce 639 million litres of water per day and is expected to meet demand in the Kinta Valley up to 2020. It is aimed at increasing water output for the Kinta district (including Ipoh city) from 136 million litres daily (MLD) to 639 MLD to cater for 350,000 consumers. The two main issues faced by the LAP to date are due the sedimentation and limited water stored during the drought season.

The issues on the sedimentation at the Sultan Azlan Shah Dam has till now been addressed via excavation of the sedimentation from the dam to keep water storage in the dam at the recommended level. Three (3) check dams were constructed before the Sultan Azlan Shah Dam by the LAP to control sedimentation as marked in **Figure 3.25** to excavate the silt ending up into the treatment facilities. The observed sedimentation at the dam is known as alluvium. Alluvium is typically made up of a variety of materials, including fine particles of silt and clay and larger particles of sand and gravel.

Figure 3.25: Google map of the dam which indicates the location of the check dam

Excavation of the silt carried out by the contractor assigned by LAP as shown in **Figure 3.26**. It is estimated around RM1mil spent annually for the excavation of the silt. Excavation of the silt by LAP were carried out according to the need, if more sediments were observed and in rainy weather, the amount of silt accumulated are more compared to dry weather, excavation will be carried out. **Figure 3.27** shows the amount of sediment excavated annually from the check dams from 2017 to 2018 as provided by LAP.

Figure 3.26: Images captured inside the Sultan Azlan Shah Dam, where the excavation is carried out

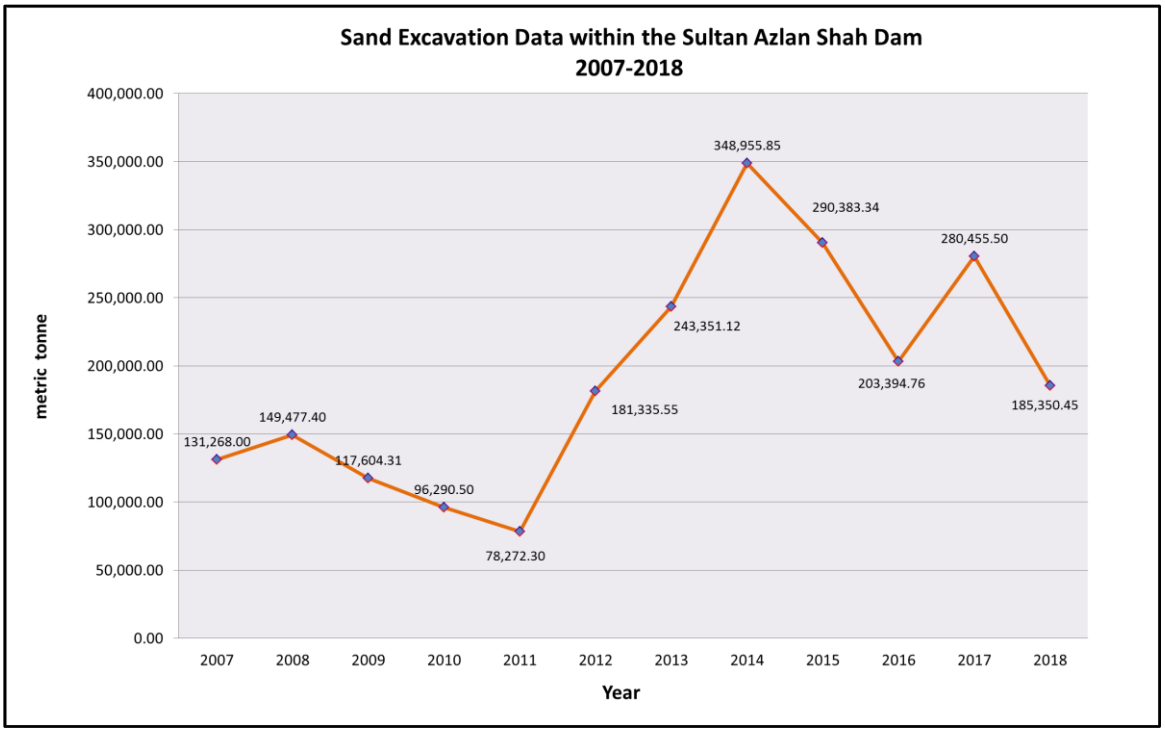


Figure 3.27: Amount of sediment excavated annually from check dams (source: LAP)

It is also noted that the water is turbid with high content of total suspended solid at the excavation site and towards the downstream of the catchment are are due to the followings:

(1) Water naturally erodes sediment from the bed and banks of rivers (source) and transports it downstream through the catchment, depositing it in areas of 'lower energy' e.g. where the flow is slower and areas of land are flatter
(2) Most of the silt and sediments settles beneath the river surface when the water movement were still or less current and when excavation is carried out the disturbed site triggers the silts to be washed down

The actual process of sediment deposition is unique to every reservoir and is impossible to predict accurately. In general, the coarser, heavier sediments, the gravel and sand, tend to settle out at the upper end of reservoir, forming a "backwater" delta which gradually advances toward the dam. The lighter sediments, the silt and clay, tend to be deposited nearer the dam. However, it was also observed and noted from the GEC's water quality sampling and secondary data received from LAP, that although excavation is carried out to reduce the amount of TSS that ends up into the treatment facilities, the content is still high and alarming as discussed in Chapter 3.3.2.4 (**Figure 3.46)**.

iv) Other activities in the Upstream of UKB

At upstream, land clearing activities for development observed. Currently, one development activity is being carried out near Markas Comondo 69 at Jalan A182, Ulu Kinta. Sediment from the development area was observed on its discharge into the nearest stream (**Figure 3.28**). The impact of development activity discussed at next section (water quality section). Besides land clearing activity, accumulation of solid waste also observed to be dumped at that area (**Figure 3.29**)

Development project signbard

Sedimentation from development area

Figure 3.28: Land clearing activity near Markas Comondo 69

Figure 3.29: Solid waste dumping at water bodies near to Markas Comondo 69

Besides this, land clearing for agriculture at Choh River upstream was observed (**Figure 3.30**) which possibly can impact the water body. River bank erosion at Pinji River also observed (**Figure 3.31**).

Figure 3.30: Land clearing activities for agriculture, Choh River

Figure 3.31: River bank erosion at Pinji River

The overall observation shows that upstream of UKB is mainly polluted by sedimentation from land clearing and development activities. Besides that, solid waste dumping into water bodies also detected. Therefore key stakeholders such as developers as well as communities in this region need to be engaged to prevent these issues from effecting UKB's water quality.

c) Midstream of UKB

In the midstream, the number of activities that affected water quality was observed. Direct sullage discharge from roadside stalls into streams at Tanjung Rambutan area was observed (**Figure 3.32**). Solid waste also observed in midstream especially at Sah River, Persiaran Meru Jaya 2 (**Figure 3.33**). Similar to upstream, development activity also observed here at Sah River which is nearby to Lebuh Meru Raya (**Figure 3.34**).

Figure 3.32: Direct sullage discharge from roadside stalls at Tanjung Rambutan

Figure 3.33: Solid waste dumped at Sah River

Development project

Sah River after development

Figure 3.34: Impact of development project to Sah River, Lebuh Meru Raya

Observation at midstream of UKB indicates this region also impacted by human activities ranging from development, sullage discharge and improper solid waste disposal. All these activities need to be curb to improve water quality through stakeholder engagement especially communities in this area.

d) Downstream of UKB

Compared to the other two (2) regions, downstream of UKB reported more pollution issues related to river pollution especially water quality. One of the main issues is discharge from wet markets due to the improper waste handling and kitchen management. Solid waste accumulation within drainage of Manjoi wet market at Jalan Sri Tanjong (**Figure 3.35**) and Gunung Rapat wet market (**Figure 3.36**) were observed. Besides this, direct solid waste dumping into the water bodies and at river banks observed at many places (**Figure 3.37**). All these can cause serious problem to Kinta River.

Manjoi wet market

Oily and smelly discharge

Figure 3.35 Pollution observed at Manjoi Wet Market, Jalan Sri Tanjong

	
Gunung Rapat wet market	Clogged drain due to rubbish

Figure 3.36: Pollution observed at Gunung Rapat Wet Market, Jalan Gunung Rapat

	
Jalan Bunga Raya, Taman Chong Kwee, Tanjung Rambutan	Tg. Rambutan cremation site
	
Tapah River, Jalan lengkok Jelapang, under Ipoh-Lumut Expressway	Buntong River, Persiaran Buntong Jaya 8

Figure 3.37 Solid waste dumping at downstream of UKB

Downstream of UKB indicates many pollution sources which can directly and indirectly affect river water quality that passing through this region. Therefore the project needs to engage

different type of stakeholders such as wet market owners, public, communities and local authorities.

3.3.2 Water Quality Status

Water quality status reported based on four (4) aspects for better understanding. Firstly, secondary data from DOE Perak, DID Perak and LAP reported. Secondly, overall UKB water quality status analyzed and reported based on eight (8) stations except for UR1 and UR2. Thirdly, the difference in water quality of UR1 and UR2 investigated to study the impact of land clearing activities for the development project. Fourthly, UK1 station analyzed for turbidity as it is located before the dam.

3.3.2.1 Water quality monitoring by agencies

The Water Quality Index (WQI) of water quality monitoring stations by DOE Perak for four (4) years monitoring is summarized in **Table 3.7** below. From the data, it is noted that most of the rivers within Kinta River basin is within Class III classification and latest data (2017) indicating the basin is within the slightly polluted river status.

Table 3.7: Water Quality Index (WQI) of rivers monitored by DOE according to EQR

River	2014		2015		2016		2017	
	WQI	Class	WQI	Class	WQI	Class	WQI	Class
Chepor	85	III	91	II	90	II	90	II
Kinta	82	II	82	II	74	III	74	III
Pinji	60	III	72	III	66	III	61	III
Pari	68	III	78	II	63	III	66	III

Table 3.8 shows the average WQI of Kinta River based on DID Perak's stations from February 2018 till October 2018. The overall average WQI within this period reported being 79 which indicate a slightly polluted condition of the Kinta River. This data served as latest reference data before sampling.

Table 3.8: Average Water Quality Index (WQI) of rivers monitored by DID Perak

WQI	February 2018	March 2018	April 2018	May 2018	June 2018	July 2018	August 2018	September 2018	October 2018
Based on 9 stations within Kinta River	79.0	79.0	81.2	77.1	77.9	76.6	77.1	81.9	81.5
Overall	**79**								

Table 3.9 shows the turbidity data provided by LAP at two (2) WTPs that sourced by Sultan Azlan Shah Dam. It is observed turbidity level rise and fall due to sedimentation issue. Although it is still within recommended raw water intake limit (<1000NTU) but it exceeds class IIB limit (50NTU) for most of the years.

Table 3.9: Average turbidity level at Sg Kinta WTP and Ulu Kinta WTP

Year	Average Turbidity (NTU)	
	Sg.Kinta WTP	Ulu Kinta WTP
2013	103.7	82.7
2014	137.3	102.2
2015	153.6	117.5
2016	46.2	43.3
2017	122.6	125.2
2018	31.7	31.4

3.3.2.2 Overall UKB water quality status

Water quality parameters were interpreted according to the National Water Quality Standard (NWQS) (**Table 3.10**). Each parameter was compared against NWQS Class IIB which indicates suitable for body contact. Besides this, overall WQI calculated.

Table 3.10: National Water Quality Standard (NWQS) for Malaysia

Parameter	UNIT	CLASS					
		I	IIA	IIB	III	IV	V
Ammoniacal Nitrogen	mg/l	0.1	0.3	0.3	0.9	2.7	> 2.7
Biochemical Oxygen Demand	mg/l	1	3	3	6	12	> 12
Chemical Oxygen Demand	mg/l	10	25	25	50	100	> 100
Dissolved Oxygen	mg/l	7	5-7	5-7	3-5	< 3	< 1
Total Suspended Solids	mg/l	25	50	50	150	300	300
pH	-	6.5 - 8.5	6.0 - 9.0	6.0 - 9.0	5.0 - 9.0	5.0 - 9.0	-
Turbidity	NTU	5	50	50	-	-	-
Faecal Coliform	count/ 100 ml	10	100	400	5000	5000	-

The overall water quality data were summarized and shown in **Table 3.11** below.

Table 3.11: Summary of water quality data for Upper Kinta River basin

Station	DO (mg/L)	Turbidity (NTU)	BOD (mg/L)	COD (mg/L)	TSS (mg/L)	NH_3N (mg/L)	F. Coliform (MPN/100 mL)	WQI	CLASS	WQ STATUS
UK1	8.66	52	13	36	18	0.8	ND < 1.8	74.5	III	SP
UK2	5.16	19	17	45	8	0.2	7.8	69.6	III	SP
UK3	3.88	23	16	43	6	0.2	2	63.7	III	SP
PJ1	4.57	29	17	47	14	2.5	25	58.5	III	P
PR1	3.16	21	18	48	4	0.3	43	59.8	III	P
CP1	8.4	14	12	36	8	0.0	ND < 1.8	82.7	II	C
CH1	5.16	39	26	70	40	0.6	15	57.4	III	P
SO1	8.28	6	10	34	6	0.0	ND < 1.8	84.7	II	C
Overall	**5.91**	**25**	**16**	**45**	**13**	**0.58**	**12.28**	**68**	**III**	**SP**

Physico-chemical parameters were analyzed to investigate the type of pollution within UKB. Variation of data reading was recorded at each sampling stations for every parameter and the variation may be caused by the identified pollution sources at each location. All the stations exceed the limit of Class IIB standard for BOD and COD. Among the sampling location, CH1 recorded highest COD (**Figure 3.38**) and BOD (**Figure 3.39**) probably due to the excess of organic and chemical discharge from the industrial area nearby to the river. All the sampling stations reported Class IIB standard for TSS (**Figure 3.40**). However, UK1 (upstream of Kinta River) which supposed to have lowest sediments reported high reading for TSS and turbidity compared to its downstream stations (UK2 & UK3) (**Figure 3.41**). This is an alarming result which gives the possibility of sediment being transport even from the source of Kinta River due to on-going land clearing activities at the upper UKB. Ammoniacal nitrogen (NH3-N) recorded the highest reading at Pinji River (PJ1) (**Figure 3.42**) probably due to the active commercial area especially residential areas and restaurants.

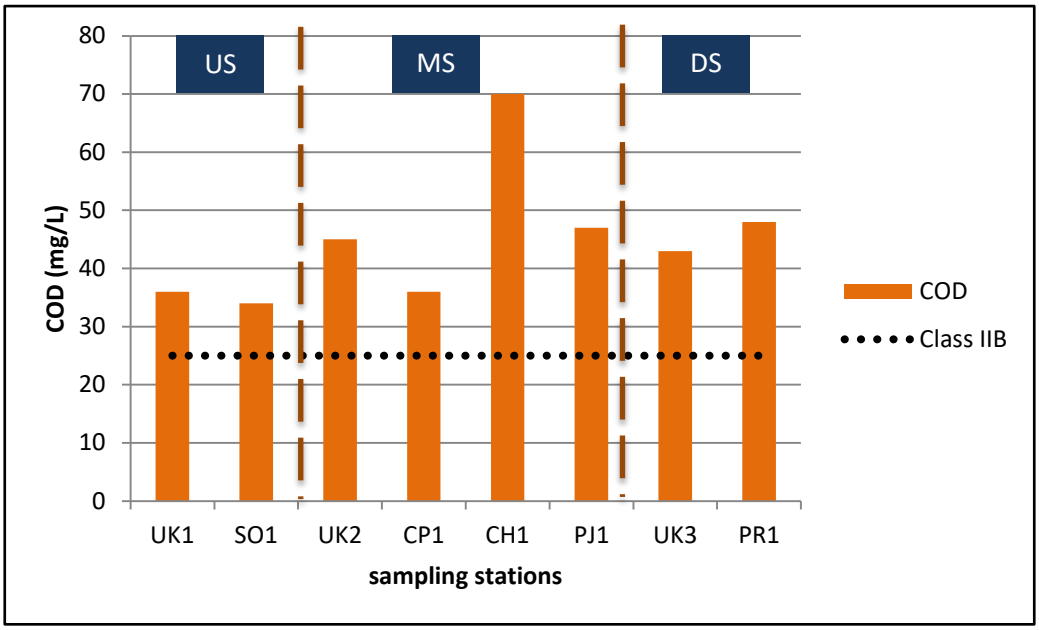


Figure 3.38: Variation of COD reading between sampling stations within UKB

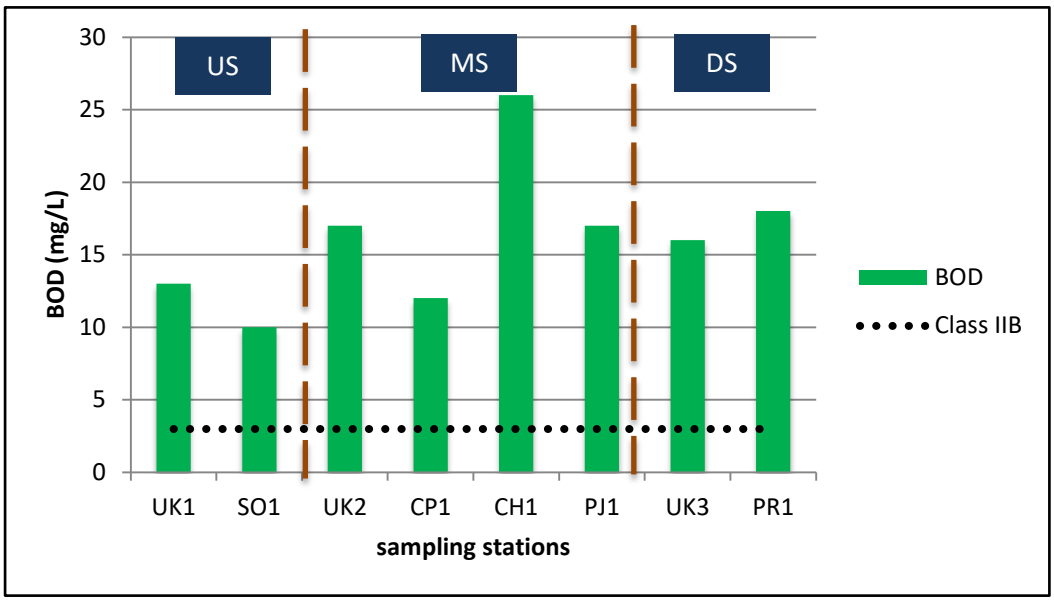


Figure 3.39: Variation of BOD reading between sampling stations within UKB

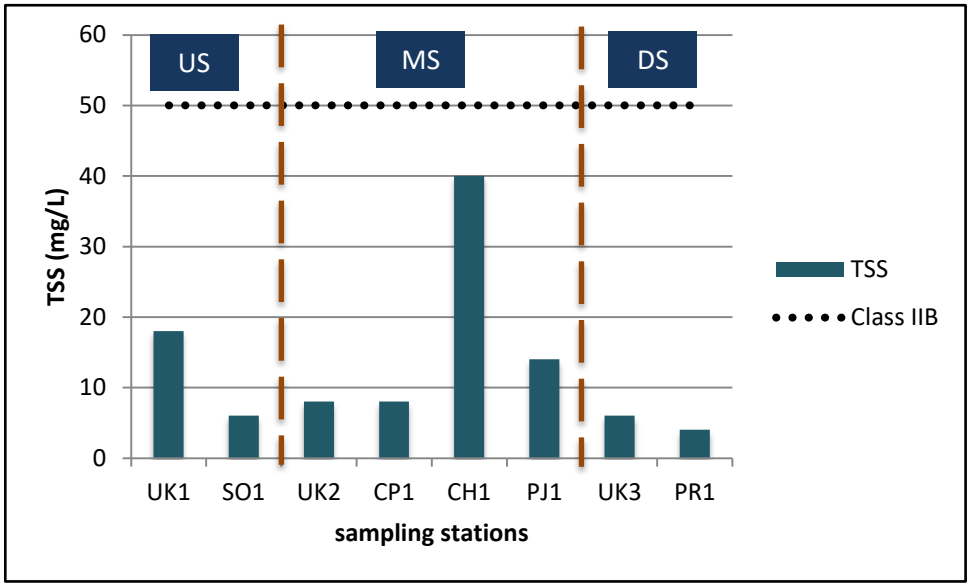


Figure 3.40: Variation of TSS reading between sampling stations within UKB

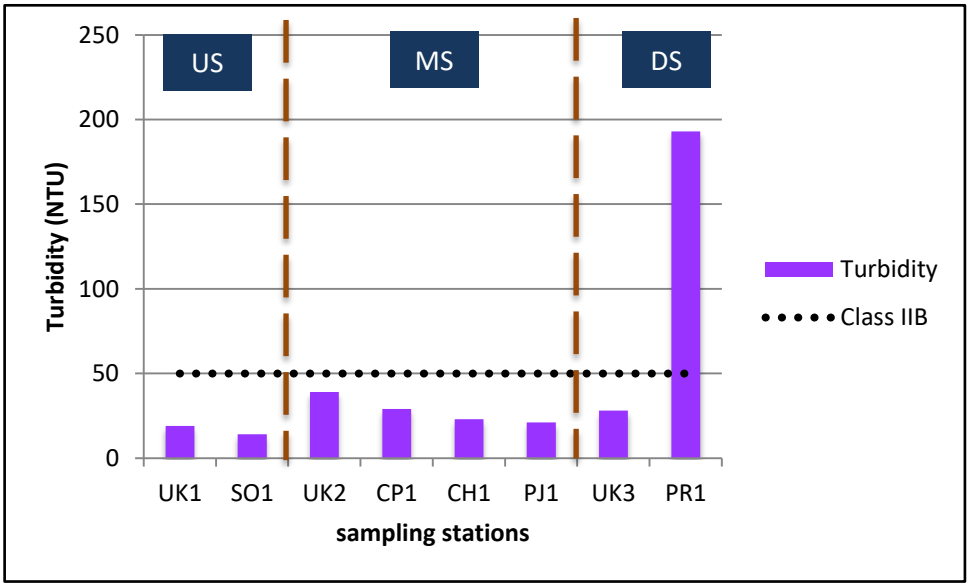


Figure 3.41: Variation of Turbidity reading between sampling stations within UKB

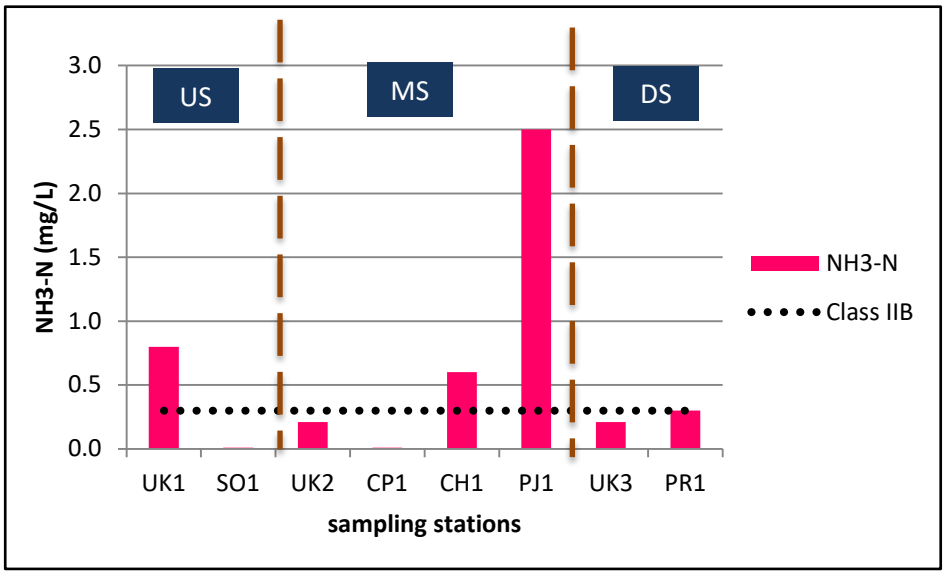


Figure 3.42: Variation of NH3-N reading between sampling stations within UKB

Figure 3.43 shows the microbiological water quality status through Faecal Coliform reading. Coliform bacteria are a form of a form of microbes which formed naturally in the intestinal track of warm blooded mammals, including human. The microbiological parameter when found in water generally indicates pollution by partially / untreated sewage. Analysis of Faecal Coliform showed all the stations recorded readings are within DOE's Class IIB standard (400 counts/100mL). This shows UKB area is not much affected by Faecal contamination. Three (3) stations which are UK1, CP1, and SO1 are not detected with Faecal Coliform (**Table 3.11**) and these three (3) stations as stated before are located at the upper stream of Kinta River basin and experience very less human activities. PR1 reported the highest reading among the others but still within the limit.

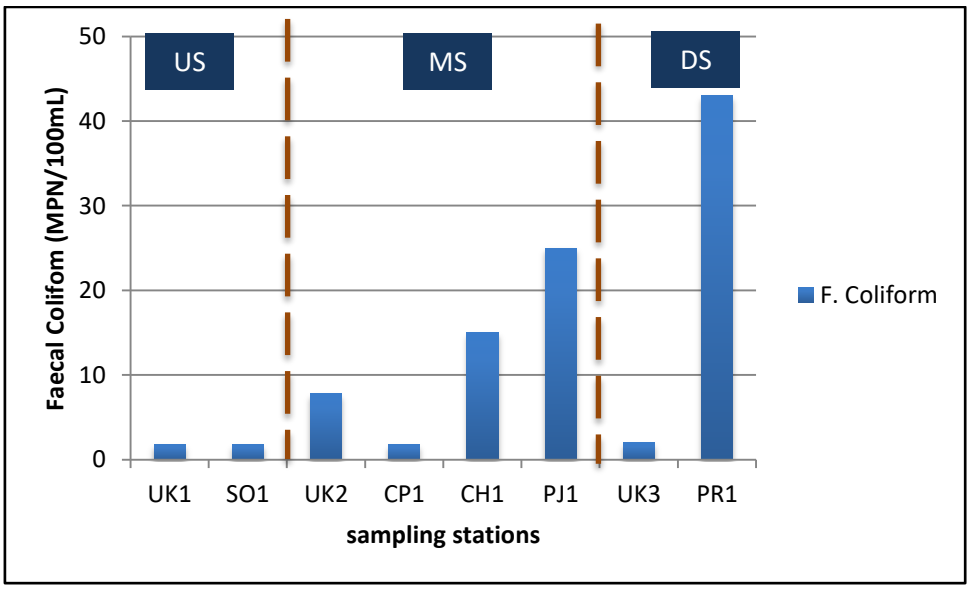


Figure 3.43: Variation of Faecal Coliform reading between sampling stations within UKB

For overall UKB status, WQI was analyzed. **Figure 3.44** shows the WQI according to UKB regions. The WQI also interpreted compared with DOE's Water Quality Classification (**Table 3.12**).

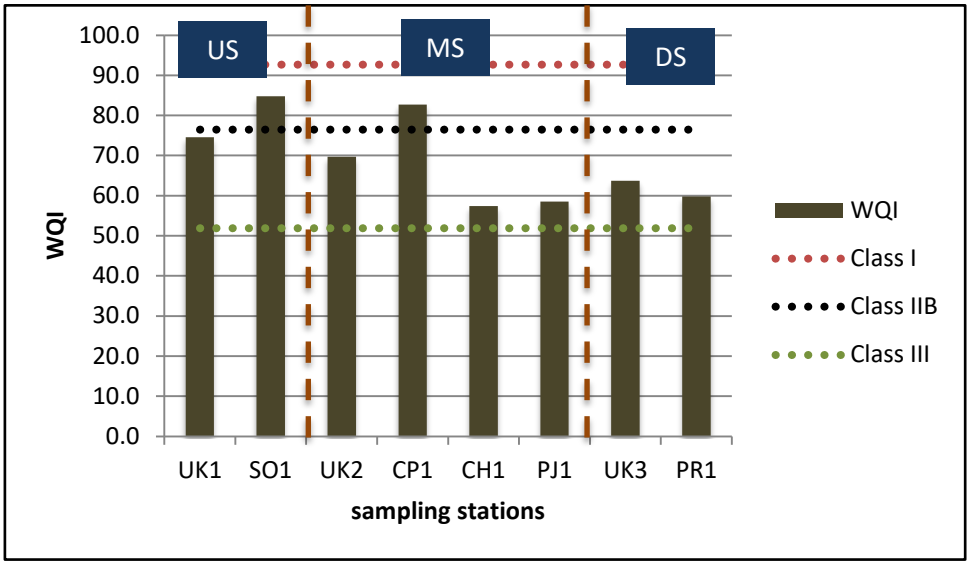


Figure 3.44: WQI status of UKB regions

Table 3.12: DOE's Water Quality Index (WQI) classification

WATER QUALITY INDEX	CLEAN (C)	SLIGHTLY POLLUTED (SP)	POLLUTED (P)
Water Quality Index(WQI)	81 - 100	60 - 80	0 - 59

SO1 and UR1 are the stations located at the upstream of UKB and showed good water quality due to less anthropogenic activities at that area. Good water quality at Senoi-oi River (SO1) shows continuous preservation and involvement of Orang Asli there as they hold major impact to that tributary. CP1 with Class IIB river water quality showed the river is suitable for body contact and considered safe till now as it is used for recreational purpose. Lowest WQI recorded at CH1 (WQI=57.4) probably due to active industrial activities and is supported with a high reading of BOD, COD and TSS. Within region, upstream of UKB reported WQI of 79.5 (Class II) and followed by midstream (WQI: 76.2, Class III), with lowest at downstream of UKB (WQI: 61.8, Class III). So, only upstream of UKB is still within Class II condition but still within slightly polluted status. Overall, average WQI of 68 reported which shows UKB is within Class III which is slightly polluted condition based on this study.

3.3.2.3 Impact of development activities

As per observation in pollution inventory study, development activity was observed at upstream of UKB. Sediments discharging into the nearest water body (UR2) also observed. Therefore 2 monitoring stations have been selected to measure the immediate impact of the land clearing (before and after) on water quality of nearby water body. **Table 3.13** shows the water quality parameters reported for these two (2) stations.

Table 3.13: Summary of water quality data for Upper Kinta River basin

Station	DO (mg/L)	Turbidity (NTU)	BOD (mg/L)	COD (mg/L)	TSS (mg/L)	NH_3N (mg/L)	F. Coliform (MPN/100mL)	WQI	CLASS	WQ STATUS
UR1	7.39	28	14	40	10	0.0	ND < 1.8	80.4	II	SP
UR2	6.09	193	15	41	50	0.3	4.5	70.2	III	SP

Among the parameters, turbidity and TSS showed significant difference before development (UR1) and after development (UR2) (**Figure 3.45**). Turbidity exceeded Class IIB limit and this shows there is a direct impact of development activity within this UKB upstream area. The situation can be worsened during heavy rain events where there are high chances for the sediments to be transported all the way to downstream.

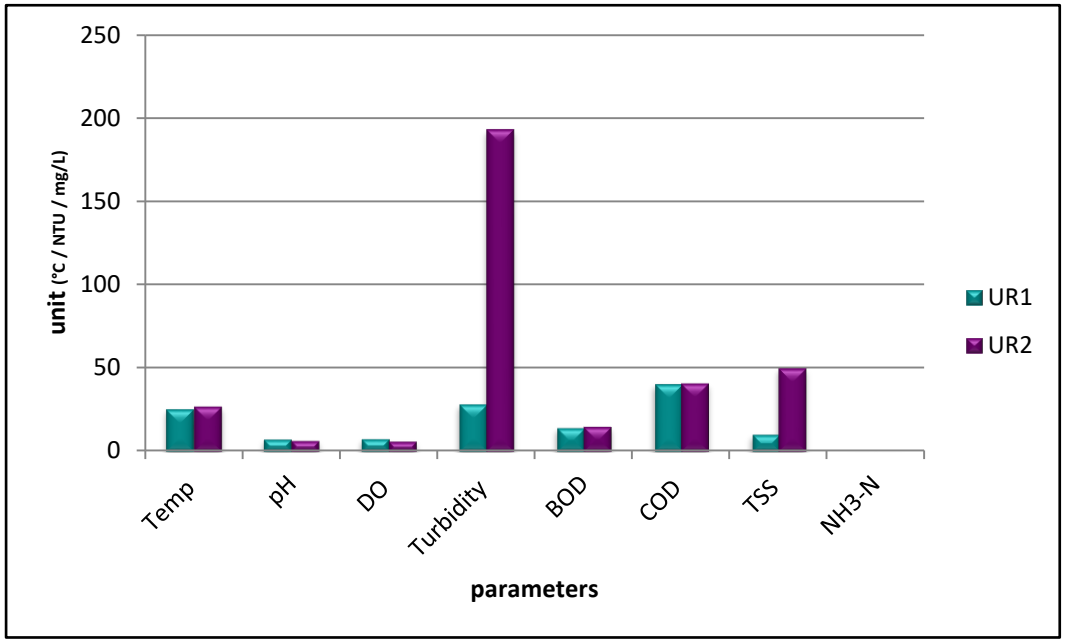


Figure 3.45: Difference in physico-chemical parameters in UR1 and UR2

3.3.2.4 Water quality status before dam

UK1 is the only station set before dam to study the impact of activities at the source of Kinta River. Any activities within this catchment will give serious impacts on Sultan Azlan Shah Dam that provides the water supply for Ipoh residents. Sedimentation issue is one among the key problems faced by Sultan Azlan Shah Dam. Therefore, turbidity was compared before dam (UK1) and after dam (Sungai Kinta WTP, SK and Ulu Kinta WTP, UK). It has been observed (**Figure 3.46**) that high turbidity already been recorded even before the dam. Some of the identified contributing factors for high sedimentation at the sampling sites (UK1) can be due to the followings; large amounts of sediment is being eroded from the Simpang Pulai - Cameron highway route especially at Km44-46 and carried to the dam via Penoh River.

In addition, land clearance at upstream for agro-tourism, as well as small-scale cultivation of orchards and plantations can also lead to erosion and sedimentation within the river basin. The erosion/re-suspension of sediments affects the turbidity of the river at station UK and SK. Although all the readings are within recommended raw water quality, it can be worsened during heavy rainfall if preventive measures not been adopted.

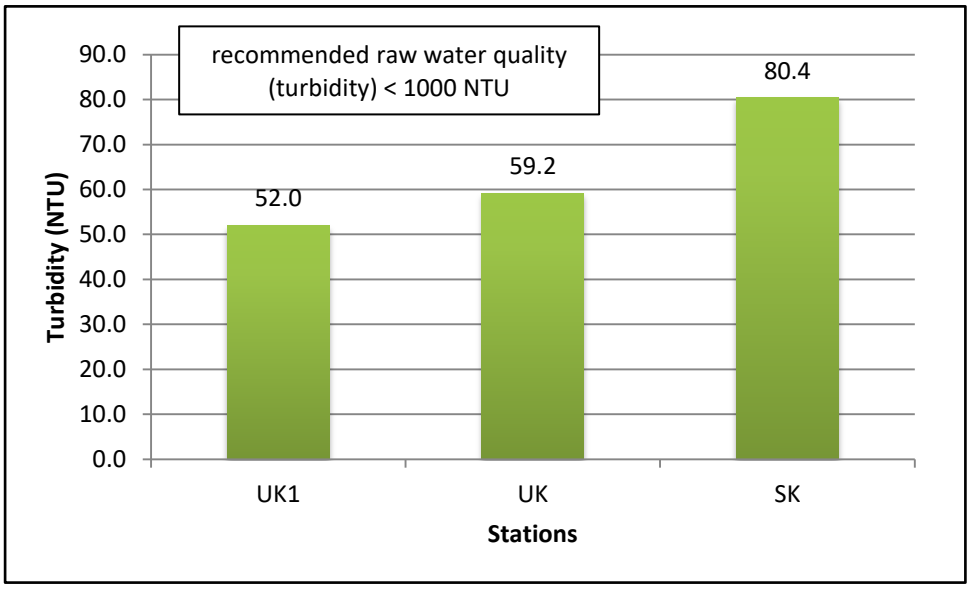


Figure 3.46: Turbidity level before and after dam

3.3.3 Biological Water Quality Status

UKB biological water quality status through bio-indicators analyzed and described according to three regions, upstream, midstream and downstream respectively. The section explained in two (2) sub-topics which are the distribution of aquatic macroinvertebrates and overall UKB biological water quality.

3.3.3.1 Distribution of benthic macroinvertebrates

The overall aquatic macroinvertebrate collected at each sampling stations is summarized in **Table 3.14** below. A total of 76 macroinvertebrate individuals from 11 Class/Order and 17 families were collected.

Table 3 .14: Overall distribution of aquatic macroinvertebrate at Upper Kinta basin

Class / Order	General Group	Family	Common Name	US		MS		DS	
				UK 1	SO 1	UK 2	CP 1	UK 3	SN 1
Decapoda	Crustaceans	Palaemonidae	Freshwater prawn				1		
		Palaemonidae	Shrimp			1			
Megaloptera	Alderflies	Corydalidae	Dobsonfly larvae		1				
Ephemeroptera	Mayflies	Baetidae	Mayflies	4	2	4	2	10	
		Heptagenidae	Flattened mayfly	3	4				
Odonata	Dragonflies	Libellulidae	Skimmer dragonfly larvae			2	1		
	Damselflies	Coenagrionidae	Common damselfly	3					
Diptera	True flies	Chironomidae	Bloodworm					4	3
		Naucoridae	Common saucer bug			1			
Trichoptera	Caddisflies	Hydropsychidae	Net-spinning caddisfly	3	3		2		
Cleopatra	Beetles	Hydrophilidae	Water beetle	2					
		Dystiscidae	Diving beetles			1			
Gastropoda	Snails	Bithyniidae	Pond snail						4
Perlidae	Stonefly	Plecoptera	Stonefly	2	2		2		
Annelida	Worms	Haplotaxidae	Haplotaxids						4
		Turbificidae	Sludge worm			1			
		Planaridae	Flatworm			1			1
	Leeches	Hirudinea	Leeches					2	2
Total Class/Order	**Total Groups**	**Total Families**	**Individual**						
11	**13**	**17**		**30**		**19**		**27**	
			Total	**76**					

**US=upperstream, MS=middle stream, DS=down stream*

Overall, UKB is suitable for aquatic life particularly the benthic macroinvertebrates as three regions recorded their presence. **Figure 3.47** summarizes the abundance and richness of aquatic macroinvertebrates at each region. Species richness observed higher at upstream and midstream compared to UKB downstream. Higher abundance observed at upstream of UKB indicating that site is better habitat for bio-indicators compared to other regions.

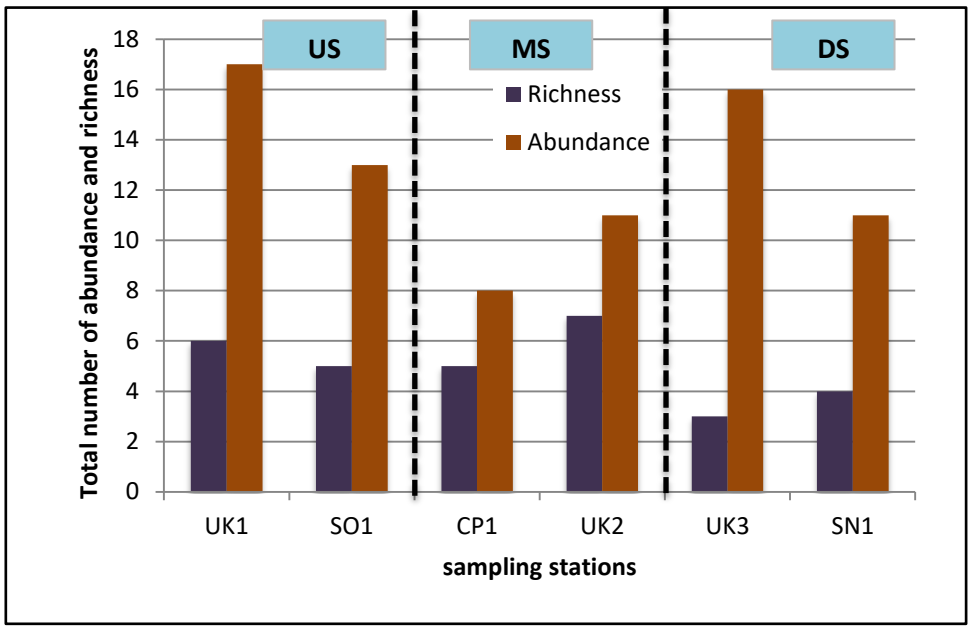


Figure 3.47: Abundance and richness of benthic macroinvertebrates within UKB

Figure 3.48 shows the overall composition of aquatic macroinvertebrate, based on general group that sampled within UKB. The dominant group is mayfly (Oder Ephemeroptera). The major presence of this group especially Family Heptagenidae at the upper stream (UK1, SO1) indicates that the upper stream of UKB is in clean condition as this group is particularly sensitive to pollution. Other than mayfly group, the presence of other good river indicators such as stonefly (Order Plecoptera, Family Perlidae) and caddisfly (Order Tricoptera, Family Hydropsychidae) indicates that this region is also in clean river status. Where else the presence of pollutant tolerance indicator at middle and lower stream of UKB shows that the rivers started to experience impact from anthropogenic activities especially at SN1 where the station is dominated by snails (Order Gastropoda, Family Bithyniidae) and worms (Order Annelida, Family Haplotaxids). Other than the impact of anthropogenic activities, there are few physical characteristics that influence the distribution and richness of these aquatic macroinvertebrates such as the riparian vegetation, depth of the river, shaded area, trapped leaves in the rivers and types of substrates. The presence of these physical characteristics supports the habitat preference of the benthic organisms and **Figure 3.49** show some of the good aquatic macroinvertebrates that can be found within UKB.

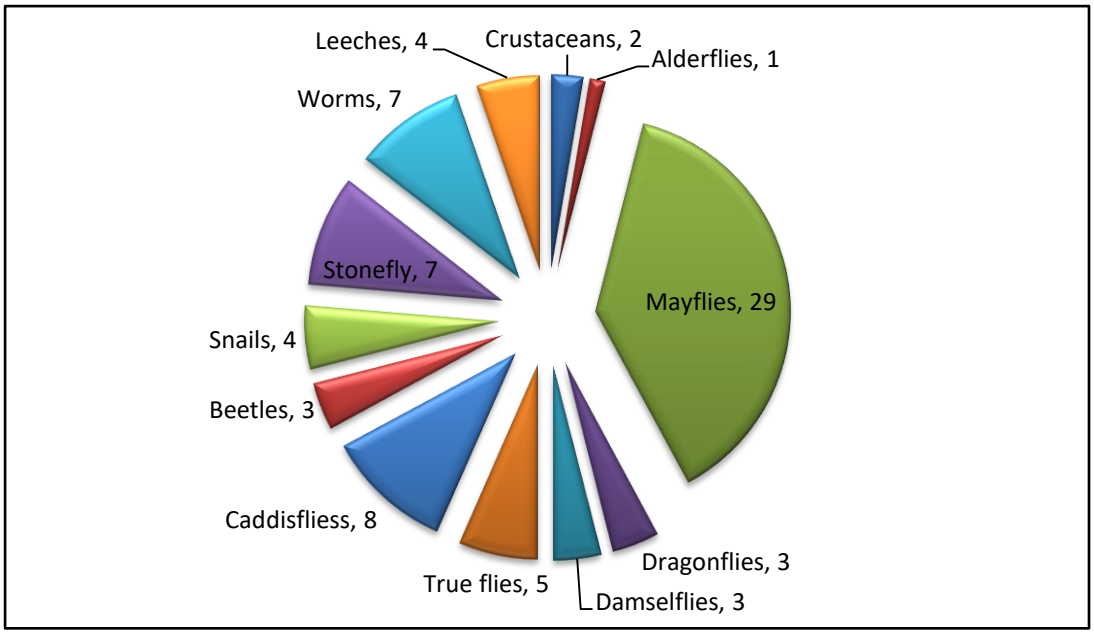


Figure 3.48: Overall compositions of aquatic macroinvertebrate collected within UKB

Freshwater prawns (Family Palaemonidae)

Mayfly larvae (Family Baetide)

Damselfly larvae (Family Coenagrionidae)

Mayfly larvae (Family Heptageniidae)

Caddisfly larvae (Family Hydropsychidae)

Stonefly larvae (Family Perldiae)

Figure 3.49: Aquatic macroinvertebrates within UKB

3.3.3.2 UKB biological water quality status

Biological water quality status of UKB reported using ASPT Index is tabulated in **Table 3.15** below. This analysis helps to classify the biological water quality status into four (4) main categories which are good, moderate, poor and bad. SO1 recorded the highest ASPT Index indicating good water quality class (ASPT = 7.6). The presence of high number of good indicator shows that this river is clean condition and free from pollutants. In contrast, the lowest ASPT Index recorded at SN1 (ASPT = 3.5) showing bad water quality class and indicates these river experience pollutants which only pollutant tolerance indicator can be found in the river. **Table 3.16** summarized the overall findings of the average ASPT Index within UKB regions. It shows that the upper stream of UKB is in good water quality class with the score range of 7.2 followed by the middle stream (ASPT = 5.8) and lower stream (ASPT = 4.0). .

Table 3.15: Water Quality Class bases on ASPT Score Index

ASPT Score Range	> 8.0	6.0 - 8.0			5.0 - 6.0	3.0 - 5.0			< 3.0
Water Quality Class	Very Good (VG)	Good (G)			Moderate (M)	Poor (P)			Bad (B)
Stations		UK1	SO1	CP1		UK2	UK3	SN1	
ASPT Score		6.7	7.6	6.6		4.9	4.5	3.5	
Total Location		3				3			

Table 3.16: Average ASPT Index for upper, middle and downstream of UKB

	Upper stream (US)	Middle stream (MS)	Downstream (DS)
Average ASPT Index	7.2	5.8	4.0
Water Quality Class	Good (G)	Moderate (M)	Moderate (M)

3.4 CONCLUSION

Pollution source rapid inventory of UKB combined main three studies which are pollution source inventory, water quality study and bio-indicator study respectively. Studies were conduated in the upper, middle and lower portion of the UKB. It was observed all the three regions experience pollution due to human activities. Upstream of UKB showed development and land clearing as a main human activity that affect the quality of water bodies. There are some serious land clearing, landslides and erosion issues along the Simpang Pullai – Cameron highway. Midstream recorded mixed of human activities such as development, sullage discharge and solid waste dumping. The downstream of UKB, showed a high number of point source pollution being observed indicating much action needed by different types of stakeholders to prevent similar issues repeating in future.

The overall water quality status of UKB reported being slightly polluted condition (WQI: 68). This is also an alarming result as upper part of Kinta River basin should be in better condition at least in clean condition as it is the water catchment area for Sultan Azlan Shah Dam. Key development activity found to be impacting the water quality of receiving bodies through water sampling at that particular area. With this evidence, relevant and related parties need to be engaged and consulted for water quality improvement. Besides this, high turbidity level at water intake area also observed which indicating corrective measures to be taken to prevent impact from human activities especially land clearing activities.

Besides this, the biological indicators study at UKB showed a relatively good abundance and diversity of aquatic indicators. The most dominant species found, being mayflies (Family Baetidae) indicates that the river is in moderate to good water quality class. It highlights that rivers in Upper Kinta River need a good protection to be preserved as it showed the presence of bio-indicators in all region. The parallel trend of ASPT scores with WQI also indicating the suitability of biomonitoring to be adopted as another option to monitor the health of UKB. The monitoring can be done by all agencies and communities with proper empowerment.

Lastly, pollution source rapid inventory of UKB helps to identify the pollution sources and enhance our understanding on the type of preventive measures that depend on various stakeholders.

CHAPTER 4: STAKEHOLDER PERCEPTION SURVEY 4-1

4.1 BACKGROUND

The perception survey aimed to collect data to understand the environmental and socio-economic issues with local communities at Upper Kinta Basin. The survey was focused to gather information on the level of their awareness, knowledge, skills and their willingness to participate in community-based river initiatives. The survey was also conducted to understand the different communities' perspective, understanding, interest, and concerns about the Upper Kinta Basin and is analysed based on three groups of communities – the Urban, peri-urban community and Orang Asli representing upstream, midstream and downstream respectively.

4.2 SURVEY DISTRIBUTION

The survey was conducted using two methods, which is through online Google Forms and face-to-face interviews and questionnaire. The questionnaire was distributed randomly to allow people in the community to have an equal chance of being chosen. The survey was targeted to all communities from various kinds of demographics within UKB to improve the quality of feedback obtained and to avoid biased data. The hard-copy questionnaires were distributed to six areas which include the following areas:

- Medan Ipoh
- Ipoh town centre
- Manjoi
- Tanjung Rambutan
- Chemor
- Orang Asli villages – Kg Tonggang, Kg Sg Suloh, Kg Chadak, Kg Baduk and Kg Makmur

Some of the survey points selected are located within high-density locations, such as the town centres, shopping complexes, and markets. This is with the expectation that there are higher chances of getting large sample distribution instead of conducting house-to-house interviews especially at the semi urban and urban area which often has a high rejection rate.

4.2.1 Method of Survey

The face-to-face interviews and questionnaire distribution was carried out from 1st November 2018 to 2nd November 2018. A total of 22 enumerators were involved to carry out the face-to-face interviews and questionnaire. The online survey was available online for two weeks from 1st to 15th November 2018 and the link to Google Forms were shared to the university students and NGOs based within UKB. Overall, 92.5% of the samples collected were through face-to-face survey and 7.5% (15 set) received through online questionnaires. A total of 300 questionnaires been distributed. Out of that, 230 questionnaires were returned. Out of the 230 sets, 200 sets were collected from the urban and peri-urban communities, and 15 sets were received from the Orang Asli community within UKB.

4.2.2 Description of the Survey

The survey was designed to measure perception and current status of the targeted groups; the survey was divided into five parts which covered the following components:

1. *Profile of Respondents* – This section aims to collate the basic demographic profile of the respondents. This section contains 10 questions
2. *Knowledge on Forest Reserve and Rivers at UKB* – This section aims to understand the general level of knowledge of the respondents on the interdependency of the population to the forest and rivers. Particularly on the ecosystem services provided by these habitats, awareness on their water resources, and simply knowledge on the presence of forest and rivers near them. This section contains 5 questions
3. *Awareness on Issues Related to Forest and Rivers at UKB* – This section aims to document the awareness of the respondents to the environmental issues surrounding their location. In this section, the survey also aims to assess the contemplation of the respondents by looking at the barriers of change and what makes them relapse. This section contains 10 questions
4. *Existing Practices and Facilities for Environmental Best Management Practices (BMPs)* – This section aims to collect information on the current best management practices of respondents and actions taken in caring for the environment, and whether they have the skills and resources to practice environmental initiatives. This section contains 4 questions
5. *Readiness and Willingness to Participate in Public Outreach Programmes* – This section aims to document the respondent's self-efficacy and willingness to participate in future activities, this could support in the future for outreach programme. This section contains 4 questions

The survey form attached in **Annex 1**.

4.3 DATA ANALYSIS

The completed survey questionnaires were compiled and sorted according to different target groups. Data analysis was conducted using frequencies and pivot figures to compute percentage distributions. Information in the figures was converted into charts to make the data statistics easier to understand.

4.3.1 Profile of respondents

A total of 230 people from were successfully interviewed for the perception survey; of which there were 116 (50%) males and remaining 114 (50%) females. The largest group of interviewees by age was between the ages of 21 – 30 years old (27%) (**Figure 4.1**). The largest group of respondents by income (36%) had a gross monthly income below RM500 (**Figure 4.2**); most of them were from the peri-urban area and work in agriculture.

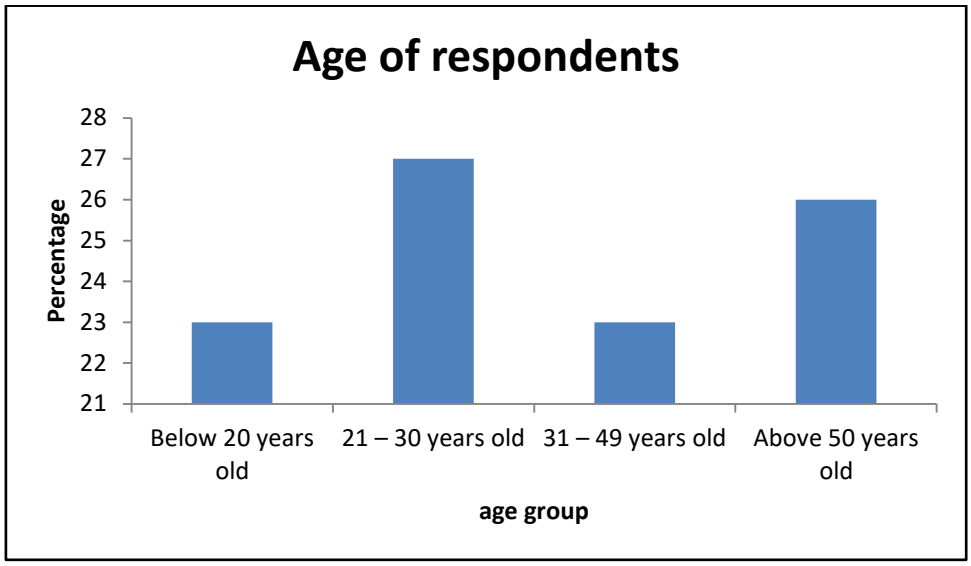


Figure 4.1: Age of respondents

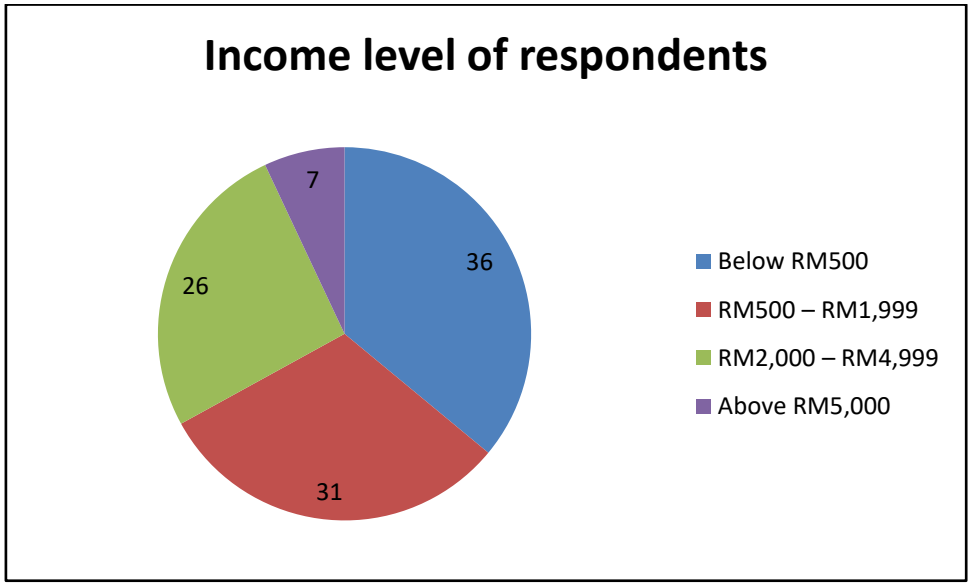


Figure 4.2: Income levels of respondents

4.3.2 Knowledge on forest reserve and rivers at UKB

This section aims to assess the knowledge of the respondents on the forest and rivers, specifically the ecosystem services provided by these habitats. Overall 91% of the respondents selected water supply as the most important ecosystem services provided by the forests and rivers while flood control is rated as the second most important service at 80% (**Figure 4.3**). **Section B1, Annex 2** shows the breakdown on the awareness of the respondents on the importance of the water and forest resources.

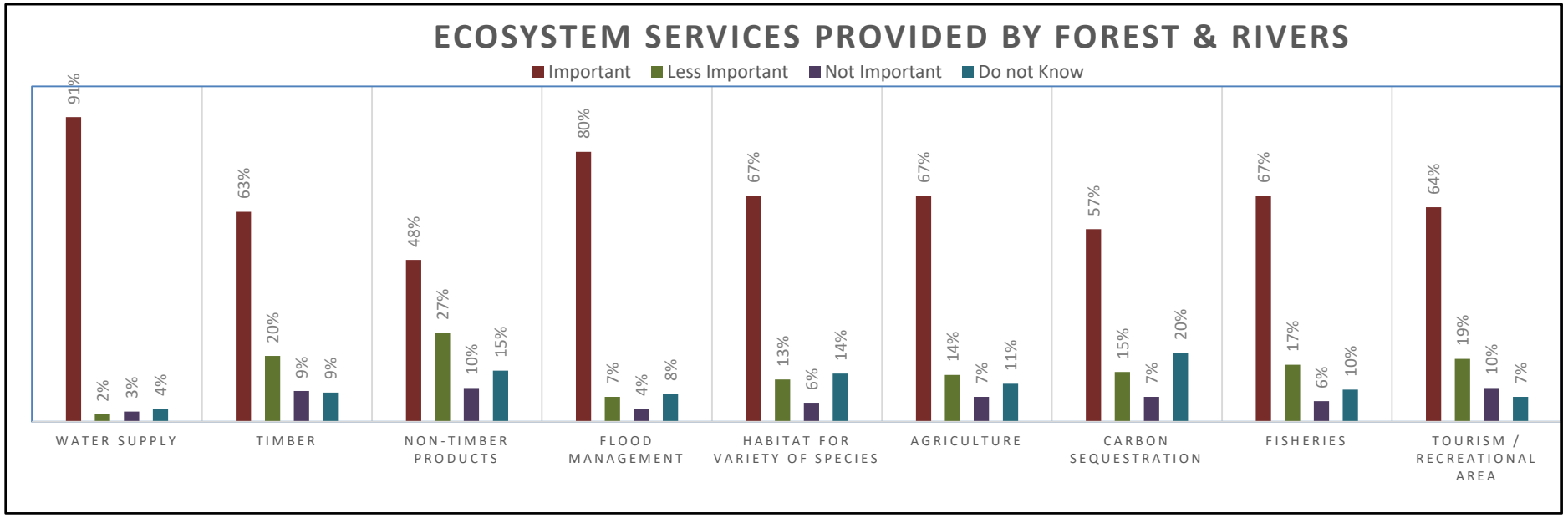


Figure 4.3: Ecosystem services provided by Forest & Rivers

Water supply was the most important service for respondents from all three (3) different areas; urban (96%), peri-urban (89%), village (88%) (**Figure 4.4**). 96% of the urban respondents said water source is most important (96%) followed with the importance of biological diversity at 86%, flood control at 80% followed with agriculture feed at 78%. Peri-urban community highlights that forest and water resources are most important as for water source (89%), flood control (81%), 66% for both fisheries and agriculture. As for the Orang Asli community, 88% choose the importance of the forest and the river mainly for water source followed with timber (forest resource) and flood control at 69% as well as for fisheries (65%).

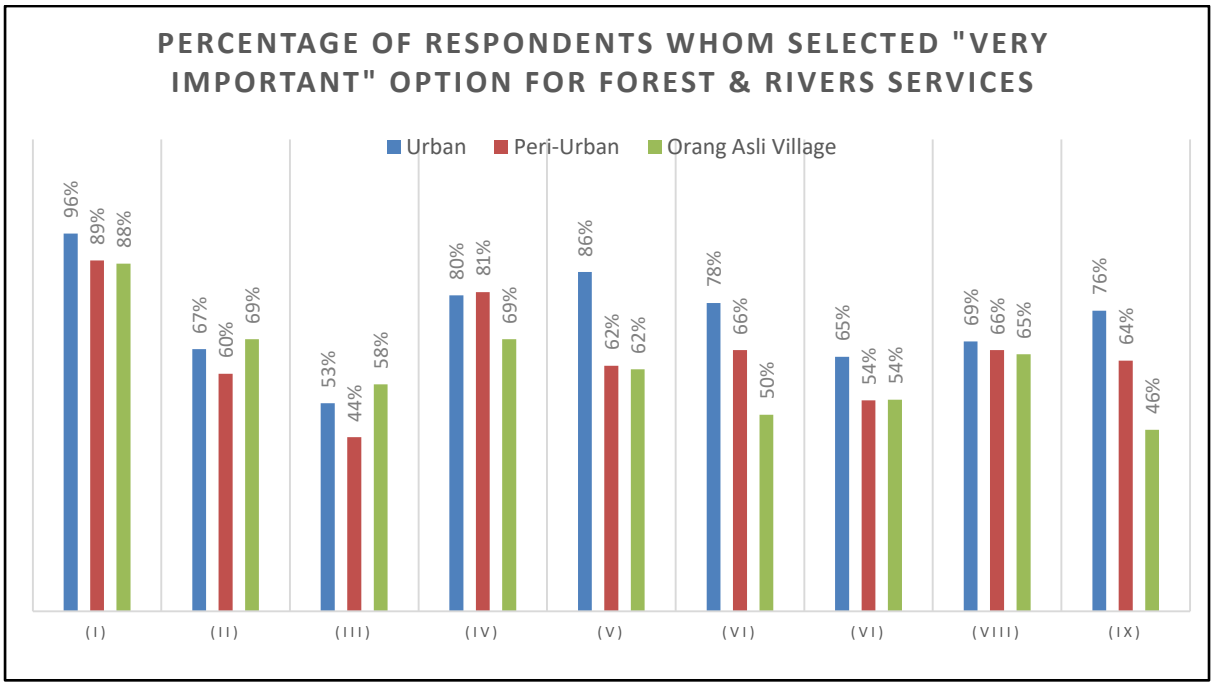


Figure 4.4: Percentage of respondents whom selected "Very Important" option for Forest & Rivers services

In general, almost half of the respondents were not aware on the source of the their drinking water (49%) **(Section B2, Annex 2**). Majority of the respondents also have no knowledge of the forest reserves (64%) and the drainage system (64%). However, 60% of the respondents were aware of the rivers nearby to their neighbourhood (**Section B3, Annex 2**). Comparing between the three community groups, people from the village have higher knowledge of their drinking water source (58%), presence of rivers and forest nearby (73% and 64%). This could be due to the fact that their lives are closer and more connected to the forest and rivers, as their drinking water pipeline is setup, managed and maintained by the villagers themselves. In contrary, communities in the urban and peri-urban areas receives water supply through the municipal pipeline which they have less hands on the management and knowledge on the source. Common in all communities are the lack of knowledge on where their drainage discharges, with only at 29%, 37% and 42% of urban, peri-urban and village respondents were aware. Overall, the Orang Asli community has higher knowledge on the forest and water resource compared to the urban and peri-urban communities (**Figure 4.5**).

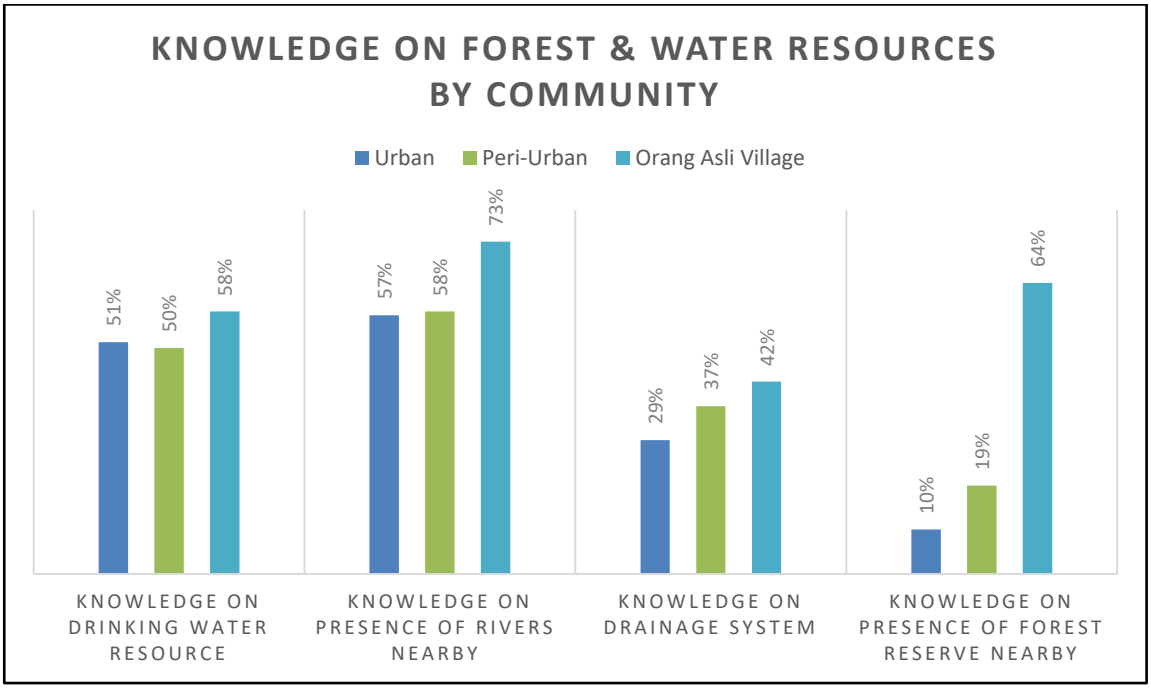
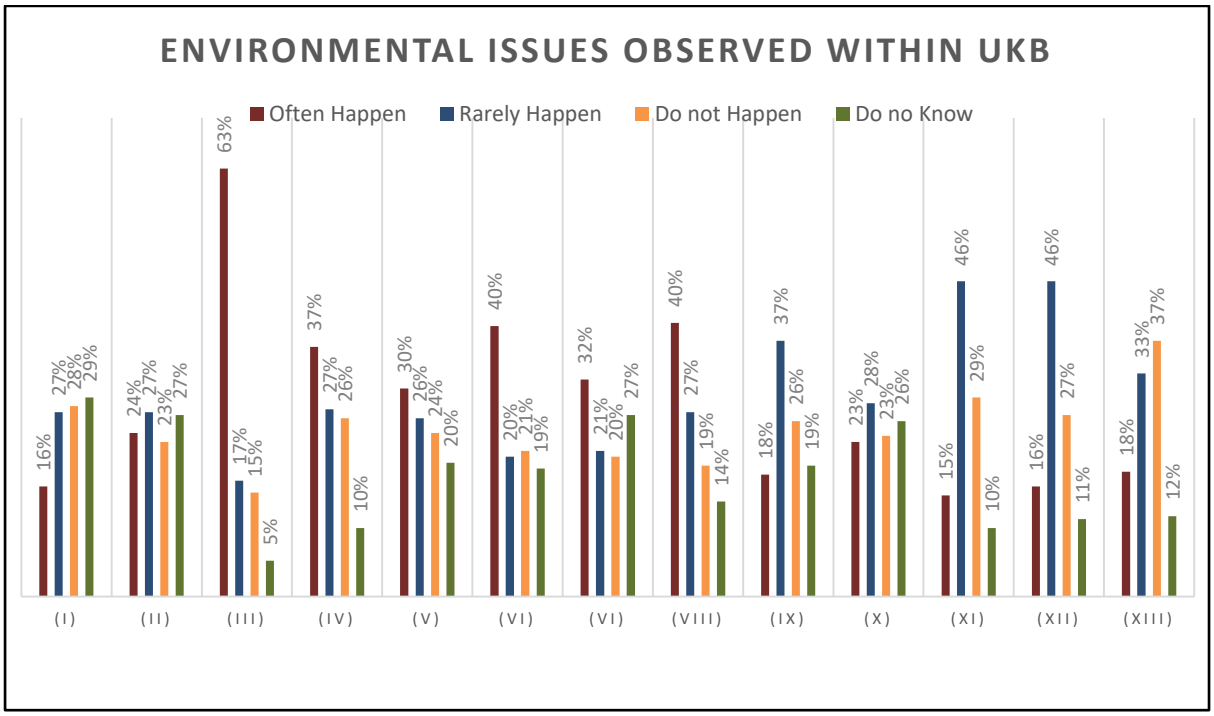


Figure 4.5: Knowledge on forest & water resources by community

Among the four age groups, above 50 years old group has the highest acknowledge and awareness of nearby rivers, forest reserve, drainage system and drinking water resource. While the below 20 years old group observed to have the least knowledge and awareness of all. This shows that the older age group is more aware of their surroundings may be due have been living there for longer period of time compared to the younger group. The proposed planned awareness programmes for the community can bring back the people closer to forest and rivers, as survey result shows that the urban and peri-urban community, and the younger generation in all communities is losing its connection to these natural resources. Overall, it indicates that the respondents are aware on the importance of the water source mainly for their drinking and domestic needs as well as economic dependencies (fisheries and agriculture). Although the communities are well informed and knowledgeable with the rivers within their vicinity, they fail to acknowledge that the discharges from household and nearby drainage that's finally end up into the main river system. Moreover, the respondents were also not alert or aware on the existence of the forest reserve within their vicinity except for the villages (35%) aware about it. This indicates the implementation program and activities should also focused on creating awareness on the importance of the resources, engaging them to monitor and protect the resources and at the same time to participate and play a significant engagement roles with the respective caretakers/agencies to ensure the resources are protected.

4.3.3 Awareness on issues related to forest reserve and rivers at UKB

Illegal rubbish dumping (63%) was rated as the most serious issue at UKB, followed by disposal of waste from restaurant and hawker into ditches or rivers, and clogged ditches with both at 40% (**Figure 4.6**). Nevertheless, 40% of respondents also said that disruption of water supply (40%) and smelly or coloured water supply are rarely happen in their areas. Orang Asli villages recorded the range of highest percentage (50% - 65%) of non-occurrence for 10 out of 13 environmental issues. Urban and peri-urban communities perceived illegal rubbish dumping as main environmental issue that affecting them. Besides that, peri-urban communities also perceived that disruption of water supply (53%) and smelly/coloured water supply (48%) as their main environmental issues.



I. Encroachment of forest reserve
II. Conversion of reserved land for plantation or farming
III. Illegal rubbish dumping
IV. Poor garbage collection service
V. Poor wastewater management
VI. Waste dumping into rivers/drains by the restaurants and hawkers
VII. Waste dumping from factories into rivers/drains
VIII. Blacked drainage
IX. Landslide
X. Poor management of construction areas
XI. Water shortage
XII. Smelly and cloudy water supply
XIII. Flood

Figure 4.6: Environmental issues observed within UKB

Despite being aware and able to recognise environmental issues, the majority of the respondents (75% urban, 72% peri-urban, and 69% village) were not aware who are the responsible authorities or individuals for the maintenance of forests and rivers (**Section C2, Annex 2**). Only a small number of responses in each community have acknowledged that the good keeping of forests and rivers is also the community's responsibility.

Respondents were also asked to provide their views or suggestions to improve the current situation. The responses were grouped into five elements; education and awareness, enforcement, facility, authority, and working together (**Table 4.1**). Facility provision is mainly on providing better access to waste management facilities. 'Authority' includes suggestion such as the responsible government agencies to take prompt and better actions in attending to reported issues by the people, and to make themselves more visible to the public. 'Working together' refers to suggestion that all levels of the society is responsible to in conserving and managing the forests and rivers. **Table 4.1** shows that majority of the people suggest that education and awareness are needed in their community to improve their environmental condition.

Table 4.1 Suggestion to improve the current situation by community

Elements	Percentage		
	Urban	**Peri-urban**	**Orang Asli Villages**
Education and awareness	43	44	42
Tighter enforcement	26	16	25
Facility provision	4	3	0
Authority	22	27	25
Working together	4	11	8

Generally the majority of respondents think that the rivers have either remained the same or getting better as compared to getting worse, in terms of the cleanliness, smell, water quality, river care initiatives, enforcement or monitoring of authorities, and public participation in environmental sustainability programs (**Figure 4.7**).

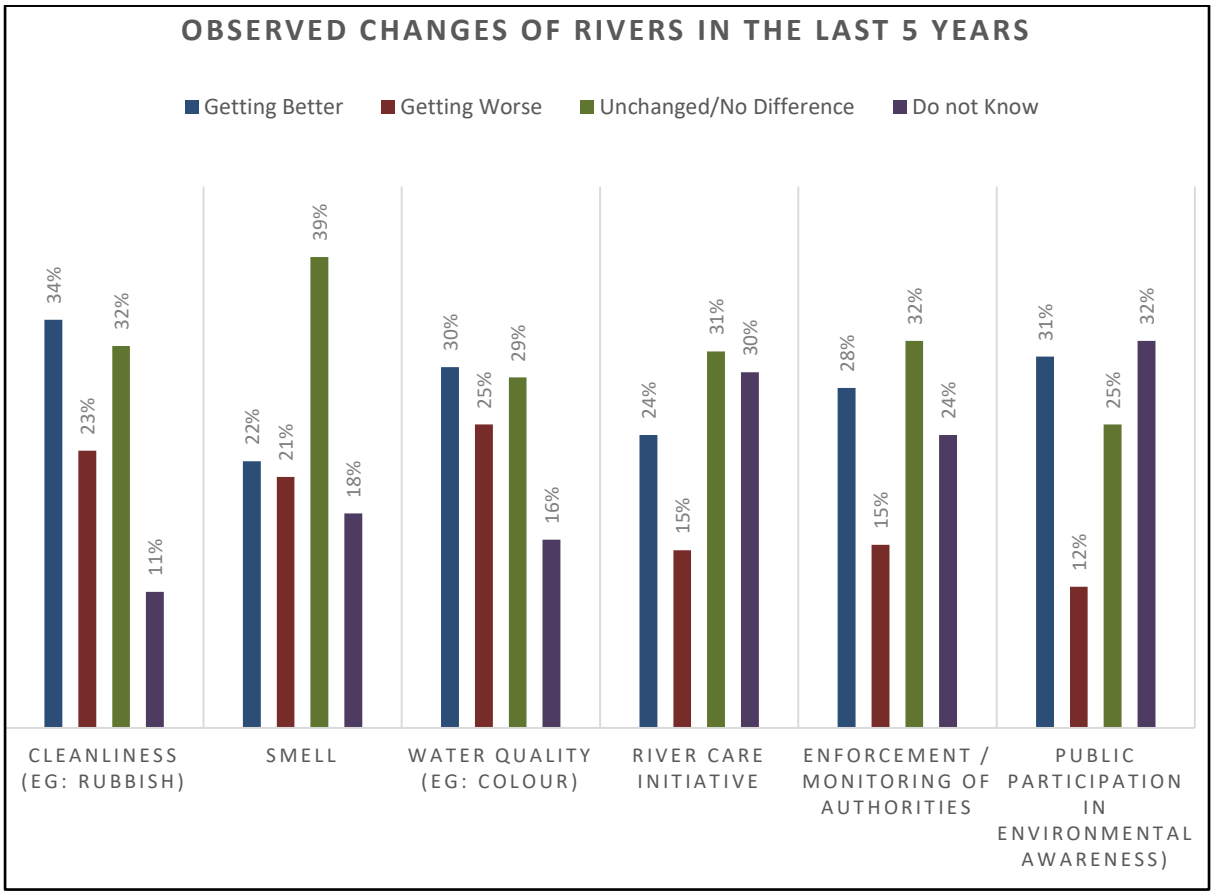
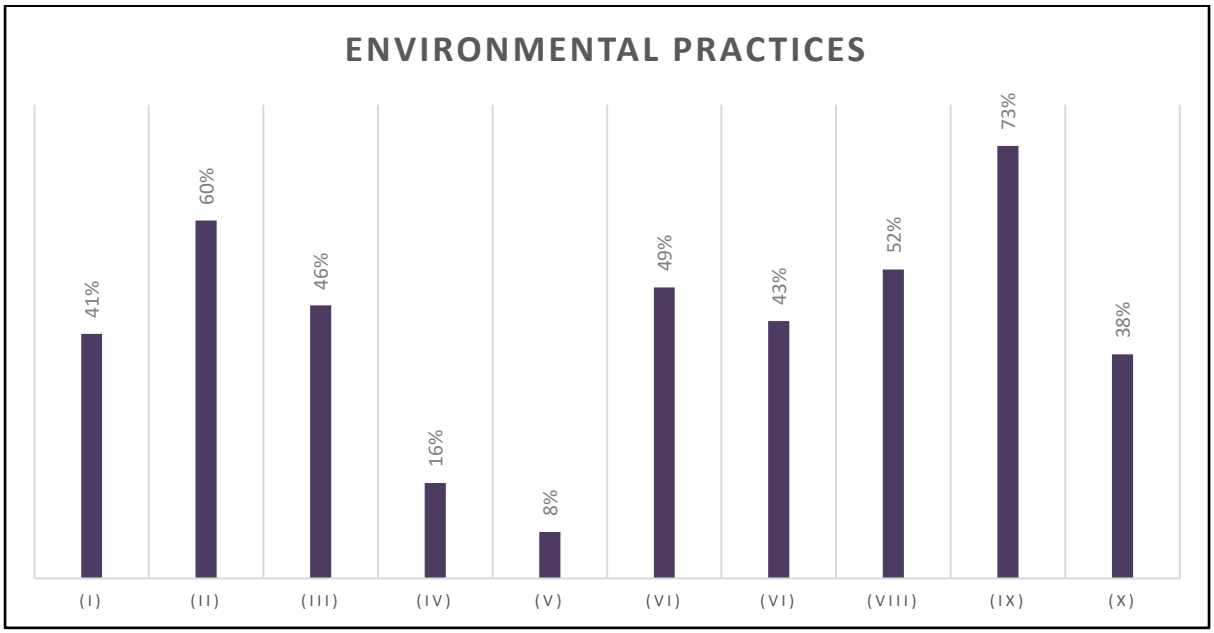


Figure 4.7: Observed changes of rivers in the last 5 years

4.3.4 Existing practices and facilities for environmental best management practices (BMPs)

Overall, highest percentage of respondents (73%) selected option to avoid pesticides as a part of their BMP (**Figure 4.8**). This may be due to the awareness of its content that might include dangerours chemical substances that can be harmful to human, animals, river/water and the nature. Usage of energy efficient appliances rated as second highest (60%) environmental practice among the respondents (example, usage of energy saving appliances and solar panel for electricty or water heater). While used of recycle paper was the least practices (8%) adopted by them.



I. Use reusable bags
II. Use energy efficient electrical appliances
III. Separate recyclable waste and send it to the recycling centre
IV. Turn off the tap while brushing teeth
V. Use recycled papers
VI. Turn kitchen waste into compost
VII. Switch off the lights and electrical items when not in use
VIII. Use CFC free aerosol spray
IX. Use chemical free pesticides
X. Avoid single use plastics; such as straws, plastic packaging, pastic spoons, etc.

Figure 4.8: Environmental practices within UKB

All respondents [urban (90%), peri-urban (72%), and village (81%)] have the highest selection of switching off light when not in use as their environmetal friendly action (**Figure 4.9**). Overall, people from urban area have higher percentage on environmental practices, especially on the conservational effect can be to the frequect awareness campaigns and promotional by the relevant agencies as well as to lessen their financial burden especially with water and electricity. Urban people tend to use more electircal supplient or depend more on the water for domestic usage compared peri-urban and urban communtiies. Usage of recycled paper and energy efficient appliances are comment environmental practices within UKB site.

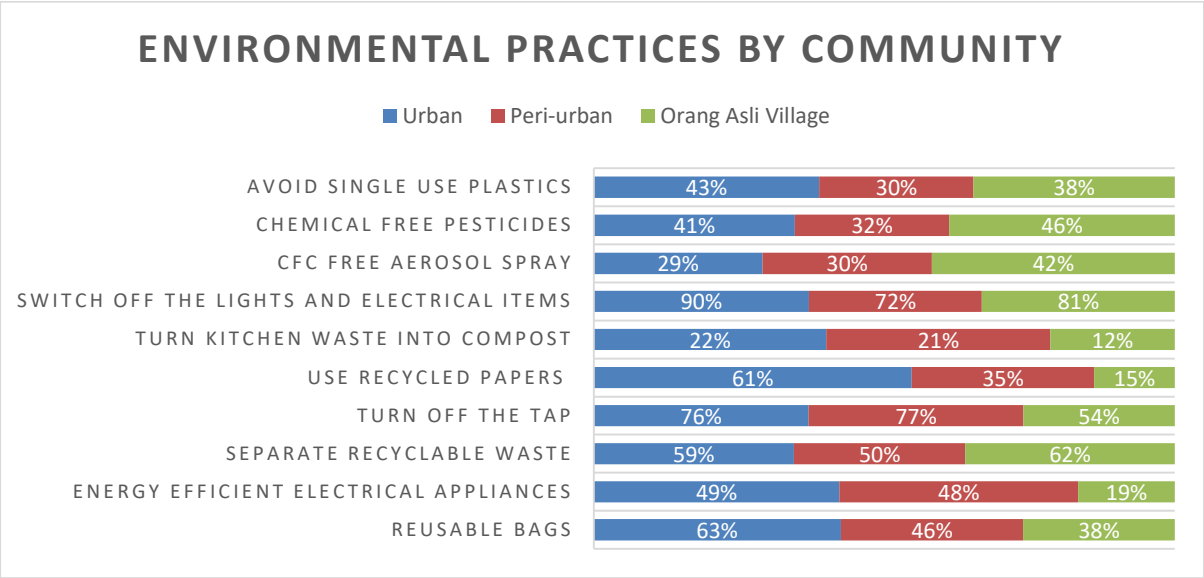


Figure 4.9: Environmental practices by community

Looking by age groups, respondents of age groups below 20 years old (77%), 21-30 years old (76%) and 31-49 years old have selected turning off water tap when not use as best environmental practice as their main activities. While respondents from age group above 50 years old have selected switch off light when not use as the highest (89%) among other activities or actions.

When asked about the availability of facilies or activities for environmental practices in their neighbourhood, gotong-royong (53%) is one of the most rated and popular activity or action among the respondents, most of the respondents have mentioned that they will at least do gotong-royong quaterly. Availability of recycling centres came the second highest (36%). Gotong-royong activity is popular among all age groups, below 20 years old (58%), 21-30 years old (48%), 31-49years old (42%), above 50 years old (61%).

4.3.5 Readiness and willingness to participate in public outreach programmes

Overall 68% of the all respondents have selected that it is very important to have a clean environment, forests and rivers (**Figure 4.10**). Similarr patterns have been noticed for all groups except the group above 50 years old (72%) which think its just important only. Higher percentage of communities [urban(70%), peri-urban (64%), and village (58%)] said that they would participate in environmental care activities. Social media (52%) was chosen to be the most preferred learning method for conservation or sustainable lifestyle with campaign and activites at open field are chosen as the second most (47%) preferred methods, which is more active and fun. Individual consultation is the least (7%) preferred as a engaging platform.

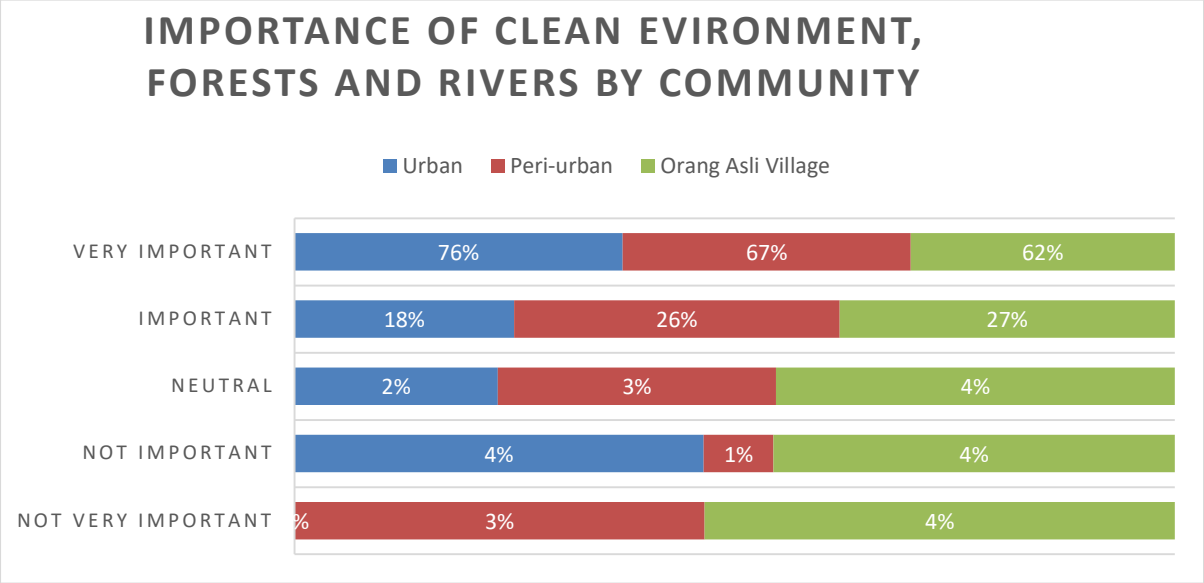


Figure 4.10: Environmental practices by community the Importance of Clean Environment, Forests and Rivers

4.4 SUMMARY

Based on the survey conducted on 230 respondents, the largest range of age for the respondents are between 21 to 30 years old (27%) with the lowest (23%) recorded for the age between 31 to 49 years old and below 20 years old respectively. The respondents' are surprisingly, well aware on the importance of the water resources as the source of our drinking water (51%) and 61% are aware on the rivers within their vicinity. Most of the respondents age below of 20 years old need more civic science approached to enhanced their acknowledgement. Generally respondents' think that their rivers condition remains same or getting better for last 5 years. The least environmental friendly activities undertaken by the respondent were to use of recycle paper at only.8%. 68% of the respondent agreed on the importance of keeping the environment in great condition with only 3% of the respondents recorded that environmental conservation as less important. Almost every age group acknowledged the importance of keeping the environment, water resources, and river and forest reserve clean and protected. The most interesting method to learn on how to take care of the forest and river is through social media which was recorded 52%, followed closely by doing hands-on activities at open field at 47%.

Based on the outcome of perception survey, it is vital to have strong community participation. The engagement of communities through the capacity building should be through establishment of forums or platforms for the Orang Asli and peri-urban communities which represent the upper and middle streams of Kinta River and also the urban communities at the downstream. The training for the Orang Asli communities will incorporate issues on sanitation, water and hygiene, alternative water resources and forest and river management. For the peri-urban and urban communities, the training will incorporate pollution mapping, flood preparedness, water conservation, recycling and corporate engagement.

For the forest protection and rehabilitation, the Orang Asli communities will be trained on community patrolling and RIVER Ranger or as Eco Tourist guide in addition to initiatives as tree or bamboo planting as part of community based forest rehabilitation programme. For the selected urban and peri-urban communities, the RIVER Ranger training will be carried out to monitor and to undertake relevant mitigation measures to manage the river basin issues within the community vicinity.

The Orang Asli communities, peri-urban and urban communities need to be exposed and provided with up-to-date information focusing to the communities through public awareness campaign in form of activities and event based programme. Information dissemination through social media, including web portal and visibility materials such as newsletter, brochure or e-poster will also enhance the environmental education and engagement within the communities.

Overall, stakeholders such as Orang Asli, peri-urban and urban communities are the current beneficiary of the UKB and the end recipients of the water supply. Proactive engagement will help these communities to develop a sense of responsibility in protecting the UKB and as long term partners for strategy and action plan implementation. Four main elements/pillars for an impactful and proactive engagement are the awareness of the community, the basic knowledge, the skill and also the behavior of the communities.

CHAPTER 5: LINKAGES TO CENTRAL FOREST SPINE 5-1

5.1 REVIEW OF CENTRAL FOREST SPINE

The Central Forest Spine (CFS) of Peninsular Malaysia, composed of four (4) main forest complexes, is an important natural landscape of Malaysia, supplying up to 90% of the population's water supply, alleviation of flood risks, regulation of climate; and supply of resources, products and services, such as ecotourism. The National Physical Plan (NPP) identified forest fragmentation as a major threat to the conservation and maintenance of biodiversity and recognizes that conserving forest lands would be integral as it is important to secure mutual co-existence and benefit for development and conservation (NPP, 2005). Optimizing the use of land in the country and that the multifunctional role of the forest lands should be enhanced through the recognition of the CFS and programmes to create linkages and corridors to the more isolated reserves.

In essence, connecting these fragmented forests recognizing the importance in securing connectivity of the fragmented forests, the Malaysian government, through the Federal Town and Country Planning Department, has therefore embarked on a master plan study whose objective is to re-establish, maintain or restore connectivity in places where it is already lost within the central forest spine of Peninsular Malaysia (Federal Department of Town and Country Planning Peninsular Malaysia). The CFS master plan was jointly tabled to the Cabinet for adoption by the Ministry of Natural Resources and Environment (NRE) and Ministry of Housing and Local Government in 2011. The CFS Master Plan was approved by the National Physical Planning Council (NPPC) on 13 August 2010 and endorsed by the Malaysian Cabinet on 1st April 2011.The Cabinet appointed NRE as the main implementing agency, supported by the Forestry Department (FD) and Department of Wildlife and National Parks (DWNP). To assist NRE in the implementation of the CFS Master Plan, A CFS Steering Committee was formed comprising representatives from state governments, agencies and NGOs.

The CFS was defined as the backbone of Peninsular Malaysia's environmentally sensitive area network, comprises four (4) major forest complexes in the National Physical Plan. In addition the CFS is a core feature of Malaysia's commitments to international conventions i.e. United Nations Convention on Biological Diversity and United Nations Framework Convention on Climate Change, both of which we are a signatory to. The CFS is also important in supporting Malaysia's national policies such as the 11th Malaysia Plan, *Transformasi Nasional 2050* (TN50), the National Policy on Climate Change, National Environment Policy and the National Policy on Biological Diversity 2016-2025. The CFS Master Plan takes a far-sighted objective of re-establishing, maintaining and enhancing connectivity between the most significant/important remaining areas of forests in Peninsular Malaysia.

The ultimate goal is to ensure the conservation of the entire range of species found in our forests, as well as maintain the host of ecological processes taking place within it. An additional objective would be to create "stepping stones" to increase habitat connectivity for some but not all species. For this purpose, "ecological linkages" are identified in areas where it is important to establish connectivity, in order to form the CFS. 37 ecological linkages (i.e., 17 Primary Linkages [PL] and 20 Secondary Linkages [SL]) were distinguished with specific emphasis needs, Primary Linkages is crucial to re-establish forest connectivity in order to achieve the main CFS link. These areas are inevitably located between the most important blocks of forests; usually in narrow stretches where non-forest land use is still minimal. The

primary linkages are important corridors for large mammals which use these areas to move from one forest to another. Primary linkages take the form of linear corridors, i.e. unbroken stretches of forested habitats connecting forest islands. Secondary Linkages Secondary linkages are complementary to primary linkages. They are identified in areas where it is unfeasible to create a primary linkage (e.g. due to vast areas of non-forested land or long distances between forests, or high human population), but it is still important to maintain some level of connectivity (albeit weaker) between forests. Secondary linkages are usually used by small animals, birds and insects. They are also beneficial to plants through pollination and seed dispersal. Secondary linkages take the form of stepping stones, i.e. patches of suitable habitats, and are usually designed to follow river corridors.

The four major forests within CFS1 and CFS2 are, *Banjaran Titiwangsa-Banjaran Bintang-Banjaran Nakawan*, *Taman Negara-Banjaran Timur*, South East Pahang, Chini and Bera Wetlands, and Endau Rompin Park-Kluang Wildlife Reserves. The CFS1 covers northern Peninsular Malaysia, stretching from the state of Kedah on the West until Terengganu in the East, i.e. states of Kedah, Perak, Kelantan, Terengganu and Pahang together with adjoining southern Thailand (i.e. transboundary linkages) encompasses an area of about 3 million hectares. The CFS2 encompasses an area of about 2.3 million hectares covers the southern part of Peninsular Malaysia central forest spine within the four states of Pahang, Johor, Negeri Sembilan and Selangor. The Upper Kinta Basin (UKB) is an important part of CFS1. Although UKB is not part of the CFS 1 or 2 linkages, it is still with a key part of the CFS as it is a potential area where the north-south linkage of the CFS is disrupted by the Simpang Pulai to Cameron Highland Highway. Without the maintenance of the integrity of this forest, the movement of wildlife along the main range will be disrupted. The CFS has already been significantly disrupted by the Cameron Highlands to Gua Musang road and the associated large scale agriculture and plantation development. Without proper maintenance of the UKB forests, the CFS integrity may be compromised. **Figure 5.1** shows the CFS (PL and SL Linkages) together with the project site.

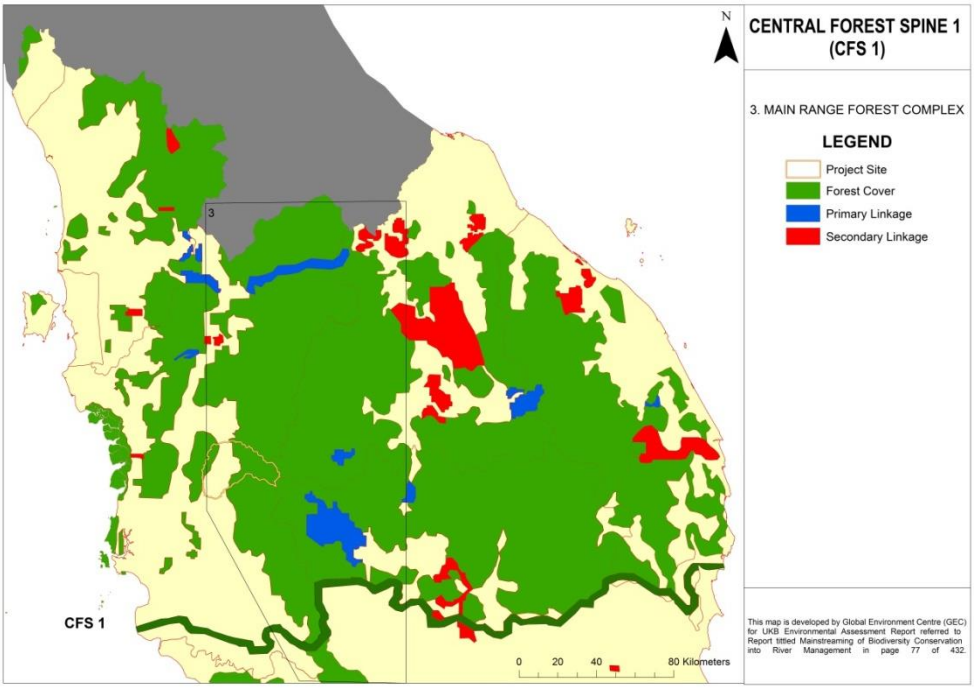


Figure 5.1: CFS and the neighboring UKB site

5.2 ISSUES WITHIN CFS

Over the years, when the CFS was developed and implemented, the effectiveness of the CFS is yet to be projected as a successful case story. It is observed that the main focus of the CFS was to connect the habitat to enable the wildlife to move around the fragmented forests within Peninsular Malaysia. This was proposed to ensure the wildlife is protected from the rapid developments in Malaysia over the decade. Some of the significant challenges include the following:

- As land resources are a state matter, the management and utilization of forests as well as implementation of development projects, remain under each state's jurisdiction.
- Many of the linkages are under-maintained due to lack in the commitment from the state governments, poor enforcement as well as insufficient resources/ department/person to implement the CFS.
- The findings from various NGOs that are working on the conservation efforts along the CFS linkages indicate that the effectiveness of the CFS is long-term and the implementation plans need the support of various stakeholders.
- SMART stakeholder partnership and support is required to ensure the implementation is significant to achieve its goal and to overcome the issues identifies.
- Some of the issues identified needs immediate action i.e. conversion of the primary forests into monoculture plantation or, forestland being leased out by the state government for logging and also a conversion for infrastructure development.
- Funding is critical to successful of the implement the CFS Master Plan. As component of many initiatives undertaken by the government, where with limited resources the outcome of the CFS is not widely emphasis or published.

Malaysian forests are divided into two different land categories; Permanent Reserved Forests (PRF); and Non-PRF (comprises of State land Forests and Alienated Forests). The PRF is legally secured and gazetted in accordance with the National Forestry Act, 1984 and managed under the Sustainable Forest Management (SFM) system for the benefit of present and future generations. According to the keynote presented by Director-General of Forestry Department of Peninsular Malaysia during the conference on Perak's Central Forest Spine on 19 February 2013, a total of 14.39 million ha of PRFs have been gazette in Malaysia. Of this total, 4.8 million ha are in Peninsular Malaysia. For the purpose of management, PRFs are further classified into two major management purposes, namely Production Forest; and Protection Forest. Production Forest is established for the purpose of supply in perpetuity which can be economically produced and marketable. Meanwhile, the Protection Forest is established for conservation purposes that were further refined into eleven multiple values of forest or forest functional classes as stipulated under Section 10 (1) of the National Forestry Act (1984). These forest functional classes are, Soil Protection Forest; Soil Reclamation Forest; Flood Control Forest; Water Catchment Forest; Forest sanctuary for wildlife; Virgin Jungle Reserved Forest; Amenity Forest; Education Forest; Research Forest; Forest for Federal purposes; and State Park.

Although water is emphasized under the Malaysian forest classification as Water Catchment Forest (PRF) and water resource management is being highlighted as one of the component

of CFS, the importance of the water resource/catchment areas are sometimes seen as a secondary need. While the Forestry department focuses on protecting the Forest Reserves for future sustainable and resource, the CFS has been focused on wildlife protection. Most of the environmentalist and the project proponent emphasized on the need of the forest as habitat for the wildlife for the conservation of Malayan Tigers and Elephant in addition to other wildlife which is low in the number due to the rapid forest clearance and logging. Although the locals and civil societies emphasized on the wildlife protection, the state government on the other hand, depends on the logging as one of main state revenue. Malaysia forests are rich with first-class timber which upon harvesting benefits the state revenue. The Perak State Government has been unable to stop timber harvesting as it will result in the loss of the revenue needed to provide services to the people and forest management in Perak. Although the Permanent Reserve Forests (PRFs) are protected under the National Forestry Act 1984 under the jurisdiction of the state forestry department; the state government has the power to excise PRFs by degazetting them. Cutting for timber production in PRFs ("timber production forest under sustained yield"), and the excision of PRFs from the state warrants replacement with another similarly-sized piece of land ("State Authority to replace land excised from permanent reserved forest") by the state is permissible. **Figure 5.2** shows the Primary linkages of CFS, where Bukit Kinta was one of the nearest sites to the Upper Kinta Basin Site (between SL3 and PL3).

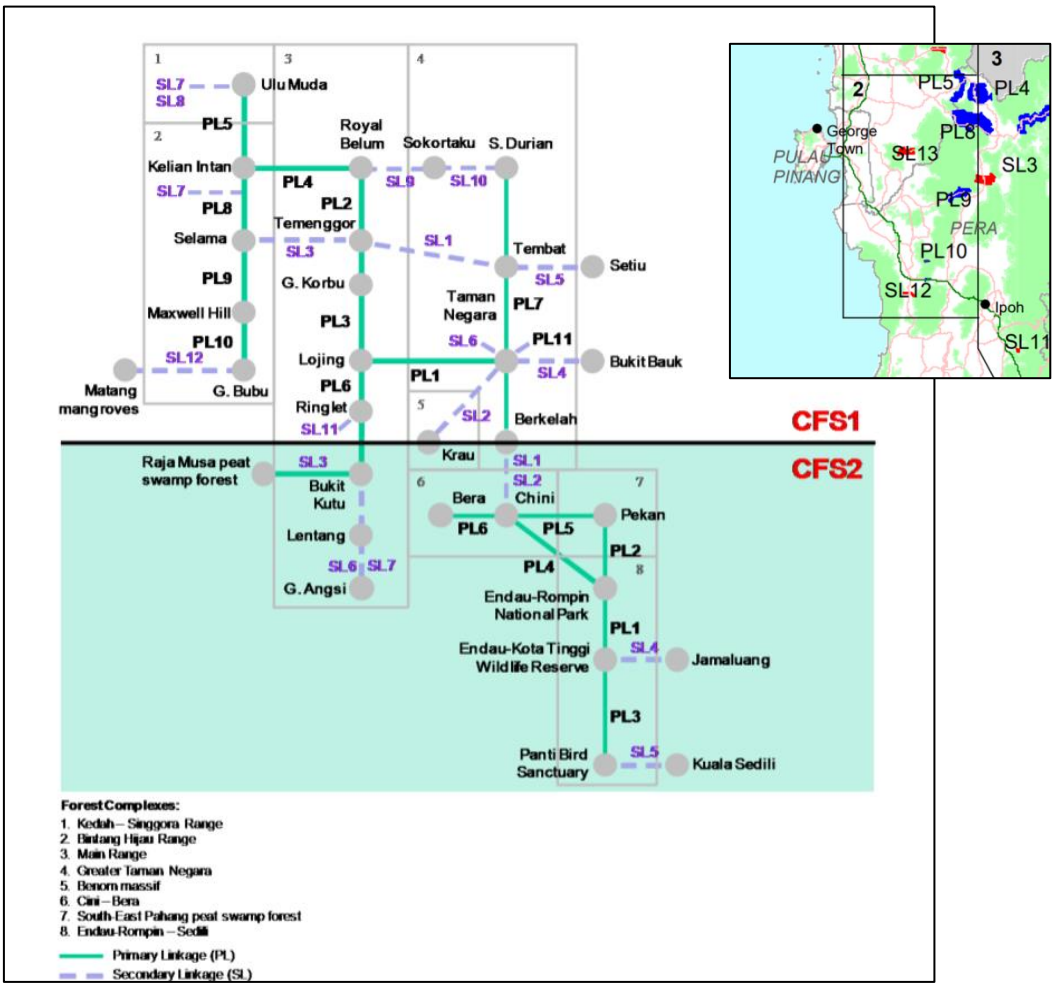


Figure 5.2: Ecological linkages in Perak border

As Perak is one of the states with highest forest cover and valuable trees, logging has been carried out in a large-scale manner either by licensed concessionaires by the state government or through illegal logging activities. Wildlife hunting and poaching run parallel with logging. When there is an area open for logging, the wildlife within the area was hunted down for its precious resources. Although water catchment area and river corridor were included in the CFS masterplan, it was listed as secondary. It is proposed for water catchment to be emphasized as the main component of CFS masterplan. As our drinking water and supply originates mainly from rivers (97%), the forest is needed as the catchment area. A fragmented forest without catchment is not sufficient for water storage or supply. A combined water store is required and the forest patches forming the linkages need to be gazetted as protected forest area (water catchment patches). The definition of water catchment need to be revised and its significant impact, if the resources not protected need to be emphasized to all stakeholders. The state governments need to be briefed and enlighten on the impact of forest destruction to their water supply. Water Supply is important not only for domestic usages but also for agriculture and industrialization. The current approaches have silenced the importance of CFS for water resource protection. As the feedback and commitment or feedback from the stakeholders may differ and committed approach can be proposed or implemented if the benefit of CFS highlighted differently, the UKB project will be inline and supportive of this.

From the review of the CFS masterplan, almost all the water catchment area was not highlighted as part of the CFS or only emphasized under CFS Secondary linkages. Secondary linkages are to support the primary linkages; in this case, river corridor management is a secondary issue to be addressed, after the linkages for the large mammals are connected. Commonsense, shows the mammals need water to survive and if water is treated as secondary issue, the objective of the linkages to create the pathway for the mammals, stop logging to create habitat and stop illegal hunting and poaching will not be materialized. On the other hand, when a forest is being gazetted, it is being protected from all form of illegal logging, hunting and poaching where the living organisms are contained within its protected area. It is proposed for all the relevant agencies, that are working on the CFS Primary linkages also to look closely into the water catchment area which was addressed as secondary linkages or those not part of the CFS for long-term resource protection. Long-term water resource protection plan is needed to ensure the water catchment area being protected, and this can only take place through the support of various stakeholders. Each stakeholder as State Economic Planning Unit (EPU), LAP, DID, State Forest Department, JAKOA, IDR and other states as well as federal agencies, need to look into long term goal. It is also important that the agencies work in hand via SMART Partnership in working together within their capacity to support each other in protecting the Bukit Kinta Forest Reserve and the Upper Kinta Basin.

Public awareness will have a significant role in pressuring the government to emphasize on the water catchment area. If the public is aware on the impact of the forest destruction on their water supply, the voice of people might create a platform for the state government to relook into their revenue plans. Payments for ecosystem services (PES), also known as payments for environmental services (or benefits), are incentives offered to farmers or landowners in exchange for managing their land to provide some sort of ecological service. PES should be enforced to industrial or corporate players which are benefiting by extracting

the water resources; e.g. Spritzer or One Water. Those farmers and agro farming activities along the water catchment area as well as the development of TNB National Gridline, Highway cutting through the forest also need to be charged with PES to enable conservation and rehabilitation efforts can be undertaken by the state government.

5.3 PROPOSED ELEMENTS TO BE INCORPORATED INTO CFS

In order to overcome the issues highlighted under the CFS, the following elements were discussed and proposed to be taken into consideration to assist the implementation of CFS

- Each state should consider adopting a long-term conservation agenda, central to which is securing and protecting the CFS.
- All state Structure Plans and Local Plans are expected to translate the policies and recommendations of the CFS Master Plan into the state and local applications. In order to enhance the implementation of the CFS policies, supporting the CFS policies at the state and local level should be part of the key performance indicators (KPIs) for state Structure Plans and Local Plans.
- Any development projects within or near the CFS should undergo review and approval by the CFS State Committee, As the CFS covers many aspects including planning, forests and water, the CFS State Committee should have representation from various departments. Civil Society Organization (CSO) should also be proportionally represented on the Committee.
- Funding is critical to successfully implement the CFS Master Plan. Adequate funding must be allocated by the Federal Government to support state governments in their efforts. An incentive and reward mechanism should be established to further incentivize the state governments to protect the CFS.
- Many CSOs have developed experiences and expertise on awareness and outreach and should be partnered to provide assistance on communication, education and public awareness programmes including within the federal, state and local government.

5.4 INCORPORATING CFS WITHIN UKB

Five primary and three secondary out of the 37 ecological linkages i.e. 17 Primary Linkages (PL) and 20 Secondary Linkages (SL) within Peninsular Malaysia is focused in Perak which is the second largest after Pahang (**Table 5.1**), However none of the linkages overlapped on the CFS linkages. The nearest linkages to the UKB sites are as within the PL3, 9 and 10 (**Figure 5.3**). Although the area within the Gunung Korbu and the Maxwell Hill are wide apart, and not connected, there are two main sources of water source for the Sultan Azlan Shah and Air Kuning Dam within the catchment of Sg Keruh Air Kuning and Sungai Kinta originate within the PL9 and PL10 as well as PL3.

Table 5.1: Number of ecological linkages within the CFS

State	Ecological Linkages		Total
	PL	SL	
Kedah	1	3	4
Perak	5	3	8
Kelantan	1	4	5
Terengganu	2	2	4
Pahang	6	3	9
Johor	2	2	4
Selangor		1	1
Negeri Sembilan		2	2
TOTAL	17	20	37

(Source: Keynote Address of the conference on Enhancing Forest Biodiversity Conversation through Central Forest Spine Programme: Future Challenges)

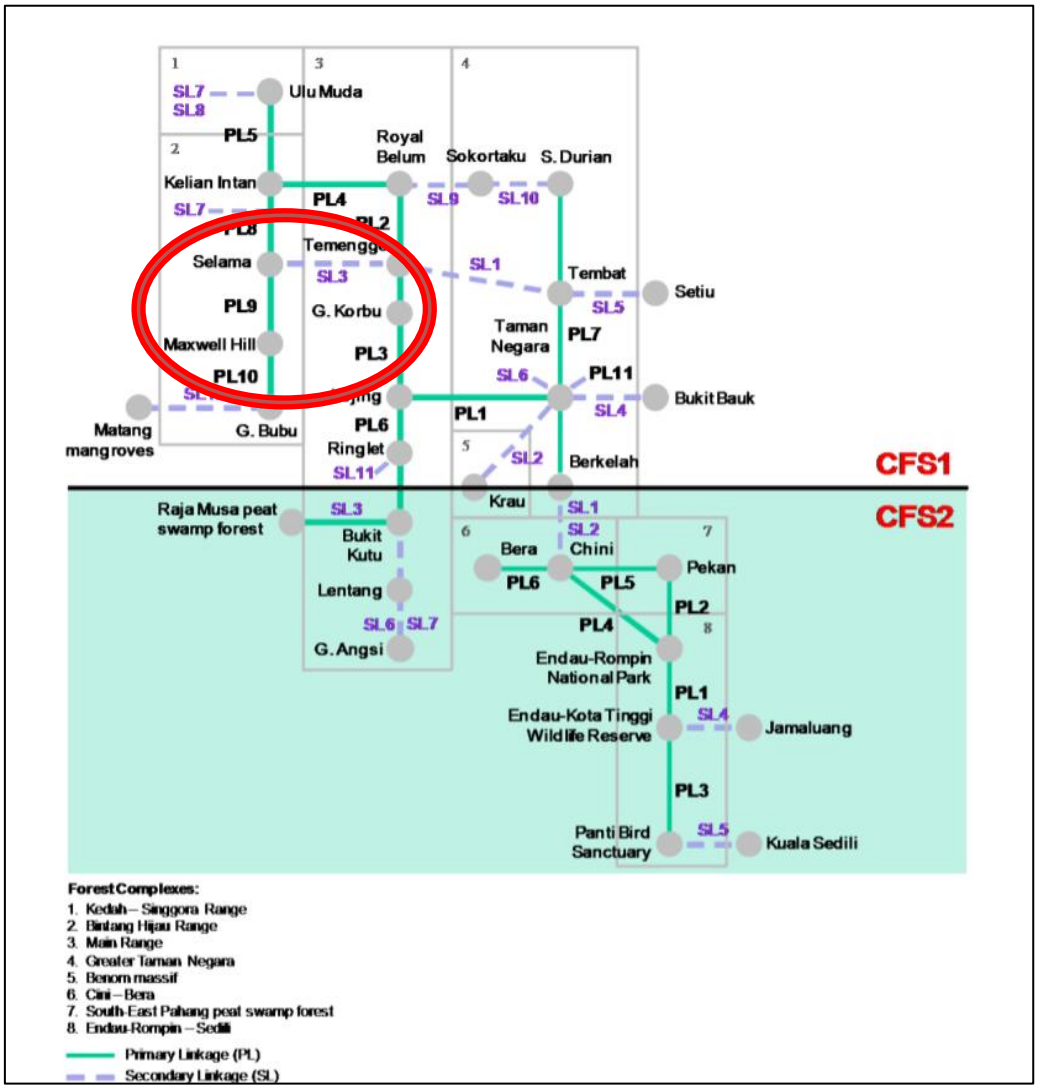


Figure 5.3: Nearest ecological linkages at UKB sites

Therefore, the activities proposed for the empowerment through the UKB action plans will be beneficial to the communities that are within the lower vicinity of the CFS with the focus on water catchment management and socio-economic empowerment for selected stakeholders including Orang Asli communities. Project objective 1 focuses on developing and adoption of the strategy for forest and water resource management of the upper Kinta basin. The Upper Kinta Basin covers about 25,000 ha between the Main Range at Cameron Highlands and Ipoh town. The basin is the main watershed that provides the potable water supply for Ipoh City and is an important part of the CFS. On-going and further development along the corridor along the Ipoh – Simpang Pulai to Cameron Highlands Highway are affecting the integrity of the catchment and water supply, biodiversity, and local communities. On the other hand, project objective 2 focuses on establishing community's engagement to address issues regarding forest management and river protection. Stakeholders like Orang Asli, peri-urban and urban communities, that are the current beneficiary of the UKB and end recipients of the water supply, are the significant stakeholders for community engagement. Proactive engagement will help these communities to develop a sense of responsibility in protecting the UKB and becoming as long-term partners for strategy and action plan implementation. The power, willingness, and capacity of the community to support work on the environment will ensure improved environmental outcomes and a sustainable future.

The CFS stakeholders that will be engaged under the UKB projects to fulfill the project objectives are as tabulated below in **Table 5.2.**

Table 5.2: List of key stakeholders

Stakeholders	Engagements
▪ State Government / State EPU ▪ Department of Irrigation and Drainage ▪ Forestry Department (FD) Peninsular Malaysia ▪ Perak Water Board (LAP) ▪ Ministry of Tourism, Arts and Culture Malaysia (MOTAC) ▪ Ministry of International Trade and Industry (MITI) ▪ Malaysian Public Works Department	The state governments are critical stakeholders in ensuring the security of the priority areas and corridors in their respective state, since forestry policy formulation and implementation is the responsibility of the state forestry departments rather than the FDPM. The key state government agency is the state EPU which oversees the development direction of the state. Within the state, a CFS Technical Committee has been established in order to manage the implementation of the CFS. The UKB's action plan that will benefit communities within the vicinity of CFS with the focus on water management and socio-economic empowerment should be presented and adopted by the CFS technical committee chaired by the State EPU.
▪ Department of Orang Asli Development ▪ Local Communities	As indigenous settlements and some local communities are still have a high dependency on forests, they plays an important role in creating awareness among them in conserving the forests and preserving the wildlife. Some of the proposed UKB project

	activities to support the understanding of the human and wildlife relationship are; empowering the stakeholders especially Orang Asli and local communities through workshops and trainings, establishing a proper platform to engagement them on forest and water catchment management, development of Community-based Participation Plan and social-economic activities (small-scale nursery, reforestation/erosion mitigation activities, tree/bamboo planting, eco-tourism and eco-products).
▪ Department of Irrigation and Drainage ▪ Ipoh City Council ▪ Department of National Unity and Integration ▪ Local communities	Urban communities are the receiving ends, which usually benefits or have higher dependencies of the resources. In order for them to appreciate and to also play a significant role in the projection, empowerment activities focusing on water conservation and pollution management (community mitigation measures) for midstream (urban and peri-urban communities) of Kinta River. The training will be focusing on pollution mapping, flood preparedness, water conservation and agency/corporate engagement
▪ Global Environment Centre (with the support of relevant stakeholders)	The CFS is not getting noticed by the public mainly due to lack of publicity and awareness. In order to get noticed and to get public support to ensure the continuity of the project, roadshow and publicity is needed. Therefore CFS will be incorporated into the proposed initiatives under UKB to raise awareness. Some of the proposed activities are series of the public awareness campaign, development of visibility materials and information sharing on the web portal.

Legislation which is relevant to the management of CFS in Perak that can be referred during the stakeholder consultation of CFS is as listed below.

i. The National Physical Plan 3 (NPP-3)
ii. National Policy on Biological Diversity 2016 – 2025
iii. The CFS Master Plan for Ecological Linkages
iv. The Town and Country Planning Act 1976
v. The National Forestry Act 1984
vi. The National Water Resources Policy / National Integrated Water Resources Management Plan

As highlighted in Section 1.2, water catchment protection should be emphasized and given priority, within the UKB project, so that CFS will incorporate the Water Catchment Protection as part of their main objectives to support the survival and connectivity of the wildlife within the forest as without water none of the objective can be achieved. Moreover, water availability and scarcity issues are very sensitive and will gain more support and interest of many stakeholders and players which depends on the resource.

CHAPTER 6: CONCLUSION 6-1

6.1 CONCLUSION

The overall goal of the project emphasizes the conservation and functioning of the forests and riverine habitats in the Central Forest Spine (CFS) region at the Upper Kinta River Basin. The impact indicator for the project is to secure the quantity and quality of the water supply of Ipoh and surroundings (660,000 people) through better catchment protection and management through stakeholder engagement (Orang Asli, local community and related government agencies).

The quality of waterbodies deteriorates with rapid development and urbanization. In addition land clearance, forest opening, industrialization, agriculture and aquaculture, also leads to changes on the land structure and hydrological flow into the river system. The waterbodies are also a pollution entry point, where the industrial effluents or runoff of sediments from development or land clearance as well as from other form of land use enters through drainage if not directly into streams. It is important to ensure the development towards urbanization is balanced by environmental protection and pollution mitigation measures.

Pollution was observed at different levels at all regions; upstream, midstream and downstream of the UKB area. Different approaches should be implemented for different target group to engage them in the environment management and protection plan. The communities at the upstream of the UKB mainly the Orang Asli depend on the river for water supply and also food. With the land clearance and development at the upstream, for agriculture, tourism industries and development, the livelihood of these people are affected to a certain extent. The Orang Asli communities need to be better informed on possible channels and agencies to address their concern and to enable then to look into alternative livelihood source of income and to protect the water source for future generations.

The peri-urban area refers to a transition or interaction zone, where urban and rural activities are juxtaposed, and landscape features are subject to rapid modification, induced by human activities (Douglas, 2006). These areas are rich with resources such as forest, limestone caves, industrial site, agricultural lands and many more which provides essential life support services for urban residents. The communities within these areas are potential contributors for the environmental problems, where exploitation of the resources for economic need is stronger and may lead to drastic pollution impact if not mitigated and monitored. A balance between the community need and the environment is important for this area, to ensure the sustainability in the long run. In order to ensure the resources within the peri-urban areas are protected and not exploited in excess, pollution reduction and monitoring of the pollution impact is required.

Communities within the urban area are the receiver of all the benefits of the resources from both the upstream and the midstream area. The communities in urban area are also the contributing pollution agents through runoff especially sullage water from households. The communities in urban area need to be enhanced with skills and knowledge to take action to address pollution and well as voice out their concerns.

CHAPTER 6: CONCLUSION 6-2

The findings of the UKB Environmental Assessment Report indicate the following:

- Land Use
    - The estimated total population in UKB (2010) was 653,838 with a population density of approximately 938 persons per square kilometers**.**
    - The total area of UKB is 69,832 ha with forest being the largest land use type (52.1 %) followed by agriculture covering an area of 9,377.2 ha, residential (7,158.6 ha) and transport facility (7,090.4 ha).
    - The overall water bodies at UKB are recorded at 721 water bodies with the overall land use are 853.4 ha or 1.2% of total area in UKB.
    - Though, water bodies are with minimal percentage, but impacts of human activities such as agriculture, development, industrial activity and so on will have greater impacts on them.
- Pollution Source
    - A major pollution source is the serious landslides and erosion along the Simpang Pulai – Cameron highway in the upper part of the UKB. It poses not only great danger for the human life, but also posed greater problem to the river and the water supply dam. In addition to landslide due to construction of the highway, land clearance also leads to erosion and landslides.
    - Beside siltation, agriculture, agro tourism at upstream of the Kinta water catchment, orchard cultivation and rubber as well as oil palm plantation also will contribute to pollution due to fertilizers/pesticides used.
    - Solid waste is another alarming issues along the water bodies, it used to be a normal sight within the midstream and downstream of the UKB site. However with the development at upstream, construction waste and food waste generated also ends up at the valley. In addition, the upstream (Simpang Pulai-Cameron Highland) site which is quite famous among the tourist as stopping point also contributes to rubbish accumulation at the valley. If the issues are not addressed, the waste trail will end up at the Sultan Azlan Shah Dam.
    - Development (sedimentation) and sullage discharge are the main observed issues at the midstream of the UKB. The situation indicates worrying status as pollutants being transported to waterbodies.
    - Downstream UKB reported mix of pollution sources ranging from sullage discharge from wet markets, clogged drains, and sedimentation issues.
    - Overall all three regions of UKB recorded very poor solid waste disposal and might have impact on few water quality parameter beside the aesthetic values. .
- Water Quality
    - Water quality of UKB reported WQI of 68 (Class III) which represents slightly polluted condition. COD and BOD reported exceeding Class IIB standard indicating high level of organic pollution in UKB. Turbidity spike after one particular development activity in upstream UKB shows direct impact of land clearing on the river and waterbodies.
    - Its shows the need proper mitigation by the developer and close monitoring by the authority.
    - The high turbidity and silt levels Higher concentration at the upstream before and at the dam site, after the mitigation (excavation to remove the silt) indicates a better and sustainable solution is required to address the issues.

- Biomonitoring
    - Presence of benthic macroinvertebrates in all of the three regions, indicating UKB is good habitat for aquatic animals which also reflecting suitable measure of water quality along with physico-chemical water quality monitoring. The dominant family in upstream UKB was mayfly which showing this area is in relatively clean status. However, snails and worms observed in middle and downstream of UKB, demonstrated that human activities in these areas had negative impacts by on the waterbodies.
- Perception Survey
    - Half of those interviewed (49%) do not know the source of their drinking water. This is really alarming as could lead to care-less attitude towards the water catchment protection.
    - Usage of recycle papers recorded the least (8%) environmental activity that being practiced by respondents.,
    - Higher percentage (68%) of the respondents agreed on having clean environment, rivers and forests. Social media reported the most preferred (52%) platform of learning method for conservation or sustainable lifestyle. Hands-on activities also reported among the most preferred (47%) method to learn on conservation and sustainable lifestyle.
- Overall Consultation with Key Stakeholders:
    - All the stakeholders have their own objectives and are currently implementing their action plan without SMART Partnership Approach.
    - The undertaken programme or activities that focused for the environment protection, economic growth, socio economic and community empowerment are not integrated nor sustained.
    - There is no project working group or agencies that are working towards leveraging and sharing their action plan, initiatives or to brainstorm to implement or to address any pertaining issues

6.2 RECOMMENDATION

The UKB needs to be protected and managed sustainability as it provides potable water for Ipoh. Therefore, a sustainable management strategy with workable financial mechanism needs to be developed. Pollution and environment deterioration is expected to take place and cannot be avoided. Therefore mitigation to lessen the impact needs to be carried out. In order for the communities to be able to address the issues, they need to be empowered through awareness, knowledge, skill as well as platform to implement their action plans.

It is recommended that the implementation must involve all the key stakeholders; government agencies, service providers, the Orang Asli as well as the peri urban and the urban communities with different action plans. The recommendation for all the target stakeholders and groups is tabulated in **Table 6.1**.

Table 6.1: Strategies and proposed action plan

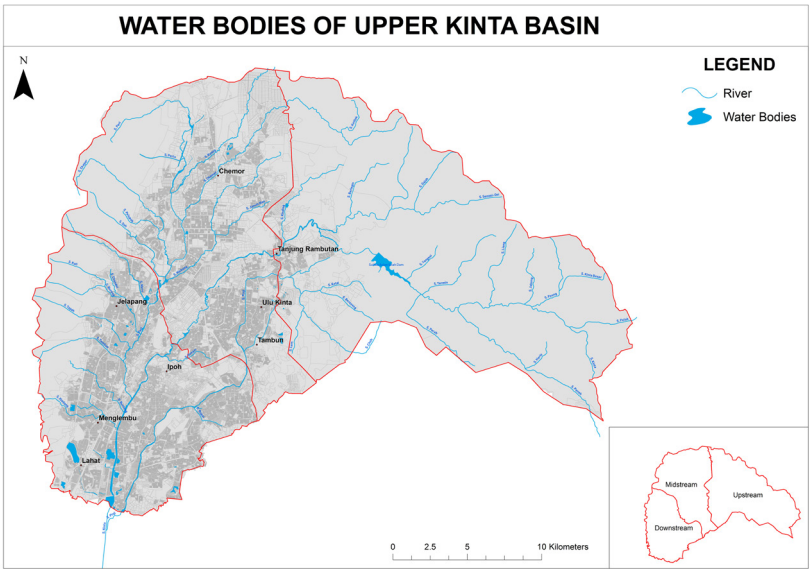
Strategies	Proposed action Plan
Strategy for forest and water resource management of the upper Kinta basin developed and adopted by the Orang Asli, local community and related government agencies	1. Stakeholder workshop on basin management Workshop for Government Agencies, Private Sector, Communities and Civil Society 2. Establishment of Upper Kinta Basin Project Working Group (PWG) to ensure the stakeholders are committed to incorporate SMART engagement with the stakeholders to reduce and mitigate the pollution load. A comprehensive Mechanism to address the identified key issues for long term benefits needs to be developed. 3. Develop Upper Kinta Basin Management Strategy (UKBMaS) which will serve as key reference and guidance for agencies as well as other relevant stakeholders, including the communities. 4. Promote the strategy to key stakeholders for adoption of UKBMaS via exhibition, leaflet materials and workshop for stakeholders 5. Work together with the travel guide that is currently working with the Orang Asli to incorporate ecotourism and economic model for the local communities. 6. Develop financing mechanism for the strategy implementation by exploring the possibilities for Payment for Ecosystem Services (PES) and Corporate Social Responsibility (CSR). 7. Setup Information materials corners or signboards to address the impact of their action at designated areas especially upstream targeting tourist (to address the solid waste dumping & fertilizer runoff) 8. Promote for the proposed Payment for Ecosystem Services (PES) to protect and conserve the state's forests to include UKB site as one of the pilot site with support of Perak Forestry Department and other agencies. 9. To take immediate action by relevant government agencies (especially JKR, DOE, LAP) with regard to control of erosion at the Simpang Pulai to Cameron Highway and sedimentation of the Sultan Azlan Shah Dam

	10. Support Orang Asli community and plantation management company on management of orchards and plantations to minimise erosion and run-off 11. To engage with the relevant agencies and department to engage the agriculture and tourism industries to address the impact of pesticide on the water catchment (if any) and to come out with possible action to mitigate their action to the environment.
Forest management and river protection issues addressed or managed by community driven platforms	1. Establishment Platform/Forum for Engagement of Communities through Capacity building – engagement Platform for Orang Asli, peri urban and urban communities and localized trainings for empowerment. 2. Orang Asli engagement in forest protection and Rehabilitation - Training on socio economic and environment monitoring and localized initiatives 3. Urban and peri-urban river pollution prevention and livelihood activities – Training, Monitoring and Implementation on Pollution Mitigation Initiatives (i) Waste minimization initiatives 4. Environmental education and outreach – public awareness campaigns and promotional Materials. (i) River Address (ii) Campaigns and programs targeted to specific groups within the communities such as schoolchildren, youths, homemakers, and hawkers. (iii) Demarcation and marking of protected areas for public awareness. (iv) Dissemination of information leaflets or boards to community concentrated areas, such as neighborhood centres, mosques, temples, and markets. (v) Setting up information booths by the agencies for public awareness on the responsible authority protecting and managing the natural resources (vi) Advocate the banning of single-use plastics (vii) Engage corporations or big businesses to support advocacy and awareness campaigns

The recommendation is expected to be able to fulfill and guide the targeted groups to implement and monitor the environment especially water and forest and will be able to achieve the targeted indicator for the project i.e.:

- A monitoring framework for the Upper Kinta basin management strategy (UKBMaS) adopted by relevant key stakeholders
- State government/agencies had various financing mechanism option identified to implement the UKBMaS
  Targeted stakeholders (Orang Asli, local community and related government agencies) adjust their behaviours and practices - GEC to think about how to measure this, i.e. by looking at tracking the number of stakeholders who have adjusted their behaviours or tracking the decrease in types of negative behaviour and practices by the stakeholders.
- The upper water catchment monitored by communities (Orang Asli and urban/peri-urban)
- Community-based river basin mitigation measures implemented

UPPER KINTA BASIN ENVIRONMENTAL ASSESSMENT REPORT



PREPARED BY:

Global Environment Centre

IN COORPERATION WITH:

YAYASAN HASANAH

A foundation of Khazanah Nasional

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CHAPTER 1: INTRODUCTION 1-1

1.1 BACKGROUND

Integrated Management of Kinta River Basin for community and ecosystem services through active community and stakeholder participation is a project initiated by Global Environment Centre (GEC). The project is funded by Yayasan Hasanah and is being implemented over a duration of 36 months, from May 2018 to April 2021. The project aspires to bring together the governing agencies, local communities, and private sectors in a bottom-up integrated approach to managing and conserving the forest and rivers in the Upper Kinta Basin (UKB), and to streamline the forest and riverine habitat conservation into development planning and policies. In this project, the local community is seen as a critical component of managing water resources as a soft-path management instrument.

The prime interest of the project is the Upper Kinta Basin in Perak. The Kinta River, which forms the Kinta Valley, is bounded by the Main Range to the east and the Keledang Range to the west. The Kinta river which flows from Gunung Korbu in Ulu Kinta at an altitude of around 2000 m above the sea level is 110 km long with the catchment area of 2,540 km^2. The Kinta River is an important water supply source to Ipoh inhabitants and its surrounding areas. The river basin has high biodiversity and is rapidly urbanizing. The state capital visions itself as a sustainable, dynamic, and excellent city by 2020. However, just as other fast-paced developing cities in Malaysia, it is a constant battle balancing urban growth, economic development, and protecting environmentally sensitive areas. A Basin-wide approach is an appropriate unit for integrated management. A basin-level perspective allows addressing the linkages between water resources management and the management of land and other related resources effectively. The importance of water resource conservation should be recognized at the highest level of decision-making as well as at the grassroots level.

This project through one of the key output, Upper Kinta Basin Management Strategy (UKBMaS) also supports the Perak State Structural Plan 2040 (*Rancangan Struktur Negeri Perak 2040*, RSN) under the Planning Policy item 23: Strengthening/empowering the role of community in caring for the environment. Moreover, the project also supports Malaysia's efforts in achieving the 2030 sustainable development goals (SDGs). Six out of the 17 SDGs goals are addressed within the project, which are:

- SDG 6 - Ensure availability and sustainable management of water and sanitation for all
- SDG 8 - Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
- SDG 11- Make cities and human settlements inclusive, safe, resilient and sustainable
- SDG 12 - Ensure sustainable consumption and production patterns
- SDG 13 - Take urgent action to combat climate change and its impacts
- SDG 15 - Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Under the project objective 2, a number of activities will be implemented to encourage responsible river usage, water consumption and waste management through community engagement. This supports the SDG 6 targets to improve water quality by reducing pollution, increase water-use efficiency, implement integrated water resources management, and to protect and restore water-related ecosystems by 2030. The proposed activities will be focused on supporting and strengthening the participation of local communities in improving water and sanitation management. Similarly, under SDG 11 and 12, the target for education environmental impacts will be focused on efficient use of natural resources and waste management including chemicals and food.

The public awareness programmes were designed to incorporate the SDG 12 and 13 by aiming to ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature, and to improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning, respectively. This project also intends to encourage entrepreneurship and job creation through supporting the Orang Asli community to establish small-scale nursery as part of tree planting initiative, providing small-scale skill training and supporting the community-based initiatives such as hiking tour guiding and nature-based tourism. This is directly within the SDG 8 goal, where one of the key implementations is to devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products by 2030. In summary, the UKBMaS initiatives at the state-level, supports the SDG 15 targets which includes to promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally, and secondly to integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts by 2020.

1.2 OBJECTIVES

The main goal of the Upper Kinta Integrated River Basin Management is to conserve forests and riverine habitats in the Upper Kinta River Basin to support the Central Forest Spine initiative (CFS) through cross-sector partnership and community empowerment.

The project aims to achieve its goal through two objectives, which are:

1. To develop and adopt a strategy for forest and water resource management of the upper Kinta basin; and
2. To establish communities engagement to address issues regarding forest management and river protection

The outcome of this project will be the empowerment of the stakeholders especially Orang Asli and the urban/peri-urban communities on the forest and water resources monitoring and protection, and the implementation and adoption of the monitoring framework as defined in the UKBMaS by all relevant stakeholders. A number of key activities as tabulated in **Table 1.1** are proposed under the respective objectives to accomplish the above-stated outcomes:

Table 1.1: Project key activities

Objective	Key Activities
1) To develop and adopt a strategy for forest and water resource management of the upper Kinta basin	1.1 Diagnostic assessment of the UKB (as described in this report)
	1.2 Stakeholder workshops and consultation on basin management
	1.3 Establishment of project working group
	1.4 Develop the UKBMaS for implementation
	1.5 Promote strategy to key stakeholders for adoption
	1.6 Develop a financing mechanism for the strategy implementation
2) To establish communities engagement to address issues regarding forest management and river protection	2.1 Establishment of a platform for community engagement through capacity building
	2.2 Orang Asli engagement in forest protection and rehabilitation
	2.3 Urban and peri-urban river livelihood and pollution prevention activities
	2.4 Environmental education and outreach

1.2.1 Target beneficiaries

There are four groups of beneficiaries targeted for the project which has been divided based on their distribution area within the project site. Essentially, the target beneficiaries are the key users of the water resources and the ecosystem services provided by the forest and riverine biodiversity in the project area as tabulated in **Table 1.2**.

Table 1.2: Target beneficiaries (communities) and the corresponding ecosystem services

Beneficiary	Ecosystem services
Orang Asli communities.	• Water supply • Livelihood
Peri-urban and urban communities	• Water supply • Amenity value
Stakeholders such as government agencies and private organizations	• Economic value • Amenity value
Downstream users of the river (outside project area)	• Amenity value

In addition to the communities, respective governing agencies responsible for river and catchment management, forest management, pollution control, and local planning and coordination are also the beneficiaries of this project as they share similar interests.

1.3 BASELINE STUDY

Managing water resource systems are directly and indirectly affected by the interaction of numerous human-related drivers of change such as:

- Governance (e.g. institution, legal framework);
- Demography (e.g. population growth, gender, urbanization);
- Land use (e.g. agriculture, urbanization, deforestation, pavement);
- Social conditions (e.g. education, culture, poverty);
- Technology (e.g. water use technologies, information technology);
- Economy (e.g. industrialization, globalization); and
- Climate change and variability – uncertain driver

This diagnostic assessment and data collection, conducted from May – November 2018, provides information to support in achieving the intended outcome of the project through active community and stakeholder participation. The assessment details out the demographic breakdown of the population, current land use, condition of the upper Kinta River and its main tributaries, community perception, and potential sources of pollution within the project area. This baseline reports the summary of the understanding and appreciation of the current state of affairs and stakeholder viewpoint within the project area.

This diagnostic assessment is essential to guide the development of the Upper Kinta Basin Management Strategy (UKBMaS) and the design of the community engagement programmes. It will also form the basis for subsequent monitoring and review, post-implementation of the results of the stakeholder engagement programmes. The UKBMas expected to be used as guidance and reference for relevant agencies and communities to ensure that the natural resources, particularly the forest and riverine habitat, is protected and sustained for the future.

1.3.1 Format of this report

The report is divided into six chapters describing different aspects of the diagnostic assessment. In addition to this introductory chapter, this report describes the following chapters:

Chapter 2: Upper Kinta Basin – This chapter provides information on the project area, including the demography and current land use.

Chapter 3: Pollution Source Inventory – This chapter outlines the sources of pollution in the project area, water quality study which describes the water quality status of rivers within the project area. In addition, this chapter will also provide information on the health and conditions of the water bodies, through the bio indicator studies focusing on macroinvertebrates.

Chapter 4: Stakeholder Perception Survey – This chapter describes the findings and results of the interviews and questionnaires carried out to assess the awareness level regarding forests, rivers and water resource, willingness to participate in the outreach programs and their current practices, if any, on environmental management.

Chapter 5: Linkages to Central Forest Spine – This chapter links the UKB to the Central Forest Spine as an ecological corridor, highlighting the issues and challenges.

Chapter 6: Overall Conclusion – This provides all the pertinent findings from the diagnostic assessment along with recommendations for the design stage.

CHAPTER 2: UPPER KINTA BASIN 2-1

2.1 PROJECT AREA

The project focuses on the upper reach of the Kinta River (hereafter referred to as Upper Kinta Basin). The Upper Kinta basin (UKB) covers an approximate area of 69,736 hectares[1], encompasses Chemor to the north, Lahat to the south, and other major towns such as Ipoh, Tanjung Rambutan, Jelapang, Tambun and Ulu Kinta. The UKB lies entirely in Mukim (sub district) Ulu Kinta in the Kinta district. The Ulu Kinta sub district is divided into Chemor, Ipoh, Lahat, and Tanjung Rambutan, administered by the *Pejabat Daerah dan Tanah Ipoh*. The project area is within the local authoritative administration of the *Majlis Bandaraya Ipoh* (MBI).

For the purpose of this project, the UKB area is divided into three main zones to facilitate project planning, designing and implementation as shown in **Figure 2.1**. The zones, identified as upstream, midstream, and downstream, represent the different regions of the Upper Kinta River that is within the project area.

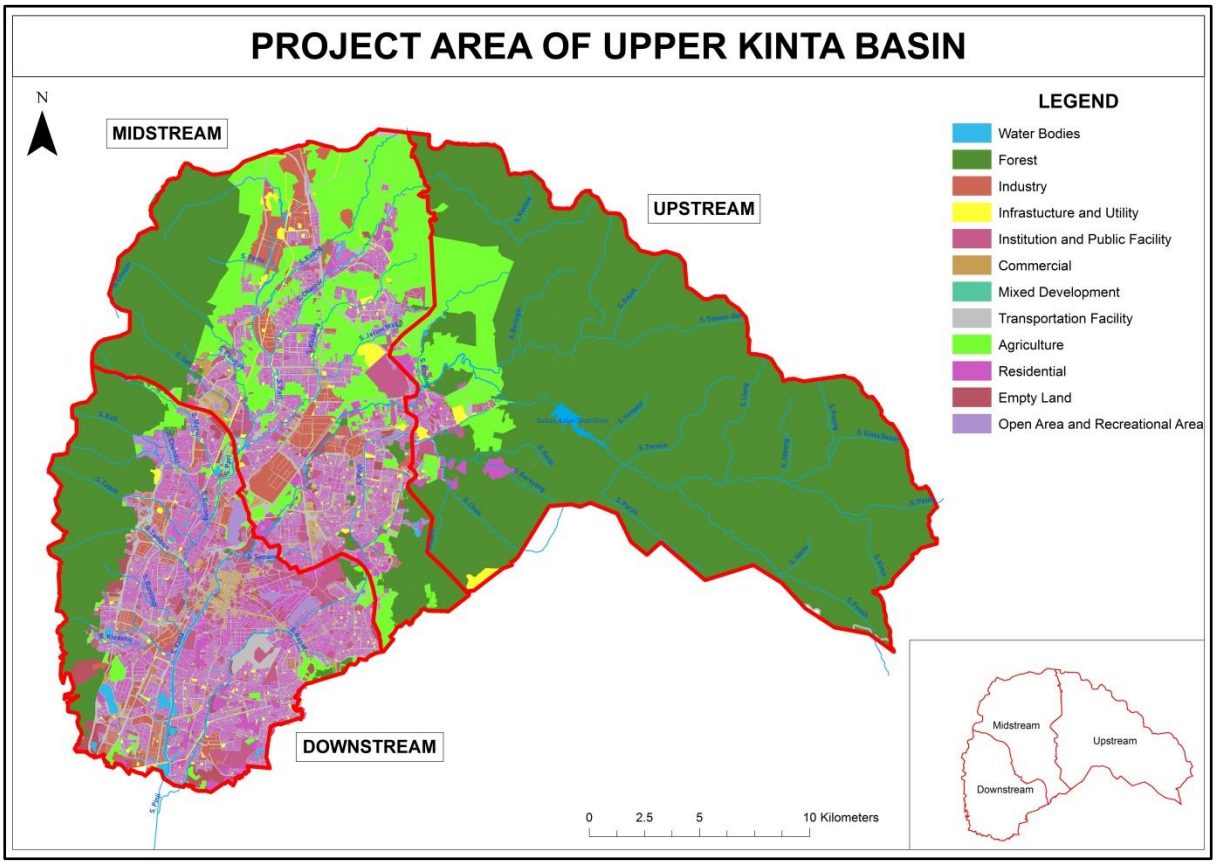


Figure 2.1: UKB project area

i. **Upstream:** Represents the upper portion of the Kinta River, to the east of the project area. The topography is hilly and mountainous with elevation ranging from

[1] *Jabatan Perancangan Bandar dan Desa* Perak, 2017

approximately 175 m above sea level (masl) to the highest peak at Yong Belar Mountain on the Main Range, at 2181 masl[2,3].

ii. Midstream: Represents the middle portion of the upper Kinta River, which includes a portion of the Pari and Pinji basin. The midstream section begins from the towns fringing the green areas in upstream, namely Chemor, Tanjung Rambutan, and Ulu Kinta, towards the North-South Expressway that bisects UKB. The elevation in the valley ranges from approximately 50 masl at the Kinta River bank, to Peninjau Mountain 1058 masl on the Keledang Range to the west, and 938 masl at Juang Mountain to the east[2,3].

iii. Downstream: Represents the lower portion of the upper Kinta River, where Ipoh town is located. The Kinta River separates Ipoh old town and new town. The topography of the downstream zone is generally higher on the range to the west, gradually decreasing towards the floodplain, and then slightly increases to the east. The elevation ranges from approximately 808 masl at the peak of Keledang Mountain to 30 masl near the Kinta River bank at the UKB boundary[2,3].

2.2 METHODOLOGY

The methodologies for undertaking the assessment of Upper Kinta Basin are as follows:

i. Land use and demographics assessment of Upper Kinta Basin – analyzed based on the satellite image analysis, secondary data collection, and field verification.
   - Site survey along Sungai Kinta basin especially after Sultan Azlan Shah Dam down to Orang Asli community, peri-urban and urban site.
   - Google Earth Mapping.
   - Secondary data from PLAN

ii. Pollution mapping and water quality monitoring – focuses on erosion/land clearance in upper basin and around settlements. The methods used for pollution mapping and water quality monitoring will be through:
   - Site survey along the upper Sg. Kinta
   - Google Earth Mapping
   - Secondary data of Water Quality Data from the Department of Irrigation and Drainage Perak & Kinta, Department of Environment as well as Lembaga Air Perak
   - Selected Water Quality Sampling/Analysis by project team; in-situ parameters and accredited lab Water Quality Analysis – APHA means Standard Methods for the Examination of Water & Wastewater, 21st Edition, 2005; American Public Health Association (APHA), American Water Works Association (AWWA) & Water Environment Federation (WEF).

     Biological Monitoring – provides accumulative assessment of environmental performance by integrating over the long-term effects of all sources of

[2] *Jabatan Ukur dan Pemetaan Malaysia,* 1986
[3] Google Earth Pro

environmental pressure involving land use and changes to water quantity and quality.

iii. Stakeholder Engagement: Organize briefing and consultation meetings with key relevant stakeholders.
- Organize individual and group consultation with key stakeholders like Department of Irrigation and Drainage Perak/Kinta; Lembaga Air Perak, Department of Forestry Perak and Department of Environment Perak.

2.3 SECONDARY DATA ANALYSIS

2.3.1 Climate

The project site experiences abundance sunshine and typical equatorial climate, humid with high temperature all year round. The mean annual humidity ranges from 63% to 99% with the lowest usually recorded in February and the highest usually recorded between October to November. In general, the climate within UKB is hot and wet with the seasons relatively defined as tabulated in **Table 2.1**. The daily temperature generally varies between 23°C and 32°C, where low air temperature occurs from December to January and the highest air temperature usually occurs from April to May. The annual rainfall ranges between 2,000 mm to 2,400mm.[4]

Table 2.1 The annual seasonal climate period within the project area

Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov
North–East Monsoon			Transitional period			South-West Monsoon			Transitional period		

The project site is sheltered from the Northeast monsoon, hence receives limited rain during this season. In contrast, the Southwest monsoon, from May to July, accumulates moderate rainfall. The peak of rainfall occurs from April to May and August to October during the transition period between the monsoons. Major floods generally occur between the months of July to December. In some events, occasional spills over the mountain range during the Northeast monsoon cause floods in November and December.[4]

2.3.2 Geology and soil type

UKB is located in the Western Tin Belt of Peninsular Malaysia and composed of Devonian sedimentary rocks of limestone. The floodplain soils range from well-drained levee soils to poorly drained heavy clays and peat soils in very poorly drained areas. Most soils are suitable for a wide range of crops. The terrain is flat to gently undulating has a general alluvial landscape that is underlain by unconsolidated to semi-consolidated sediments of variable thicknesses deposited during the Quarternary age in a variety of environmental settings. The mountain ranges are entirely of sedimentary rocks, mainly of fine-grained sandstone with interbedded shales, mudstones and minor siltstones probably of Carbo-Permian Age.[4]

[4] Sungai Perak IRBM Study, 2010

2.3.3 Water supply

Kinta River is one of the main tributaries of Perak River, flows from Mount Korbu at Ulu Kinta, Tanjung Rambutan to Perak River. Its main function is for water supply. Three (3) main rivers that flow through UKB are Kinta River and its two (2) tributaries: Pari River and Pinji River. Pari River confluences with Kinta River near Menglembu, while Pinji River meets Kinta River after the UKB boundary site. **Figure 2.2** shows the water body within UKB project site.

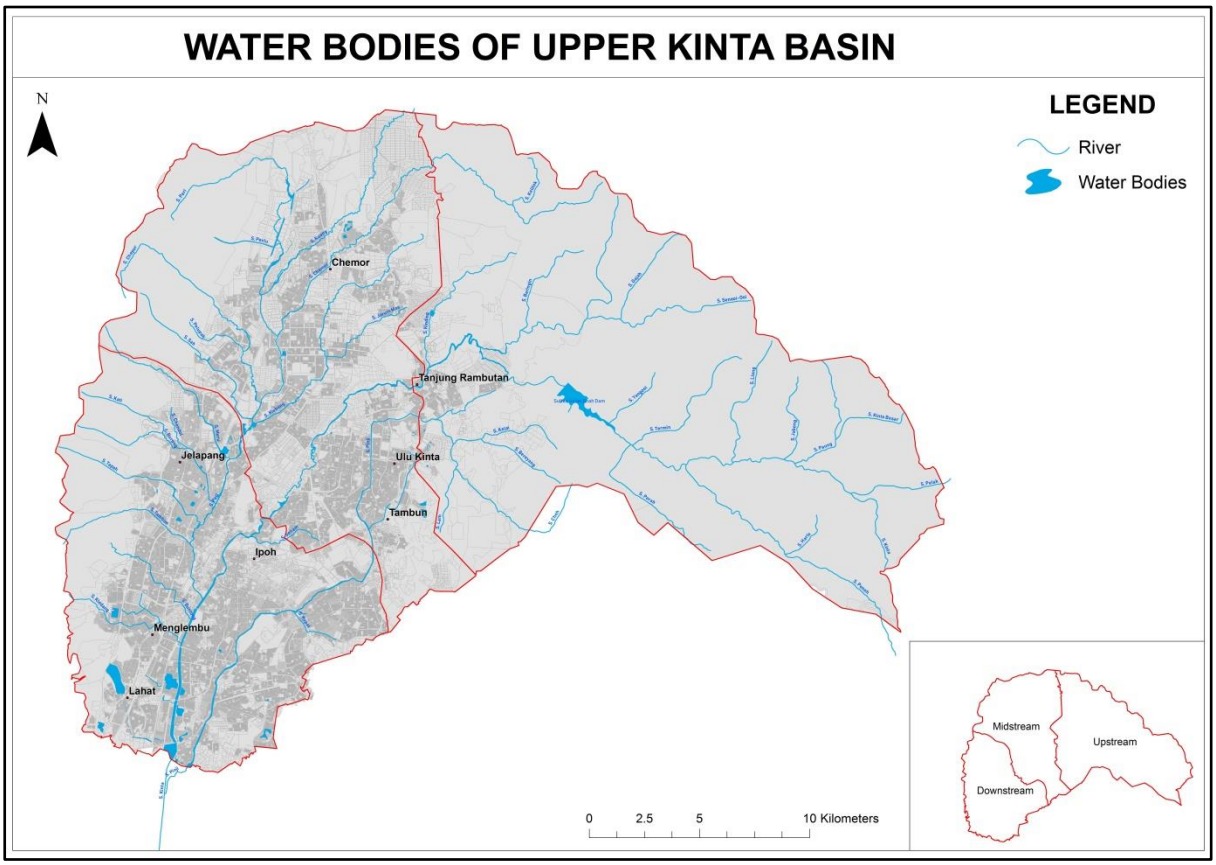


Figure 2.2: Water bodies of Upper Kinta Basin

Sultan Azlan Shah Dam is the first in the country that adopted the roller compacted concrete construction technique, where its construction period started in 1997 and was officiated on August 2, 2007. The dam was the last phase of the Greater Ipoh Water Supply II Scheme under Lembaga Air Perak (LAP). The RM253 million dam can produce 639 million litres of water per day and is expected to meet demand in the Kinta Valley up to 2020. It was constructed in order to raise the water supply of Perak by 25%. It is aimed to increase water output for the Kinta district (including Ipoh city) from 136 million litres daily (MLD) to 639 MLD to cater for 350,000 consumers.

The two main issues faced by the LAP to date are due the sedimentation and limited water stored during the dry season. The issues on the sedimentation at the Sultan Azlan Shah Dam currently were addressed via excavation of the sedimentation from the dam to maintain the water storage volume in the dam. The observed sedimentation at the dam is made up of

a variety of materials, including fine particles of silt and clay and larger particles of sand and gravel. The excavation processes take place in three (3) stages at the check dam. Three (3) check dams were constructed before the Sultan Azlan Shah Dam by the LAP to control sedimentation. This area is an active erosion environment because of the erodible material in the stream and check dams[5]. Check dams are commonly used to stabilize sedimentation, reduce the water velocity, limit catchment erosion, and increase the reservoir storage capacity of a dam.

The Kinta River is the main water source of the municipal water pipeline to the urban and peri-urban areas within UKB, enabled by LAP. LAP operates the Sultan Azlan Shah Dam and the two water treatment facilities that provide water supply to different parts of UKB; the Sungai Kinta Water Treatment Plant (WTP) and Ulu Kinta WTP. Only these two WTP are dam regulated in the Kinta district, while the rest are by the run of river scheme. The Sungai Kinta WTP is the second largest WTP in the district with a design capacity of 227 millions litres per day (MLD) (**Table 2.2**). **Table 2.3** shows the rivers contributing to the dam reservoir. The major demand points are from the town areas of Ipoh, Kampar and Tapah[4]. Based on historical data of water consumption in Ipoh (**Table 2.4**), the demand for water is expected to increase with increasing population in the future, thus depleting unregulated available water.

Table 2.2: Existing WTPs within UKB

Water treatment plant	Water sources	Forest reserve	Design capacity (MLD)
Ulu Kinta	Kinta river	Bukit Kinta	136.38
Sungai Kinta	Kinta river	Bukit Kinta	227.30

Source: Lembaga Air Perak, 2013

Table 2.3: Sultan Azlan Shah Dam catchment

Main River	Tributaries	Tributaries
Kinta	Pipit Dempak Raga Pelak Garing	
	Karok	Kejok, Mentak, Teng Wek
	Terok	
	Kinta Besar	Paung
	Jahang	
	Gerok	Senoh
	Liang Tamong Sempak	
	Penoh	Jenalik, Betek, Hariu, Chemor, Gesa Pok Wok, Buluh, Sheppiet, Tampoi
	Changoi	

[5] LAP, 2014

	Termin Perah	
	Yangooi	

Source: Lembaga Air Perak, 2017

Table 2.4: Water consumption for Ipoh

Year	Water supply to Ipoh (m^3)	Total water consumption in Ipoh (m^3)
2012	130,912,256.00	98,980,428.00
2013	137,386,394.00	100,615,459.00
2014	140,637,591.00	103,058,639.00
2015	141,164,357.00	103,934,278.00
2016	145,033,761.00	109,404,559.00
2017	130,481,853.00	98,622,167.00

Source: Lembaga Air Perak, 2017

2.3.4 Demography

The population is one of the main drivers of water consumption. Aside from consumption for survival, health and well-being, the economic activities and development that grows alongside population lead to impacts on natural resources within UKB. Therefore, knowledge on the current and future population is essential for resources planning and management. The demographic information of UKB is obtained from secondary data by Lembaga Air Perak, Population and Housing Census of Malaysia (2010), Jabatan Kemajuan Orang Asli Malaysia (JAKOA), and Pejabat Daerah dan Tanah Ipoh.

(1) Population

The population density of Kinta district is 432 persons per square kilometer. The majority of its population is of Chinese ethnicity (44%) followed Bumiputera, made up of Malay (38%) and indigenous community (Orang Asli) (0.6%), Indian (14.1%), and non-Malaysian citizen (3%). The estimated total population within UKB in 2010 was 653,838 with a population density of approximately 938 persons per squared kilometers[6]. The number is contributed by the high population density in Ipoh, being one of the largest cities in Malaysia. The population breakdown according to ethnicity within UKB is tabulated in **Table 2.5**. Most of the residents within UKB are concentrated in clusters in Menglembu, Buntong, Tasek, Ampang, Bercham and Pasir Puteh, making the area of Ipoh larger than any other town around the edge of the city. **Figure 2.3** shows the distribution of community settlement within the UKB area. The map shows that the distributions of people are along the river for both the Orang Asli and others. The map also shows that higher population is concentrated within the urban area which have more economic outcome for the people.

[6] Population and Housing Census of Malaysia, 2010

Table 2.5: Total population by ethnic groups within UKB

Area	Malaysian Citizen							Non-Malaysian Citizen	Total
	Bumiputera			Chinese	Indian	Others	Total		
	Malay	Other	Total						
Chemor	477	3	**480**	1,016	323	12	**1,831**	23	**1,854**
Jelapang	172	12	**184**	3,169	483	11	**3,847**	51	**3,898**
Lahat	8	N/A	**8**	284	81	N/A	**373**	25	**398**
Ipoh	126,419	2,137	**128,556**	226,853	67,745	1,173	**424,327**	9,877	**434,204**
Tambun	375	1	**376**	264	78	3	**721**	38	**759**
Tg.Rambutan	3,254	19	**3,273**	902	2,494	18	**6,687**	153	**6,840**
Other areas	118,066	1,548	**119,614**	54,982	21,234	339	**196,169**	9,716	**205,885**
Total	**248,771**	**3,720**	**252,491**	**287,470**	**92,438**	**1,556**	**633,955**	**19,883**	**653,838**

Source: Population and Housing Census of Malaysia, 2010

There are six Orang Asli villages; Kg. Chadak, Kg. Makmur, Kg. Tonggang, Kg. Sg Suluh, Kg. Sg. Choh and Kg. Sg. Baduk within UKB (**Table 2.6**). All these villages are located either along Kinta River or Seno-oi River. All the villages are managed by Jabatan Kemajuan Orang Asli Malaysia (JAKOA) Batu Gajah under a plan called Rancangan Penempatan Semula Orang Asli Ulu Kinta. The easiest village to access is Kampung Chadak and Kampung Tonggang. Kampung Sg Suloh is about 2km away from Kg Chadak and the access road started from Kg Chadak. Kampung Sg Suloh can also be accessed from Kampung Tonggang via 2km road. Kampung Makmur located about 4km away from Kg Chadak on winding hilly road.

The Temiar and Semai tribe were found within the site with most of the Temiar tribe located within Kampung Chadak, Makmur, Tonggang, and Sg. Suluh whereas the Semai[7] were found in Kg Sg. Choh. The main Kg Makmur is made up of five villages that were relocated during the construction of the Sultan Azlan Shah Dam.

Some of the initial discussion and consultation with the Orang Asli communities indicate the followings:

- Kampung Chadak is the only village that is located directly along the Kinta River.
- Kampung Makmur, Kampung Sg. Suloh and Kampung Tonggang are situated within sub-basin of Senoi-oi River.
- The Kampung Chadak community cannot use the Kinta River flowing adjacent to the village for their water supply or fishing activities due to high siltation effect.
- Kampung Chadak's drinking water supply comes from another tributary known as Tongyang River. Whereas drinking water for Kampung Makmur is from Senoi-oi River and Kampung Sg. Suloh from Suloh River.

[7] Sungai Kinta Dam EIA (1998)

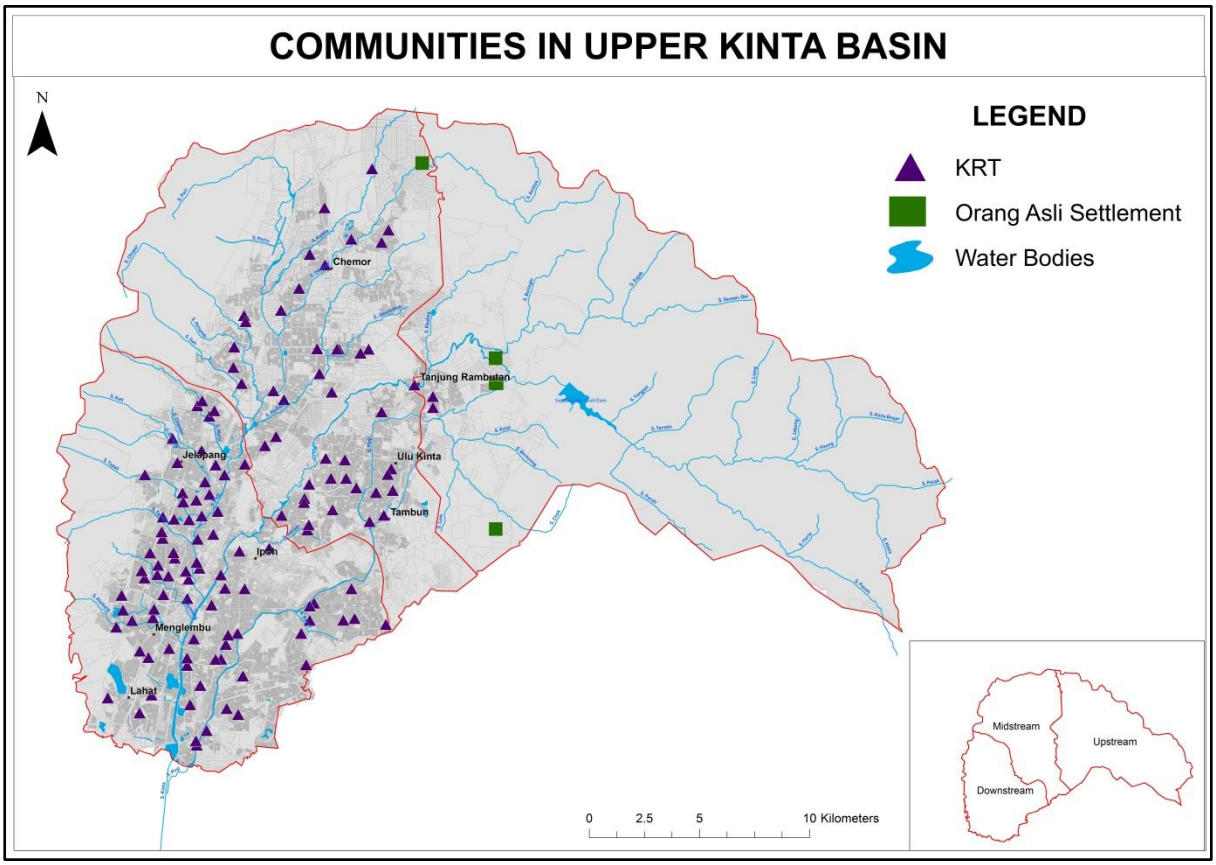


Figure 2.3: The communities in Upper Kinta Basin

Table 2.6: Orang Asli community within UKB

Village name	Number of residents	Average household	Public facility				Utilities	
			Community hall	Primary school	Pre-school	Prayer room	Water	Electric
Kg. Chadak	474	4	Yes	No	Yes	Yes	Gravity	Yes
Kg. Makmur	625	2	Yes	No	Yes	Yes	Gravity	Yes
Kg. Tonggang	372	4	Yes	Yes	Yes	Yes	Gravity	Yes
Kg. Sg Suloh	167	3	No	No	No	Yes	Gravity	Yes
Kg. Sg. Choh	163	3	Yes	No	No	Yes	Gravity	Yes
Kg. Sg. Baduk	125	3	No	No	No	Yes	Gravity	Yes

Source: JAKOA, 2014

(2) Projected population

The Kinta district population projection is shown in **Table 2.7**. The projections, exhibit an increasing trend to 2050. On average, it is expected that the population in Kinta district will increase by approximately 33% in 2050.

Table 2.7: Population projections (in thousands) under high, medium and low variant assumptions for Kinta district

	2020	2030	2040	2050
High	999	1126	1211	1291
Medium	973.6	1020.2	1064.9	1090.3
Low	879.6	928.2	965.9	987

Source: Population and Housing Census of Malaysia, 2010

(3) Urbanization

Peninsular Malaysia experienced rapid urbanization over the past decades whereby the proportion of people staying in urban areas increased from 28.7% in 1970 to 65% in 2000. UKB is considered highly urbanized with relatively 90% of the population living in urban areas. Based on the data available for Kinta district, at the current rate of growth, UKB is expected to be fully urbanized in 2040 (**Table 2.8**)[8].

Table 2.8: Projected urbanization level in Kinta district 2020-2050

Year	2020	2030	2040	2050
Percentage	93	96	100	100

2.3.5 Land use assessment

Land use and water resources are inseparable. The current land use and practices can affect the quantity and quality of water resources. The change in land use impact on water resources, for example through changes in catchment yields, infiltration rates, dissolved organic carbon and nutrient transfers. The significance of this land use assessment is to identify and document the current land use within UKB as a basis for subsequent monitoring references and review.

The 2017 land use database from the Jabatan Perancangan Bandar dan Desa Negeri Perak (PLAN) was used as the main reference for the land use assessment. The land use databases shared are in the editable shapefile format (*.shp*) for the entire Kinta district. For the purpose of the project, only the land uses within the Mukim Ulu Kinta were maintained, cropping out the rest of the district. This step was carried out using the ArcGIS version 10.3. Minor modifications were done on areas with no information identified by empty spots on the map. The land uses in these areas were corrected to match the neighboring land uses, cross-validated with Google satellite imagery and on-site verification.

[8] Population and Housing Census of Malaysia, 2000

2.4 LAND USE WITHIN UKB

The total area of UKB is 69,832 ha. Overall, the largest land use type within UKB is forest, which is more than half of the total size of UKB (52.1 %). Second largest is agriculture covering an area of 9,377.2 ha, followed by residential (7,158.6 ha) and transport facility (7,090.4 ha). The main land use(s) are shown in **Table 2.9** and the land use map of UKB is in **Figure 2.4**.

Table 2.9: Breakdown of land uses within UKB area according to the zones: upstream, midstream, and downstream

	Upstream		Midstream		Downstream		Total		
Type of Land Use	**Unit**	**Area (ha)**	**Unit**	**Area (ha)**	**Unit**	**Area (ha)**	**Unit**	**Area (ha)**	**%**
Water Bodies	77	64	179	245	465	545	721	853	1
Forest	300	26841	260	5259	309	4277	869	36,377	52
Industry	0	0	2189	1,491	6016	841	8,205	2,331	3
Infrastructure and Utility	132	156	1173	502	1210	231	2,515	888	1
Institution and Public Facility	83	1210	696	879	1082	1173	1861	2181	3
Commercial	238	9	10336	449	13673	500	24,247	958	1
Mixed Development	0	0	3	2	4	0	7	2	0
Transportation Facility	20	275	448	3066	245	3752	713	7090	10
Agriculture	1240	2418	5100	6275	3213	684	9553	9377	13
Residential	4169	405	103769	2657	141502	4097	249440	7159	10
Empty Land	2206	61	3230	268	5683	841	11119	1170	2
Open Area and Recreational Area	146	31	1564	530	1982	884	3692	1445	2
Total	**8611**	**30389**	**128947**	**21621**	**175384**	**17822**	**312942**	**69832**	**100**

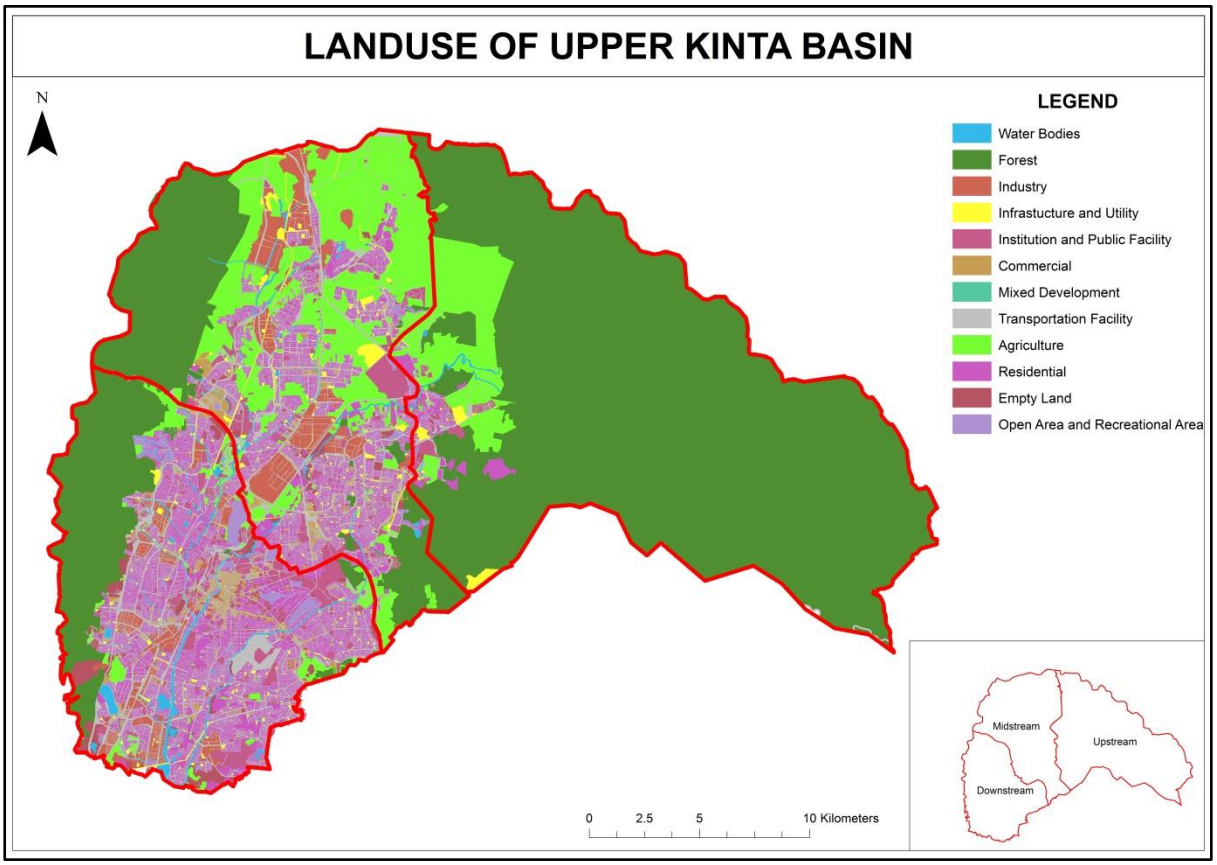


Figure 2.4: Land use of Upper Kinta Basin

2.4.1 Forest

The total area recorded within UKB as forest is 36,377 ha with 73.8% of it is within upstream, followed by the downstream (4,2767 ha) and the lowest at the midstream (5,259 ha). Within this land use, Bukit Kinta on the Main Range and Keledang Range, is Environmentally Sensitive Areas (ESA) in Perak where else Hutan Simpan Kekal Bukit Kinta covers an area of more than 65,000 ha. This forest reserve is managed by Perak State Forestry Department through Kinta District Forest Officer Office. The permanent forest reserve status was given to this area on 29th August 1930 with gazette number 6158. The highest point is in Mount Korbu which more than 3000 meter above sea level and it is the second highest mountain in the Peninsula of Malaysia after Mount Tahan. The department has taken the necessary steps to gazette almost the entire forest area at Bukit Kinta (green area to the east of UKB) and a small portion of forestland at Keledang Saiong as a 'Water Catchment Area'. A number of high conservation value (HCV) species are found in the UKB area such as the Resak abdulrahman and Gerutu Pasir Daun Besar.

2.4.2 Agriculture

The total area of land use within UKB for agriculture is 13.4% of total land or 9377.2 ha. Most of the agriculture activities are carried out at the midstream with total area of 6275.4 ha with only 2417.9 ha at upstream. The main agricultural activities includes the fruit farms (28.5 ha), rubber plantations (1.7 ha), coconut trees plantations (0.4 ha), palm oil plantations (276.7 ha), mixed agriculture (256 ha) and others (685 ha). Almost 85% of the agricultural land within UKB is not cultivated. There are 20 aquaculture activities carried out within UKB covers 44.1 ha. **Figure 2.5** shows the figure of agricultural and aquaculture activities carried out within UKB which privately owned and in small scale.

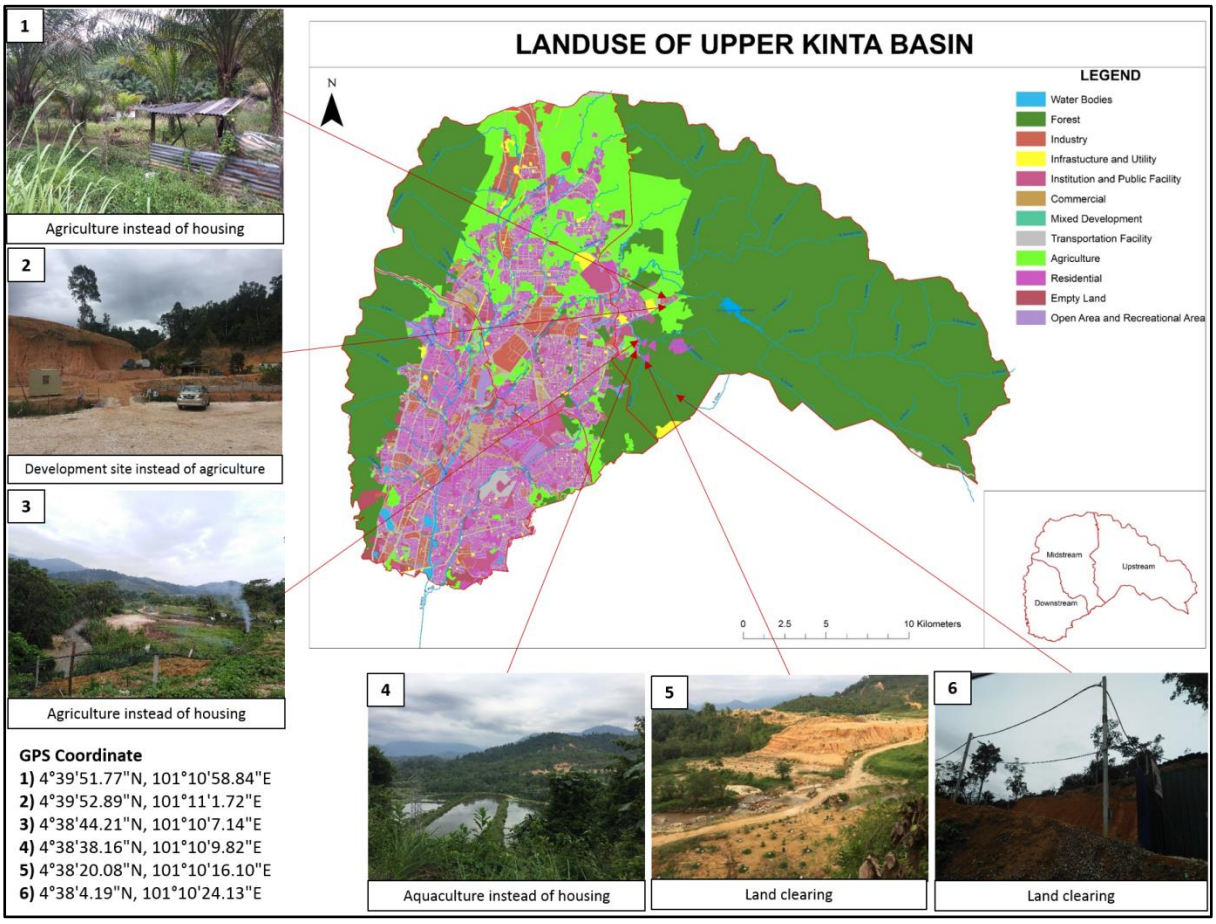


Figure 2.5: Agriculture and aquaculture activities within UKB

2.4.3 Residential and transportation facility

The residential area is highly populated at the downstream at 141,502 units (4097 ha) and the less dense population is at the upstream with only 4169 unit that covered 405 ha. The total area covered by residential units is 10.3% of the total land use within UKB. For the transportation facilities, the midstream shows the highest quantity at 448 facilities and area covered is 3064 ha. The lowest is at the upstream (20 facilities) with the area covered up to 275 ha.

2.4.4 Industries

The overall land use for the industrial units within UKB is 2331.4 ha which include heavy industries (259.3 ha), special industries (283.5 ha), small and medium industries (1733.3 ha) and mining/quarries (55.2 ha). Downstream of UKB is concentrated with industries (6016 unit) with an area cover of 840.7 ha followed by midstream; 1490.7 ha (2189 unit). There are eight (8) main industrial zones within UKB focusing on manufacturing industries such as iron and steel, food industries, rubber and electronic and computer industries. The **Table 2.10** shows the industrial zones within UKB together with the types of industries and adjacent river. Aside from the manufacturing industries within UKB, there are three quarries, operated by Cabaran Quarry (near to Pari River) and Lafarge Cement in Chemor, and Tasek Cement in Tasek (adjacent to Kinta River). Main industrial areas within UKB are as pointed in **Figure 2.6.**

Table 2.10: Industrial zones within UKB

Industrial zone	Types of industries	Adjacent River
IGB Industrial Zone	Electronics and computer Iron and steel Textile Cement Rubber Printing	Klebang, Kinta
Tasek Industrial Zone	Cement Iron and steel Rubber Timber and wood-based Electronic	Kinta
Bercham Industrial Zone	Tyre Iron and steel Food Metal Wood based Plastic	Kinta
Bukit Merah Industrial Zone	Ore processing Radioactive compound Chemical Iron and steel Food	Serokai
Jelapang Industrial Zone	Food Robber Wood-based Iron and steel Electronics and computer Textile Wood-based Marble Plastic	Tapah

Menglembu industrial Zone	Iron and steel Textile Plastic Food Tyre	Kledang, Kinta
Silibin Industrial Zone	Plastic Iron and steel Food Pottery Electronics and computer Wood-based	Tambun
Zarib Industrial Zon	Food Plastic Toiletries	Pinji

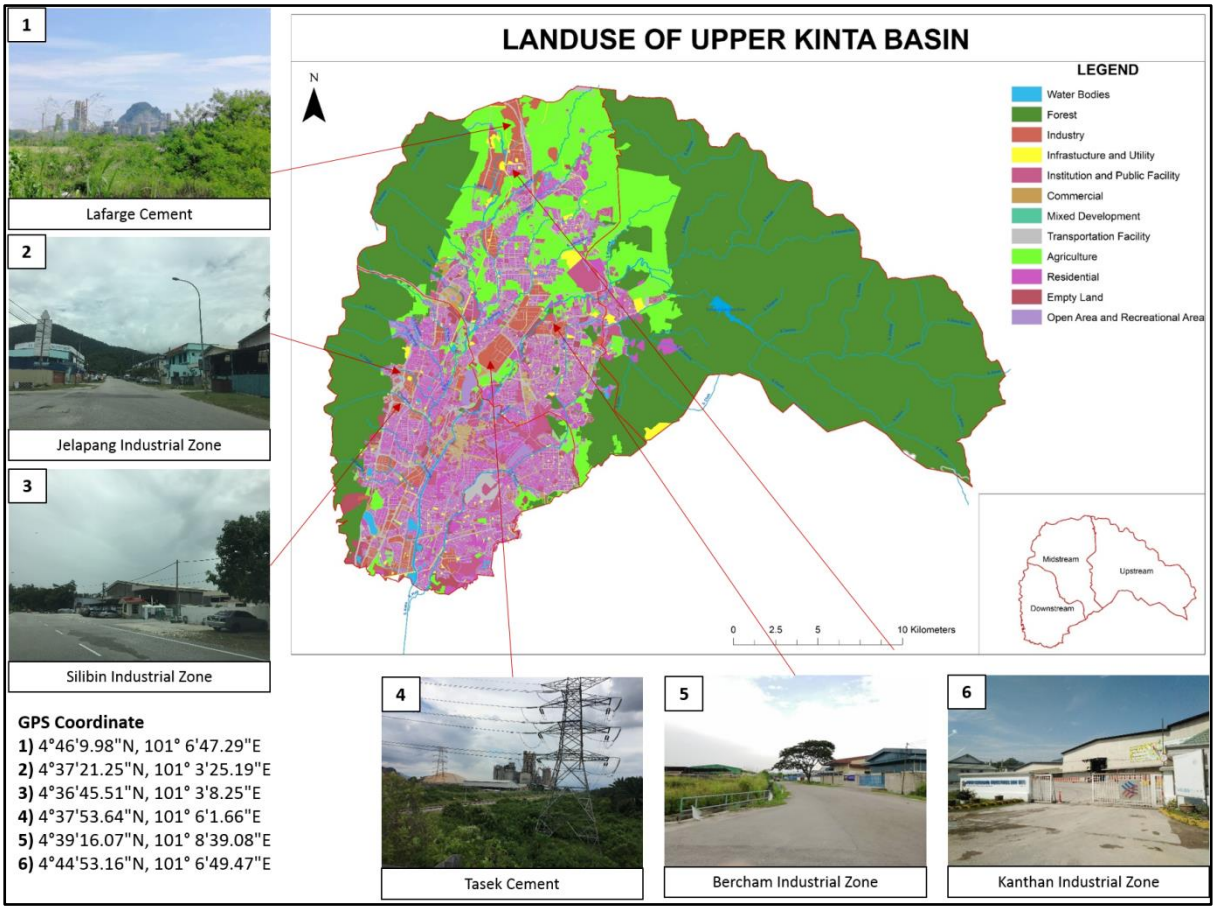


Figure 2.6: Main industrial areas within UKB

2.4.5 Waterbody

The overall water bodies at UKB are recorded at 721 water bodies with the overall land use are 853.4 ha or 1.2% of total area within UKB. Most of lake and ex-mining pond were found scattered at the downstream of the UKB, within the Ipoh Town. Ipoh Town is one of the main mining areas, leaving behind ex-mining ponds turned into an aquaculture or recreational lake/pond. The highest water bodies recorded are at the downstream with 465 water bodies covered up to 544.7 ha. The lowest water bodies recorded are at the upstream with only 77 water bodies with total area covered at 63.8 ha. **Table 2.11** tabulated the different types of water bodies recorded within upstream, midstream and downstream of UKB site. Some of the ex-mining sites are secured within the forest reserve area where 14 former mining pools 6km south of Batu Gajah covers 395 ha located within the Ulu Kinta Forest Reserve and around seven (7) hot spring pools are located within the Tambun Lost World Hotspring. Observations along the Kinta River visit are as in **Figure 2.7**.

Table 2.11: Breakdown of waterbodies within UKB

Water Bodies	Upstream		Midstream		Downstream		Total		
	Unit	Area (ha)	Unit	Area (ha)	Unit	Area (ha)	Unit	Area (ha)	%
River	5	55	79	197	211	338	295	591	1
Lake/Pond	71	8	65	21	230	93	366	122	0
Recreational Lake	0	0	3	5	11	40	14	45	0
Others	1	1	1	0	4	2	6	3	0
Mining/Ex-mining Pond	0	0	31	197	9	72	40	270	0
Water Bodies	77	64	179	245	465	545	721	853	1

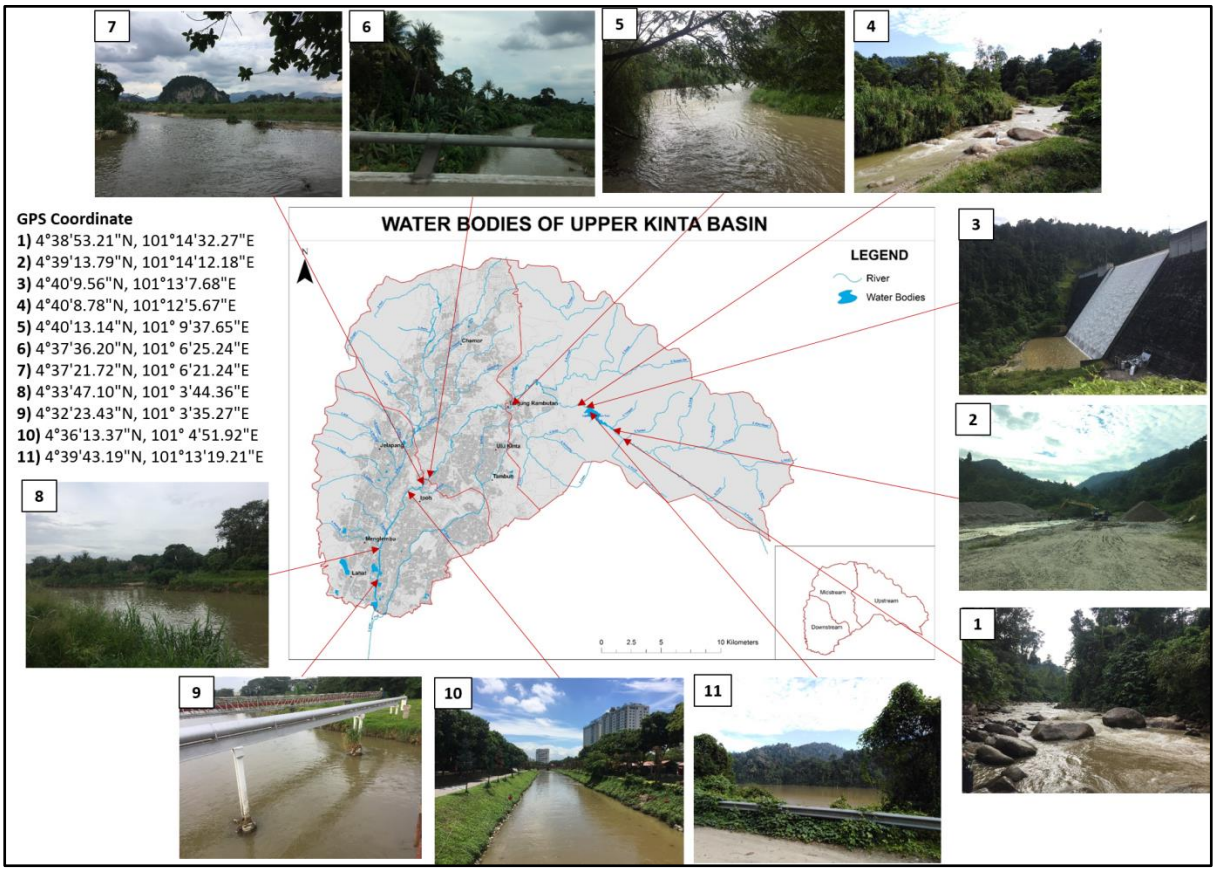


Figure 2.7: Observations along Kinta River

2.4.6 Others

Most of the infrastructure and utilities are located at the downstream with the area covered at 230.5 ha followed by the midstream with 1173 infrastructure (502.2 ha) with the overall land use at 888.4 ha (1.3%). The highest institutional and public facilities are provided at the downstream which is the urban area with 1082 facilities (1172.6 ha). The upstream shows the lowest facilities at only 83 unit that covered 129.6 ha of the land used. For commercial purpose, the downstream recorded the highest quantity with 13,673 (500.2 ha) and the lowest is at the upstream which covered the area up to 8.7 ha. The recreational area covers 2.1% a total land use within UKB area with the highest areas (883.6 ha) are at the downstream with only 146 units within upstream.

Overall 1.7% total land use within UKB is recorded as empty land recorded with highest empty land recorded is at the downstream with 840.9 ha with the lowest empty land is recorded at the upstream with 61.1 ha.

2.5 LAND USE AND WATER BODIES

The land use along the vicinity of the water bodies within the watershed has great impacts on the water quality of rivers. The water quality of the water bodies will degrade due to the changes in the land cover patterns due to human activities. The impacts of pollution within the developed area or ongoing development site are more alarming compared to rural. Changes in the land cover and land management practices have been regarded as the key influencing factors behind the alteration of the hydrological system, which will lead to the change in runoff as well as the water quality. Sanitation and hygiene issues related to water bodies are important to be addressed spirally at the upstream and midstream where the residential areas are scattered especially at Chemor on their own/family lands where the sewerage tanks are buried underground. Moreover, in certain area villages, the discharge of the sullage or the sewerage might end up polluting the river from upstream if proper education and guidance not given to the communities.

CHAPTER 3: POLLUTION SOURCE RAPID INVENTORY 3-1

3.1 INTRODUCTION

The pollution source rapid inventory study included three elements - a pollution source inventory, a water quality study and a bio-indicator study. Pollution source inventory helps to identify possible issues that affecting the UKB. It is important as visual observation of point source pollution enables the design of preventive measures as well as to identify the stakeholders that need to be engaged.

There are two types of river pollution; point and non-point sources pollution. Point source discharge pollutants at specific locations through pipelines or sewers into the surface water. This includes the visible pollution factors as sewage treatment plants, manufacturing and industries, wet markets, squatters and many others. Non-point source defined as diffused sources as surface runoff which carries the natural and human made pollutants as excessive fertilizers, pesticides from residential and agriculture, oil and grease from urban runoffs, as well as sediments, erosion from land clearance and development along and depositing them to the nearby water bodies. In general, the increase in the percentage of developed land and urbanization usually associated with a high concentration of waterborne pollutants.

On the other hand, water quality and biological monitoring will help us to identify the impacts of both point source as well as non-point source pollution. A river basin is an interconnected system of main river course and its tributaries (Viera et al., 2012) and it serves as the major source of water resources for domestic, industrial and agricultural practices as well the transportation mode at remote areas. As such, poor management of river systems will result in deteriorating water quality, frequent flash floods, water shortage due to high pollutant concentration and sedimentation. This, in turn, will have a negative impact on the economy, social, economic and health of that particular area and/or country. The protection, preservation and monitoring of the rivers cannot be diminished nor understated so that the importance, value and benefits of the river can be fully realized and any river problems can be prevented. The focus of water quality study in Upper Kinta River basin (UKB) is to know the current condition of the rivers section within Upper Kinta Basin.

Knowledge on the health status of aquatic ecosystems and the value of the potential services that they can provide, allows optimal and sustainable use of the available resources (Constanza et al., 1997). Some aquatic organisms, due to their inherent traits and characteristics, will react to changes and degradation of their habitat. They can be used as an indicator species of any changes to their environment. Some known organisms have limitation towards nutrients and dissolved oxygen concentration in the water. Hence, the presence of organisms living within habitat with such limitation indicates that these organisms are resistant and able to survive within that range of conditions. Hence, biological water quality monitoring for this study is done to know the health of UKB that is suitable for aquatic life as well as to classify UKB according to biological water quality status.

The output will enable the project working group to design appropriate best management practices to address the problems concentrating on the major river pollution within UKB.

3.2 METHODOLOGY

The methodologies used for the three different aspects as explained below:

3.2.1 Pollution source inventory

The preparation of the pollution source inventory involves a number of processes. The first step was a desktop land use analysis of the project area to map the location of different land use (as described in Chapter 2) and recognize the land use to prioritize in terms of the possible pollution area as well as its impact to the nearest waterbody. Relevant research, secondary data and existing information from relevant agencies were reviewed to augment into the inventory. Then, field visits and periodical site assessments were conducted from May 2018 to October 2018 to verify and validate the information. The rivers near the possible pollution sources were observed.

3.2.2 Water quality study

There were two (2) main sub-method used for this aspect. Firstly, secondary data was collected from relevant agencies on existing water quality monitoring. Secondly, GEC team has identified ten (10) stations within UKB to study the current water quality status.

3.2.2.1 Secondary data collection

Existing water quality monitoring information by relevant agencies was collected and analyzed. The water quality data received from three (3) main agencies which are Department of Environment (DOE) Perak, Department of Irrigation and Drainage (DID), Perak and Lembaga Air Perak (LAP). DOE Perak has 14 stations within Kinta River Basin with eight (8) of the stations are within UKB. **Figure 3.1** shows the DOE's sampling stations within UKB. DID Perak also monitor the Kinta River water quality. However, the agency only monitors the main Kinta River. It has a total of nine (9) stations located on Kinta River and all of them within UKB (**Figure 3.2**). Besides this, LAP has two (2) water treatment plants (WTP) that receive raw water supply from Sultan Azlan Shah Dam, located within UKB (**Figure 3.3**).

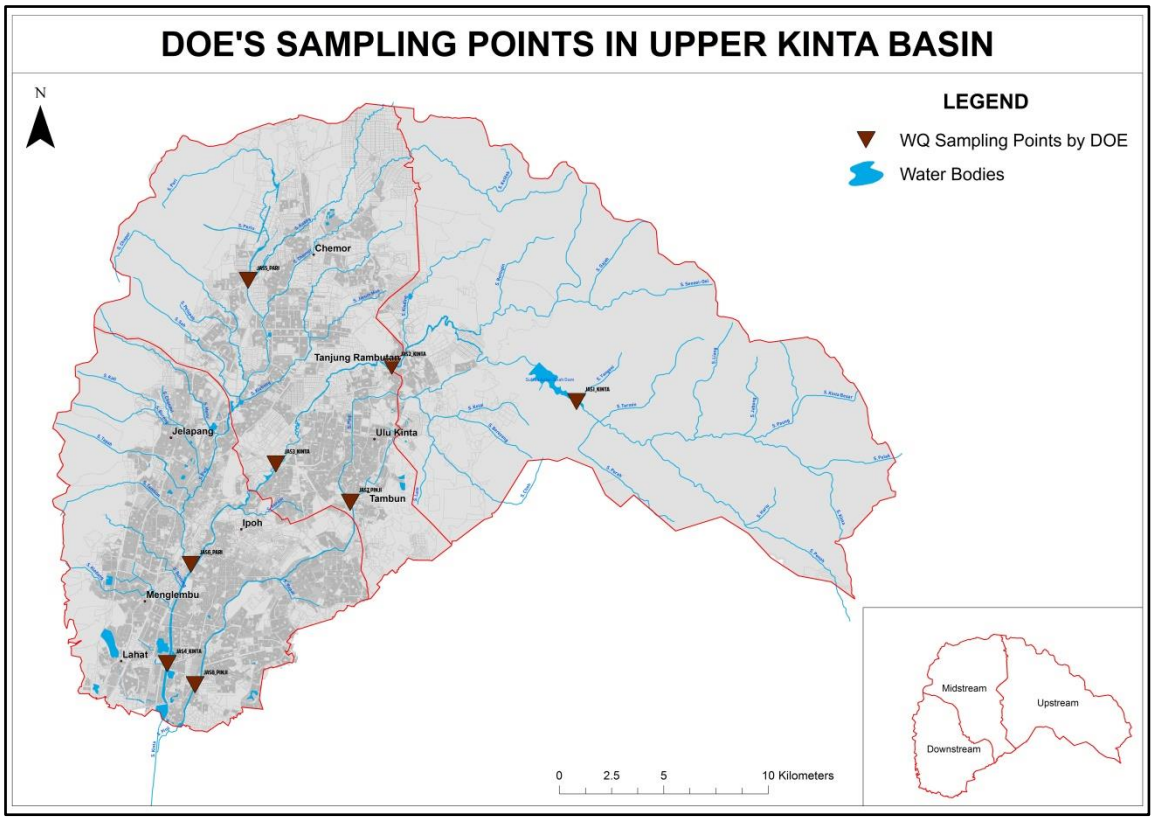


Figure 3.1: DOE Perak's water quality sampling points within UKB

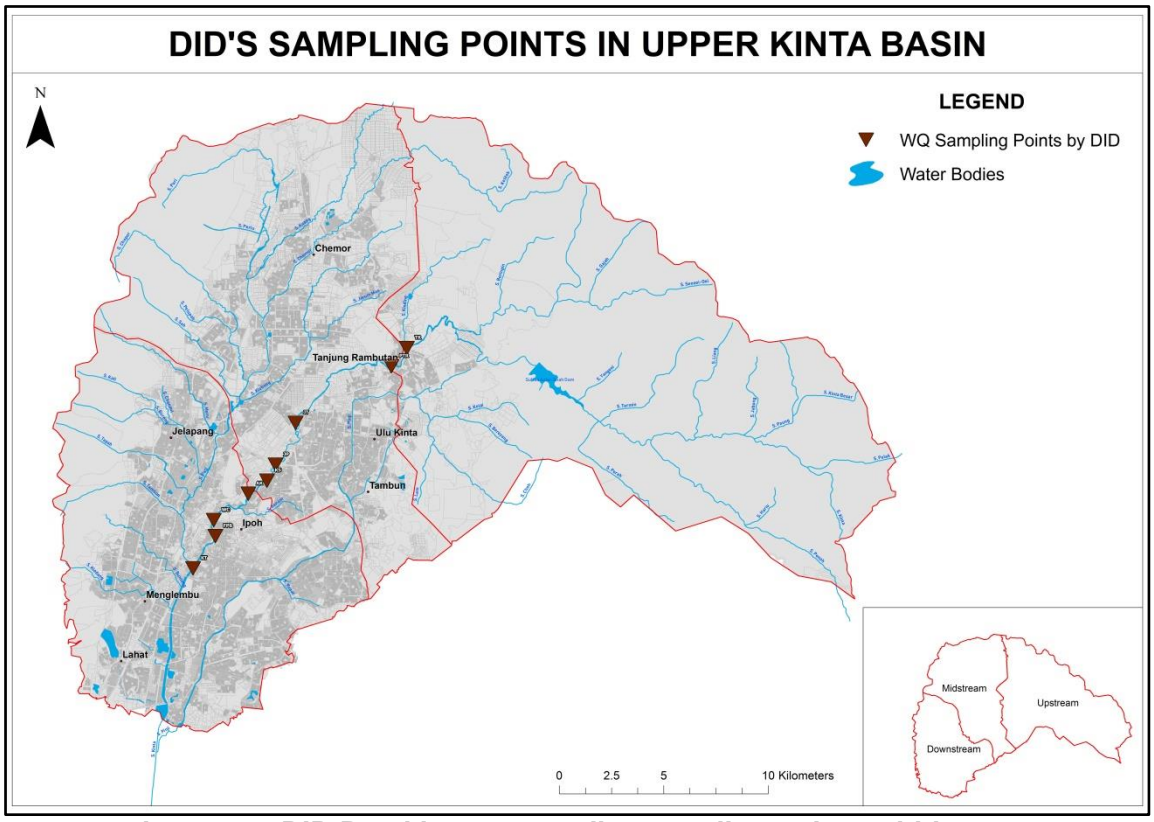


Figure 3.2: DID Perak's water quality sampling points within UKB

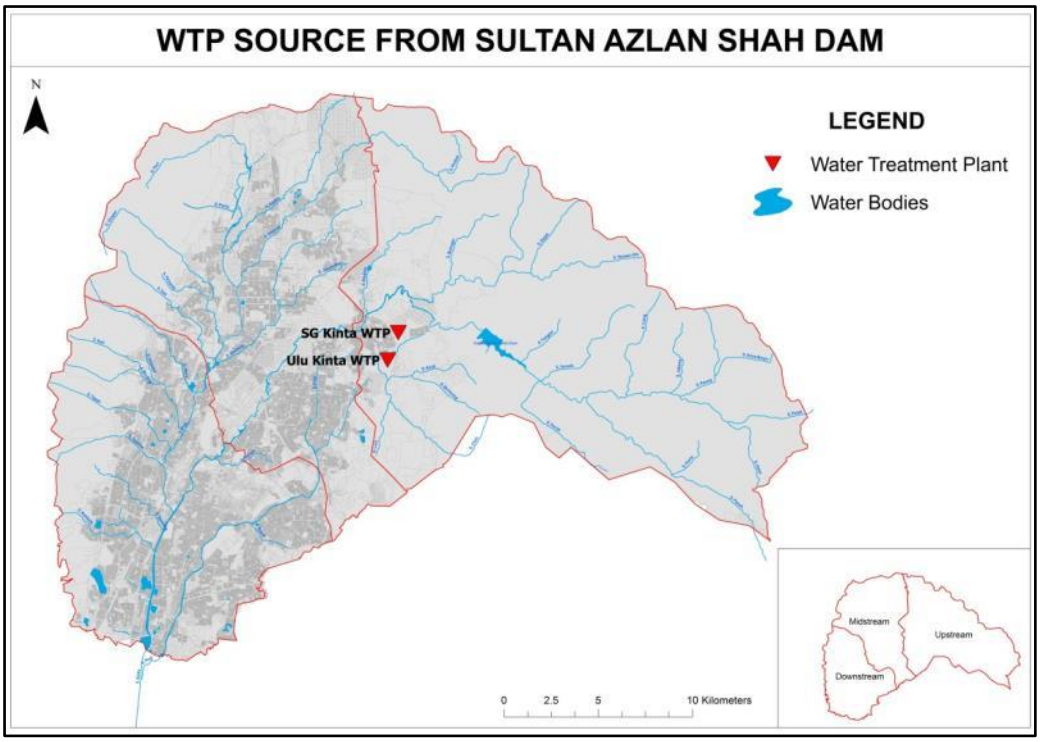


Figure 3.3: WTP's sourced by Sultan Azlan Shah Dam

3.2.2.2 Sampling by GEC team

Ten (10) sampling station (**Figure 3.4**) selected for this study within UKB to assess the current water quality status. Within the ten stations, eight (8) stations are identified to study the current water quality of the UKB and serve as baseline data. In additional, two (2) sites before and after the observed key development activity within UKB site was selected to identify the impact of the development to monitor the impact of pollution within the site. The site justification is as per **Table 3.1**. The water sampling was conducted on 21st and 22nd October 2018 from 0800 hours to 1700 hours. Water sample was collected through the grab sampling method (**Figure 3.5**). Water quality parameters measured through both in-situ (**Figure 3.6**) and ex-situ method. For ex-situ measurement, water samples were sent to KenEp Laboratories (M) Sdn. Bhd, which is accredited by Malaysian Accreditation Council under the Malaysian Laboratory Accreditation Scheme. Water quality parameters involved (**Table 3.2**) analyzed according to the standard methods recommended by APHA 2005 and MN Method.

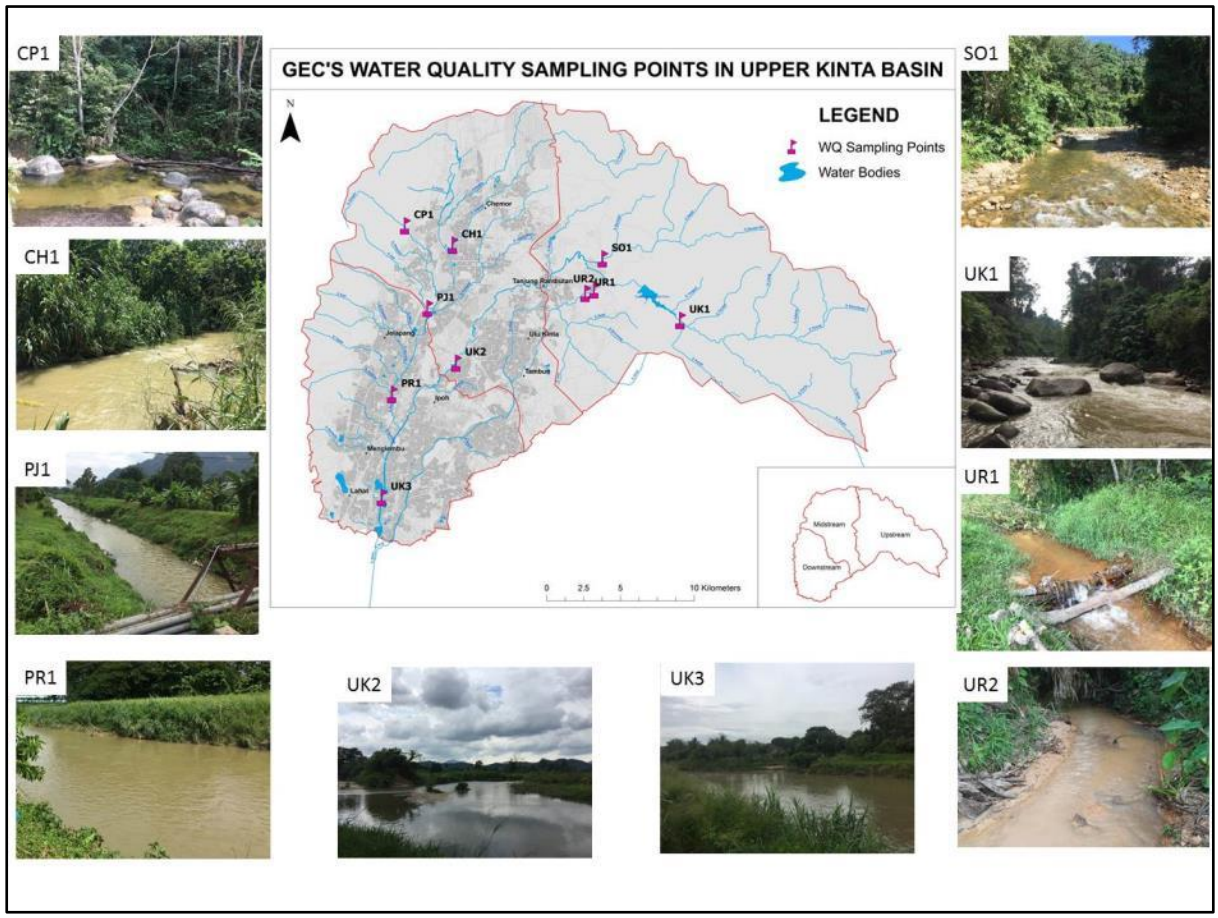


Figure 3.4: GEC's water quality sampling points

Table 3.1: Water quality stations, length and GPS coordinates of the river

UKB Region	River	Station	GPS Coordinates	Site Justification
Upstream	Kinta	UK1	4°38'53.39"N 101°14'32.17"E	• Close to source of Kinta River • Impact of activities upstream of dam • Water quality upstream of dam
	Senoi-oi	SO1	4°41'9.07"N 101°11'41.46"E	• Important tributary • Effect of activities of Orang Asli villagers
	Unnamed river	UR1	4°40'0.57"N 101°11'23.10"E	• Sampling point before the key ongoing development activity within UKB
	Unnamed river	UR2	4°39'52.92"N 101°11'3.40"E	• Sampling point after the key ongoing development activity within UKB

Midstream	Chepor	CP1	4°42'22.13"N 101° 4'26.51"E	• Tributary of Pari River basin • Source as well as place for recreational activities
	Chemor	CH1	4°41'39.41"N 101° 6'11.51"E	• Upstream of Pari river basin • Located in industrial area
	Pinji	PJ1	4°36'34.75"N 101° 8'19.51"E	• Among the key tributaries of UKB • Located in commercial area especially restaurants
	Kinta	UK2	4°37'19.62"N 101° 6'18.99"E	• Located on main Kinta River • Surrounded by commercial area
Downstream	Pari	PR1	4°36'10.61"N 101° 3'57.93"E	• Key sub-basin of UKB • Effect of residential area
	Kinta	KT1	4°32'23.43"N 101° 3'35.27"E	• Last point/region within UKB • Effect of residential area and commercial area

Figure 3.5: Collection of water sample using grab sampling method

Figure 3.6: In-situ sampling

Table 3.2: Water quality parameters analysis

Characteristics	Parameters	Unit	Method used
Physico-chemical	pH	-	In-situ
	DO	mg/L	In-situ
	Turbidity	NTU	APHA 2130 B, 2005
	Total Suspended Solids	mg/L	APHA 2540 D, 2005
	Ammoniacal Nitrogen	mg/L	MN Method 91805
	Biochemical Oxygen Demand	mg/L	APHA 5210 B, 2005 MN Method 985822
	Chemical Oxygen Demand	mg/L	APHA 5220 D, 2005 MN Method 985026
Microbiological	Faecal Coliform	MPN/100mL	APHA 9222 D, 2005.

3.2.3 Biological water quality study

Biological water quality monitoring utilizes the presence of biological indicator as a water quality indicator. Among the communities that are considered as bio-indicator of water quality, the most commonly used are benthic macroinvertebrate (Bonada et al., 2006). For this study, a total of six (6) sampling sites were chosen to assess biological water quality status of UKB (**Figure 3.7**). Five (5) of the sampling stations are same as the water quality sampling stations (UK1, UK2, UK3, CP1, SO1) and the other one at downstream is pointed differently at Senam River (SN1) which is tributary of Kinta River due to site accessibility factor. The geographical coordinate of each sampling station is detailed in **Table 3.3**.

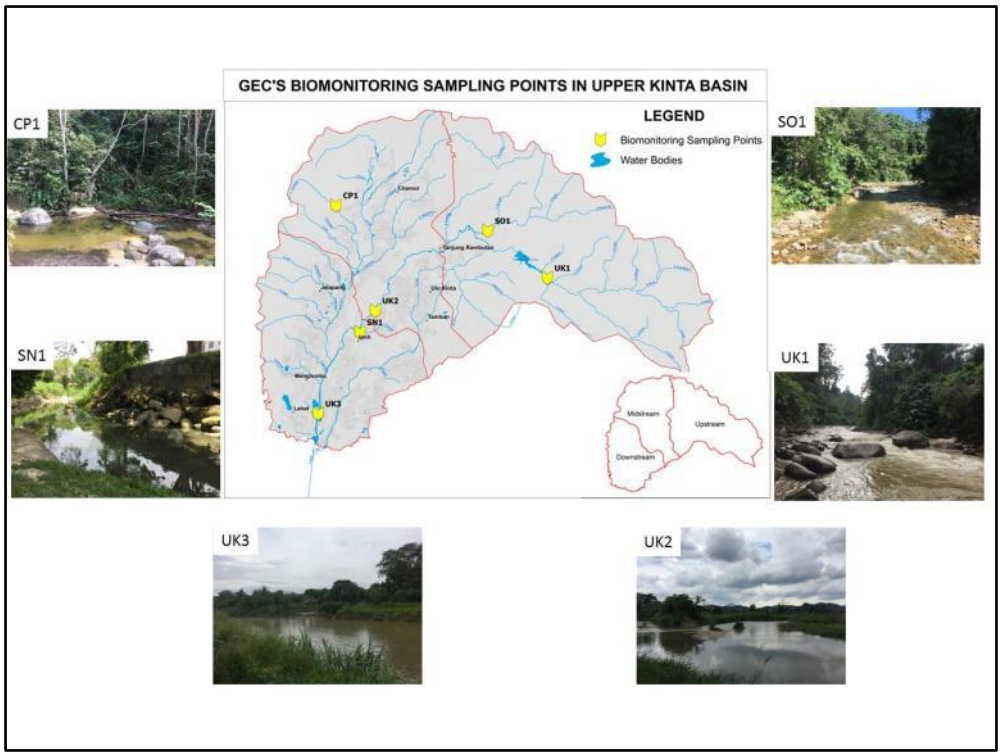


Figure 3.7: GEC's biomonitoring sampling points within UKB

Table 3.3: Geographical location for biomonitoring study

River	Station	Coordinates
Kinta	UK1	4°38'53.39"N 101°14'32.17"E
Senoi-oi	SO1	4°41'9.07"N 101°11'41.46"E
Kinta	UK2	4°37'19.62"N 101° 6'18.99"E
Chepor	CP1	4°42'22.13"N 101° 4'26.51"E
Kinta	UK3	4°32'23.43"N 101° 3'35.27"E
Senam	SN1	4°36'17.55"N 101° 5'34.91"E

3.3 RESULTS & DISCUSSIONS

3.3.1 Pollution source inventory

a) Secondary data analysis

The overall pollution source inventory was carried out based on secondary data as well as through site surveys. The secondary data of pollution source from various source and reports was analyzed based on three regions within UKB, upstream midstream and downstream. The major causes of pollution in the Kinta River Basin are industrial discharge, improper sewage treatment, residential discharge, sand mining, land development and soil erosion (Kalithasan 2008).

Based on the Study on Pollution Prevention and Water Quality Improvement at Sungai Kinta, Perak, by Department of Irrigation (DID) Malaysia in 2010, the possible source of pollution

within the UKB is identified mainly from three main categories: non-plantation, plantation, and developed area. Based on the report, a total of 4,884 ha of plantation activities mainly rubber, palm oil and crop cultivation could be possible cause of river pollution. Based on local council, a total 9,650 ha of developed area also reported as possible pollution sources from residential and roads. The last category, which is non-plantation, is made up of a number of land uses; animal farms, aquaculture, business, fields, industrial, planned industrial, infrastructure or services, institution, landfill, mining, service facilities, sewage treatment plant, and transportation.

Table 3.4, 3.5, and 3.6 highlights the summary plantation, developed, and non-plantation areas at the upper Kinta River and its main tributaries.

Table 3.4: Plantation areas by catchment

River	Rubber area (ha)	Palm oil area (ha)	Crops area (ha)	Total area (ha)
Kuang	80	883	1	892
Chemor	100	164	0.1	264.1
Pari	10	938	0.14	948.1
Jarun Mas	377	179	3	559
Chepor	0.1	493	0.1	493.2
Sah	0.03	239	-	239
Kinta	6	501	0.01	507
Meru	0.02	3	-	3
Pinji	92	696	0.02	788
Kledang	4	10	-	14
Serokai	3	62	-	65
Johan	32	53	27	112
			Total:	4884.5

Source: Study on Pollution Prevention and Water Quality Improvement at Sungai Kinta, Perak, by DID Malaysia, 2010

Table 3.5: Developed areas by catchment

River	Residential area (ha)	Road area (ha)	Total area (ha)
Kuang	152	90	242
Chemor	204	172	376
Pari	159	252	411
Jarun Mas	226	305	531
Chepor	32	54	86
Sah	2	89	91
Kinta	1,033	1,052	2,085
Meru	97	173	270
Pinji	186	144	330
Kledang	164	149	313
Serokai	115	150	265
Johan	2,211	1,480	3,691
		Total:	9,650

Source: Study on Pollution Prevention and Water Quality Improvement at Sungai Kinta, Perak, by DID Malaysia, 2010

Table 3.6: Summary of possible pollution sources other than plantation and development

Types of pollution by land use	River														
	Kuang	Chemor	Pari	Jarum Mas	Chepor	Sah	Kinta	Meru	Kati	Tapah	Tambun	Pinji	Kledang	Serokai	Johan
Animal farms	4	5	10	5			2					1	1		1
Aquaculture			1				1			1		2			
Business	15	7	145	70	2	6	512	15	19	57	82	490	173	15	145
Fields							3					3			
Industrial			10	24			97	6	5	31	49	25	8	12	15
Industrial (planned)	1		44	32			142	5	15	90	117	79	127	14	185
Infrastructure/ services				2		1	6					3	2		1
Institution			16	10	1		50	5	5	5	2	55	6	1	2
Landfill							1								
Mining				1			1			1		1			
Service facilities			1				1						1		
STP	14	8	20	20	2	1	77	5	1	4	18	203	23	5	23
Transportation			1			2	2					1			
Total	34	20	248	164	5	10	895	36	45	189	268	863	341	47	372

Source: Study on Pollution Prevention and Water Quality Improvement at Sungai Kinta, Perak, by DID Malaysia, 2010

b) Assessment of upstream of UKB

The Sungai Kinta River basin system has six (6) main tributaries as Termin River, Changor River, Penoh River, Sempak River, Tamong River and Liang River. However there are more than 12 secondary sub-tributaries and 13 tertiary sub-tributaries flowing from Mount Korbu and the Ulu Kinta Water Catchment Forest Reserve (**Figure 3.8**). The contributing factor for high sedimentation at the upper Kinta River is originates from one of these tributaries. As illustrated in **Figure 3.9,** all the identified tributaries are located deep inside the forest reserve area, further from other land use activities.

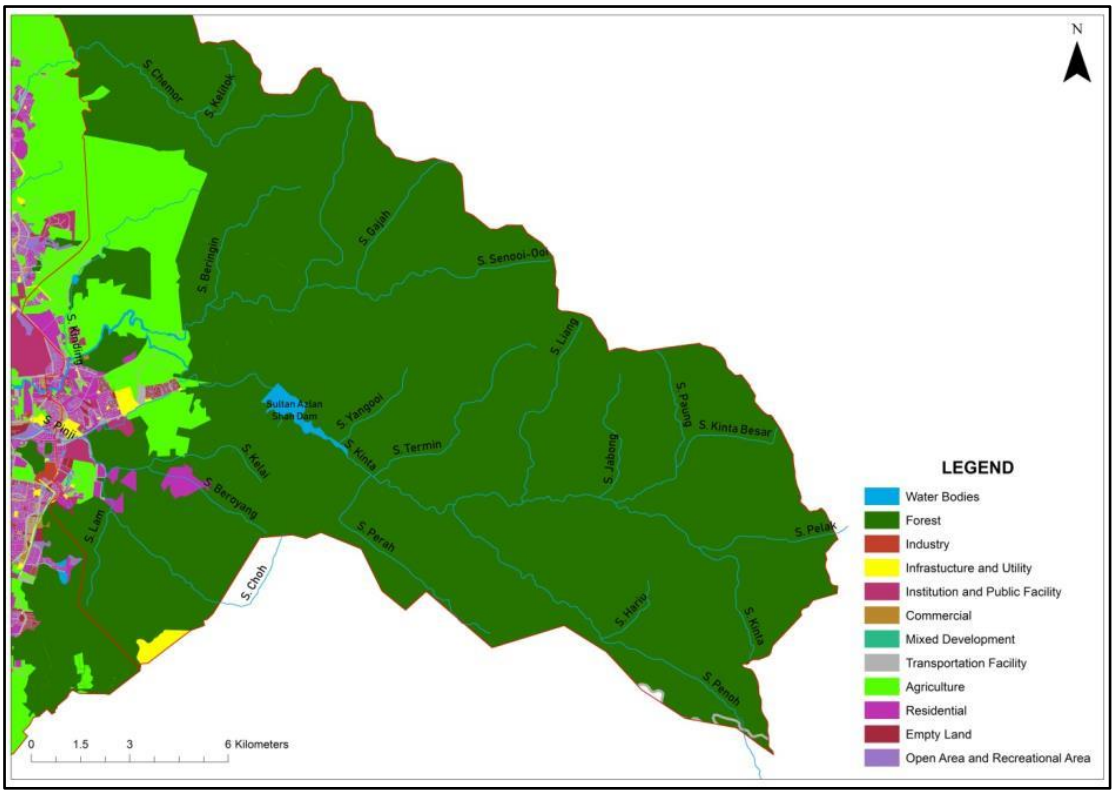


Figure 3.8: Kinta River main and sub-tributaries forming the water catchment of Upper Kinta

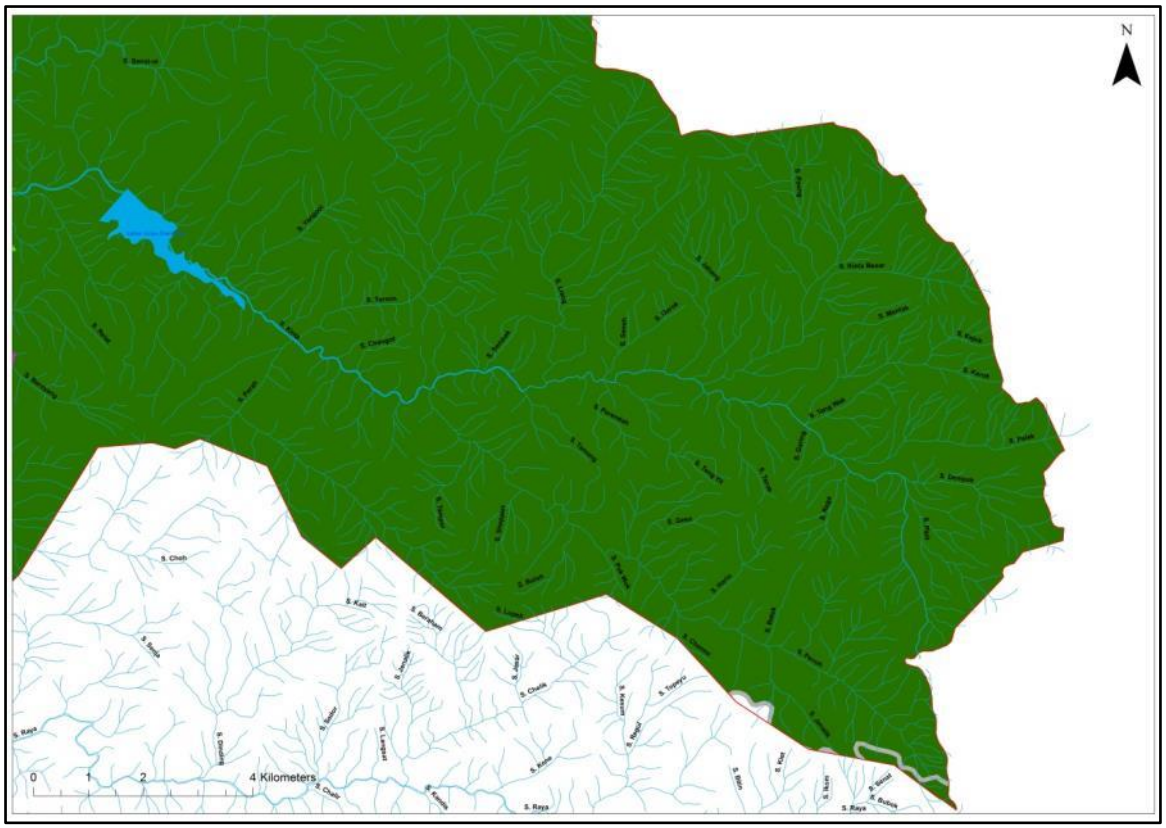


Figure 3.9: Tributaries located inside the green sketch inside the forest reserve area as informed by The Perak Forestry Department

As classified as forest reserve and moreover water catchment forest area, no development, logging or any form of activities can take place within this area. Moreover the catchment of Kinta River above the water intake weir is steep and mountainous. The ridge along the head of the catchment forms part of the watershed of the main range (Titiwangsa Range). From the satellite image, no large scale land use activities or landslide detected at or near the majority of the main or sub tributaries (**Figure 3.10**).

Figure 3.10: Satellite map of upstream portion of at Upper Kinta Basin

However when the image was focused more towards the tributary closest to the Simpang Pulai-CH Route A181, erosion and some landslide issues can be noticed as shown below **(Figure 3.11).**

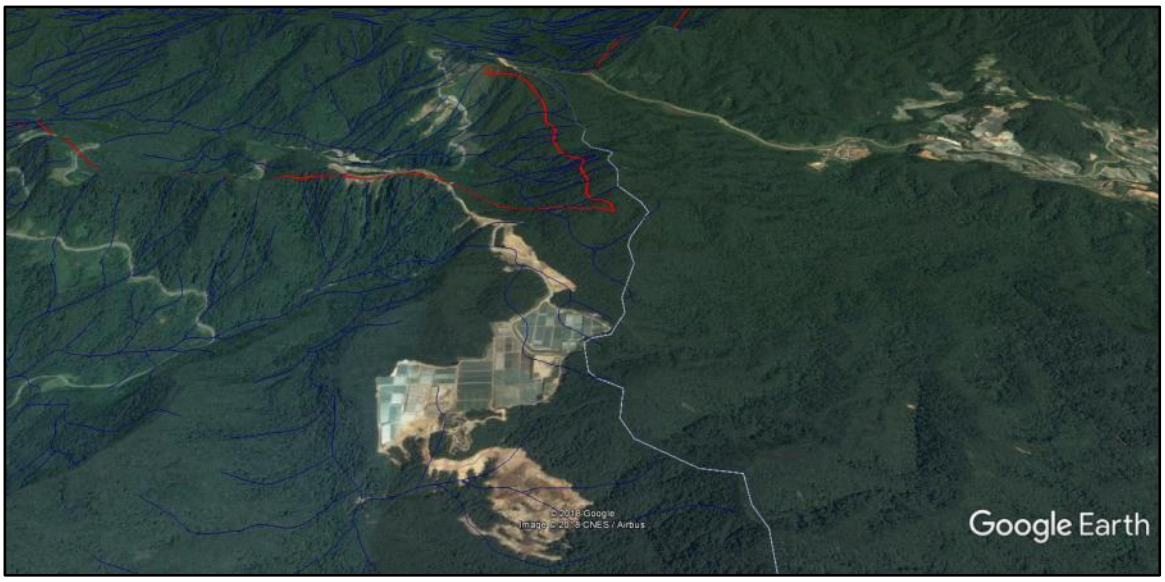


Figure 3.11: Satellite map indicating land clearance and landslides

A site visit was conducted along the Simpang Pulai-CH Route A181 to locate the number of landslide occurred at the range as well as to identify the route to access the tributary that

have caused the massive erosion. The image below **(Figure 3.12)** shows some of the land opening and landslides along the route.

Figure 3.12: Landslide and the clearance along the route through the UKB

The major landslide detected at Km 44-46 were identified and verified as the main cause of the high sedimentation of the alluvium at the Sultan Azlan Shah Dam. The contributing factor significant to the landslide is known as the northern earth flow, movement of the plates of the Gunung Pass. The area affected is the western hillside of the Gunung Pass ridge; where the eroded landslides were washed down to the Penoh River during heavy downpour. The deeply-incised Penoh River is located 600 m below into the valley densely forested and generally steeper than 30°, leading down from the Gunung Pass which has an elevation of 1587 m above the sea level. Satellite image**, Figure 3.13** shows the location of the landslide and the sub-tributaries flowing from the ridge going down to Penoh River.

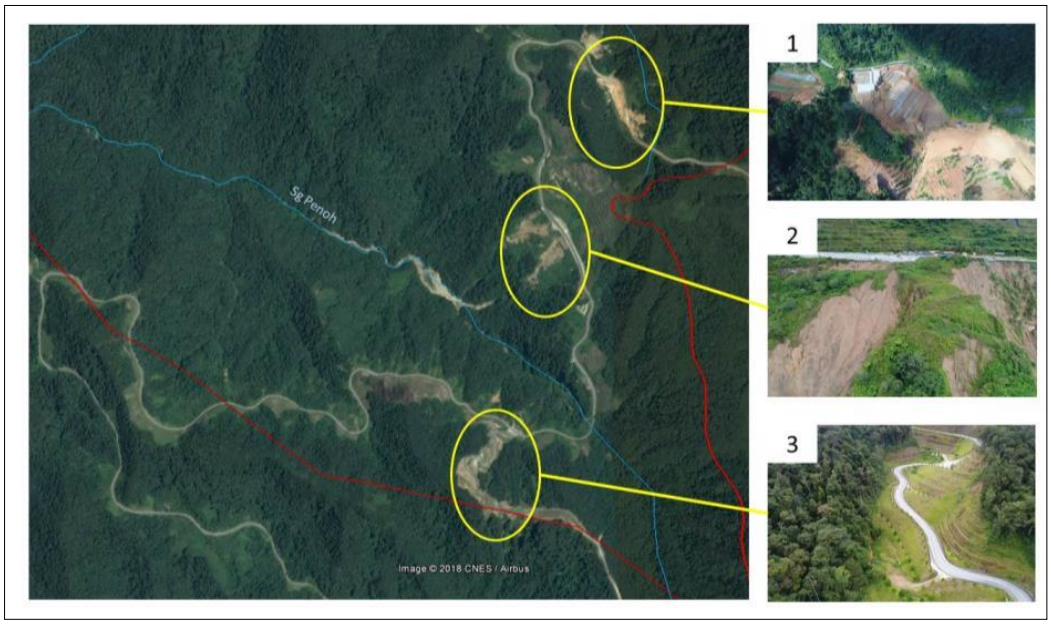


Figure 3.13: Satellite image and drone photo of the landslide and the erosion ending up into the Penoh River feeding into the Kinta River (Sultan Azlan Shah Dam) as in November 2018

i) Erosion in the upper catchment

In terms of the upstream of the UKB, one of the key issues is hill cutting and erosion which can lead to sedimentation of the river channel and siltation of the water supply dam. Site visits were undertaken to various points in the upper catchment between January to November 2018. This section also draws on earlier assessments undertaken by GEC of the catchment including partnership with Institute Darul Ridzuan (IDR) in 2013 and further surveys undertaken in 2018 in conjunction with the state government. The following were found to be the key sources of siltation in the upstream area:

i. Landslide at KM 44-46 Simpang Pulai to Cameron Highland highway
ii. Highland Agriculture/Agro Tourism project in Ulu Kinta/Sg Raia catchment Perak

i. Landslide at KM 44-46 Simpang Pulai to Cameron Highland Highway

The landslide at km 44-46 Simpang Pulai to Cameron Highland started in 2003 following hillside excavation at the terrain along the highway which starting 1997. According to the study conducted by Andres Malone Ltd in 2007, movement occurred at roadside when the slope was cut in the vicinity of chainage 23+900 during the roadworks (**Figure 3.14a**). The slope was cut back to a flatter angle but due to the persistent instability, more extensive slope flattening was undertaken in response until the works reached the ridgeline, 200 m to 260 m above the road. This lead to the gross movements which occurred in the cut in September 2013 (**Figure 3.14b**) with the formation of a main scarp and associated disruption and the displaced mass has since moved continuously. This is later known as the Northern Earthflow where the main scarp of the failure extends to the north into unexcavated ground in the more weathered part of the slope where natural hillside valley existed and has now extended to road level.

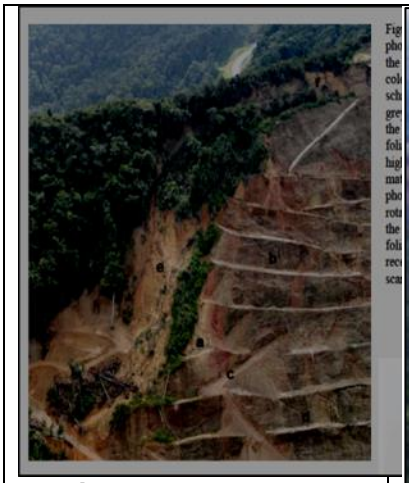


Figure 3.14a: Stope cutting along highway route (extracted from the Landslide Study at CH23+800 Simpang Pulai – Lojing Highway Malaysia Report submitted by Andres Malone Ltd (May 2007)

Figure 3.14b: Erosion at slope as of 2013 (extracted from GEC - IDR Report - 2014)

The Malaysian Public Works Department (PWD) Kuala Lumpur has classified the landside at Section 44 (Km44) and Section 46 (Km46) of Simpang Pulai-Lojing Road (FT185) as a critical area.

Figure 3.15: Status of the landslide area along Simpang Pulai-Cameron Highland as of November 2018

Figure 3.15 shows the stretch of the Simpang Pulai – Cameron Highland CH44 landslide area as of November 2018. In order to mitigate the continuous impact of the landslide, the federal government allocated RM34 million to repair two slopes along the Simpang Pulai-Kampung Raja road leading to Cameron Highlands in 2015-2017. Two (2) companies were appointed to carry out the slope strengthening works at Km44 (JJM Integrated Sdn Bhd) and Km46 (Jati Estetika Sdn Bhd). The project at Km44 focused on a piled embankment to withstand erosion (**Figure 3.16**). Reinforced concrete landslide shed was built to enable any landslip to slide over the shed and fall beyond it. This would protect road users. The shed will also acts as a retaining wall[1].

Figure 3.16: Mitigation measures – piled embankment undertaken to reduce the impact of landslide

[1] https://www.malaymail.com/s/907623/rm34m-to-repair-cameron-highlands-slopes

Although mitigation measures were undertaken to address the issue, continuous slope failure keeps on taking place as highlighted in **Figure 3.17**. This is caused by multiple geological factors and complex. The structure of the rocks along the slopes is unstable and weak because due to weathering, structure and geology. In addition to landslides along the Simpang Pulai – Cameron Highland stretch, two other incident happened this year, i.e. mudflow as the retaining wall collapse due to continuous rain sent a river of mud flowing down the hillslope[2] and six orang asli houses were destroyed after earth fissures measuring 1.2 m wide at Kampung Pawong, near Simpang Pulai[3].

Landslide in 2017 (31 January 2017[4])

Landslide in 2016 (16 July 2016[5])

Mud flood in 2018 (26 September 2018)

Earth fissures in 2018, October 23, 2018

Figure 3.17: Examples of landslides during the last two years

[2] https://www.thestar.com.my/news/nation/2018/09/28/dept-simpang-pulaicamerons-road-safe/#GohoStBQDcyvsA5F.99flowing

[3] https://www.thestar.com.my/news/nation/2018/10/24/earth-fissures-damage-six-orang-asli-houses-near-simpang-pulai/#h7LGv3uwV8BoRi1W.99

[4] http://english.astroawani.com/malaysia-videos/laluan-simpang-pulai-cameron-highlands-selamat-digunakan-141363
http://english.astroawani.com/malaysia-videos/laluan-simpang-pulai-cameron-highland-selamat-digunakan-120257

[5] http://www.utusan.com.my/berita/nasional/jalan-simpang-pulai-cameron-highlands-selamat-digunakan-1.354061

As a result of the continuous erosion of the highway slope large amounts of sediment are washed downstream choking the bed of the Penoh River and being washed downstream to the dam (**Figure 3.18**).

Figure 3.18: The sediment in the bed of the Penoh River in November 2018 below the eroding highway slope

ii. Highland Agriculture/Agro Tourism project in Ulu Kinta/Sg Raia catchment Perak

Land opening at the highland for agro-tourism also contributes to significant siltation and high sedimentation which ends up in the dam. During the 2013 study, the development of agriculture (Agrotourism) (Collecting, Processing and Packaging Center by Agroto Business (M) Sdn Bhd Agroto) on Lot PT24507, and the road and vegetable farm on PT 245072 Mukim Ulu Kinta, PT23157 Mukim Sg Raia was causing a lot of issues and contributed to the sediment runoff at the dam as in **Figure 3.19**. Although during the current site visit, it was observed that the project area is now covered with cover crop a patch of landslide was observed. The drainage of storm water from the uphill to the downhill where the water flows through or absorbed by the ground was identified as the contributing factor and need to be addressed to avoid unforeseen landslides. **Figure 3.20** shows the current condition of the site. The images indicates the mitigation undertaken and current landslide issues within the site (**Figure 3.21**)

Figure 3.19: Dumping of the soils along the slope and uncomplete discharge point into the slope towards the water catchment area in 2013

Figure 3.20: The site in November 2018 after mitigation being undertaken

Figure 3.21: Two patches of slope erosion on either side of the Agroto Sdn Bhd store which shows the flow of the water from the drainage from the agro tourism site flowing contributing to slope erosion in the Kinta Catchment

During the site visit, land opening was observed and some activities were seen focusing on the agro farming and agro tourism at an upper portion of the site (at GPS coordinate 4.601013; 101.345473 – **Figure 3.22**). This land clearing is in the adjacent Raia River catchment which also is classified in the National Physical Plan as an Environmentally Sensitive Area (ESA) Class 1 as it is a proposed dam catchment and it needs to be totally protected. High sedimentation during this project period will end up into the catchment. In addition to land clearance, once the site is ready for agro farming and tourism, there are possible that issues related to pesticide and fungicide will pose direct threat to the water body. Runoff from both the Agroto Business (M) Sdn Bhd and the upcoming of agro farming and agro tourism at (GPS coordinate 4.601013; 101.345473) will end up into the Kinta River.

Figure 3.22: Current land clearance activities for agro tourism within adjacent Raia River catchment area (linked to access road on main Punoh/Kinta River catchment

As mention earlier, one of the main concerns of the pollution source at upstream area relies mainly of the agro farming and tourism at the hilly slopes. The usage of fertilizers for the vegetables and plants in the farm will eventually end up into the catchment in form of runoff; as no holding pond noticed there to stop the fertilizers from entering the water bodies

ii) Small scale land development

There are three (3) Orang Asli settlements; Kampong Pawong, Kampung Chiduk and Kampung Jantung Baru along the river stretch downhill from the landslide stretch (but in the adjacent catchment of Raia River) which will be affected significantly from the activities upstream (**Figure 3.23**). The settlements are located very near to the river as they community depend mainly on the river and the natural resources for their livelihood. Moreover, Orang Asli also has orchard and small land opening for agriculture for livelihood.

Figure 3.23: Kampong Pawong, Kampung Chiduk and Kampung Jantung Baru settlement and the land use within the settlement

The plantation and orchard belonging to the Orang Asli upstream of the Sultan Azlan Shah Dam were also highlighted as the possible contributing factor if no proper mitigation taken or monitor accordingly. **Figure 3.24** shows some of the Orang Asli's durian orchard and oil palm as well the rubber plantation at the upstream.

Figure 3.24: The plantation area within the Orang Asli settlement

iii) Sultan Azlan Shah Dam

Beside orang asli, LAP is another main beneficiary of the Kinta River which acts as source of drinking water. These upstream activities have a direct impact on river and deteriorating the quality of the raw water at the Sultan Azlan Shah Dam. Sultan Azlan Shah Dam constructed period starting in 1997 and was officiated in August 2, 2007. The RM253 million dam can produce 639 million litres of water per day and is expected to meet demand in the Kinta Valley up to 2020. It is aimed at increasing water output for the Kinta district (including Ipoh city) from 136 million litres daily (MLD) to 639 MLD to cater for 350,000 consumers. The two main issues faced by the LAP to date are due the sedimentation and limited water stored during the drought season.

The issues on the sedimentation at the Sultan Azlan Shah Dam has till now been addressed via excavation of the sedimentation from the dam to keep water storage in the dam at the recommended level. Three (3) check dams were constructed before the Sultan Azlan Shah Dam by the LAP to control sedimentation as marked in **Figure 3.25** to excavate the silt ending up into the treatment facilities. The observed sedimentation at the dam is known as alluvium. Alluvium is typically made up of a variety of materials, including fine particles of silt and clay and larger particles of sand and gravel.

Figure 3.25: Google map of the dam which indicates the location of the check dam

Excavation of the silt carried out by the contractor assigned by LAP as shown in **Figure 3.26**. It is estimated around RM1mil spent annually for the excavation of the silt. Excavation of the silt by LAP were carried out according to the need, if more sediments were observed and in rainy weather, the amount of silt accumulated are more compared to dry weather, excavation will be carried out. **Figure 3.27** shows the amount of sediment excavated annually from the check dams from 2017 to 2018 as provided by LAP.

Figure 3.26: Images captured inside the Sultan Azlan Shah Dam, where the excavation is carried out

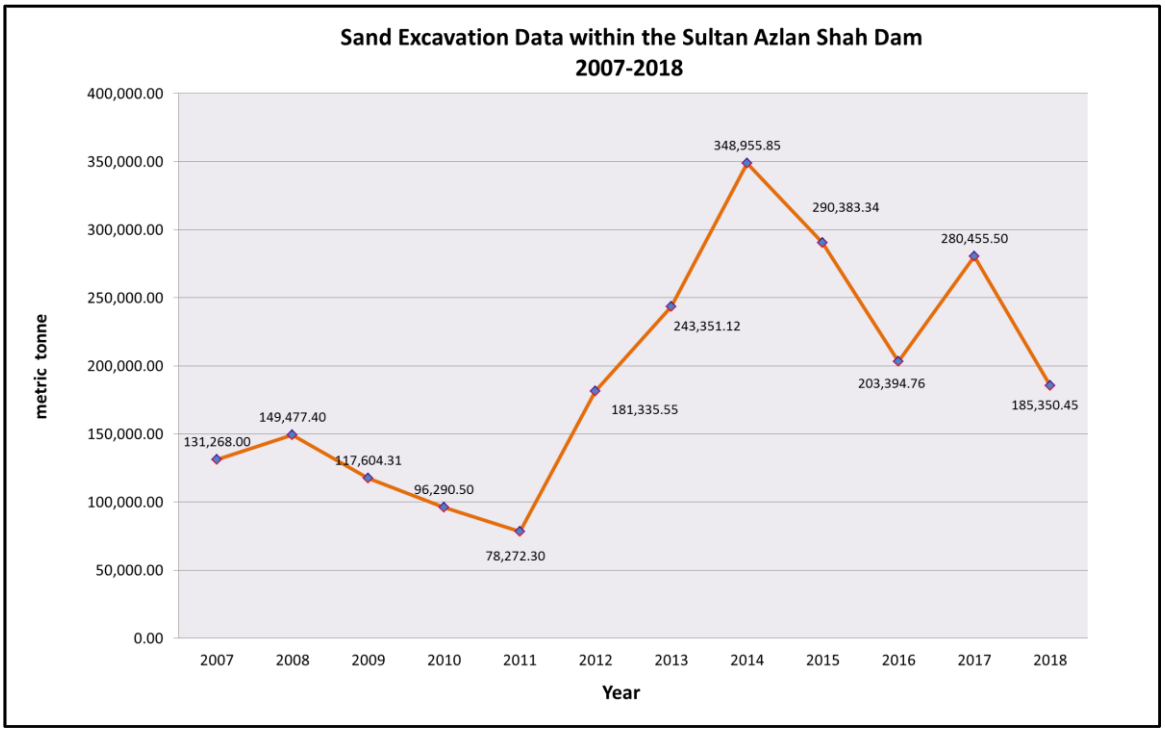


Figure 3.27: Amount of sediment excavated annually from check dams (source: LAP)

It is also noted that the water is turbid with high content of total suspended solid at the excavation site and towards the downstream of the catchment are are due to the followings:

(1) Water naturally erodes sediment from the bed and banks of rivers (source) and transports it downstream through the catchment, depositing it in areas of 'lower energy' e.g. where the flow is slower and areas of land are flatter
(2) Most of the silt and sediments settles beneath the river surface when the water movement were still or less current and when excavation is carried out the disturbed site triggers the silts to be washed down

The actual process of sediment deposition is unique to every reservoir and is impossible to predict accurately. In general, the coarser, heavier sediments, the gravel and sand, tend to settle out at the upper end of reservoir, forming a "backwater" delta which gradually advances toward the dam. The lighter sediments, the silt and clay, tend to be deposited nearer the dam. However, it was also observed and noted from the GEC's water quality sampling and secondary data received from LAP, that although excavation is carried out to reduce the amount of TSS that ends up into the treatment facilities, the content is still high and alarming as discussed in Chapter 3.3.2.4 (**Figure 3.46)**.

iv) Other activities in the Upstream of UKB

At upstream, land clearing activities for development observed. Currently, one development activity is being carried out near Markas Comondo 69 at Jalan A182, Ulu Kinta. Sediment from the development area was observed on its discharge into the nearest stream (**Figure 3.28**). The impact of development activity discussed at next section (water quality section). Besides land clearing activity, accumulation of solid waste also observed to be dumped at that area (**Figure 3.29**)

Development project signbard

Sedimentation from development area

Figure 3.28: Land clearing activity near Markas Comondo 69

Figure 3.29: Solid waste dumping at water bodies near to Markas Comondo 69

Besides this, land clearing for agriculture at Choh River upstream was observed (**Figure 3.30**) which possibly can impact the water body. River bank erosion at Pinji River also observed (**Figure 3.31**).

Figure 3.30: Land clearing activities for agriculture, Choh River

Figure 3.31: River bank erosion at Pinji River

The overall observation shows that upstream of UKB is mainly polluted by sedimentation from land clearing and development activities. Besides that, solid waste dumping into water bodies also detected. Therefore key stakeholders such as developers as well as communities in this region need to be engaged to prevent these issues from effecting UKB's water quality.

c) Midstream of UKB

In the midstream, the number of activities that affected water quality was observed. Direct sullage discharge from roadside stalls into streams at Tanjung Rambutan area was observed (**Figure 3.32**). Solid waste also observed in midstream especially at Sah River, Persiaran Meru Jaya 2 (**Figure 3.33**). Similar to upstream, development activity also observed here at Sah River which is nearby to Lebuh Meru Raya (**Figure 3.34**).

Figure 3.32: Direct sullage discharge from roadside stalls at Tanjung Rambutan

Figure 3.33: Solid waste dumped at Sah River

Development project

Sah River after development

Figure 3.34: Impact of development project to Sah River, Lebuh Meru Raya

Observation at midstream of UKB indicates this region also impacted by human activities ranging from development, sullage discharge and improper solid waste disposal. All these activities need to be curb to improve water quality through stakeholder engagement especially communities in this area.

d) Downstream of UKB

Compared to the other two (2) regions, downstream of UKB reported more pollution issues related to river pollution especially water quality. One of the main issues is discharge from wet markets due to the improper waste handling and kitchen management. Solid waste accumulation within drainage of Manjoi wet market at Jalan Sri Tanjong (**Figure 3.35**) and Gunung Rapat wet market (**Figure 3.36**) were observed. Besides this, direct solid waste dumping into the water bodies and at river banks observed at many places (**Figure 3.37**). All these can cause serious problem to Kinta River.

Manjoi wet market

Oily and smelly discharge

Figure 3.35 Pollution observed at Manjoi Wet Market, Jalan Sri Tanjong

	
Gunung Rapat wet market	Clogged drain due to rubbish

Figure 3.36: Pollution observed at Gunung Rapat Wet Market, Jalan Gunung Rapat

	
Jalan Bunga Raya, Taman Chong Kwee, Tanjung Rambutan	Tg. Rambutan cremation site
	
Tapah River, Jalan lengkok Jelapang, under Ipoh-Lumut Expressway	Buntong River, Persiaran Buntong Jaya 8

Figure 3.37 Solid waste dumping at downstream of UKB

Downstream of UKB indicates many pollution sources which can directly and indirectly affect river water quality that passing through this region. Therefore the project needs to engage

different type of stakeholders such as wet market owners, public, communities and local authorities.

3.3.2 Water Quality Status

Water quality status reported based on four (4) aspects for better understanding. Firstly, secondary data from DOE Perak, DID Perak and LAP reported. Secondly, overall UKB water quality status analyzed and reported based on eight (8) stations except for UR1 and UR2. Thirdly, the difference in water quality of UR1 and UR2 investigated to study the impact of land clearing activities for the development project. Fourthly, UK1 station analyzed for turbidity as it is located before the dam.

3.3.2.1 Water quality monitoring by agencies

The Water Quality Index (WQI) of water quality monitoring stations by DOE Perak for four (4) years monitoring is summarized in **Table 3.7** below. From the data, it is noted that most of the rivers within Kinta River basin is within Class III classification and latest data (2017) indicating the basin is within the slightly polluted river status.

Table 3.7: Water Quality Index (WQI) of rivers monitored by DOE according to EQR

River	2014		2015		2016		2017	
	WQI	Class	WQI	Class	WQI	Class	WQI	Class
Chepor	85	III	91	II	90	II	90	II
Kinta	82	II	82	II	74	III	74	III
Pinji	60	III	72	III	66	III	61	III
Pari	68	III	78	II	63	III	66	III

Table 3.8 shows the average WQI of Kinta River based on DID Perak's stations from February 2018 till October 2018. The overall average WQI within this period reported being 79 which indicate a slightly polluted condition of the Kinta River. This data served as latest reference data before sampling.

Table 3.8: Average Water Quality Index (WQI) of rivers monitored by DID Perak

WQI	February 2018	March 2018	April 2018	May 2018	June 2018	July 2018	August 2018	September 2018	October 2018
Based on 9 stations within Kinta River	79.0	79.0	81.2	77.1	77.9	76.6	77.1	81.9	81.5
Overall	**79**								

Table 3.9 shows the turbidity data provided by LAP at two (2) WTPs that sourced by Sultan Azlan Shah Dam. It is observed turbidity level rise and fall due to sedimentation issue. Although it is still within recommended raw water intake limit (<1000NTU) but it exceeds class IIB limit (50NTU) for most of the years.

Table 3.9: Average turbidity level at Sg Kinta WTP and Ulu Kinta WTP

Year	Average Turbidity (NTU)	
	Sg.Kinta WTP	Ulu Kinta WTP
2013	103.7	82.7
2014	137.3	102.2
2015	153.6	117.5
2016	46.2	43.3
2017	122.6	125.2
2018	31.7	31.4

3.3.2.2 Overall UKB water quality status

Water quality parameters were interpreted according to the National Water Quality Standard (NWQS) (**Table 3.10**). Each parameter was compared against NWQS Class IIB which indicates suitable for body contact. Besides this, overall WQI calculated.

Table 3.10: National Water Quality Standard (NWQS) for Malaysia

Parameter	UNIT	CLASS					
		I	IIA	IIB	III	IV	V
Ammoniacal Nitrogen	mg/l	0.1	0.3	0.3	0.9	2.7	> 2.7
Biochemical Oxygen Demand	mg/l	1	3	3	6	12	> 12
Chemical Oxygen Demand	mg/l	10	25	25	50	100	> 100
Dissolved Oxygen	mg/l	7	5-7	5-7	3-5	< 3	< 1
Total Suspended Solids	mg/l	25	50	50	150	300	300
pH	-	6.5 - 8.5	6.0 - 9.0	6.0 - 9.0	5.0 - 9.0	5.0 - 9.0	-
Turbidity	NTU	5	50	50	-	-	-
Faecal Coliform	count/ 100 ml	10	100	400	5000	5000	-

The overall water quality data were summarized and shown in **Table 3.11** below.

Table 3.11: Summary of water quality data for Upper Kinta River basin

Station	DO (mg/L)	Turbidity (NTU)	BOD (mg/L)	COD (mg/L)	TSS (mg/L)	NH_3N (mg/L)	F. Coliform (MPN/100 mL)	WQI	CLASS	WQ STATUS
UK1	8.66	52	13	36	18	0.8	ND < 1.8	74.5	III	SP
UK2	5.16	19	17	45	8	0.2	7.8	69.6	III	SP
UK3	3.88	23	16	43	6	0.2	2	63.7	III	SP
PJ1	4.57	29	17	47	14	2.5	25	58.5	III	P
PR1	3.16	21	18	48	4	0.3	43	59.8	III	P
CP1	8.4	14	12	36	8	0.0	ND < 1.8	82.7	II	C
CH1	5.16	39	26	70	40	0.6	15	57.4	III	P
SO1	8.28	6	10	34	6	0.0	ND < 1.8	84.7	II	C
Overall	**5.91**	**25**	**16**	**45**	**13**	**0.58**	**12.28**	**68**	**III**	**SP**

Physico-chemical parameters were analyzed to investigate the type of pollution within UKB. Variation of data reading was recorded at each sampling stations for every parameter and the variation may be caused by the identified pollution sources at each location. All the stations exceed the limit of Class IIB standard for BOD and COD. Among the sampling location, CH1 recorded highest COD (**Figure 3.38**) and BOD (**Figure 3.39**) probably due to the excess of organic and chemical discharge from the industrial area nearby to the river. All the sampling stations reported Class IIB standard for TSS (**Figure 3.40**). However, UK1 (upstream of Kinta River) which supposed to have lowest sediments reported high reading for TSS and turbidity compared to its downstream stations (UK2 & UK3) (**Figure 3.41**). This is an alarming result which gives the possibility of sediment being transport even from the source of Kinta River due to on-going land clearing activities at the upper UKB. Ammoniacal nitrogen (NH3-N) recorded the highest reading at Pinji River (PJ1) (**Figure 3.42**) probably due to the active commercial area especially residential areas and restaurants.

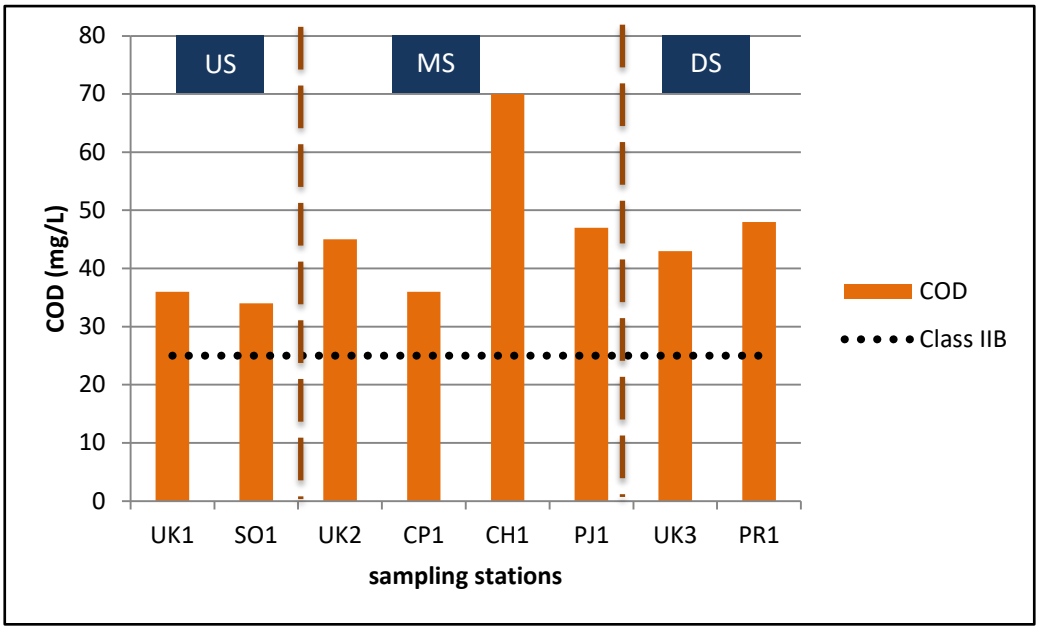


Figure 3.38: Variation of COD reading between sampling stations within UKB

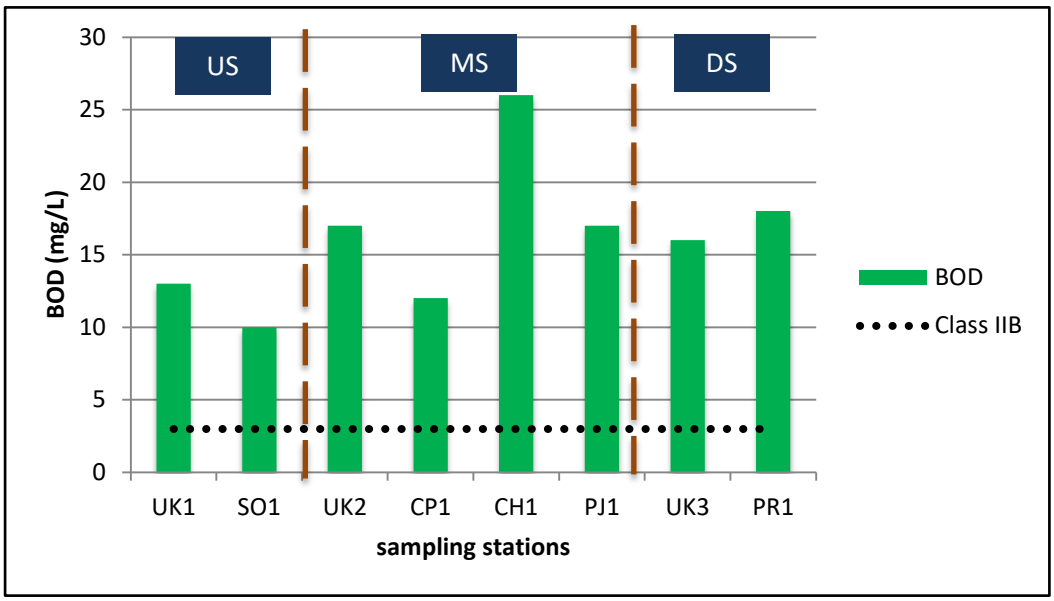


Figure 3.39: Variation of BOD reading between sampling stations within UKB

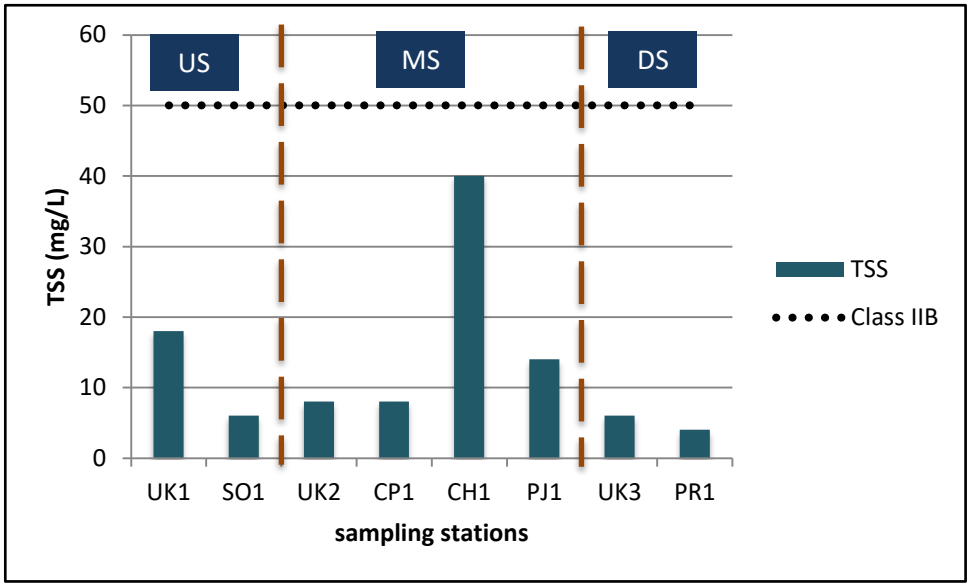


Figure 3.40: Variation of TSS reading between sampling stations within UKB

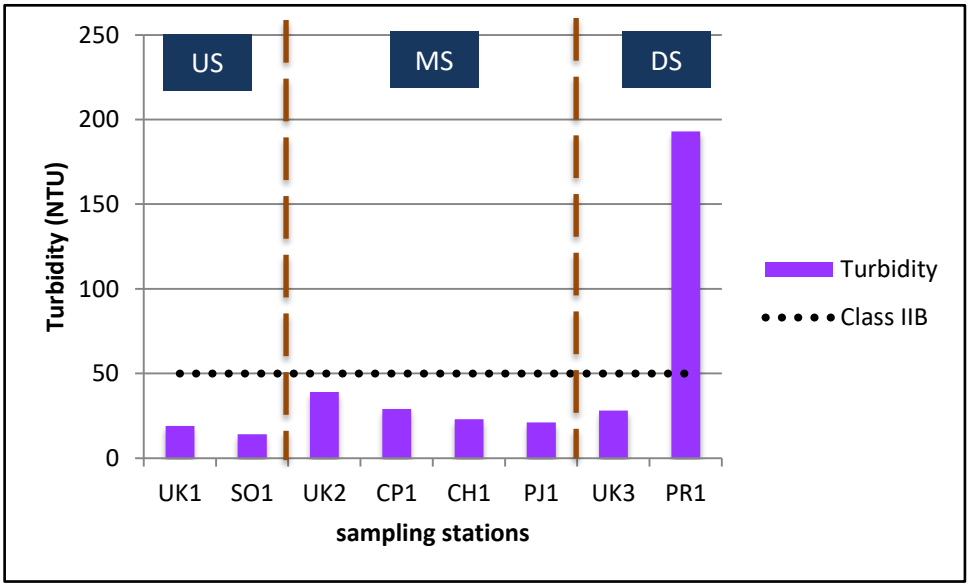


Figure 3.41: Variation of Turbidity reading between sampling stations within UKB

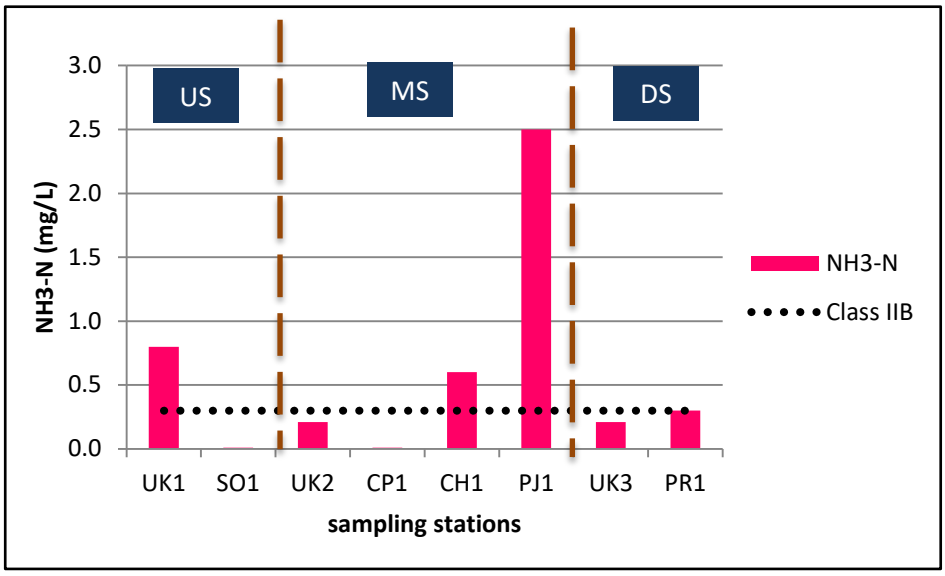


Figure 3.42: Variation of NH3-N reading between sampling stations within UKB

Figure 3.43 shows the microbiological water quality status through Faecal Coliform reading. Coliform bacteria are a form of a form of microbes which formed naturally in the intestinal track of warm blooded mammals, including human. The microbiological parameter when found in water generally indicates pollution by partially / untreated sewage. Analysis of Faecal Coliform showed all the stations recorded readings are within DOE's Class IIB standard (400 counts/100mL). This shows UKB area is not much affected by Faecal contamination. Three (3) stations which are UK1, CP1, and SO1 are not detected with Faecal Coliform (**Table 3.11**) and these three (3) stations as stated before are located at the upper stream of Kinta River basin and experience very less human activities. PR1 reported the highest reading among the others but still within the limit.

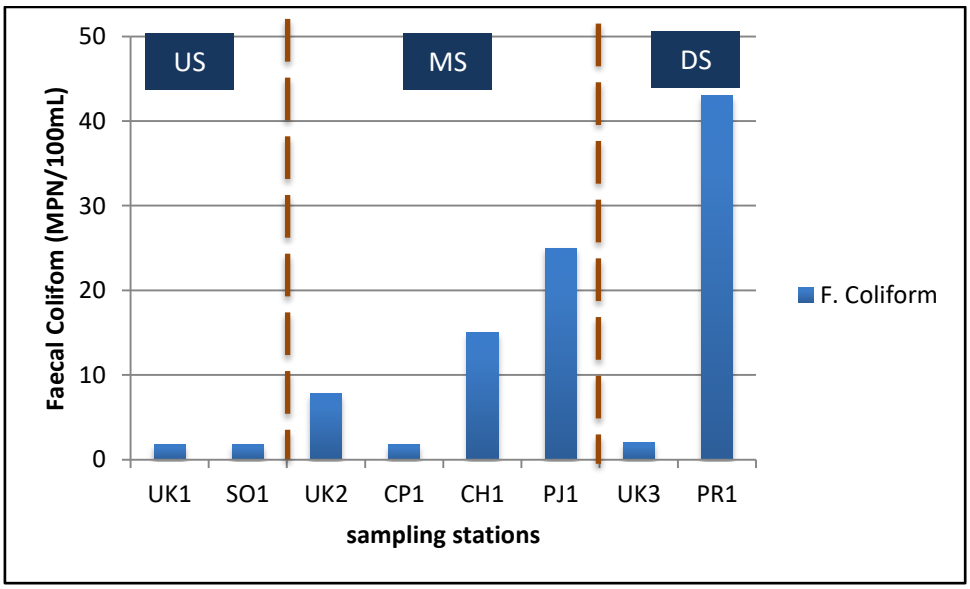


Figure 3.43: Variation of Faecal Coliform reading between sampling stations within UKB

For overall UKB status, WQI was analyzed. **Figure 3.44** shows the WQI according to UKB regions. The WQI also interpreted compared with DOE's Water Quality Classification (**Table 3.12**).

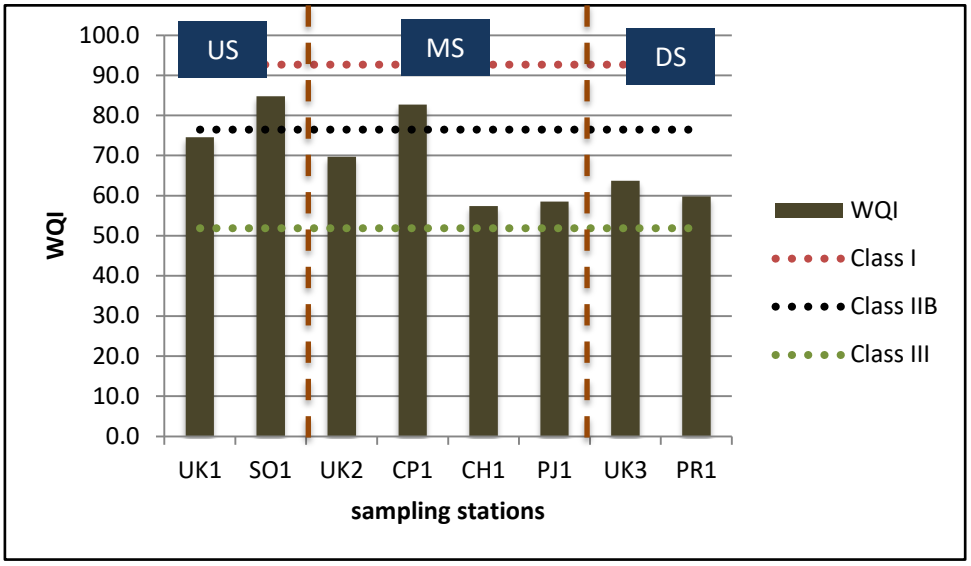


Figure 3.44: WQI status of UKB regions

Table 3.12: DOE's Water Quality Index (WQI) classification

WATER QUALITY INDEX	CLEAN (C)	SLIGHTLY POLLUTED (SP)	POLLUTED (P)
Water Quality Index(WQI)	81 - 100	60 - 80	0 - 59

SO1 and UR1 are the stations located at the upstream of UKB and showed good water quality due to less anthropogenic activities at that area. Good water quality at Senoi-oi River (SO1) shows continuous preservation and involvement of Orang Asli there as they hold major impact to that tributary. CP1 with Class IIB river water quality showed the river is suitable for body contact and considered safe till now as it is used for recreational purpose. Lowest WQI recorded at CH1 (WQI=57.4) probably due to active industrial activities and is supported with a high reading of BOD, COD and TSS. Within region, upstream of UKB reported WQI of 79.5 (Class II) and followed by midstream (WQI: 76.2, Class III), with lowest at downstream of UKB (WQI: 61.8, Class III). So, only upstream of UKB is still within Class II condition but still within slightly polluted status. Overall, average WQI of 68 reported which shows UKB is within Class III which is slightly polluted condition based on this study.

3.3.2.3 Impact of development activities

As per observation in pollution inventory study, development activity was observed at upstream of UKB. Sediments discharging into the nearest water body (UR2) also observed. Therefore 2 monitoring stations have been selected to measure the immediate impact of the land clearing (before and after) on water quality of nearby water body. **Table 3.13** shows the water quality parameters reported for these two (2) stations.

Table 3.13: Summary of water quality data for Upper Kinta River basin

Station	DO (mg/L)	Turbidity (NTU)	BOD (mg/L)	COD (mg/L)	TSS (mg/L)	NH_3N (mg/L)	F. Coliform (MPN/100mL)	WQI	CLASS	WQ STATUS
UR1	7.39	28	14	40	10	0.0	ND < 1.8	80.4	II	SP
UR2	6.09	193	15	41	50	0.3	4.5	70.2	III	SP

Among the parameters, turbidity and TSS showed significant difference before development (UR1) and after development (UR2) (**Figure 3.45**). Turbidity exceeded Class IIB limit and this shows there is a direct impact of development activity within this UKB upstream area. The situation can be worsened during heavy rain events where there are high chances for the sediments to be transported all the way to downstream.

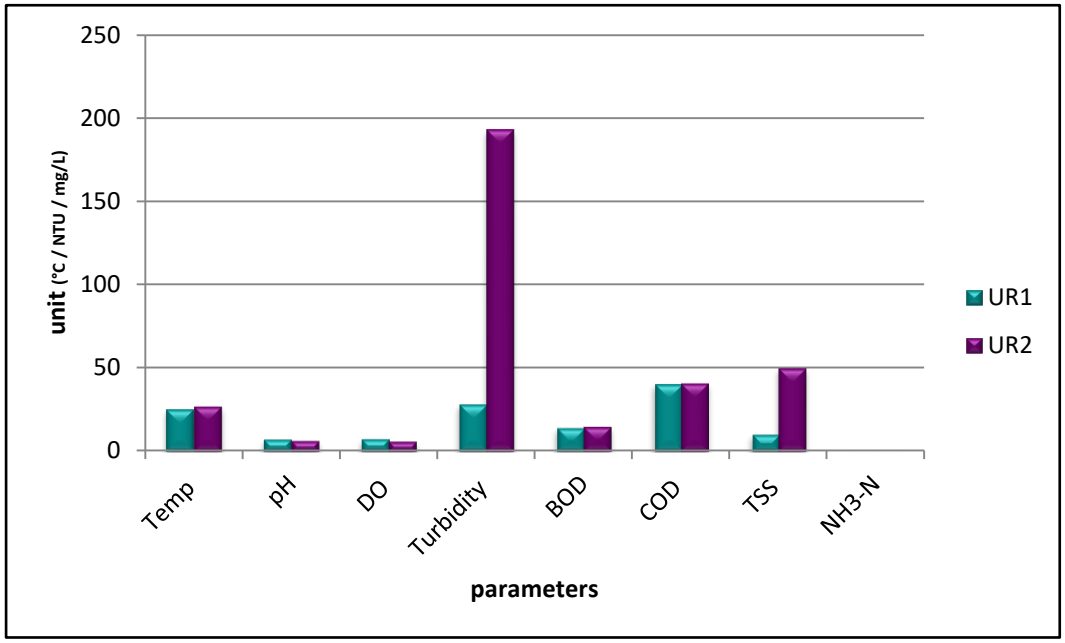


Figure 3.45: Difference in physico-chemical parameters in UR1 and UR2

3.3.2.4 Water quality status before dam

UK1 is the only station set before dam to study the impact of activities at the source of Kinta River. Any activities within this catchment will give serious impacts on Sultan Azlan Shah Dam that provides the water supply for Ipoh residents. Sedimentation issue is one among the key problems faced by Sultan Azlan Shah Dam. Therefore, turbidity was compared before dam (UK1) and after dam (Sungai Kinta WTP, SK and Ulu Kinta WTP, UK). It has been observed (**Figure 3.46**) that high turbidity already been recorded even before the dam. Some of the identified contributing factors for high sedimentation at the sampling sites (UK1) can be due to the followings; large amounts of sediment is being eroded from the Simpang Pulai - Cameron highway route especially at Km44-46 and carried to the dam via Penoh River.

In addition, land clearance at upstream for agro-tourism, as well as small-scale cultivation of orchards and plantations can also lead to erosion and sedimentation within the river basin. The erosion/re-suspension of sediments affects the turbidity of the river at station UK and SK. Although all the readings are within recommended raw water quality, it can be worsened during heavy rainfall if preventive measures not been adopted.

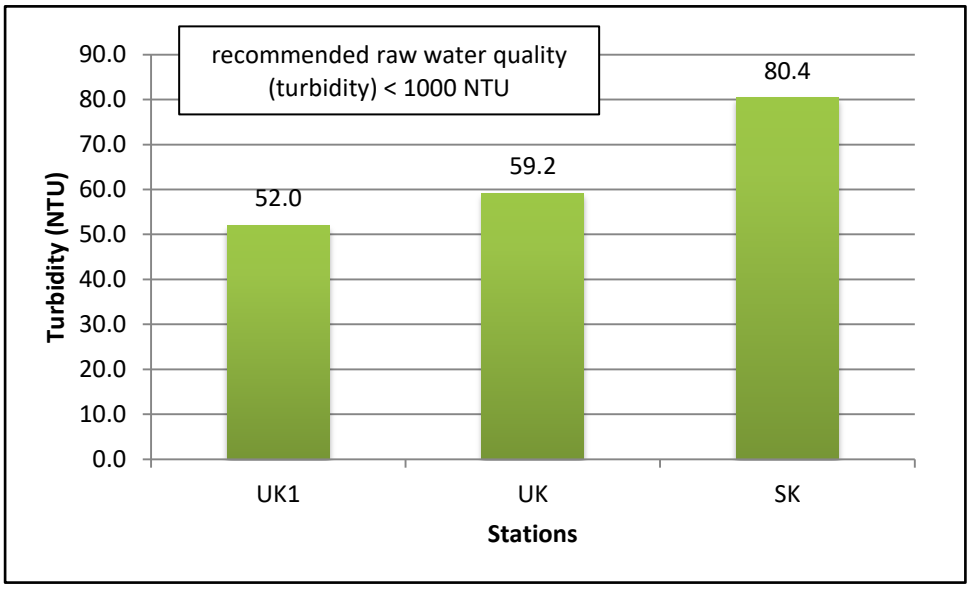


Figure 3.46: Turbidity level before and after dam

3.3.3 Biological Water Quality Status

UKB biological water quality status through bio-indicators analyzed and described according to three regions, upstream, midstream and downstream respectively. The section explained in two (2) sub-topics which are the distribution of aquatic macroinvertebrates and overall UKB biological water quality.

3.3.3.1 Distribution of benthic macroinvertebrates

The overall aquatic macroinvertebrate collected at each sampling stations is summarized in **Table 3.14** below. A total of 76 macroinvertebrate individuals from 11 Class/Order and 17 families were collected.

Table 3 .14: Overall distribution of aquatic macroinvertebrate at Upper Kinta basin

Class / Order	General Group	Family	Common Name	US		MS		DS	
				UK 1	SO 1	UK 2	CP 1	UK 3	SN 1
Decapoda	Crustaceans	Palaemonidae	Freshwater prawn				1		
		Palaemonidae	Shrimp			1			
Megaloptera	Alderflies	Corydalidae	Dobsonfly larvae		1				
Ephemeroptera	Mayflies	Baetidae	Mayflies	4	2	4	2	10	
		Heptagenidae	Flattened mayfly	3	4				
Odonata	Dragonflies	Libellulidae	Skimmer dragonfly larvae			2	1		
	Damselflies	Coenagrionidae	Common damselfly	3					
Diptera	True flies	Chironomidae	Bloodworm					4	3
		Naucoridae	Common saucer bug			1			
Trichoptera	Caddisflies	Hydropsychidae	Net-spinning caddisfly	3	3		2		
Cleopatra	Beetles	Hydrophilidae	Water beetle	2					
		Dystiscidae	Diving beetles			1			
Gastropoda	Snails	Bithyniidae	Pond snail						4
Perlidae	Stonefly	Plecoptera	Stonefly	2	2		2		
Annelida	Worms	Haplotaxidae	Haplotaxids						4
		Turbificidae	Sludge worm			1			
		Planaridae	Flatworm			1			1
	Leeches	Hirudinea	Leeches					2	2
Total Class/Order	**Total Groups**	**Total Families**	**Individual**						
11	**13**	**17**		**30**		**19**		**27**	
			Total	**76**					

**US=upperstream, MS=middle stream, DS=down stream*

Overall, UKB is suitable for aquatic life particularly the benthic macroinvertebrates as three regions recorded their presence. **Figure 3.47** summarizes the abundance and richness of aquatic macroinvertebrates at each region. Species richness observed higher at upstream and midstream compared to UKB downstream. Higher abundance observed at upstream of UKB indicating that site is better habitat for bio-indicators compared to other regions.

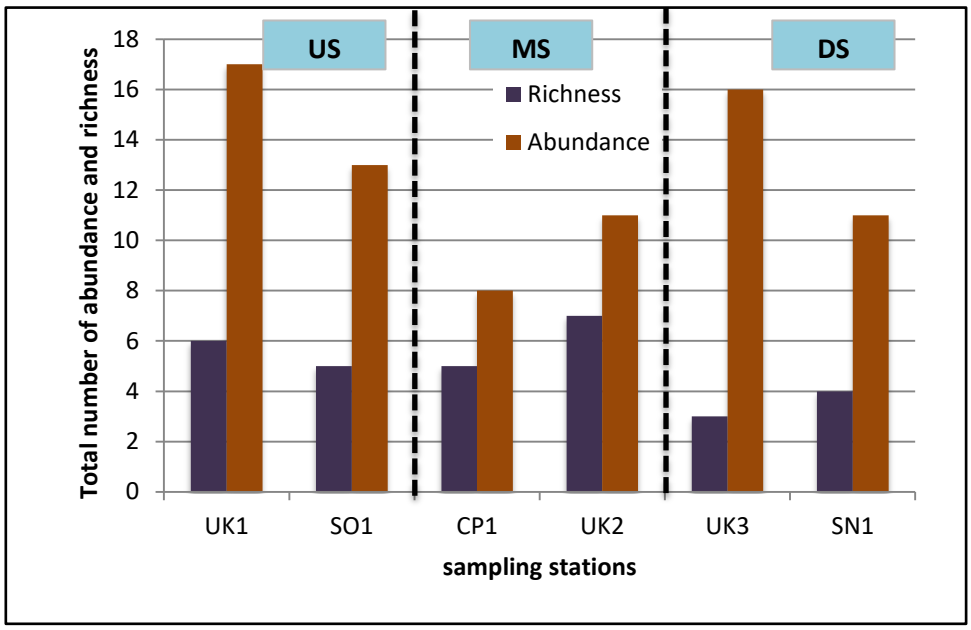


Figure 3.47: Abundance and richness of benthic macroinvertebrates within UKB

Figure 3.48 shows the overall composition of aquatic macroinvertebrate, based on general group that sampled within UKB. The dominant group is mayfly (Oder Ephemeroptera). The major presence of this group especially Family Heptagenidae at the upper stream (UK1, SO1) indicates that the upper stream of UKB is in clean condition as this group is particularly sensitive to pollution. Other than mayfly group, the presence of other good river indicators such as stonefly (Order Plecoptera, Family Perlidae) and caddisfly (Order Tricoptera, Family Hydropsychidae) indicates that this region is also in clean river status. Where else the presence of pollutant tolerance indicator at middle and lower stream of UKB shows that the rivers started to experience impact from anthropogenic activities especially at SN1 where the station is dominated by snails (Order Gastropoda, Family Bithyniidae) and worms (Order Annelida, Family Haplotaxids). Other than the impact of anthropogenic activities, there are few physical characteristics that influence the distribution and richness of these aquatic macroinvertebrates such as the riparian vegetation, depth of the river, shaded area, trapped leaves in the rivers and types of substrates. The presence of these physical characteristics supports the habitat preference of the benthic organisms and **Figure 3.49** show some of the good aquatic macroinvertebrates that can be found within UKB.

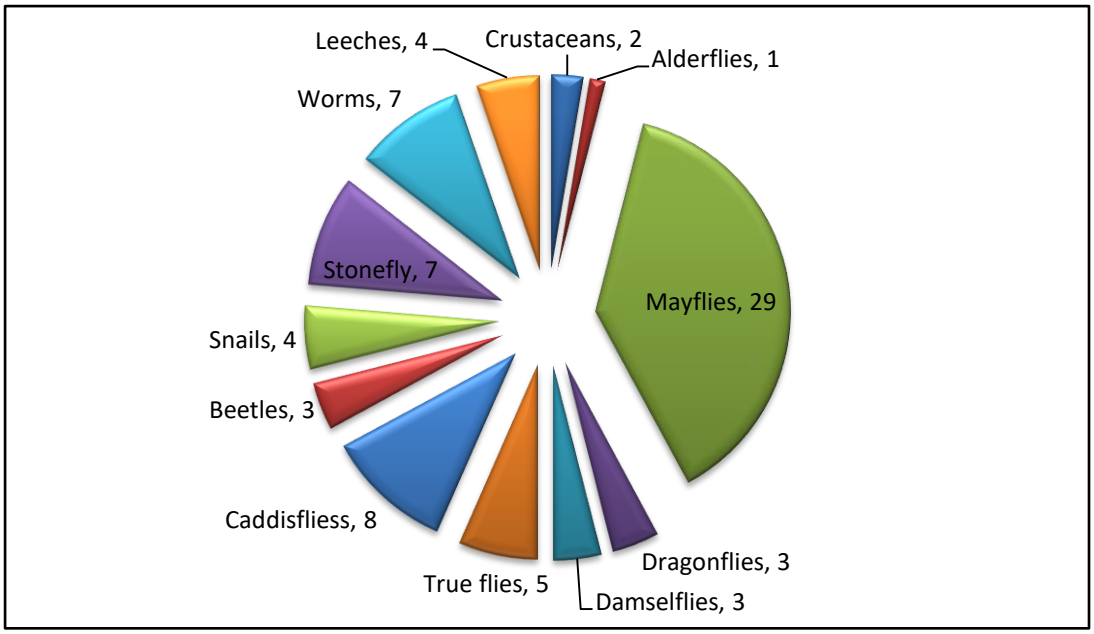


Figure 3.48: Overall compositions of aquatic macroinvertebrate collected within UKB

Freshwater prawns (Family Palaemonidae)

Mayfly larvae (Family Baetide)

Damselfly larvae (Family Coenagrionidae)

Mayfly larvae (Family Heptageniidae)

Caddisfly larvae (Family Hydropsychidae)

Stonefly larvae (Family Perldiae)

Figure 3.49: Aquatic macroinvertebrates within UKB

3.3.3.2 UKB biological water quality status

Biological water quality status of UKB reported using ASPT Index is tabulated in **Table 3.15** below. This analysis helps to classify the biological water quality status into four (4) main categories which are good, moderate, poor and bad. SO1 recorded the highest ASPT Index indicating good water quality class (ASPT = 7.6). The presence of high number of good indicator shows that this river is clean condition and free from pollutants. In contrast, the lowest ASPT Index recorded at SN1 (ASPT = 3.5) showing bad water quality class and indicates these river experience pollutants which only pollutant tolerance indicator can be found in the river. **Table 3.16** summarized the overall findings of the average ASPT Index within UKB regions. It shows that the upper stream of UKB is in good water quality class with the score range of 7.2 followed by the middle stream (ASPT = 5.8) and lower stream (ASPT = 4.0). .

Table 3.15: Water Quality Class bases on ASPT Score Index

ASPT Score Range	> 8.0	6.0 - 8.0			5.0 - 6.0	3.0 - 5.0			< 3.0
Water Quality Class	Very Good (VG)	Good (G)			Moderate (M)	Poor (P)			Bad (B)
Stations		UK1	SO1	CP1		UK2	UK3	SN1	
ASPT Score		6.7	7.6	6.6		4.9	4.5	3.5	
Total Location		3				3			

Table 3.16: Average ASPT Index for upper, middle and downstream of UKB

	Upper stream (US)	Middle stream (MS)	Downstream (DS)
Average ASPT Index	7.2	5.8	4.0
Water Quality Class	Good (G)	Moderate (M)	Moderate (M)

3.4 CONCLUSION

Pollution source rapid inventory of UKB combined main three studies which are pollution source inventory, water quality study and bio-indicator study respectively. Studies were conduated in the upper, middle and lower portion of the UKB. It was observed all the three regions experience pollution due to human activities. Upstream of UKB showed development and land clearing as a main human activity that affect the quality of water bodies. There are some serious land clearing, landslides and erosion issues along the Simpang Pullai – Cameron highway. Midstream recorded mixed of human activities such as development, sullage discharge and solid waste dumping. The downstream of UKB, showed a high number of point source pollution being observed indicating much action needed by different types of stakeholders to prevent similar issues repeating in future.

The overall water quality status of UKB reported being slightly polluted condition (WQI: 68). This is also an alarming result as upper part of Kinta River basin should be in better condition at least in clean condition as it is the water catchment area for Sultan Azlan Shah Dam. Key development activity found to be impacting the water quality of receiving bodies through water sampling at that particular area. With this evidence, relevant and related parties need to be engaged and consulted for water quality improvement. Besides this, high turbidity level at water intake area also observed which indicating corrective measures to be taken to prevent impact from human activities especially land clearing activities.

Besides this, the biological indicators study at UKB showed a relatively good abundance and diversity of aquatic indicators. The most dominant species found, being mayflies (Family Baetidae) indicates that the river is in moderate to good water quality class. It highlights that rivers in Upper Kinta River need a good protection to be preserved as it showed the presence of bio-indicators in all region. The parallel trend of ASPT scores with WQI also indicating the suitability of biomonitoring to be adopted as another option to monitor the health of UKB. The monitoring can be done by all agencies and communities with proper empowerment.

Lastly, pollution source rapid inventory of UKB helps to identify the pollution sources and enhance our understanding on the type of preventive measures that depend on various stakeholders.

CHAPTER 4: STAKEHOLDER PERCEPTION SURVEY 4-1

4.1 BACKGROUND

The perception survey aimed to collect data to understand the environmental and socio-economic issues with local communities at Upper Kinta Basin. The survey was focused to gather information on the level of their awareness, knowledge, skills and their willingness to participate in community-based river initiatives. The survey was also conducted to understand the different communities' perspective, understanding, interest, and concerns about the Upper Kinta Basin and is analysed based on three groups of communities – the Urban, peri-urban community and Orang Asli representing upstream, midstream and downstream respectively.

4.2 SURVEY DISTRIBUTION

The survey was conducted using two methods, which is through online Google Forms and face-to-face interviews and questionnaire. The questionnaire was distributed randomly to allow people in the community to have an equal chance of being chosen. The survey was targeted to all communities from various kinds of demographics within UKB to improve the quality of feedback obtained and to avoid biased data. The hard-copy questionnaires were distributed to six areas which include the following areas:

- Medan Ipoh
- Ipoh town centre
- Manjoi
- Tanjung Rambutan
- Chemor
- Orang Asli villages – Kg Tonggang, Kg Sg Suloh, Kg Chadak, Kg Baduk and Kg Makmur

Some of the survey points selected are located within high-density locations, such as the town centres, shopping complexes, and markets. This is with the expectation that there are higher chances of getting large sample distribution instead of conducting house-to-house interviews especially at the semi urban and urban area which often has a high rejection rate.

4.2.1 Method of Survey

The face-to-face interviews and questionnaire distribution was carried out from 1st November 2018 to 2nd November 2018. A total of 22 enumerators were involved to carry out the face-to-face interviews and questionnaire. The online survey was available online for two weeks from 1st to 15th November 2018 and the link to Google Forms were shared to the university students and NGOs based within UKB. Overall, 92.5% of the samples collected were through face-to-face survey and 7.5% (15 set) received through online questionnaires. A total of 300 questionnaires been distributed. Out of that, 230 questionnaires were returned. Out of the 230 sets, 200 sets were collected from the urban and peri-urban communities, and 15 sets were received from the Orang Asli community within UKB.

4.2.2 Description of the Survey

The survey was designed to measure perception and current status of the targeted groups; the survey was divided into five parts which covered the following components:

1. *Profile of Respondents* – This section aims to collate the basic demographic profile of the respondents. This section contains 10 questions
2. *Knowledge on Forest Reserve and Rivers at UKB* – This section aims to understand the general level of knowledge of the respondents on the interdependency of the population to the forest and rivers. Particularly on the ecosystem services provided by these habitats, awareness on their water resources, and simply knowledge on the presence of forest and rivers near them. This section contains 5 questions
3. *Awareness on Issues Related to Forest and Rivers at UKB* – This section aims to document the awareness of the respondents to the environmental issues surrounding their location. In this section, the survey also aims to assess the contemplation of the respondents by looking at the barriers of change and what makes them relapse. This section contains 10 questions
4. *Existing Practices and Facilities for Environmental Best Management Practices (BMPs)* – This section aims to collect information on the current best management practices of respondents and actions taken in caring for the environment, and whether they have the skills and resources to practice environmental initiatives. This section contains 4 questions
5. *Readiness and Willingness to Participate in Public Outreach Programmes* – This section aims to document the respondent's self-efficacy and willingness to participate in future activities, this could support in the future for outreach programme. This section contains 4 questions

The survey form attached in **Annex 1**.

4.3 DATA ANALYSIS

The completed survey questionnaires were compiled and sorted according to different target groups. Data analysis was conducted using frequencies and pivot figures to compute percentage distributions. Information in the figures was converted into charts to make the data statistics easier to understand.

4.3.1 Profile of respondents

A total of 230 people from were successfully interviewed for the perception survey; of which there were 116 (50%) males and remaining 114 (50%) females. The largest group of interviewees by age was between the ages of 21 – 30 years old (27%) (**Figure 4.1**). The largest group of respondents by income (36%) had a gross monthly income below RM500 (**Figure 4.2**); most of them were from the peri-urban area and work in agriculture.

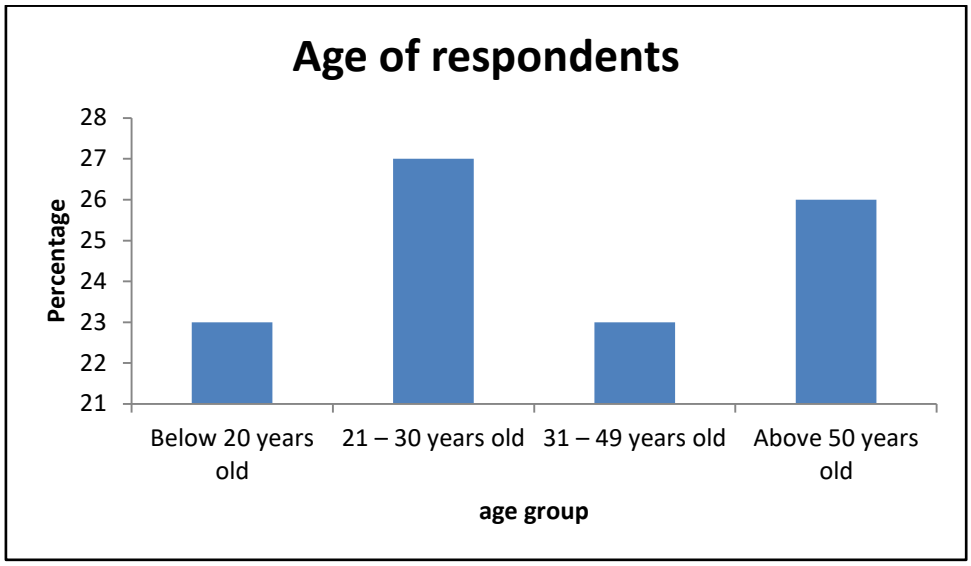


Figure 4.1: Age of respondents

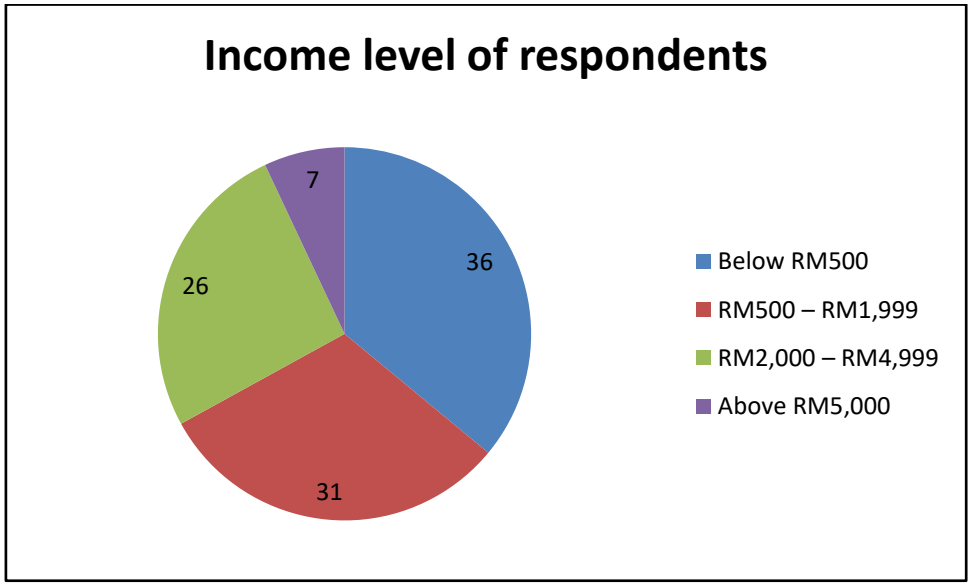


Figure 4.2: Income levels of respondents

4.3.2 Knowledge on forest reserve and rivers at UKB

This section aims to assess the knowledge of the respondents on the forest and rivers, specifically the ecosystem services provided by these habitats. Overall 91% of the respondents selected water supply as the most important ecosystem services provided by the forests and rivers while flood control is rated as the second most important service at 80% (**Figure 4.3**). **Section B1, Annex 2** shows the breakdown on the awareness of the respondents on the importance of the water and forest resources.

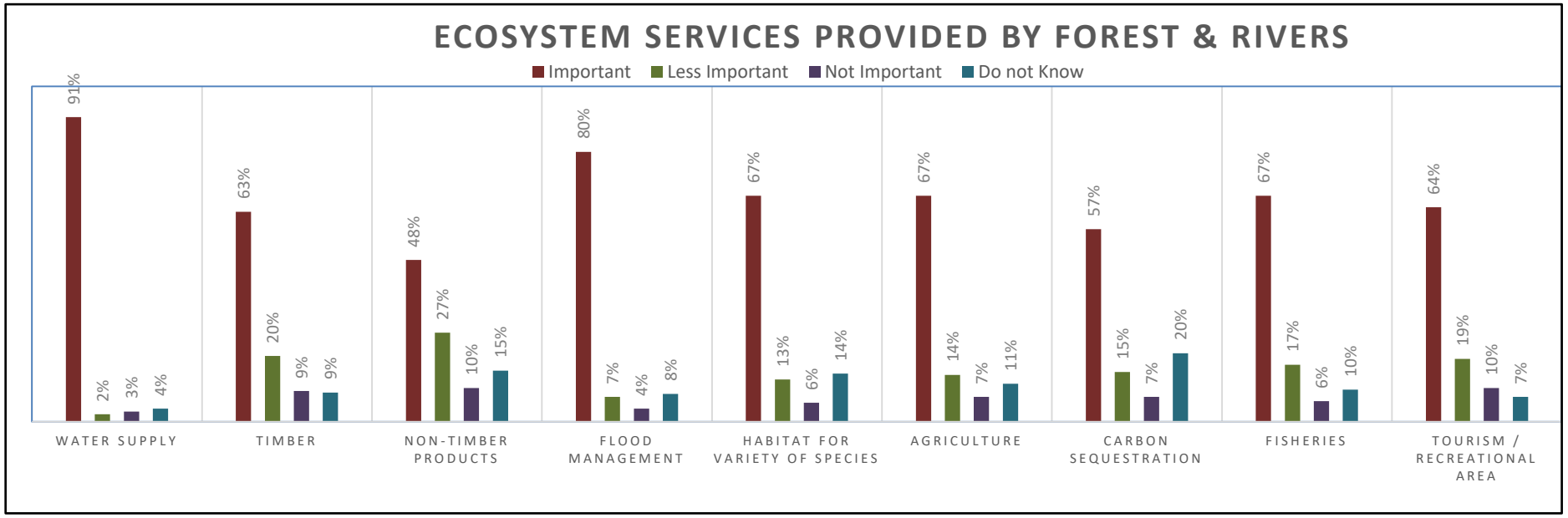


Figure 4.3: Ecosystem services provided by Forest & Rivers

Water supply was the most important service for respondents from all three (3) different areas; urban (96%), peri-urban (89%), village (88%) (**Figure 4.4**). 96% of the urban respondents said water source is most important (96%) followed with the importance of biological diversity at 86%, flood control at 80% followed with agriculture feed at 78%. Peri-urban community highlights that forest and water resources are most important as for water source (89%), flood control (81%), 66% for both fisheries and agriculture. As for the Orang Asli community, 88% choose the importance of the forest and the river mainly for water source followed with timber (forest resource) and flood control at 69% as well as for fisheries (65%).

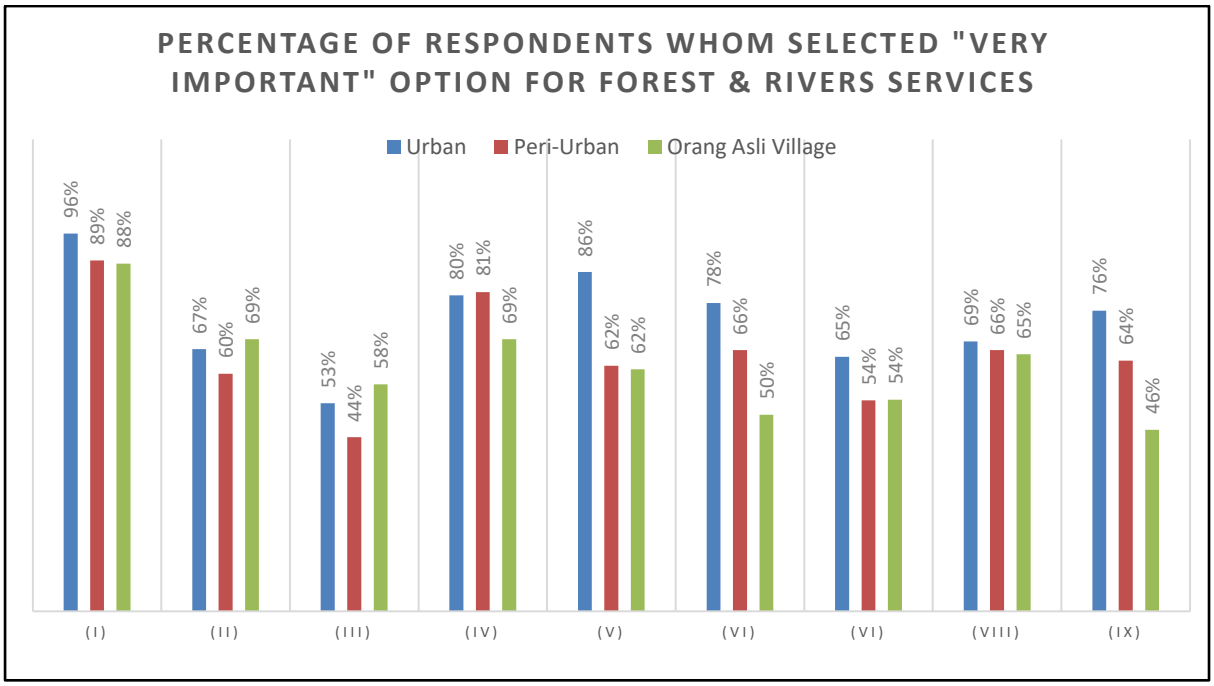


Figure 4.4: Percentage of respondents whom selected "Very Important" option for Forest & Rivers services

In general, almost half of the respondents were not aware on the source of the their drinking water (49%) **(Section B2, Annex 2**). Majority of the respondents also have no knowledge of the forest reserves (64%) and the drainage system (64%). However, 60% of the respondents were aware of the rivers nearby to their neighbourhood (**Section B3, Annex 2**). Comparing between the three community groups, people from the village have higher knowledge of their drinking water source (58%), presence of rivers and forest nearby (73% and 64%). This could be due to the fact that their lives are closer and more connected to the forest and rivers, as their drinking water pipeline is setup, managed and maintained by the villagers themselves. In contrary, communities in the urban and peri-urban areas receives water supply through the municipal pipeline which they have less hands on the management and knowledge on the source. Common in all communities are the lack of knowledge on where their drainage discharges, with only at 29%, 37% and 42% of urban, peri-urban and village respondents were aware. Overall, the Orang Asli community has higher knowledge on the forest and water resource compared to the urban and peri-urban communities (**Figure 4.5**).

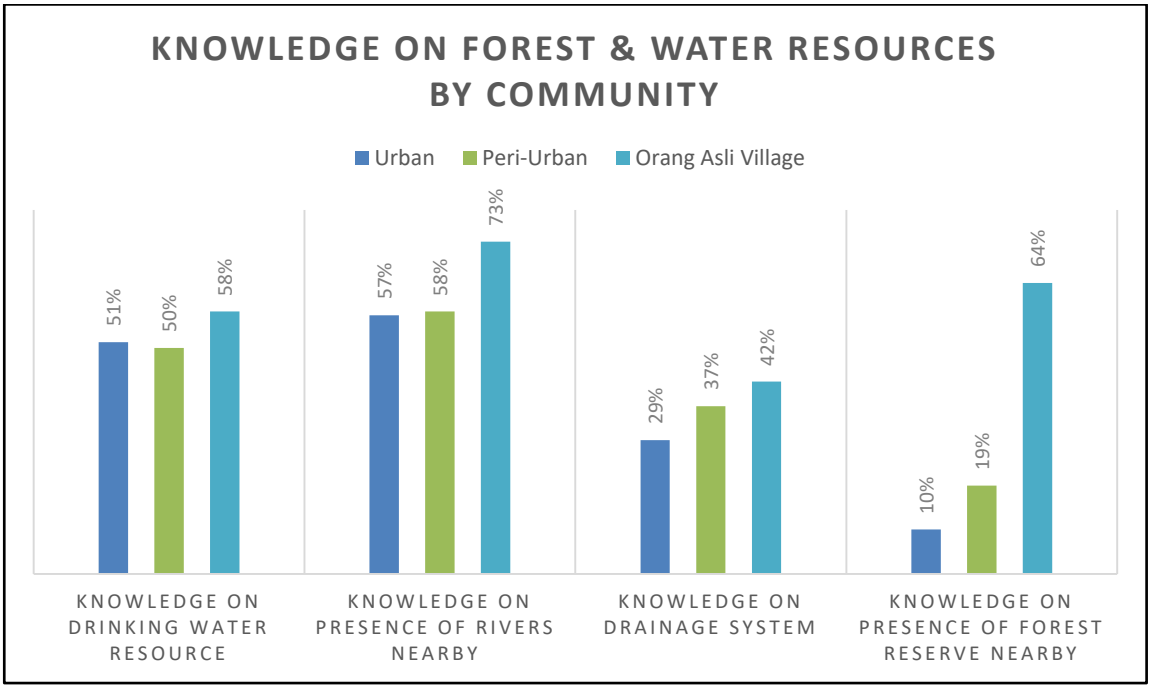
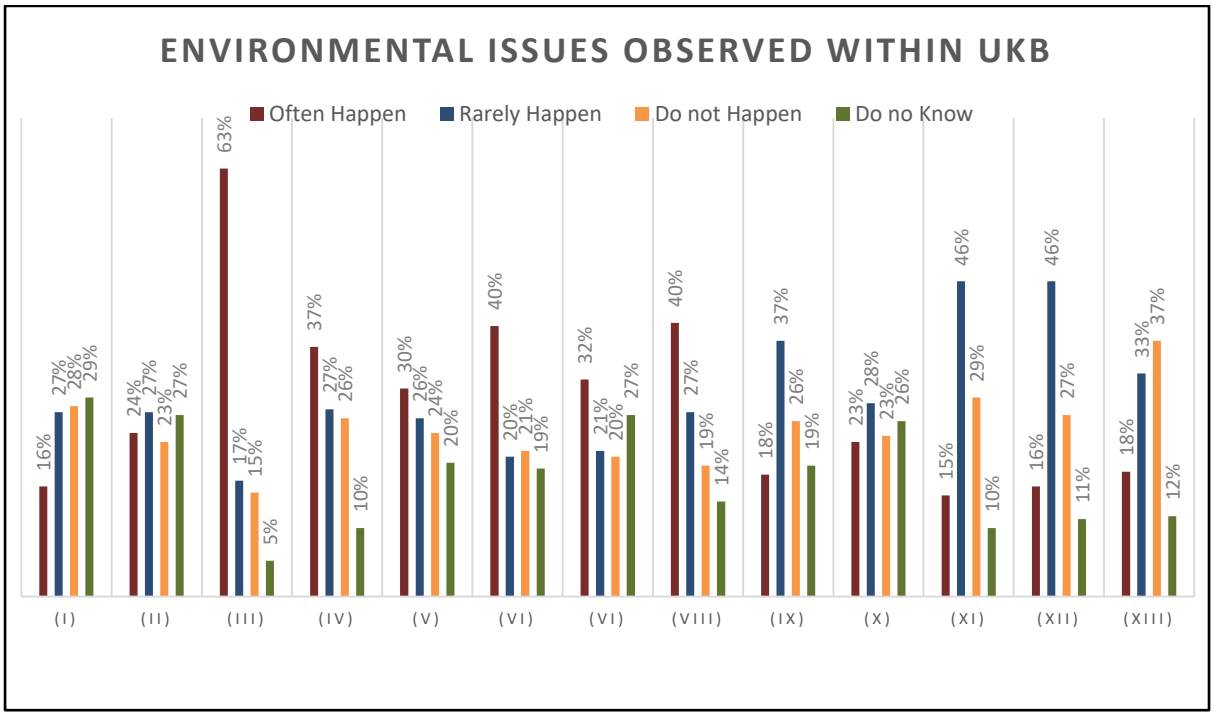


Figure 4.5: Knowledge on forest & water resources by community

Among the four age groups, above 50 years old group has the highest acknowledge and awareness of nearby rivers, forest reserve, drainage system and drinking water resource. While the below 20 years old group observed to have the least knowledge and awareness of all. This shows that the older age group is more aware of their surroundings may be due have been living there for longer period of time compared to the younger group. The proposed planned awareness programmes for the community can bring back the people closer to forest and rivers, as survey result shows that the urban and peri-urban community, and the younger generation in all communities is losing its connection to these natural resources. Overall, it indicates that the respondents are aware on the importance of the water source mainly for their drinking and domestic needs as well as economic dependencies (fisheries and agriculture). Although the communities are well informed and knowledgeable with the rivers within their vicinity, they fail to acknowledge that the discharges from household and nearby drainage that's finally end up into the main river system. Moreover, the respondents were also not alert or aware on the existence of the forest reserve within their vicinity except for the villages (35%) aware about it. This indicates the implementation program and activities should also focused on creating awareness on the importance of the resources, engaging them to monitor and protect the resources and at the same time to participate and play a significant engagement roles with the respective caretakers/agencies to ensure the resources are protected.

4.3.3 Awareness on issues related to forest reserve and rivers at UKB

Illegal rubbish dumping (63%) was rated as the most serious issue at UKB, followed by disposal of waste from restaurant and hawker into ditches or rivers, and clogged ditches with both at 40% (**Figure 4.6**). Nevertheless, 40% of respondents also said that disruption of water supply (40%) and smelly or coloured water supply are rarely happen in their areas. Orang Asli villages recorded the range of highest percentage (50% - 65%) of non-occurrence for 10 out of 13 environmental issues. Urban and peri-urban communities perceived illegal rubbish dumping as main environmental issue that affecting them. Besides that, peri-urban communities also perceived that disruption of water supply (53%) and smelly/coloured water supply (48%) as their main environmental issues.



I. Encroachment of forest reserve
II. Conversion of reserved land for plantation or farming
III. Illegal rubbish dumping
IV. Poor garbage collection service
V. Poor wastewater management
VI. Waste dumping into rivers/drains by the restaurants and hawkers
VII. Waste dumping from factories into rivers/drains
VIII. Blacked drainage
IX. Landslide
X. Poor management of construction areas
XI. Water shortage
XII. Smelly and cloudy water supply
XIII. Flood

Figure 4.6: Environmental issues observed within UKB

Despite being aware and able to recognise environmental issues, the majority of the respondents (75% urban, 72% peri-urban, and 69% village) were not aware who are the responsible authorities or individuals for the maintenance of forests and rivers (**Section C2, Annex 2**). Only a small number of responses in each community have acknowledged that the good keeping of forests and rivers is also the community's responsibility.

Respondents were also asked to provide their views or suggestions to improve the current situation. The responses were grouped into five elements; education and awareness, enforcement, facility, authority, and working together (**Table 4.1**). Facility provision is mainly on providing better access to waste management facilities. 'Authority' includes suggestion such as the responsible government agencies to take prompt and better actions in attending to reported issues by the people, and to make themselves more visible to the public. 'Working together' refers to suggestion that all levels of the society is responsible to in conserving and managing the forests and rivers. **Table 4.1** shows that majority of the people suggest that education and awareness are needed in their community to improve their environmental condition.

Table 4.1 Suggestion to improve the current situation by community

Elements	Percentage		
	Urban	**Peri-urban**	**Orang Asli Villages**
Education and awareness	43	44	42
Tighter enforcement	26	16	25
Facility provision	4	3	0
Authority	22	27	25
Working together	4	11	8

Generally the majority of respondents think that the rivers have either remained the same or getting better as compared to getting worse, in terms of the cleanliness, smell, water quality, river care initiatives, enforcement or monitoring of authorities, and public participation in environmental sustainability programs (**Figure 4.7**).

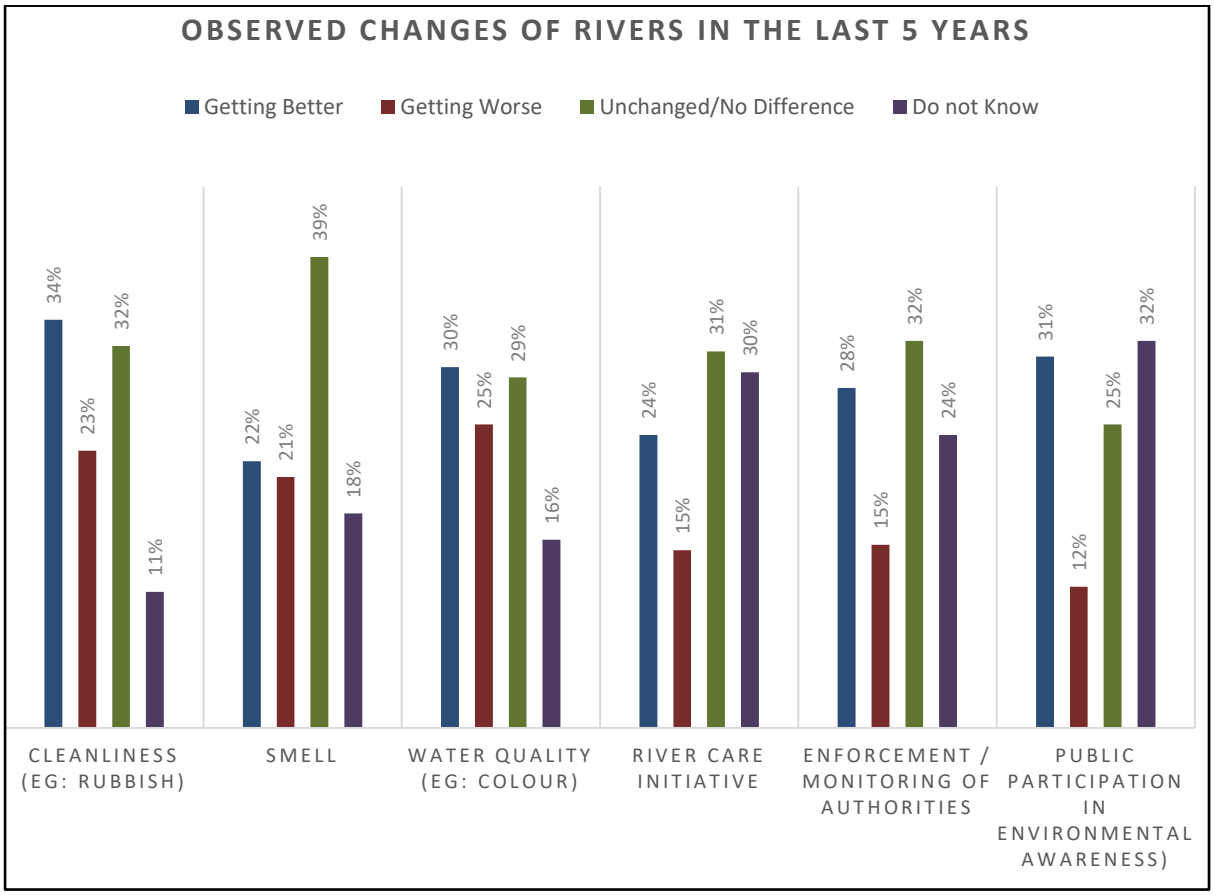
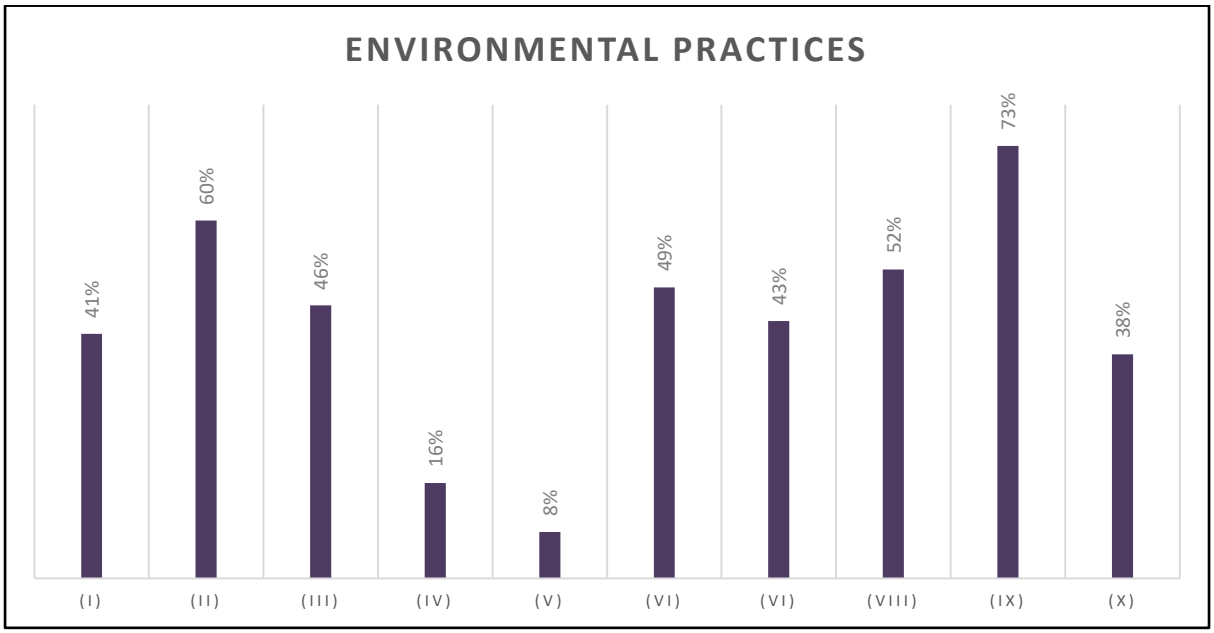


Figure 4.7: Observed changes of rivers in the last 5 years

4.3.4 Existing practices and facilities for environmental best management practices (BMPs)

Overall, highest percentage of respondents (73%) selected option to avoid pesticides as a part of their BMP (**Figure 4.8**). This may be due to the awareness of its content that might include dangerours chemical substances that can be harmful to human, animals, river/water and the nature. Usage of energy efficient appliances rated as second highest (60%) environmental practice among the respondents (example, usage of energy saving appliances and solar panel for electricty or water heater). While used of recycle paper was the least practices (8%) adopted by them.



I. Use reusable bags
II. Use energy efficient electrical appliances
III. Separate recyclable waste and send it to the recycling centre
IV. Turn off the tap while brushing teeth
V. Use recycled papers
VI. Turn kitchen waste into compost
VII. Switch off the lights and electrical items when not in use
VIII. Use CFC free aerosol spray
IX. Use chemical free pesticides
X. Avoid single use plastics; such as straws, plastic packaging, pastic spoons, etc.

Figure 4.8: Environmental practices within UKB

All respondents [urban (90%), peri-urban (72%), and village (81%)] have the highest selection of switching off light when not in use as their environmetal friendly action (**Figure 4.9**). Overall, people from urban area have higher percentage on environmental practices, especially on the conservational effect can be to the frequect awareness campaigns and promotional by the relevant agencies as well as to lessen their financial burden especially with water and electricity. Urban people tend to use more electircal supplient or depend more on the water for domestic usage compared peri-urban and urban communtiies. Usage of recycled paper and energy efficient appliances are comment environmental practices within UKB site.

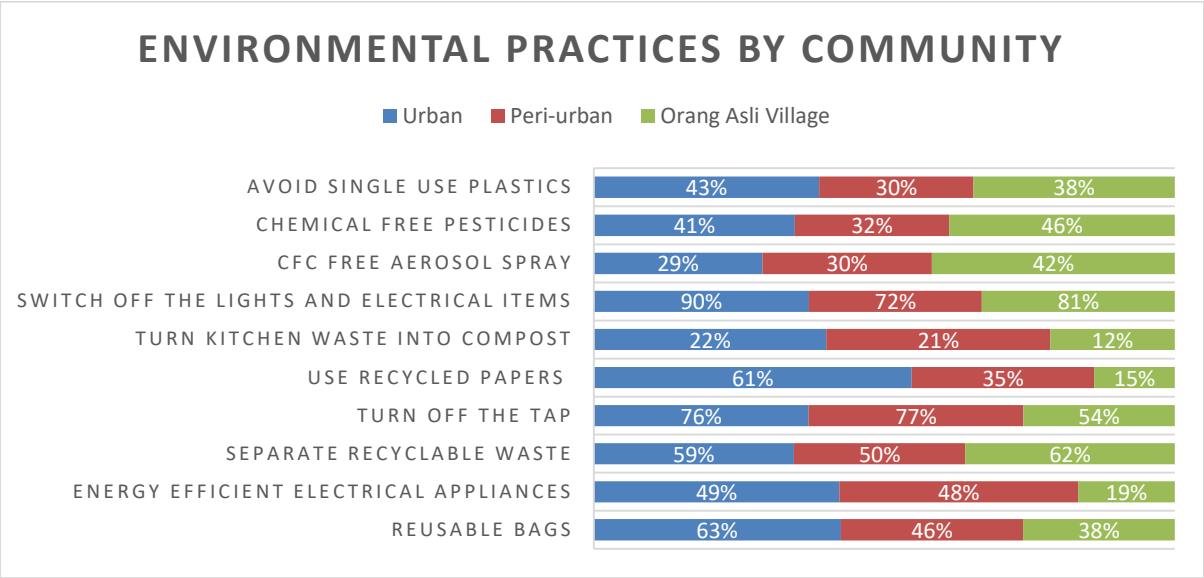


Figure 4.9: Environmental practices by community

Looking by age groups, respondents of age groups below 20 years old (77%), 21-30 years old (76%) and 31-49 years old have selected turning off water tap when not use as best environmental practice as their main activities. While respondents from age group above 50 years old have selected switch off light when not use as the highest (89%) among other activities or actions.

When asked about the availability of facilies or activities for environmental practices in their neighbourhood, gotong-royong (53%) is one of the most rated and popular activity or action among the respondents, most of the respondents have mentioned that they will at least do gotong-royong quaterly. Availability of recycling centres came the second highest (36%). Gotong-royong activity is popular among all age groups, below 20 years old (58%), 21-30 years old (48%), 31-49years old (42%), above 50 years old (61%).

4.3.5 Readiness and willingness to participate in public outreach programmes

Overall 68% of the all respondents have selected that it is very important to have a clean environment, forests and rivers (**Figure 4.10**). Similarr patterns have been noticed for all groups except the group above 50 years old (72%) which think its just important only. Higher percentage of communities [urban(70%), peri-urban (64%), and village (58%)] said that they would participate in environmental care activities. Social media (52%) was chosen to be the most preferred learning method for conservation or sustainable lifestyle with campaign and activites at open field are chosen as the second most (47%) preferred methods, which is more active and fun. Individual consultation is the least (7%) preferred as a engaging platform.

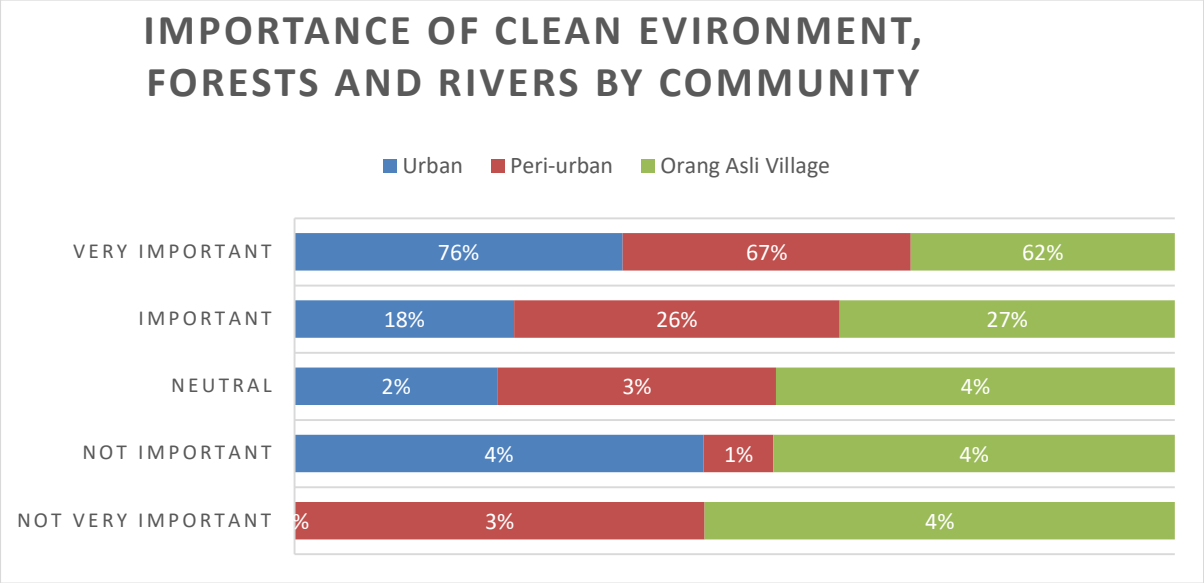


Figure 4.10: Environmental practices by community the Importance of Clean Environment, Forests and Rivers

4.4 SUMMARY

Based on the survey conducted on 230 respondents, the largest range of age for the respondents are between 21 to 30 years old (27%) with the lowest (23%) recorded for the age between 31 to 49 years old and below 20 years old respectively. The respondents' are surprisingly, well aware on the importance of the water resources as the source of our drinking water (51%) and 61% are aware on the rivers within their vicinity. Most of the respondents age below of 20 years old need more civic science approached to enhanced their acknowledgement. Generally respondents' think that their rivers condition remains same or getting better for last 5 years. The least environmental friendly activities undertaken by the respondent were to use of recycle paper at only.8%. 68% of the respondent agreed on the importance of keeping the environment in great condition with only 3% of the respondents recorded that environmental conservation as less important. Almost every age group acknowledged the importance of keeping the environment, water resources, and river and forest reserve clean and protected. The most interesting method to learn on how to take care of the forest and river is through social media which was recorded 52%, followed closely by doing hands-on activities at open field at 47%.

Based on the outcome of perception survey, it is vital to have strong community participation. The engagement of communities through the capacity building should be through establishment of forums or platforms for the Orang Asli and peri-urban communities which represent the upper and middle streams of Kinta River and also the urban communities at the downstream. The training for the Orang Asli communities will incorporate issues on sanitation, water and hygiene, alternative water resources and forest and river management. For the peri-urban and urban communities, the training will incorporate pollution mapping, flood preparedness, water conservation, recycling and corporate engagement.

For the forest protection and rehabilitation, the Orang Asli communities will be trained on community patrolling and RIVER Ranger or as Eco Tourist guide in addition to initiatives as tree or bamboo planting as part of community based forest rehabilitation programme. For the selected urban and peri-urban communities, the RIVER Ranger training will be carried out to monitor and to undertake relevant mitigation measures to manage the river basin issues within the community vicinity.

The Orang Asli communities, peri-urban and urban communities need to be exposed and provided with up-to-date information focusing to the communities through public awareness campaign in form of activities and event based programme. Information dissemination through social media, including web portal and visibility materials such as newsletter, brochure or e-poster will also enhance the environmental education and engagement within the communities.

Overall, stakeholders such as Orang Asli, peri-urban and urban communities are the current beneficiary of the UKB and the end recipients of the water supply. Proactive engagement will help these communities to develop a sense of responsibility in protecting the UKB and as long term partners for strategy and action plan implementation. Four main elements/pillars for an impactful and proactive engagement are the awareness of the community, the basic knowledge, the skill and also the behavior of the communities.

CHAPTER 5: LINKAGES TO CENTRAL FOREST SPINE 5-1

5.1 REVIEW OF CENTRAL FOREST SPINE

The Central Forest Spine (CFS) of Peninsular Malaysia, composed of four (4) main forest complexes, is an important natural landscape of Malaysia, supplying up to 90% of the population's water supply, alleviation of flood risks, regulation of climate; and supply of resources, products and services, such as ecotourism. The National Physical Plan (NPP) identified forest fragmentation as a major threat to the conservation and maintenance of biodiversity and recognizes that conserving forest lands would be integral as it is important to secure mutual co-existence and benefit for development and conservation (NPP, 2005). Optimizing the use of land in the country and that the multifunctional role of the forest lands should be enhanced through the recognition of the CFS and programmes to create linkages and corridors to the more isolated reserves.

In essence, connecting these fragmented forests recognizing the importance in securing connectivity of the fragmented forests, the Malaysian government, through the Federal Town and Country Planning Department, has therefore embarked on a master plan study whose objective is to re-establish, maintain or restore connectivity in places where it is already lost within the central forest spine of Peninsular Malaysia (Federal Department of Town and Country Planning Peninsular Malaysia). The CFS master plan was jointly tabled to the Cabinet for adoption by the Ministry of Natural Resources and Environment (NRE) and Ministry of Housing and Local Government in 2011. The CFS Master Plan was approved by the National Physical Planning Council (NPPC) on 13 August 2010 and endorsed by the Malaysian Cabinet on 1st April 2011.The Cabinet appointed NRE as the main implementing agency, supported by the Forestry Department (FD) and Department of Wildlife and National Parks (DWNP). To assist NRE in the implementation of the CFS Master Plan, A CFS Steering Committee was formed comprising representatives from state governments, agencies and NGOs.

The CFS was defined as the backbone of Peninsular Malaysia's environmentally sensitive area network, comprises four (4) major forest complexes in the National Physical Plan. In addition the CFS is a core feature of Malaysia's commitments to international conventions i.e. United Nations Convention on Biological Diversity and United Nations Framework Convention on Climate Change, both of which we are a signatory to. The CFS is also important in supporting Malaysia's national policies such as the 11th Malaysia Plan, *Transformasi Nasional 2050* (TN50), the National Policy on Climate Change, National Environment Policy and the National Policy on Biological Diversity 2016-2025. The CFS Master Plan takes a far-sighted objective of re-establishing, maintaining and enhancing connectivity between the most significant/important remaining areas of forests in Peninsular Malaysia.

The ultimate goal is to ensure the conservation of the entire range of species found in our forests, as well as maintain the host of ecological processes taking place within it. An additional objective would be to create "stepping stones" to increase habitat connectivity for some but not all species. For this purpose, "ecological linkages" are identified in areas where it is important to establish connectivity, in order to form the CFS. 37 ecological linkages (i.e., 17 Primary Linkages [PL] and 20 Secondary Linkages [SL]) were distinguished with specific emphasis needs, Primary Linkages is crucial to re-establish forest connectivity in order to achieve the main CFS link. These areas are inevitably located between the most important blocks of forests; usually in narrow stretches where non-forest land use is still minimal. The

primary linkages are important corridors for large mammals which use these areas to move from one forest to another. Primary linkages take the form of linear corridors, i.e. unbroken stretches of forested habitats connecting forest islands. Secondary Linkages Secondary linkages are complementary to primary linkages. They are identified in areas where it is unfeasible to create a primary linkage (e.g. due to vast areas of non-forested land or long distances between forests, or high human population), but it is still important to maintain some level of connectivity (albeit weaker) between forests. Secondary linkages are usually used by small animals, birds and insects. They are also beneficial to plants through pollination and seed dispersal. Secondary linkages take the form of stepping stones, i.e. patches of suitable habitats, and are usually designed to follow river corridors.

The four major forests within CFS1 and CFS2 are, *Banjaran Titiwangsa-Banjaran Bintang-Banjaran Nakawan*, *Taman Negara-Banjaran Timur*, South East Pahang, Chini and Bera Wetlands, and Endau Rompin Park-Kluang Wildlife Reserves. The CFS1 covers northern Peninsular Malaysia, stretching from the state of Kedah on the West until Terengganu in the East, i.e. states of Kedah, Perak, Kelantan, Terengganu and Pahang together with adjoining southern Thailand (i.e. transboundary linkages) encompasses an area of about 3 million hectares. The CFS2 encompasses an area of about 2.3 million hectares covers the southern part of Peninsular Malaysia central forest spine within the four states of Pahang, Johor, Negeri Sembilan and Selangor. The Upper Kinta Basin (UKB) is an important part of CFS1. Although UKB is not part of the CFS 1 or 2 linkages, it is still with a key part of the CFS as it is a potential area where the north-south linkage of the CFS is disrupted by the Simpang Pulai to Cameron Highland Highway. Without the maintenance of the integrity of this forest, the movement of wildlife along the main range will be disrupted. The CFS has already been significantly disrupted by the Cameron Highlands to Gua Musang road and the associated large scale agriculture and plantation development. Without proper maintenance of the UKB forests, the CFS integrity may be compromised. **Figure 5.1** shows the CFS (PL and SL Linkages) together with the project site.

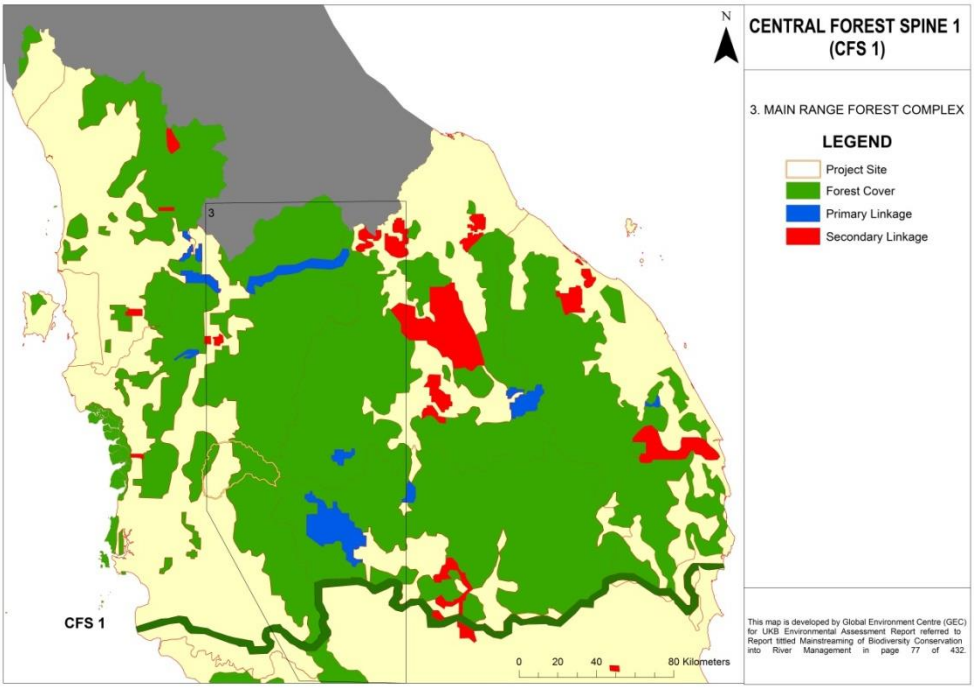


Figure 5.1: CFS and the neighboring UKB site

5.2 ISSUES WITHIN CFS

Over the years, when the CFS was developed and implemented, the effectiveness of the CFS is yet to be projected as a successful case story. It is observed that the main focus of the CFS was to connect the habitat to enable the wildlife to move around the fragmented forests within Peninsular Malaysia. This was proposed to ensure the wildlife is protected from the rapid developments in Malaysia over the decade. Some of the significant challenges include the following:

- As land resources are a state matter, the management and utilization of forests as well as implementation of development projects, remain under each state's jurisdiction.
- Many of the linkages are under-maintained due to lack in the commitment from the state governments, poor enforcement as well as insufficient resources/ department/person to implement the CFS.
- The findings from various NGOs that are working on the conservation efforts along the CFS linkages indicate that the effectiveness of the CFS is long-term and the implementation plans need the support of various stakeholders.
- SMART stakeholder partnership and support is required to ensure the implementation is significant to achieve its goal and to overcome the issues identifies.
- Some of the issues identified needs immediate action i.e. conversion of the primary forests into monoculture plantation or, forestland being leased out by the state government for logging and also a conversion for infrastructure development.
- Funding is critical to successful of the implement the CFS Master Plan. As component of many initiatives undertaken by the government, where with limited resources the outcome of the CFS is not widely emphasis or published.

Malaysian forests are divided into two different land categories; Permanent Reserved Forests (PRF); and Non-PRF (comprises of State land Forests and Alienated Forests). The PRF is legally secured and gazetted in accordance with the National Forestry Act, 1984 and managed under the Sustainable Forest Management (SFM) system for the benefit of present and future generations. According to the keynote presented by Director-General of Forestry Department of Peninsular Malaysia during the conference on Perak's Central Forest Spine on 19 February 2013, a total of 14.39 million ha of PRFs have been gazette in Malaysia. Of this total, 4.8 million ha are in Peninsular Malaysia. For the purpose of management, PRFs are further classified into two major management purposes, namely Production Forest; and Protection Forest. Production Forest is established for the purpose of supply in perpetuity which can be economically produced and marketable. Meanwhile, the Protection Forest is established for conservation purposes that were further refined into eleven multiple values of forest or forest functional classes as stipulated under Section 10 (1) of the National Forestry Act (1984). These forest functional classes are, Soil Protection Forest; Soil Reclamation Forest; Flood Control Forest; Water Catchment Forest; Forest sanctuary for wildlife; Virgin Jungle Reserved Forest; Amenity Forest; Education Forest; Research Forest; Forest for Federal purposes; and State Park.

Although water is emphasized under the Malaysian forest classification as Water Catchment Forest (PRF) and water resource management is being highlighted as one of the component

of CFS, the importance of the water resource/catchment areas are sometimes seen as a secondary need. While the Forestry department focuses on protecting the Forest Reserves for future sustainable and resource, the CFS has been focused on wildlife protection. Most of the environmentalist and the project proponent emphasized on the need of the forest as habitat for the wildlife for the conservation of Malayan Tigers and Elephant in addition to other wildlife which is low in the number due to the rapid forest clearance and logging. Although the locals and civil societies emphasized on the wildlife protection, the state government on the other hand, depends on the logging as one of main state revenue. Malaysia forests are rich with first-class timber which upon harvesting benefits the state revenue. The Perak State Government has been unable to stop timber harvesting as it will result in the loss of the revenue needed to provide services to the people and forest management in Perak. Although the Permanent Reserve Forests (PRFs) are protected under the National Forestry Act 1984 under the jurisdiction of the state forestry department; the state government has the power to excise PRFs by degazetting them. Cutting for timber production in PRFs ("timber production forest under sustained yield"), and the excision of PRFs from the state warrants replacement with another similarly-sized piece of land ("State Authority to replace land excised from permanent reserved forest") by the state is permissible. **Figure 5.2** shows the Primary linkages of CFS, where Bukit Kinta was one of the nearest sites to the Upper Kinta Basin Site (between SL3 and PL3).

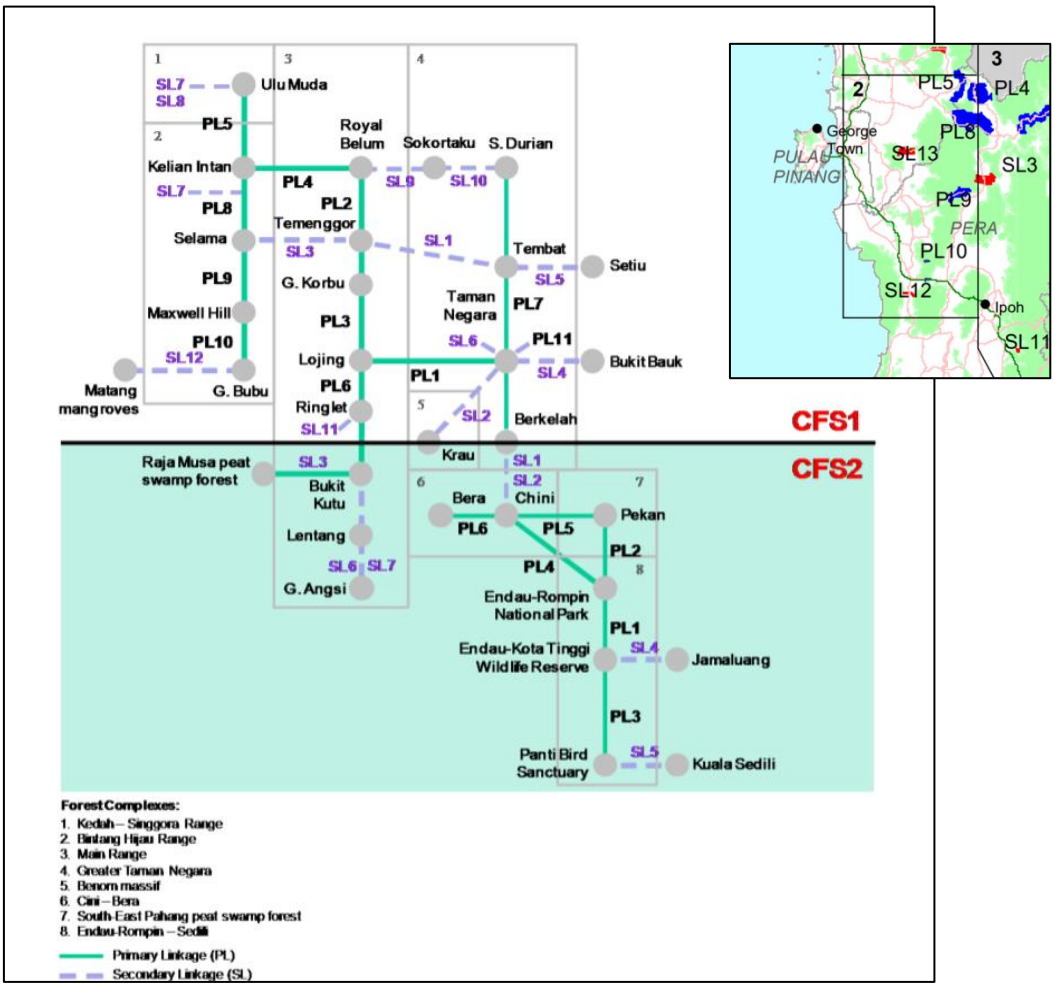


Figure 5.2: Ecological linkages in Perak border

As Perak is one of the states with highest forest cover and valuable trees, logging has been carried out in a large-scale manner either by licensed concessionaires by the state government or through illegal logging activities. Wildlife hunting and poaching run parallel with logging. When there is an area open for logging, the wildlife within the area was hunted down for its precious resources. Although water catchment area and river corridor were included in the CFS masterplan, it was listed as secondary. It is proposed for water catchment to be emphasized as the main component of CFS masterplan. As our drinking water and supply originates mainly from rivers (97%), the forest is needed as the catchment area. A fragmented forest without catchment is not sufficient for water storage or supply. A combined water store is required and the forest patches forming the linkages need to be gazetted as protected forest area (water catchment patches). The definition of water catchment need to be revised and its significant impact, if the resources not protected need to be emphasized to all stakeholders. The state governments need to be briefed and enlighten on the impact of forest destruction to their water supply. Water Supply is important not only for domestic usages but also for agriculture and industrialization. The current approaches have silenced the importance of CFS for water resource protection. As the feedback and commitment or feedback from the stakeholders may differ and committed approach can be proposed or implemented if the benefit of CFS highlighted differently, the UKB project will be inline and supportive of this.

From the review of the CFS masterplan, almost all the water catchment area was not highlighted as part of the CFS or only emphasized under CFS Secondary linkages. Secondary linkages are to support the primary linkages; in this case, river corridor management is a secondary issue to be addressed, after the linkages for the large mammals are connected. Commonsense, shows the mammals need water to survive and if water is treated as secondary issue, the objective of the linkages to create the pathway for the mammals, stop logging to create habitat and stop illegal hunting and poaching will not be materialized. On the other hand, when a forest is being gazetted, it is being protected from all form of illegal logging, hunting and poaching where the living organisms are contained within its protected area. It is proposed for all the relevant agencies, that are working on the CFS Primary linkages also to look closely into the water catchment area which was addressed as secondary linkages or those not part of the CFS for long-term resource protection. Long-term water resource protection plan is needed to ensure the water catchment area being protected, and this can only take place through the support of various stakeholders. Each stakeholder as State Economic Planning Unit (EPU), LAP, DID, State Forest Department, JAKOA, IDR and other states as well as federal agencies, need to look into long term goal. It is also important that the agencies work in hand via SMART Partnership in working together within their capacity to support each other in protecting the Bukit Kinta Forest Reserve and the Upper Kinta Basin.

Public awareness will have a significant role in pressuring the government to emphasize on the water catchment area. If the public is aware on the impact of the forest destruction on their water supply, the voice of people might create a platform for the state government to relook into their revenue plans. Payments for ecosystem services (PES), also known as payments for environmental services (or benefits), are incentives offered to farmers or landowners in exchange for managing their land to provide some sort of ecological service. PES should be enforced to industrial or corporate players which are benefiting by extracting

the water resources; e.g. Spritzer or One Water. Those farmers and agro farming activities along the water catchment area as well as the development of TNB National Gridline, Highway cutting through the forest also need to be charged with PES to enable conservation and rehabilitation efforts can be undertaken by the state government.

5.3 PROPOSED ELEMENTS TO BE INCORPORATED INTO CFS

In order to overcome the issues highlighted under the CFS, the following elements were discussed and proposed to be taken into consideration to assist the implementation of CFS

- Each state should consider adopting a long-term conservation agenda, central to which is securing and protecting the CFS.
- All state Structure Plans and Local Plans are expected to translate the policies and recommendations of the CFS Master Plan into the state and local applications. In order to enhance the implementation of the CFS policies, supporting the CFS policies at the state and local level should be part of the key performance indicators (KPIs) for state Structure Plans and Local Plans.
- Any development projects within or near the CFS should undergo review and approval by the CFS State Committee, As the CFS covers many aspects including planning, forests and water, the CFS State Committee should have representation from various departments. Civil Society Organization (CSO) should also be proportionally represented on the Committee.
- Funding is critical to successfully implement the CFS Master Plan. Adequate funding must be allocated by the Federal Government to support state governments in their efforts. An incentive and reward mechanism should be established to further incentivize the state governments to protect the CFS.
- Many CSOs have developed experiences and expertise on awareness and outreach and should be partnered to provide assistance on communication, education and public awareness programmes including within the federal, state and local government.

5.4 INCORPORATING CFS WITHIN UKB

Five primary and three secondary out of the 37 ecological linkages i.e. 17 Primary Linkages (PL) and 20 Secondary Linkages (SL) within Peninsular Malaysia is focused in Perak which is the second largest after Pahang (**Table 5.1**), However none of the linkages overlapped on the CFS linkages. The nearest linkages to the UKB sites are as within the PL3, 9 and 10 (**Figure 5.3**). Although the area within the Gunung Korbu and the Maxwell Hill are wide apart, and not connected, there are two main sources of water source for the Sultan Azlan Shah and Air Kuning Dam within the catchment of Sg Keruh Air Kuning and Sungai Kinta originate within the PL9 and PL10 as well as PL3.

Table 5.1: Number of ecological linkages within the CFS

State	Ecological Linkages		Total
	PL	SL	
Kedah	1	3	4
Perak	5	3	8
Kelantan	1	4	5
Terengganu	2	2	4
Pahang	6	3	9
Johor	2	2	4
Selangor		1	1
Negeri Sembilan		2	2
TOTAL	17	20	37

(Source: Keynote Address of the conference on Enhancing Forest Biodiversity Conversation through Central Forest Spine Programme: Future Challenges)

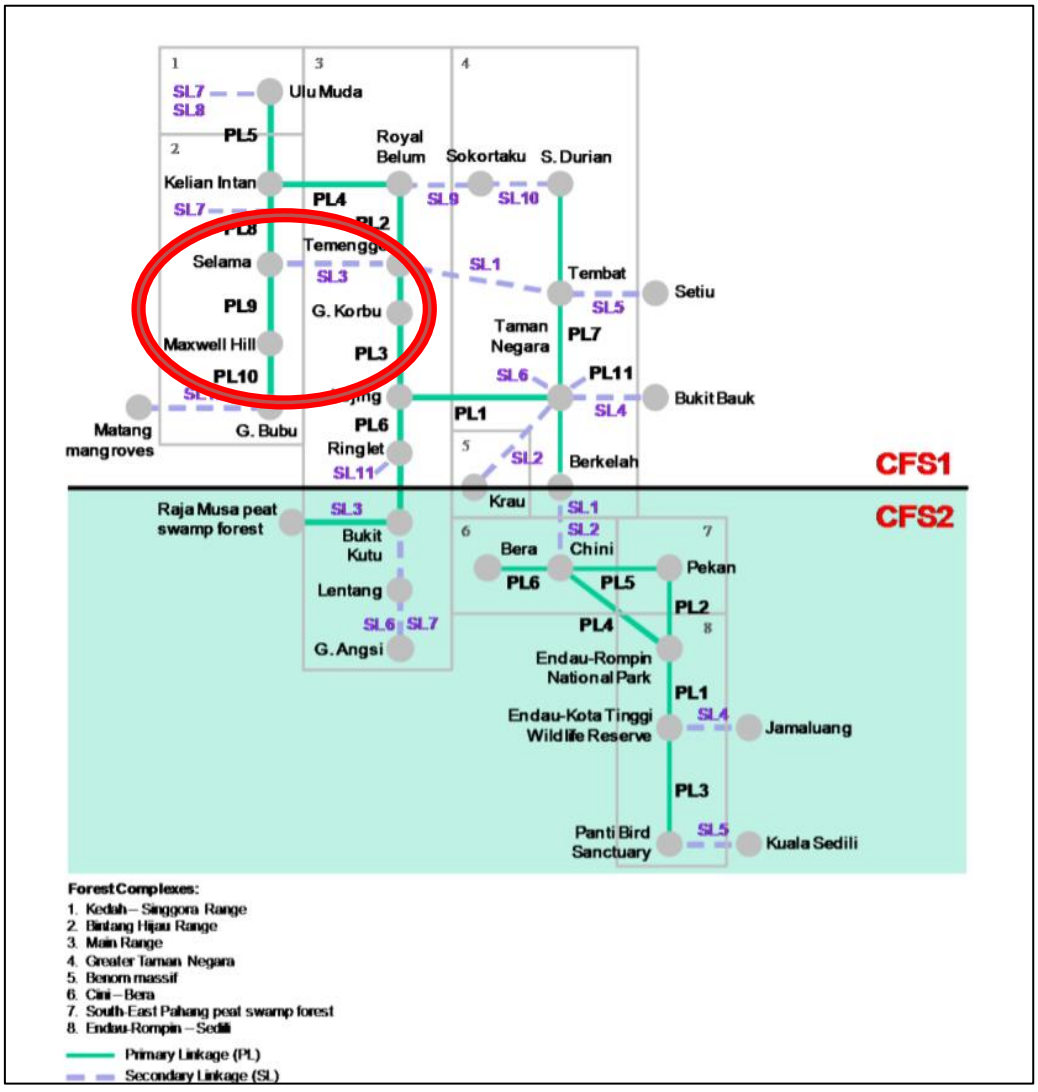


Figure 5.3: Nearest ecological linkages at UKB sites

Therefore, the activities proposed for the empowerment through the UKB action plans will be beneficial to the communities that are within the lower vicinity of the CFS with the focus on water catchment management and socio-economic empowerment for selected stakeholders including Orang Asli communities. Project objective 1 focuses on developing and adoption of the strategy for forest and water resource management of the upper Kinta basin. The Upper Kinta Basin covers about 25,000 ha between the Main Range at Cameron Highlands and Ipoh town. The basin is the main watershed that provides the potable water supply for Ipoh City and is an important part of the CFS. On-going and further development along the corridor along the Ipoh – Simpang Pulai to Cameron Highlands Highway are affecting the integrity of the catchment and water supply, biodiversity, and local communities. On the other hand, project objective 2 focuses on establishing community's engagement to address issues regarding forest management and river protection. Stakeholders like Orang Asli, peri-urban and urban communities, that are the current beneficiary of the UKB and end recipients of the water supply, are the significant stakeholders for community engagement. Proactive engagement will help these communities to develop a sense of responsibility in protecting the UKB and becoming as long-term partners for strategy and action plan implementation. The power, willingness, and capacity of the community to support work on the environment will ensure improved environmental outcomes and a sustainable future.

The CFS stakeholders that will be engaged under the UKB projects to fulfill the project objectives are as tabulated below in **Table 5.2.**

Table 5.2: List of key stakeholders

Stakeholders	Engagements
▪ State Government / State EPU ▪ Department of Irrigation and Drainage ▪ Forestry Department (FD) Peninsular Malaysia ▪ Perak Water Board (LAP) ▪ Ministry of Tourism, Arts and Culture Malaysia (MOTAC) ▪ Ministry of International Trade and Industry (MITI) ▪ Malaysian Public Works Department	The state governments are critical stakeholders in ensuring the security of the priority areas and corridors in their respective state, since forestry policy formulation and implementation is the responsibility of the state forestry departments rather than the FDPM. The key state government agency is the state EPU which oversees the development direction of the state. Within the state, a CFS Technical Committee has been established in order to manage the implementation of the CFS. The UKB's action plan that will benefit communities within the vicinity of CFS with the focus on water management and socio-economic empowerment should be presented and adopted by the CFS technical committee chaired by the State EPU.
▪ Department of Orang Asli Development ▪ Local Communities	As indigenous settlements and some local communities are still have a high dependency on forests, they plays an important role in creating awareness among them in conserving the forests and preserving the wildlife. Some of the proposed UKB project

	activities to support the understanding of the human and wildlife relationship are; empowering the stakeholders especially Orang Asli and local communities through workshops and trainings, establishing a proper platform to engagement them on forest and water catchment management, development of Community-based Participation Plan and social-economic activities (small-scale nursery, reforestation/erosion mitigation activities, tree/bamboo planting, eco-tourism and eco-products).
▪ Department of Irrigation and Drainage ▪ Ipoh City Council ▪ Department of National Unity and Integration ▪ Local communities	Urban communities are the receiving ends, which usually benefits or have higher dependencies of the resources. In order for them to appreciate and to also play a significant role in the projection, empowerment activities focusing on water conservation and pollution management (community mitigation measures) for midstream (urban and peri-urban communities) of Kinta River. The training will be focusing on pollution mapping, flood preparedness, water conservation and agency/corporate engagement
▪ Global Environment Centre (with the support of relevant stakeholders)	The CFS is not getting noticed by the public mainly due to lack of publicity and awareness. In order to get noticed and to get public support to ensure the continuity of the project, roadshow and publicity is needed. Therefore CFS will be incorporated into the proposed initiatives under UKB to raise awareness. Some of the proposed activities are series of the public awareness campaign, development of visibility materials and information sharing on the web portal.

Legislation which is relevant to the management of CFS in Perak that can be referred during the stakeholder consultation of CFS is as listed below.

i. The National Physical Plan 3 (NPP-3)
ii. National Policy on Biological Diversity 2016 – 2025
iii. The CFS Master Plan for Ecological Linkages
iv. The Town and Country Planning Act 1976
v. The National Forestry Act 1984
vi. The National Water Resources Policy / National Integrated Water Resources Management Plan

As highlighted in Section 1.2, water catchment protection should be emphasized and given priority, within the UKB project, so that CFS will incorporate the Water Catchment Protection as part of their main objectives to support the survival and connectivity of the wildlife within the forest as without water none of the objective can be achieved. Moreover, water availability and scarcity issues are very sensitive and will gain more support and interest of many stakeholders and players which depends on the resource.

CHAPTER 6: CONCLUSION 6-1

6.1 CONCLUSION

The overall goal of the project emphasizes the conservation and functioning of the forests and riverine habitats in the Central Forest Spine (CFS) region at the Upper Kinta River Basin. The impact indicator for the project is to secure the quantity and quality of the water supply of Ipoh and surroundings (660,000 people) through better catchment protection and management through stakeholder engagement (Orang Asli, local community and related government agencies).

The quality of waterbodies deteriorates with rapid development and urbanization. In addition land clearance, forest opening, industrialization, agriculture and aquaculture, also leads to changes on the land structure and hydrological flow into the river system. The waterbodies are also a pollution entry point, where the industrial effluents or runoff of sediments from development or land clearance as well as from other form of land use enters through drainage if not directly into streams. It is important to ensure the development towards urbanization is balanced by environmental protection and pollution mitigation measures.

Pollution was observed at different levels at all regions; upstream, midstream and downstream of the UKB area. Different approaches should be implemented for different target group to engage them in the environment management and protection plan. The communities at the upstream of the UKB mainly the Orang Asli depend on the river for water supply and also food. With the land clearance and development at the upstream, for agriculture, tourism industries and development, the livelihood of these people are affected to a certain extent. The Orang Asli communities need to be better informed on possible channels and agencies to address their concern and to enable then to look into alternative livelihood source of income and to protect the water source for future generations.

The peri-urban area refers to a transition or interaction zone, where urban and rural activities are juxtaposed, and landscape features are subject to rapid modification, induced by human activities (Douglas, 2006). These areas are rich with resources such as forest, limestone caves, industrial site, agricultural lands and many more which provides essential life support services for urban residents. The communities within these areas are potential contributors for the environmental problems, where exploitation of the resources for economic need is stronger and may lead to drastic pollution impact if not mitigated and monitored. A balance between the community need and the environment is important for this area, to ensure the sustainability in the long run. In order to ensure the resources within the peri-urban areas are protected and not exploited in excess, pollution reduction and monitoring of the pollution impact is required.

Communities within the urban area are the receiver of all the benefits of the resources from both the upstream and the midstream area. The communities in urban area are also the contributing pollution agents through runoff especially sullage water from households. The communities in urban area need to be enhanced with skills and knowledge to take action to address pollution and well as voice out their concerns.

CHAPTER 6: CONCLUSION 6-2

The findings of the UKB Environmental Assessment Report indicate the following:

- Land Use
    - The estimated total population in UKB (2010) was 653,838 with a population density of approximately 938 persons per square kilometers**.**
    - The total area of UKB is 69,832 ha with forest being the largest land use type (52.1 %) followed by agriculture covering an area of 9,377.2 ha, residential (7,158.6 ha) and transport facility (7,090.4 ha).
    - The overall water bodies at UKB are recorded at 721 water bodies with the overall land use are 853.4 ha or 1.2% of total area in UKB.
    - Though, water bodies are with minimal percentage, but impacts of human activities such as agriculture, development, industrial activity and so on will have greater impacts on them.
- Pollution Source
    - A major pollution source is the serious landslides and erosion along the Simpang Pulai – Cameron highway in the upper part of the UKB. It poses not only great danger for the human life, but also posed greater problem to the river and the water supply dam. In addition to landslide due to construction of the highway, land clearance also leads to erosion and landslides.
    - Beside siltation, agriculture, agro tourism at upstream of the Kinta water catchment, orchard cultivation and rubber as well as oil palm plantation also will contribute to pollution due to fertilizers/pesticides used.
    - Solid waste is another alarming issues along the water bodies, it used to be a normal sight within the midstream and downstream of the UKB site. However with the development at upstream, construction waste and food waste generated also ends up at the valley. In addition, the upstream (Simpang Pulai-Cameron Highland) site which is quite famous among the tourist as stopping point also contributes to rubbish accumulation at the valley. If the issues are not addressed, the waste trail will end up at the Sultan Azlan Shah Dam.
    - Development (sedimentation) and sullage discharge are the main observed issues at the midstream of the UKB. The situation indicates worrying status as pollutants being transported to waterbodies.
    - Downstream UKB reported mix of pollution sources ranging from sullage discharge from wet markets, clogged drains, and sedimentation issues.
    - Overall all three regions of UKB recorded very poor solid waste disposal and might have impact on few water quality parameter beside the aesthetic values. .
- Water Quality
    - Water quality of UKB reported WQI of 68 (Class III) which represents slightly polluted condition. COD and BOD reported exceeding Class IIB standard indicating high level of organic pollution in UKB. Turbidity spike after one particular development activity in upstream UKB shows direct impact of land clearing on the river and waterbodies.
    - Its shows the need proper mitigation by the developer and close monitoring by the authority.
    - The high turbidity and silt levels Higher concentration at the upstream before and at the dam site, after the mitigation (excavation to remove the silt) indicates a better and sustainable solution is required to address the issues.

- Biomonitoring
    - Presence of benthic macroinvertebrates in all of the three regions, indicating UKB is good habitat for aquatic animals which also reflecting suitable measure of water quality along with physico-chemical water quality monitoring. The dominant family in upstream UKB was mayfly which showing this area is in relatively clean status. However, snails and worms observed in middle and downstream of UKB, demonstrated that human activities in these areas had negative impacts by on the waterbodies.
- Perception Survey
    - Half of those interviewed (49%) do not know the source of their drinking water. This is really alarming as could lead to care-less attitude towards the water catchment protection.
    - Usage of recycle papers recorded the least (8%) environmental activity that being practiced by respondents.,
    - Higher percentage (68%) of the respondents agreed on having clean environment, rivers and forests. Social media reported the most preferred (52%) platform of learning method for conservation or sustainable lifestyle. Hands-on activities also reported among the most preferred (47%) method to learn on conservation and sustainable lifestyle.
- Overall Consultation with Key Stakeholders:
    - All the stakeholders have their own objectives and are currently implementing their action plan without SMART Partnership Approach.
    - The undertaken programme or activities that focused for the environment protection, economic growth, socio economic and community empowerment are not integrated nor sustained.
    - There is no project working group or agencies that are working towards leveraging and sharing their action plan, initiatives or to brainstorm to implement or to address any pertaining issues

6.2 RECOMMENDATION

The UKB needs to be protected and managed sustainability as it provides potable water for Ipoh. Therefore, a sustainable management strategy with workable financial mechanism needs to be developed. Pollution and environment deterioration is expected to take place and cannot be avoided. Therefore mitigation to lessen the impact needs to be carried out. In order for the communities to be able to address the issues, they need to be empowered through awareness, knowledge, skill as well as platform to implement their action plans.

It is recommended that the implementation must involve all the key stakeholders; government agencies, service providers, the Orang Asli as well as the peri urban and the urban communities with different action plans. The recommendation for all the target stakeholders and groups is tabulated in **Table 6.1**.

Table 6.1: Strategies and proposed action plan

Strategies	Proposed action Plan
Strategy for forest and water resource management of the upper Kinta basin developed and adopted by the Orang Asli, local community and related government agencies	1. Stakeholder workshop on basin management Workshop for Government Agencies, Private Sector, Communities and Civil Society 2. Establishment of Upper Kinta Basin Project Working Group (PWG) to ensure the stakeholders are committed to incorporate SMART engagement with the stakeholders to reduce and mitigate the pollution load. A comprehensive Mechanism to address the identified key issues for long term benefits needs to be developed. 3. Develop Upper Kinta Basin Management Strategy (UKBMaS) which will serve as key reference and guidance for agencies as well as other relevant stakeholders, including the communities. 4. Promote the strategy to key stakeholders for adoption of UKBMaS via exhibition, leaflet materials and workshop for stakeholders 5. Work together with the travel guide that is currently working with the Orang Asli to incorporate ecotourism and economic model for the local communities. 6. Develop financing mechanism for the strategy implementation by exploring the possibilities for Payment for Ecosystem Services (PES) and Corporate Social Responsibility (CSR). 7. Setup Information materials corners or signboards to address the impact of their action at designated areas especially upstream targeting tourist (to address the solid waste dumping & fertilizer runoff) 8. Promote for the proposed Payment for Ecosystem Services (PES) to protect and conserve the state's forests to include UKB site as one of the pilot site with support of Perak Forestry Department and other agencies. 9. To take immediate action by relevant government agencies (especially JKR, DOE, LAP) with regard to control of erosion at the Simpang Pulai to Cameron Highway and sedimentation of the Sultan Azlan Shah Dam

	10. Support Orang Asli community and plantation management company on management of orchards and plantations to minimise erosion and run-off 11. To engage with the relevant agencies and department to engage the agriculture and tourism industries to address the impact of pesticide on the water catchment (if any) and to come out with possible action to mitigate their action to the environment.
Forest management and river protection issues addressed or managed by community driven platforms	1. Establishment Platform/Forum for Engagement of Communities through Capacity building – engagement Platform for Orang Asli, peri urban and urban communities and localized trainings for empowerment. 2. Orang Asli engagement in forest protection and Rehabilitation - Training on socio economic and environment monitoring and localized initiatives 3. Urban and peri-urban river pollution prevention and livelihood activities – Training, Monitoring and Implementation on Pollution Mitigation Initiatives (i) Waste minimization initiatives 4. Environmental education and outreach – public awareness campaigns and promotional Materials. (i) River Address (ii) Campaigns and programs targeted to specific groups within the communities such as schoolchildren, youths, homemakers, and hawkers. (iii) Demarcation and marking of protected areas for public awareness. (iv) Dissemination of information leaflets or boards to community concentrated areas, such as neighborhood centres, mosques, temples, and markets. (v) Setting up information booths by the agencies for public awareness on the responsible authority protecting and managing the natural resources (vi) Advocate the banning of single-use plastics (vii) Engage corporations or big businesses to support advocacy and awareness campaigns

The recommendation is expected to be able to fulfill and guide the targeted groups to implement and monitor the environment especially water and forest and will be able to achieve the targeted indicator for the project i.e.:

- A monitoring framework for the Upper Kinta basin management strategy (UKBMaS) adopted by relevant key stakeholders
- State government/agencies had various financing mechanism option identified to implement the UKBMaS
  Targeted stakeholders (Orang Asli, local community and related government agencies) adjust their behaviours and practices - GEC to think about how to measure this, i.e. by looking at tracking the number of stakeholders who have adjusted their behaviours or tracking the decrease in types of negative behaviour and practices by the stakeholders.
- The upper water catchment monitored by communities (Orang Asli and urban/peri-urban)
- Community-based river basin mitigation measures implemented

SOAL SELIDIK BERKAITAN SUMBER DAN PENGGUNAAN AIR DI LEMBANGAN SUNGAI HULU KINTA

PENILAIAN INI DIJALANKAN OLEH
GLOBAL ENVIRONMENT CENTRE (GEC)
UNTUK PROJEK PENGURUSAN LEMBANGAN SUNGAI BERSEPADU
HULU KINTA

Tuan/Puan yang dihormati,

Kami amat menghargai sekiranya Tuan/Puan dapat memberi kerjasama dan sokongan untuk mengisi maklumbalas pada soalselidik ini. Komuniti tempatan merupakan tunjang bagi pelaksanaan projek yang melibatkan lembangan ini. Kerjasama dan sokongan Tuan/Puan dapat membantu kami untuk menyediakan laporan penilaian awal mengenai tahap kesedaran komuniti tempatan tentang isu-isu berkaitan hutan dan sumber air yang berhampiran serta kesediaan komuniti untuk terlibat dalam aktiviti-aktiviti berkaitan perlindungan dan pembaikpulihan sumber air dan sungai untuk kesejahteraan bersama. Pihak GEC mendekati komuniti tuan/puan kerana daerah anda terletak di lembangan sungai Hulu Kinta.

Latar Belakang Organisasi
Global Environment Centre (GEC) ialah sebuah badan bukan kerajaan (NGO) yang bergiat aktif dalam menangani isu-isu alam sekitar. GEC ditubuhkan pada tahun 1998 di Malaysia (No. 473058-T) dan telah bekerjasama rapat dengan banyak agensi daripada sektor kerajaan, swasta, orang awam, dan institusi pendidikan mengenai pengurusan air serta sungai, hutan, dan sisa pepejal bersepadu.

Latar Belakang Projek
Projek Pengurusan Lembangan Sungai Bersepadu Hulu Kinta merupakan salah satu inisiatif oleh **Yayasan Hasanah** dengan kerjasama **GEC** dan **Jabatan Pengairan dan Saliran Perak**. Matlamat utama projek ini adalah untuk memelihara dan memulihara habitat hutan dan sungai di lembangan sungai Hulu Kinta dengan mengutamakan kerjasama komuniti tempatan dan agensi-agensi lain untuk turut serta memainkan peranan mereka dalam ekosistem yang unik, berpotensi tinggi, dan kaya dengan biodiversiti ini.

Tiada jawapan salah atau betul yang diharapkan pihak GEC. Oleh itu, kami memohon agar anda dapat menjawab soalan ini dengan sejujurnya. Maklumat daripada hasil kaji selidik ini akan digunakan untuk merangka strategi pengurusan lembangan dan maklumat peribadi anda dijamin sulit.

Panduan kepada responden

I. Sila baca arahan dengan teliti sebelum menjawab soalan
II. Sila tandakan [√] pada jawapan yang sesuai. Sesetengah soalan mungkin mempunyai lebih daripada satu jawapan.
III. Sesetengah soalan perlukan jawapan bertulis.

Terima kasih atas penyertaan anda.

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ANNEX 1: QUESTIONNAIRE

BAHAGIAN A: Maklumat Responden

1. Nama : ……

2. Alamat : ……

3. No. Telefon : ……

4. Jantina
[ ] Lelaki
[ ] Perempuan

5. Umur
[ ] 20 tahun ke bawah
[ ] 21-30 tahun
[ ] 31-49 tahun
[ ] 50 tahun dan ke atas

6. Tempoh masa menetap di alamat tertulis di no.**2**:
[ ] Kurang dari 5 tahun
[ ] 6-10 tahun
[ ] 11- 20 tahun
[ ] Lebih dari 21 tahun

7. Bilangan isi rumah
[ ] 1-4
[ ] 5-9
[ ] 10 dan ke atas.

8. Tahap pendidikan
[ ] Tiada pendidikan rasmi
[ ] Sekolah rendah
[ ] Sekolah menengah
[ ] STPM/Diploma/Sijil
[ ] Sarjana muda/Sarjana/Phd

9. Pekerjaan
[ ] Bekerja dengan kerajaan, sila nyatakan .....
[ ] Bekerja dengan swasta
[ ] Mengusahakan kebun kelapa sawit / getah persendirian
[ ] Petani
[ ] Peniaga
[ ] Lain-lain; sila nyatakan.....

10. Pendapatan purata setiap bulan
[ ] Kurang dari RM500
[ ] RM500– RM1,999
[ ] RM2,000 – RM4,999
[ ] RM5,000 atau lebih

BAHAGIAN B: <u>Kesedaran Tentang Hutan Simpan dan Sungai-sungai di Hulu Kinta</u>

1. Sila tandakan kepentingan hutan simpan dan sungai-sungai di Hulu Kinta <u>bagi anda</u>.

		Penting	Kurang penting	Tidak penting	Tidak tahu
i.	Bekalan air	[ ]	[ ]	[ ]	[ ]
ii.	Sumber kayu (balak)	[ ]	[ ]	[ ]	[ ]
iii.	Hasil-hasil bukan kayu	[ ]	[ ]	[ ]	[ ]
iv.	Kawalan banjir	[ ]	[ ]	[ ]	[ ]
v.	Habitat bagi kepelbagaian biologi	[ ]	[ ]	[ ]	[ ]
vi.	Kawasan pertanian / tanaman	[ ]	[ ]	[ ]	[ ]
vii.	Penyimpanan karbon	[ ]	[ ]	[ ]	[ ]
viii.	Perikanan	[ ]	[ ]	[ ]	[ ]
ix.	Kawasan pelancongan / Tempat rekreasi	[ ]	[ ]	[ ]	[ ]
x.	Lain-lain; Sila nyatakan:	[ ]	[ ]	[ ]	[ ]

2. Adakah anda mengetahui sumber bagi air minuman anda?
[ ] Ya, sila nyatakan sumber berkenaan: ……
[ ] Tidak

3. Adakah anda mengenali sungai berhampiran dengan kawasan perumahan anda?
[ ] Ya, sila nyatakan nama sungai berkenaan: ……
[ ] Tidak

4. Adakah anda mengetahui ke mana penghujung saluran longkang atau sistem perparitan dalam kawasan perumahan anda?
[ ] Ya, sila nyatakan: ……
[ ] Tidak

5. Adakah anda mempunyai pengetahuan tentang kewujudan kawasan hutan simpanan berdekatan dengan kawasan perumahan anda?
[ ] Ya, sila nyatakan nama hutan simpan berkenaan: ……
[ ] Tidak

BAHAGIAN C: **<u>Isu-isu Semasa Berkaitan Hutan Simpan dan Sungai-sungai di Hulu Kinta</u>**

1. Berdasarkan pemerhatian anda, apakah isu-isu alam sekitar yang sering berlaku berhampiran kawasan tempat tinggal anda

		Tidak berlaku	Jarang berlaku	Sering berlaku	Tidak tahu
i.	Pencerobohan hutan simpan	[ ]	[ ]	[ ]	[ ]
ii.	Penerokaan tanah rizab tujuan perladangan / pertanian	[ ]	[ ]	[ ]	[ ]
iii.	Longgokan sampah merata-rata	[ ]	[ ]	[ ]	[ ]
iv.	Perkhidmatan pengutipan sampah yang lemah	[ ]	[ ]	[ ]	[ ]
v.	Pengurusan sisa air kumbahan yang lemah	[ ]	[ ]	[ ]	[ ]
vi.	Pembuangan sisa restoran dan medan penjaja ke dalam parit/sungai	[ ]	[ ]	[ ]	[ ]
vii.	Pembuangan sisa dari kilang ke dalam parit/sungai	[ ]	[ ]	[ ]	[ ]
viii.	Parit tersumbat	[ ]	[ ]	[ ]	[ ]
ix.	Hakisan tanah	[ ]	[ ]	[ ]	[ ]
x.	Pengurusan projek pembinaan yang lemah	[ ]	[ ]	[ ]	[ ]
xi.	Gangguan bekalan air	[ ]	[ ]	[ ]	[ ]
xii.	Bekalan air paip berbau / berwarna	[ ]	[ ]	[ ]	[ ]
xiii.	Banjir	[ ]	[ ]	[ ]	[ ]
xiv.	Lain-lain; Sila nyatakan:	[ ]	[ ]	[ ]	[ ]

2. (Jika berkaitan) sila nyatakan sebab dan paras banjir:
……

3. Adakah anda tahu pihak atau individu yang bertanggungjawab menjaga kesejahteraan sungai-sungai dan/atau hutan simpan di Hulu Kinta?
[ ] Ya, sila nyatakan semua yang anda tahu:……
[ ] Tidak

4. Pada pemerhatian anda, bagaimanakah perubahan aspek-aspek berikut pada sungai berhampiran anda sejak lima tahun lalu?

		Semakin baik	Semakin teruk	Tiada/ tidak berubah	Tidak tahu
i.	Kebersihan	[ ]	[ ]	[ ]	[ ]
ii.	Bau	[ ]	[ ]	[ ]	[ ]
iii.	Kualiti air	[ ]	[ ]	[ ]	[ ]
iv.	Penguatkuasaan	[ ]	[ ]	[ ]	[ ]
v.	Inisiatif penjagaan sungai	[ ]	[ ]	[ ]	[ ]

vi.	Penyertaan orang ramai dalam program-program kelestarian alam sekitar	[ ]	[ ]	[ ]	[ ]
vii.	Lain-lain; Sila nyatakan:	[ ]	[ ]	[ ]	[ ]

5. Pernahkan anda berbincang dengan agensi kerajaan/swata atau individu yang bertanggunjawab untuk mendapatkan penyelesaian bagi isu-isu alam sekitar yang dihadapi di kawasan anda?
[ ] Ya
[ ] Tidak

6. Sila berikan pandangan atau cadangan anda bagi menyelesaikan masalah ini.
.....
.....
.....
.....
.....

BAHAGIAN D: **<u>Kemudahan Pengamalan Pengurusan Terbaik bagi Hutan Simpan dan Sungai-sungai di Hulu Kinta</u>**

1. Dari manakah anda sering menerima maklumat berkaitan alam sekitar; seperti sungai, hutan, sumber air, dan lain-lain? (Boleh pilih lebih daripada satu pilihan)
[ ] Surat khabar
[ ] Media sosial (Twitter, Facebook, WhatsApp, dll.)
[ ] Televisyen / radio
[ ] Organisasi alam sekitar
[ ] Lain-lain; Sila nyatakan: ……..……..…..……..

2. Antara berikut yang manakah aktiviti mesra alam harian yang sering dilakukan oleh anda? (Boleh pilih lebih daripada satu pilihan)
[ ] Membawa beg sendiri apabila pergi membeli-belah barangan keperluan harian
[ ] Menggunakan peralatan jimat tenaga secara efisyen
[ ] Mengasingkan bahan buangan yang boleh dikitar semula, dan menghantar ke pusat kitar semula
[ ] Menutup paip air sewaktu memberus gigi, sabun, dan shampu
[ ] Menggunakan kertas yang telah dikitar semula
[ ] Membuat baja kompos daripada sisa dapur
[ ] Mematikan suis lampu dan perkakas elektrik ketika tidak menggunakannya
[ ] Menggunakan penyembur aerosol yang bebas daripada bahan CFC
[ ] Tidak menggunakan racun serangga yang mengandungi bahan kimia
[ ] Mengelakkan penggunaan plastik bungkusan, straw, dll
[ ] Lain-lain; Sila nyatakan: ……..……..…..……..

3. Pernahkan anda mengambil bahagian dalam aktiviti-aktiviti penjagaan alam sekitar?
[ ] Ya, sila nyatakan aktiviti:……
[ ] Tidak

4. Adakah kawasan perumahan anda melakukan aktiviti-aktiviti penjagaan alam sekitar atau mempunyai pusat kemudahan yang membantu komuniti tempatan meningkatkan kebersihan alam sekitar? (Boleh pilih lebih daripada satu pilihan)
[ ] Tiada sebarang kemudahan atau aktiviti
[ ] Pusat pengumpulan sisa pepejal atau minyak masak terpakai
[ ] Pusat kitar semula
[ ] Pusat penghasilan baja kompos
[ ] Pusat informasi sungai/alam sekitar
[ ] Gotong-royong membersihkan kawasan perumahan,
sila nyatakan kekerapan aktiviti: ……
[ ] Lain-lain; Sila nyatakan: ……..……..…..…….

BAHAGIAN E: <u>Keperluan dan Kesediaan Responden</u>

1. Sila nilai tahap kepentingan isu berkaitan kebersihan alam sekitar/sumber air/sungai kepada anda?
   [ ] Sangat tidak penting
   [ ] Tidak penting
   [ ] Tiada perasaan
   [ ] Penting
   [ ] Sangat Penting

2. Apakah halangan utama kepada anda jika diberi peluang untuk mengamalkan aktiviti mesra alam di kawasan perumahan anda?
   [ ] Tiada halangan
   [ ] Kekurangan pengetahuan/kemahiran
   [ ] Kekurangan insentif atau dana
   [ ] Kekurangan fasiliti atau sokongan tempatan
   [ ] Kekurangan waktu
   [ ] Tidak berminat / bukan satu kepentingan

3. Adakah anda berminat untuk melibatkan diri dalam aktiviti penjagaan dan perlindungan hutan dan sumber air/sungai (jangka masa panjang) pada masa yang akan datang?
   [ ] Ya, sila nyatakan kekerapan: ……
   [ ] Tidak, sila nyatakan sebab: ……

4. Jika ya, sila pilih cara yang anda berminat untuk belajar tentang kemahiran penjagaan dan perlindungan hutan dan sumber air/sungai di kawasan perumahan anda?
   (Boleh pilih lebih daripada satu pilihan)
   [ ] Bengkel
   [ ] Kempen
   [ ] Forum
   [ ] Perundingan persendirian
   [ ] Menyertai aktiviti di lapangan
   [ ] Bahan cetak
   [ ] Email
   [ ] Media sosial
   [ ] Lain-lain; Sila nyatakan: ……..……..…..……

SEKIAN, TERIMA KASIH

ANNEX 2: QUESTIONAIRE ANALYSIS

Perception survey results in percentages

SECTION A: Profile of Respondents

1. Sex:

	Male	Female
Urban	35	65
Peri-urban	52	48
Orang Asli village	60	40

2. Age

	20 and below	21-30	31-49	50 and above
Urban	20	37	16	27
Peri-urban	25	25	26	24
Orang Asli village	7	20	13	60

3. Duration of stay at the given address:

	Less than 5 years	6 - 10 years	11 - 20 years	21 years and above
Urban	22	14	37	27
Peri-urban	15	22	28	35
Orang Asli village	7	7	13	73

4. Number of households

	1-4	5-9	10 and above
Urban	57	39	4
Peri-urban	54	43	4
Orang Asli village	40	47	13

5. Education level

	No formal education	Primary school	Secondary school	STPM/ Diploma Certificate	Bachelors/ Masters/ Phd
Urban	2	2	47	24	24
Peri-urban	1	7	51	25	12
Orang Asli village	47	13	40	0	0

6. Occupation

	Government	Private sector	Privately owned oil palm / rubber plantation	Farmer / agriculture	Trading / business owner	Others
Urban	6	33	2	0	14	45
Peri-urban	10	34	0	2	26	29
Orang Asli village	7	0	33	0	0	60

7. Average monthly income

	Less than RM500	RM500– RM1,999	RM2,000 – RM4,999	RM5,000 or more
Urban	33	22	39	6
Peri-urban	37	32	24	7
Orang Asli village	53	40	7	0

SECTION B: Knowledge on Forest Reserve and Rivers at Upper Kinta

1. Please mark the importance of forests and rivers in Upper Kinta according to you.

		Water supply	Timber	Non-timber products	Flood management	Habitat for variety of species	Agriculture	Carbon sequestration	Fisheries	Tourism / recreational area
Urban	**Important**	96	65	53	82	86	80	65	69	78
	Less important	2	22	24	8	4	14	20	22	14
	Not important	2	8	8	4	4	0	6	4	6
	Don't know	0	4	14	6	6	6	8	4	2
Peri-urban	**Important**	89	60	44	81	62	66	54	66	64
	Less important	3	19	25	6	13	11	13	15	18
	Not important	3	11	13	3	7	8	9	5	9
	Don't know	5	10	18	9	17	15	25	13	9
Orang Asli Village	**Important**	80	93	80	73	67	47	60	87	27
	Less important	0	0	20	7	20	40	7	0	13
	Not important	7	0	0	7	0	7	0	13	40
	Don't know	13	7	0	13	13	7	33	0	20

2. Do you know the source of your drinking water?

	Yes	**No**
Urban	49	51
Peri-urban	50	50
Orang Asli village	93	7

3. Do you have any knowledge of rivers near to your housing area?

	Yes	**No**
Urban	55	45
Peri-urban	58	42
Orang Asli village	100	0

4. Do you know where does the drainage system in your housing area discharges into?

	Yes	No
Urban	27	73
Peri-urban	37	63
Orang Asli village	87	13

5. Do you have any knowledge of forest near your housing area?

	Yes	No	Don't know
Urban	6	84	10
Peri-urban	19	64	17
Orang Asli village	67	33	0

SECTION C: Awareness on Issues Related to Forest and Rivers at Upper Kinta

1. In your opinion, what are the environmental issues happening in your housing area.

i. Encroachment of forest reserve
ii. Conversion of reserved land for plantation or farming
iii. Illegal rubbish dumping
iv. Poor garbage collection service
v. Poor wastewater management
vi. Waste dumping into rivers/drains by the restaurants and hawkers
vii. Waste dumping from factories into rivers/drains
viii. Blacked drainage
ix. Landslide
x. Poor management of construction areas
xi. Water shortage
xii. Smelly and cloudy water supply
xiii. Flood

		(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)	(xiii)
Urban	Not happening	14	14	0	16	14	6	8	12	20	14	35	29	37
	Seldom happen	29	27	10	33	31	22	29	20	43	24	39	43	39
	Often happen	27	29	83	39	39	53	31	47	12	24	16	16	14
	Don't know	31	31	6	12	16	18	33	20	24	37	10	12	10
Peri-urban	Not happening	26	2100	1000	23	19	17	16	13	26	19	20	23	32
	Seldom happen	28	2600	2100	26	26	21	20	31	34	32	53	48	33
	Often happen	14	2300	6300	40	32	41	36	44	19	23	16	16	22
	Don't know	32	2900	600	11	23	21	28	13	21	26	11	12	13
Orang Asli Village	Not happening	73	53	93	93	54	93	87	93	40	93	93	53	87
	Seldom happen	13	20	0	0	0	0	7	0	47	0	0	40	0
	Often happen	7	20	7	7	4	7	7	7	13	7	7	7	7
	Don't know	7	7	0	0	42	0	0	0	0	0	0	0	7

2. Do you know the authority or person(s) responsible for the management of forests and/or rivers in Upper Kinta?

	Yes	No
Urban	24	76
Peri-urban	28	72
Orang Asli village	40	60

3. According to your observation, how have the following aspects progressed since the past 5 years?

		Cleanliness	Smell	Water quality	Enforcement	River conservation/care initiative	Public participation in environmental sustainability programs
Urban	**Getting better**	33	20	29	20	31	31
	Getting worse	35	35	35	18	22	18
	No change	24	35	29	35	27	29
	Don't know	8	10	8	27	20	22
Peri-urban	**Getting better**	35	40	31	27	28	30
	Getting worse	13	35	19	31	27	37
	No change	33	63	28	28	31	22
	Don't know	19	25	21	15	13	10
Orang Asli Village	**Getting better**	20	27	7	27	7	27
	Getting worse	27	27	20	27	0	0
	No change	53	47	67	47	67	60
	Don't know	0	0	7	0	27	13

4. Have you ever discussed these environmental issues with the responsible authority or person(s) in order to seek solutions?

	Yes	**No**
Urban	12	88
Peri-urban	17	83
Orang Asli village	27	73

SECTION D: Existing Practices and Facilities for Environmental Best Management Practices (BMPs)

1. Where do you usually receive information on the environment; such as rivers, forests, water resource, etc.? (May choose more that one option)

	Newspaper	Social media	Television / radio	Environental organization	Others
Urban	21	36	27	14	3
Peri-urban	28	37	23	9	3
Orang Asli village	5	16	53	5	11

2. Which of the following environmental friendly initiatives do you practice? (May choose more that one option)

i. Use reusable bags
ii. Use energy efficient electrical appliances
iii. Separate recyclable waste and send it to the recycling centre
iv. Turn off the tap while brushing teeth
v. Use recycled papers
vi. Turn kitchen waste into compost
vii. Switch off the lights and electrical items when not in use
viii. Use CFC free aerosol spray
ix. Use chemical free pesticides
x. Avoid single use plastics; such as straws, plastic packaging, pastic spoons, etc.
xi. Others

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
Urban	12	9	11	14	12	4	17	5	7	8
Peri-urban	10	11	12	17	8	6	16	7	8	6
Orang Asli village	6	2	22	8	2	0	25	14	18	4

3. Have you ever take part in any environmental care/awareness programs or activities?

	Yes	No
Urban	37	63
Peri-urban	23	77
Orang Asli village	87	13

4. Does your housing area undertake any environmental care/awareness initiatives or have the facility for the community to practice environmental friendly initiatives? (May choose more than one)

	No facility	Solid waste and used cooking oil collection centre	Recycling centre	Composting centre	Environmental awareness centre	Gotong-royong or community clean-up of housing area	Others
Urban	14	26	18	11	4	26	14
Peri-urban	19	7	29	5	7	34	19
Orang Asli village	0	0	0	0	0	100	0

SECTION E: Readiness and Willingness to Participate in Public Outreach Programmes

1. Please rate the importance of environmental issues such as cleanliness, and conservation of rivers to you.

	Very unimportant	Not important	Normal	Important	Very important
Urban	0	4	2	18	76
Peri-urban	4	4	3	27	63
Orang Asli village	0	8	0	0	92

2. What is the main detterent if given the chance to undertake environmental practices at your housing area?

	No restrain	Lack of knowledge or expertise	Lack of incentive or funds	Lack of facility or local support	Lack of time	Not interested / not important
Urban	12	10	22	22	24	10
Peri-urban	16	12	14	23	29	6
Orang Asli village	25	0	0	0	50	25

3. Are you interested to participate in (long term) forest and water/river conservation activities in the future?

	Yes	No
Urban	71	29
Peri-urban	64	36
Orang Asli village	67	33

4. If yes, please choose the preferred method to learn about the conservation and protection of forest and water/rivers in your houseing area. (May choose more than one)

	Workshop / Forum	Campaign	Individual consultation	Participate in field activities	Printed material	Email/ newsletters	Social media
Urban	21	11	2	22	8	10	26
Peri-urban	19	14	3	21	14	6	23
Orang Asli village	10	24	0	33	10	0	24

SOAL SELIDIK BERKAITAN SUMBER DAN PENGGUNAAN AIR DI LEMBANGAN SUNGAI HULU KINTA

PENILAIAN INI DIJALANKAN OLEH
GLOBAL ENVIRONMENT CENTRE (GEC)
UNTUK PROJEK PENGURUSAN LEMBANGAN SUNGAI BERSEPADU
HULU KINTA

Tuan/Puan yang dihormati,

Kami amat menghargai sekiranya Tuan/Puan dapat memberi kerjasama dan sokongan untuk mengisi maklumbalas pada soalselidik ini. Komuniti tempatan merupakan tunjang bagi pelaksanaan projek yang melibatkan lembangan ini. Kerjasama dan sokongan Tuan/Puan dapat membantu kami untuk menyediakan laporan penilaian awal mengenai tahap kesedaran komuniti tempatan tentang isu-isu berkaitan hutan dan sumber air yang berhampiran serta kesediaan komuniti untuk terlibat dalam aktiviti-aktiviti berkaitan perlindungan dan pembaikpulihan sumber air dan sungai untuk kesejahteraan bersama. Pihak GEC mendekati komuniti tuan/puan kerana daerah anda terletak di lembangan sungai Hulu Kinta.

Latar Belakang Organisasi
Global Environment Centre (GEC) ialah sebuah badan bukan kerajaan (NGO) yang bergiat aktif dalam menangani isu-isu alam sekitar. GEC ditubuhkan pada tahun 1998 di Malaysia (No. 473058-T) dan telah bekerjasama rapat dengan banyak agensi daripada sektor kerajaan, swasta, orang awam, dan institusi pendidikan mengenai pengurusan air serta sungai, hutan, dan sisa pepejal bersepadu.

Latar Belakang Projek
Projek Pengurusan Lembangan Sungai Bersepadu Hulu Kinta merupakan salah satu inisiatif oleh **Yayasan Hasanah** dengan kerjasama **GEC** dan **Jabatan Pengairan dan Saliran Perak**. Matlamat utama projek ini adalah untuk memelihara dan memulihara habitat hutan dan sungai di lembangan sungai Hulu Kinta dengan mengutamakan kerjasama komuniti tempatan dan agensi-agensi lain untuk turut serta memainkan peranan mereka dalam ekosistem yang unik, berpotensi tinggi, dan kaya dengan biodiversiti ini.

Tiada jawapan salah atau betul yang diharapkan pihak GEC. Oleh itu, kami memohon agar anda dapat menjawab soalan ini dengan sejujurnya. Maklumat daripada hasil kaji selidik ini akan digunakan untuk merangka strategi pengurusan lembangan dan maklumat peribadi anda dijamin sulit.

Panduan kepada responden

I. Sila baca arahan dengan teliti sebelum menjawab soalan
II. Sila tandakan [√] pada jawapan yang sesuai. Sesetengah soalan mungkin mempunyai lebih daripada satu jawapan.
III. Sesetengah soalan perlukan jawapan bertulis.

Terima kasih atas penyertaan anda.

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ANNEX 1: QUESTIONNAIRE

BAHAGIAN A: Maklumat Responden

1. Nama : ……

2. Alamat : ……

3. No. Telefon : ……

4. Jantina
[ ] Lelaki
[ ] Perempuan

5. Umur
[ ] 20 tahun ke bawah
[ ] 21-30 tahun
[ ] 31-49 tahun
[ ] 50 tahun dan ke atas

6. Tempoh masa menetap di alamat tertulis di no.**2**:
[ ] Kurang dari 5 tahun
[ ] 6-10 tahun
[ ] 11- 20 tahun
[ ] Lebih dari 21 tahun

7. Bilangan isi rumah
[ ] 1-4
[ ] 5-9
[ ] 10 dan ke atas.

8. Tahap pendidikan
[ ] Tiada pendidikan rasmi
[ ] Sekolah rendah
[ ] Sekolah menengah
[ ] STPM/Diploma/Sijil
[ ] Sarjana muda/Sarjana/Phd

9. Pekerjaan
[ ] Bekerja dengan kerajaan, sila nyatakan .....
[ ] Bekerja dengan swasta
[ ] Mengusahakan kebun kelapa sawit / getah persendirian
[ ] Petani
[ ] Peniaga
[ ] Lain-lain; sila nyatakan.....

10. Pendapatan purata setiap bulan
[ ] Kurang dari RM500
[ ] RM500– RM1,999
[ ] RM2,000 – RM4,999
[ ] RM5,000 atau lebih

BAHAGIAN B: <u>Kesedaran Tentang Hutan Simpan dan Sungai-sungai di Hulu Kinta</u>

1. Sila tandakan kepentingan hutan simpan dan sungai-sungai di Hulu Kinta <u>bagi anda</u>.

		Penting	Kurang penting	Tidak penting	Tidak tahu
i.	Bekalan air	[ ]	[ ]	[ ]	[ ]
ii.	Sumber kayu (balak)	[ ]	[ ]	[ ]	[ ]
iii.	Hasil-hasil bukan kayu	[ ]	[ ]	[ ]	[ ]
iv.	Kawalan banjir	[ ]	[ ]	[ ]	[ ]
v.	Habitat bagi kepelbagaian biologi	[ ]	[ ]	[ ]	[ ]
vi.	Kawasan pertanian / tanaman	[ ]	[ ]	[ ]	[ ]
vii.	Penyimpanan karbon	[ ]	[ ]	[ ]	[ ]
viii.	Perikanan	[ ]	[ ]	[ ]	[ ]
ix.	Kawasan pelancongan / Tempat rekreasi	[ ]	[ ]	[ ]	[ ]
x.	Lain-lain; Sila nyatakan:	[ ]	[ ]	[ ]	[ ]

2. Adakah anda mengetahui sumber bagi air minuman anda?
[ ] Ya, sila nyatakan sumber berkenaan: ……
[ ] Tidak

3. Adakah anda mengenali sungai berhampiran dengan kawasan perumahan anda?
[ ] Ya, sila nyatakan nama sungai berkenaan: ……
[ ] Tidak

4. Adakah anda mengetahui ke mana penghujung saluran longkang atau sistem perparitan dalam kawasan perumahan anda?
[ ] Ya, sila nyatakan: ……
[ ] Tidak

5. Adakah anda mempunyai pengetahuan tentang kewujudan kawasan hutan simpanan berdekatan dengan kawasan perumahan anda?
[ ] Ya, sila nyatakan nama hutan simpan berkenaan: ……
[ ] Tidak

BAHAGIAN C: **<u>Isu-isu Semasa Berkaitan Hutan Simpan dan Sungai-sungai di Hulu Kinta</u>**

1. Berdasarkan pemerhatian anda, apakah isu-isu alam sekitar yang sering berlaku berhampiran kawasan tempat tinggal anda

		Tidak berlaku	Jarang berlaku	Sering berlaku	Tidak tahu
i.	Pencerobohan hutan simpan	[ ]	[ ]	[ ]	[ ]
ii.	Penerokaan tanah rizab tujuan perladangan / pertanian	[ ]	[ ]	[ ]	[ ]
iii.	Longgokan sampah merata-rata	[ ]	[ ]	[ ]	[ ]
iv.	Perkhidmatan pengutipan sampah yang lemah	[ ]	[ ]	[ ]	[ ]
v.	Pengurusan sisa air kumbahan yang lemah	[ ]	[ ]	[ ]	[ ]
vi.	Pembuangan sisa restoran dan medan penjaja ke dalam parit/sungai	[ ]	[ ]	[ ]	[ ]
vii.	Pembuangan sisa dari kilang ke dalam parit/sungai	[ ]	[ ]	[ ]	[ ]
viii.	Parit tersumbat	[ ]	[ ]	[ ]	[ ]
ix.	Hakisan tanah	[ ]	[ ]	[ ]	[ ]
x.	Pengurusan projek pembinaan yang lemah	[ ]	[ ]	[ ]	[ ]
xi.	Gangguan bekalan air	[ ]	[ ]	[ ]	[ ]
xii.	Bekalan air paip berbau / berwarna	[ ]	[ ]	[ ]	[ ]
xiii.	Banjir	[ ]	[ ]	[ ]	[ ]
xiv.	Lain-lain; Sila nyatakan:	[ ]	[ ]	[ ]	[ ]

2. (Jika berkaitan) sila nyatakan sebab dan paras banjir:
……

3. Adakah anda tahu pihak atau individu yang bertanggungjawab menjaga kesejahteraan sungai-sungai dan/atau hutan simpan di Hulu Kinta?
[ ] Ya, sila nyatakan semua yang anda tahu:……
[ ] Tidak

4. Pada pemerhatian anda, bagaimanakah perubahan aspek-aspek berikut pada sungai berhampiran anda sejak lima tahun lalu?

		Semakin baik	Semakin teruk	Tiada/ tidak berubah	Tidak tahu
i.	Kebersihan	[ ]	[ ]	[ ]	[ ]
ii.	Bau	[ ]	[ ]	[ ]	[ ]
iii.	Kualiti air	[ ]	[ ]	[ ]	[ ]
iv.	Penguatkuasaan	[ ]	[ ]	[ ]	[ ]
v.	Inisiatif penjagaan sungai	[ ]	[ ]	[ ]	[ ]

vi.	Penyertaan orang ramai dalam program-program kelestarian alam sekitar	[ ]	[ ]	[ ]	[ ]
vii.	Lain-lain; Sila nyatakan:	[ ]	[ ]	[ ]	[ ]

5. Pernahkan anda berbincang dengan agensi kerajaan/swata atau individu yang bertanggunjawab untuk mendapatkan penyelesaian bagi isu-isu alam sekitar yang dihadapi di kawasan anda?
[ ] Ya
[ ] Tidak

6. Sila berikan pandangan atau cadangan anda bagi menyelesaikan masalah ini.
.....
.....
.....
.....
.....

BAHAGIAN D: **<u>Kemudahan Pengamalan Pengurusan Terbaik bagi Hutan Simpan dan Sungai-sungai di Hulu Kinta</u>**

1. Dari manakah anda sering menerima maklumat berkaitan alam sekitar; seperti sungai, hutan, sumber air, dan lain-lain? (Boleh pilih lebih daripada satu pilihan)
[ ] Surat khabar
[ ] Media sosial (Twitter, Facebook, WhatsApp, dll.)
[ ] Televisyen / radio
[ ] Organisasi alam sekitar
[ ] Lain-lain; Sila nyatakan: ……..……..…..……..

2. Antara berikut yang manakah aktiviti mesra alam harian yang sering dilakukan oleh anda? (Boleh pilih lebih daripada satu pilihan)
[ ] Membawa beg sendiri apabila pergi membeli-belah barangan keperluan harian
[ ] Menggunakan peralatan jimat tenaga secara efisyen
[ ] Mengasingkan bahan buangan yang boleh dikitar semula, dan menghantar ke pusat kitar semula
[ ] Menutup paip air sewaktu memberus gigi, sabun, dan shampu
[ ] Menggunakan kertas yang telah dikitar semula
[ ] Membuat baja kompos daripada sisa dapur
[ ] Mematikan suis lampu dan perkakas elektrik ketika tidak menggunakannya
[ ] Menggunakan penyembur aerosol yang bebas daripada bahan CFC
[ ] Tidak menggunakan racun serangga yang mengandungi bahan kimia
[ ] Mengelakkan penggunaan plastik bungkusan, straw, dll
[ ] Lain-lain; Sila nyatakan: ……..……..…..……..

3. Pernahkan anda mengambil bahagian dalam aktiviti-aktiviti penjagaan alam sekitar?
[ ] Ya, sila nyatakan aktiviti:……
[ ] Tidak

4. Adakah kawasan perumahan anda melakukan aktiviti-aktiviti penjagaan alam sekitar atau mempunyai pusat kemudahan yang membantu komuniti tempatan meningkatkan kebersihan alam sekitar? (Boleh pilih lebih daripada satu pilihan)
[ ] Tiada sebarang kemudahan atau aktiviti
[ ] Pusat pengumpulan sisa pepejal atau minyak masak terpakai
[ ] Pusat kitar semula
[ ] Pusat penghasilan baja kompos
[ ] Pusat informasi sungai/alam sekitar
[ ] Gotong-royong membersihkan kawasan perumahan,
sila nyatakan kekerapan aktiviti: ……
[ ] Lain-lain; Sila nyatakan: ……..……..…..…….

BAHAGIAN E: <u>Keperluan dan Kesediaan Responden</u>

1. Sila nilai tahap kepentingan isu berkaitan kebersihan alam sekitar/sumber air/sungai kepada anda?
   [ ] Sangat tidak penting
   [ ] Tidak penting
   [ ] Tiada perasaan
   [ ] Penting
   [ ] Sangat Penting

2. Apakah halangan utama kepada anda jika diberi peluang untuk mengamalkan aktiviti mesra alam di kawasan perumahan anda?
   [ ] Tiada halangan
   [ ] Kekurangan pengetahuan/kemahiran
   [ ] Kekurangan insentif atau dana
   [ ] Kekurangan fasiliti atau sokongan tempatan
   [ ] Kekurangan waktu
   [ ] Tidak berminat / bukan satu kepentingan

3. Adakah anda berminat untuk melibatkan diri dalam aktiviti penjagaan dan perlindungan hutan dan sumber air/sungai (jangka masa panjang) pada masa yang akan datang?
   [ ] Ya, sila nyatakan kekerapan: ……
   [ ] Tidak, sila nyatakan sebab: ……

4. Jika ya, sila pilih cara yang anda berminat untuk belajar tentang kemahiran penjagaan dan perlindungan hutan dan sumber air/sungai di kawasan perumahan anda?
   (Boleh pilih lebih daripada satu pilihan)
   [ ] Bengkel
   [ ] Kempen
   [ ] Forum
   [ ] Perundingan persendirian
   [ ] Menyertai aktiviti di lapangan
   [ ] Bahan cetak
   [ ] Email
   [ ] Media sosial
   [ ] Lain-lain; Sila nyatakan: ……..……..…..……

SEKIAN, TERIMA KASIH

ANNEX 2: QUESTIONAIRE ANALYSIS

Perception survey results in percentages

SECTION A: Profile of Respondents

1. Sex:

	Male	Female
Urban	35	65
Peri-urban	52	48
Orang Asli village	60	40

2. Age

	20 and below	21-30	31-49	50 and above
Urban	20	37	16	27
Peri-urban	25	25	26	24
Orang Asli village	7	20	13	60

3. Duration of stay at the given address:

	Less than 5 years	6 - 10 years	11 - 20 years	21 years and above
Urban	22	14	37	27
Peri-urban	15	22	28	35
Orang Asli village	7	7	13	73

4. Number of households

	1-4	5-9	10 and above
Urban	57	39	4
Peri-urban	54	43	4
Orang Asli village	40	47	13

5. Education level

	No formal education	Primary school	Secondary school	STPM/ Diploma Certificate	Bachelors/ Masters/ Phd
Urban	2	2	47	24	24
Peri-urban	1	7	51	25	12
Orang Asli village	47	13	40	0	0

6. Occupation

	Government	Private sector	Privately owned oil palm / rubber plantation	Farmer / agriculture	Trading / business owner	Others
Urban	6	33	2	0	14	45
Peri-urban	10	34	0	2	26	29
Orang Asli village	7	0	33	0	0	60

7. Average monthly income

	Less than RM500	RM500– RM1,999	RM2,000 – RM4,999	RM5,000 or more
Urban	33	22	39	6
Peri-urban	37	32	24	7
Orang Asli village	53	40	7	0

SECTION B: Knowledge on Forest Reserve and Rivers at Upper Kinta

1. Please mark the importance of forests and rivers in Upper Kinta according to you.

		Water supply	Timber	Non-timber products	Flood management	Habitat for variety of species	Agriculture	Carbon sequestration	Fisheries	Tourism / recreational area
Urban	**Important**	96	65	53	82	86	80	65	69	78
	Less important	2	22	24	8	4	14	20	22	14
	Not important	2	8	8	4	4	0	6	4	6
	Don't know	0	4	14	6	6	6	8	4	2
Peri-urban	**Important**	89	60	44	81	62	66	54	66	64
	Less important	3	19	25	6	13	11	13	15	18
	Not important	3	11	13	3	7	8	9	5	9
	Don't know	5	10	18	9	17	15	25	13	9
Orang Asli Village	**Important**	80	93	80	73	67	47	60	87	27
	Less important	0	0	20	7	20	40	7	0	13
	Not important	7	0	0	7	0	7	0	13	40
	Don't know	13	7	0	13	13	7	33	0	20

2. Do you know the source of your drinking water?

	Yes	**No**
Urban	49	51
Peri-urban	50	50
Orang Asli village	93	7

3. Do you have any knowledge of rivers near to your housing area?

	Yes	**No**
Urban	55	45
Peri-urban	58	42
Orang Asli village	100	0

4. Do you know where does the drainage system in your housing area discharges into?

	Yes	No
Urban	27	73
Peri-urban	37	63
Orang Asli village	87	13

5. Do you have any knowledge of forest near your housing area?

	Yes	No	Don't know
Urban	6	84	10
Peri-urban	19	64	17
Orang Asli village	67	33	0

SECTION C: Awareness on Issues Related to Forest and Rivers at Upper Kinta

1. In your opinion, what are the environmental issues happening in your housing area.

i. Encroachment of forest reserve
ii. Conversion of reserved land for plantation or farming
iii. Illegal rubbish dumping
iv. Poor garbage collection service
v. Poor wastewater management
vi. Waste dumping into rivers/drains by the restaurants and hawkers
vii. Waste dumping from factories into rivers/drains
viii. Blacked drainage
ix. Landslide
x. Poor management of construction areas
xi. Water shortage
xii. Smelly and cloudy water supply
xiii. Flood

		(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)	(xiii)
Urban	Not happening	14	14	0	16	14	6	8	12	20	14	35	29	37
	Seldom happen	29	27	10	33	31	22	29	20	43	24	39	43	39
	Often happen	27	29	83	39	39	53	31	47	12	24	16	16	14
	Don't know	31	31	6	12	16	18	33	20	24	37	10	12	10
Peri-urban	Not happening	26	2100	1000	23	19	17	16	13	26	19	20	23	32
	Seldom happen	28	2600	2100	26	26	21	20	31	34	32	53	48	33
	Often happen	14	2300	6300	40	32	41	36	44	19	23	16	16	22
	Don't know	32	2900	600	11	23	21	28	13	21	26	11	12	13
Orang Asli Village	Not happening	73	53	93	93	54	93	87	93	40	93	93	53	87
	Seldom happen	13	20	0	0	0	0	7	0	47	0	0	40	0
	Often happen	7	20	7	7	4	7	7	7	13	7	7	7	7
	Don't know	7	7	0	0	42	0	0	0	0	0	0	0	7

2. Do you know the authority or person(s) responsible for the management of forests and/or rivers in Upper Kinta?

	Yes	No
Urban	24	76
Peri-urban	28	72
Orang Asli village	40	60

3. According to your observation, how have the following aspects progressed since the past 5 years?

		Cleanliness	Smell	Water quality	Enforcement	River conservation/care initiative	Public participation in environmental sustainability programs
Urban	**Getting better**	33	20	29	20	31	31
	Getting worse	35	35	35	18	22	18
	No change	24	35	29	35	27	29
	Don't know	8	10	8	27	20	22
Peri-urban	**Getting better**	35	40	31	27	28	30
	Getting worse	13	35	19	31	27	37
	No change	33	63	28	28	31	22
	Don't know	19	25	21	15	13	10
Orang Asli Village	**Getting better**	20	27	7	27	7	27
	Getting worse	27	27	20	27	0	0
	No change	53	47	67	47	67	60
	Don't know	0	0	7	0	27	13

4. Have you ever discussed these environmental issues with the responsible authority or person(s) in order to seek solutions?

	Yes	**No**
Urban	12	88
Peri-urban	17	83
Orang Asli village	27	73

SECTION D: Existing Practices and Facilities for Environmental Best Management Practices (BMPs)

1. Where do you usually receive information on the environment; such as rivers, forests, water resource, etc.? (May choose more that one option)

	Newspaper	Social media	Television / radio	Environental organization	Others
Urban	21	36	27	14	3
Peri-urban	28	37	23	9	3
Orang Asli village	5	16	53	5	11

2. Which of the following environmental friendly initiatives do you practice? (May choose more that one option)

i. Use reusable bags
ii. Use energy efficient electrical appliances
iii. Separate recyclable waste and send it to the recycling centre
iv. Turn off the tap while brushing teeth
v. Use recycled papers
vi. Turn kitchen waste into compost
vii. Switch off the lights and electrical items when not in use
viii. Use CFC free aerosol spray
ix. Use chemical free pesticides
x. Avoid single use plastics; such as straws, plastic packaging, pastic spoons, etc.
xi. Others

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
Urban	12	9	11	14	12	4	17	5	7	8
Peri-urban	10	11	12	17	8	6	16	7	8	6
Orang Asli village	6	2	22	8	2	0	25	14	18	4

3. Have you ever take part in any environmental care/awareness programs or activities?

	Yes	No
Urban	37	63
Peri-urban	23	77
Orang Asli village	87	13

4. Does your housing area undertake any environmental care/awareness initiatives or have the facility for the community to practice environmental friendly initiatives? (May choose more than one)

	No facility	Solid waste and used cooking oil collection centre	Recycling centre	Composting centre	Environmental awareness centre	Gotong-royong or community clean-up of housing area	Others
Urban	14	26	18	11	4	26	14
Peri-urban	19	7	29	5	7	34	19
Orang Asli village	0	0	0	0	0	100	0

SECTION E: Readiness and Willingness to Participate in Public Outreach Programmes

1. Please rate the importance of environmental issues such as cleanliness, and conservation of rivers to you.

	Very unimportant	Not important	Normal	Important	Very important
Urban	0	4	2	18	76
Peri-urban	4	4	3	27	63
Orang Asli village	0	8	0	0	92

2. What is the main detterent if given the chance to undertake environmental practices at your housing area?

	No restrain	Lack of knowledge or expertise	Lack of incentive or funds	Lack of facility or local support	Lack of time	Not interested / not important
Urban	12	10	22	22	24	10
Peri-urban	16	12	14	23	29	6
Orang Asli village	25	0	0	0	50	25

3. Are you interested to participate in (long term) forest and water/river conservation activities in the future?

	Yes	No
Urban	71	29
Peri-urban	64	36
Orang Asli village	67	33

4. If yes, please choose the preferred method to learn about the conservation and protection of forest and water/rivers in your houseing area. (May choose more than one)

	Workshop / Forum	Campaign	Individual consultation	Participate in field activities	Printed material	Email/ newsletters	Social media
Urban	21	11	2	22	8	10	26
Peri-urban	19	14	3	21	14	6	23
Orang Asli village	10	24	0	33	10	0	24