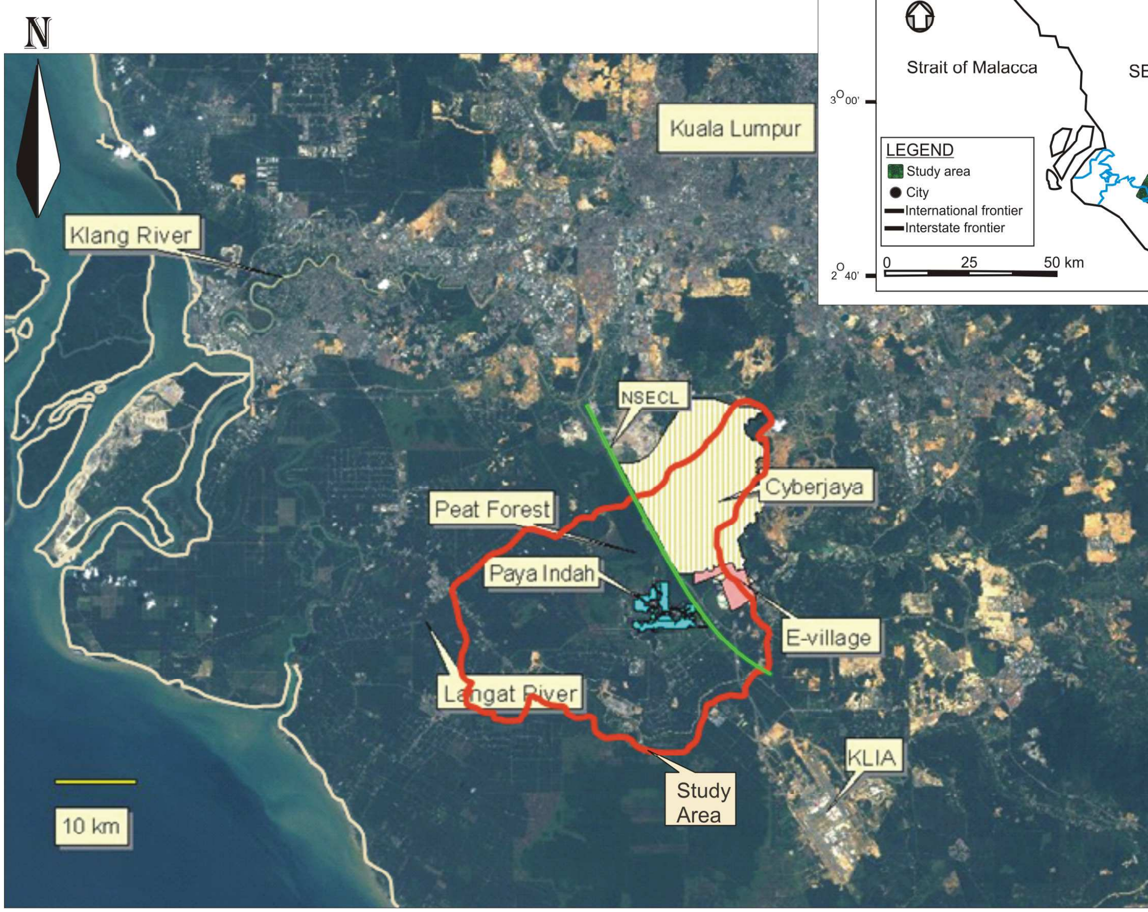
CHAPTER I

INTRODUCTION

1.1 DESCRIPTION OF THE STUDY AREA

Paya Indah wetland is located in the Kuala Langat District in the State of Selangor within the quadrant of longitude 101°10′ E to 101°50′ E and latitude 2°50′ N and 3°00′ N The area is considered a green lung of the Multimedia Super Corridor due to its strategic location 30 km south of Kuala Lumpur, 12 km west of Putra Jaya, 15 km north of Kuala Lumpur International Airport and the nearest town Dengkil, is 4 km away (Figure 1.1). It covers an area of 242.21 km^2, and encompasses a myriad of ecosystems, namely, degraded ex-tin mining land and peat swamp forest. It portrays Malaysia's commitment to preserving and the wise use of wetlands (Haniba et al., 2002; Paya Indah Wetland, 2005).

The area presented a mix of ecosystems for a diverse range of flora and fauna and is habitats for bird population both local and migratory. The wildlife in this area is representative of lowland forest habitats. The dominating swamp forest is reflected in the bird and human profile of 131 species of birds and 26 species of mammals were recorded within the area (Paya Indah Wetland, 2005).



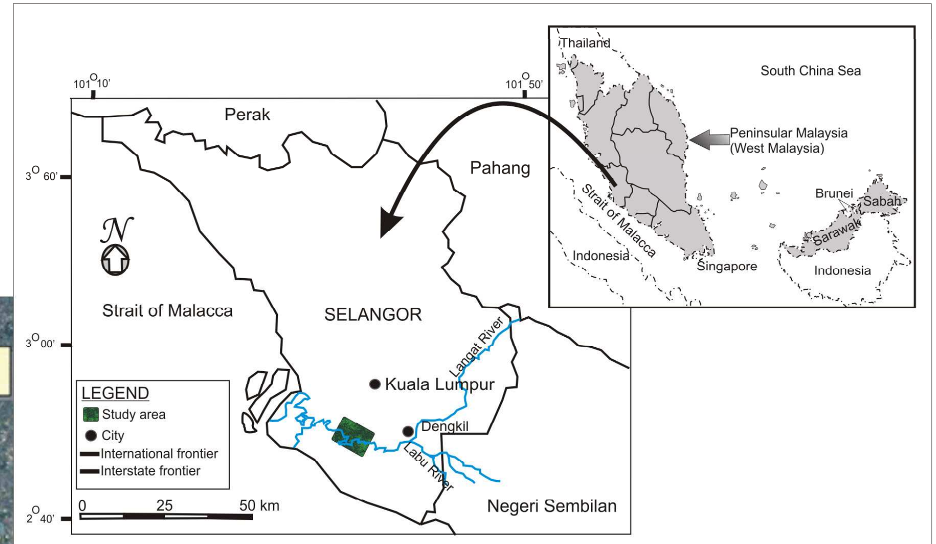


FIGURE 1.1
Index Map of the Study Area.
NSECL: North-South Expressway Central Link
KLIA: Kuala Lumpur International Airport

The area is also characterized by a uniform temperature, high humidity, light wind and copious rainfall. The average annual rainfall at the area is approximately 2,400 mm, ranging from 1800 to 3000 mm. A trend of gradual increase in rainfall from the coast towards the hilly areas prevails. The highest rainfall occurs in the months of November and April with an average of 280 mm. The lowest rainfall occurs in the month of June with a mean of 115 mm. The wet seasons occur in the transitional periods of the monsoons, from March to April and from October to November (Minerals and Geoscience Department, 2002).

1.1.1 Geology

The study area is a part of the Langat river basin which consists of four major rock types (Figure 1.2). These include metamorphic rocks, sedimentary rocks, igneous rocks and the alluvial plan (Gobbett, 1973). The granitic rocks occupy about 30% of the study area and forms prominent mountain ranges in the east and northeast part of the Langat basin. The foothills include the Kenny Hill Formation and Kajang Formation which consist of metamorphosed sandstone, shale, mudstone and schist (Minerals and Geoscience Department of Malaysia 2001; Omar et al., 1999). In the low flatlands, thick Quaternary layers are deposited on the bedrock and distributed along the coastal fringe. These deposits, from top to bottom, consist of Beruas Formation (0.5 m to 5.5 m) with peat layer at the top, clayey Gula Formation and Kempadang Formation which start at the hilly area and have a thickness between 40 to 50 m near the coast (Minerals and Geoscience Department 2001; Bosch, 1988). These deposits are underlain by the Simpang Formation of sand and gravel with thickness of several meters at the hilly areas and about 50 m to >100 m in the low flatlands (Minerals and Geoscience Department, 2002).

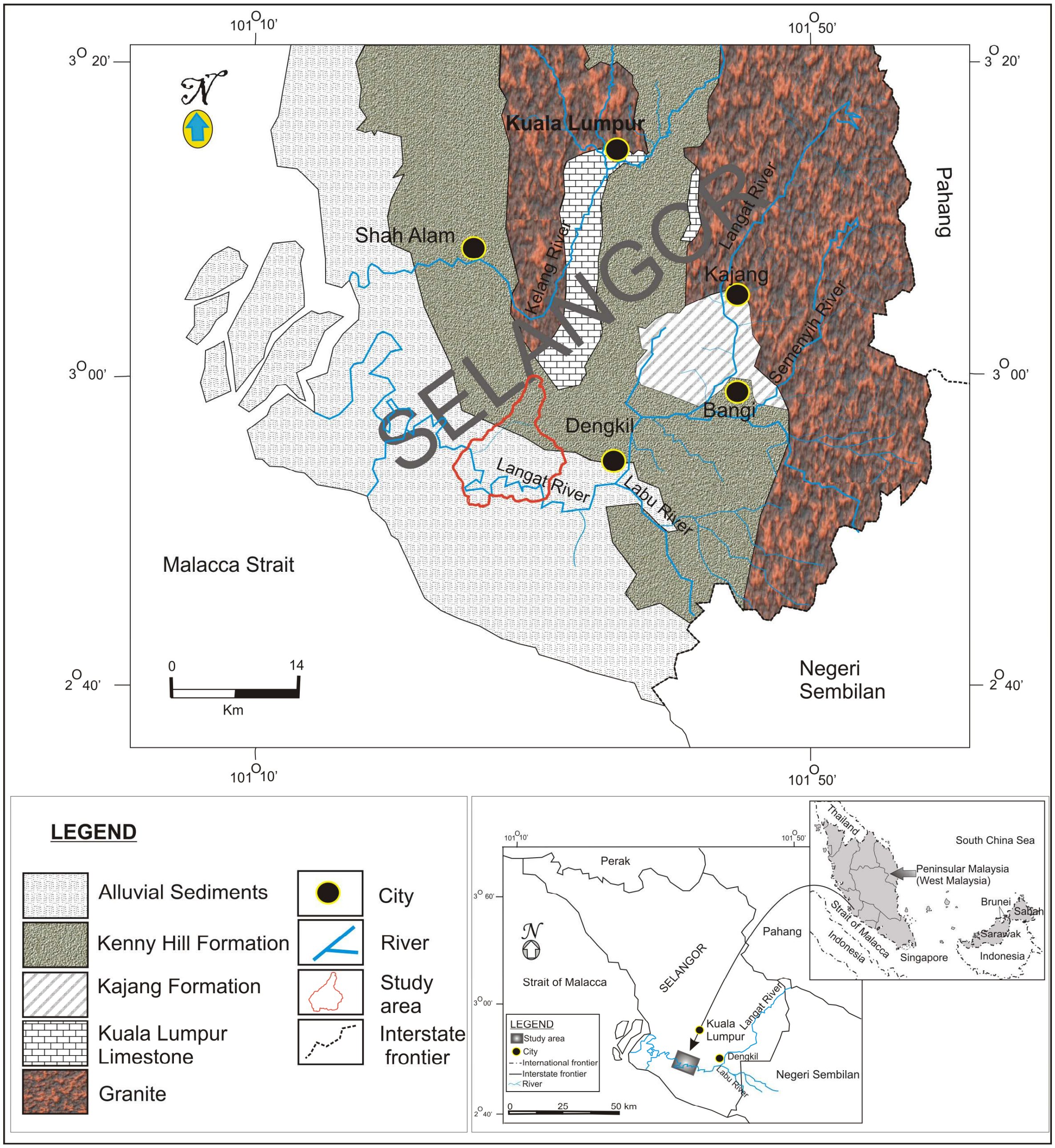


FIGURE 1.2
Geological and Location Map of the Study Area (Modified after Geological Survey Department of Malaysia, 1985)

1.1.2 Hydrology

The hydrologic system in the Paya Indah Wetland catchment consists mainly of the Langat River and a network of 14 lakes and seven natural stream canals (Figure 1.3; Table 1.1). The water flows into the Kuala Langat peat swamp forest through Cyberjaya Canal, North Canal_N1 and North Canal_S1 at the further upstream northern boundary and finally flowing out through the Outlet which hits the Langat River downstream at the south-western corner of the catchment.

Water flows into the lakes network mainly from the North-Inlet-Canal (SWL1) and flows out through the Lotus-Outlet canal (SWL2) which connects to the Langat River. The Langat River in turn, flows out of the catchment heading towards Malacca Strait. Weirs are constructed to increase the water levels in each sub-section of the canals. However, the weir at SWL2 was in operation but the flow strategy was not available.

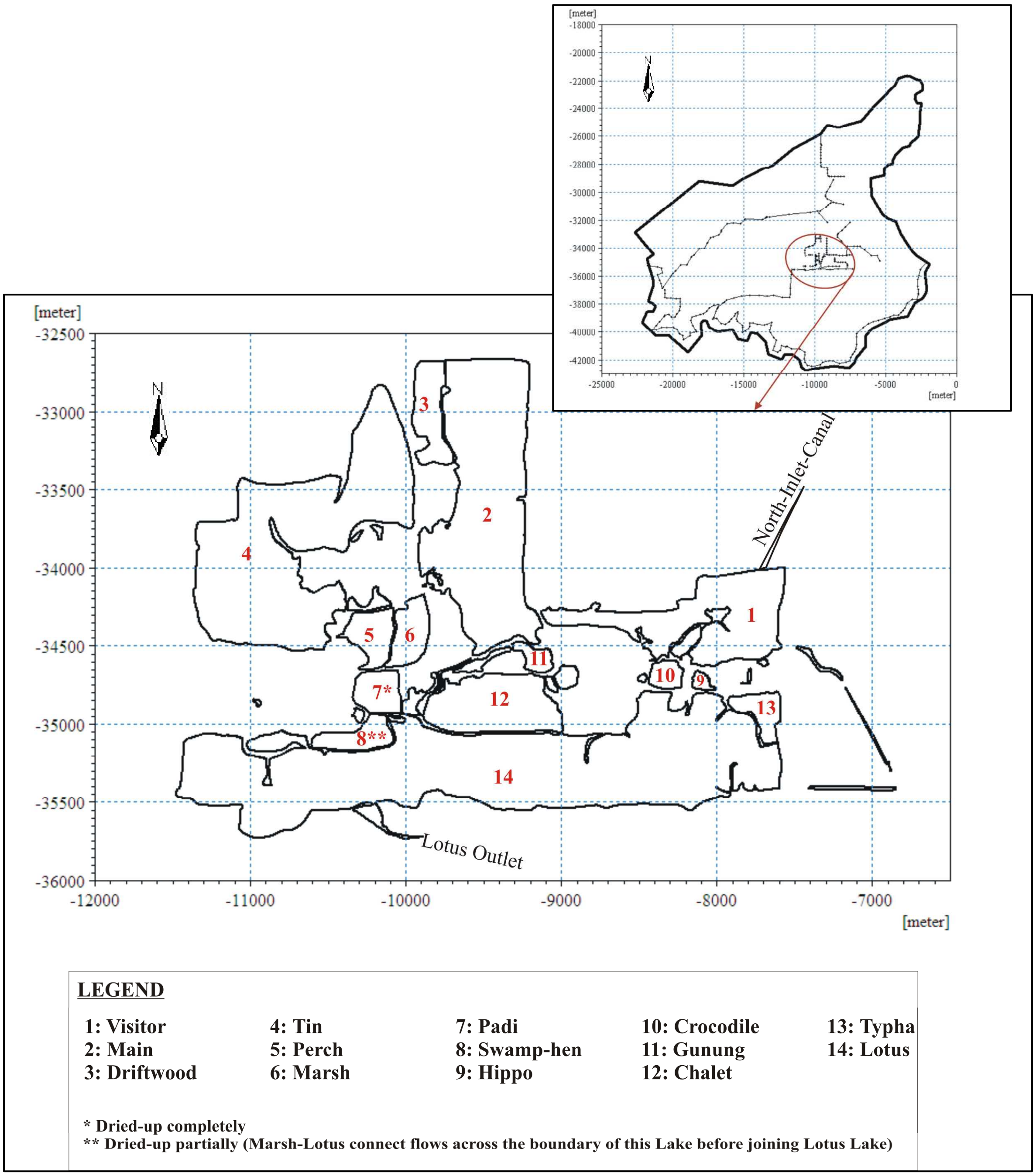


FIGURE 1.3
Components of the Paya Indah Lakes System

TABLE 1.1
Names and Lengths of the Hydrologic System Components of the Paya Indah Wetland Catchment Model

Name	**Length** (m)
Langat River	57260
North canal	15000
North canal_N1	1900
North canal_S1	600
Visitor Lake	1500
Lotus Lake	3800
Driftwood Lake	730
Tin Lake	1960
Driftwood-Tin-Connect	100
South-Inlet-Canal	3200
North-Inlet-Canal (SWL1)	2200
Perch Lake	380
Marsh Lake	470
Padi Lake	280
Swamphen Lake	390
Perch-Marsh-Connection	100
Tin-Perch-Connection	100
Marsh-Padi-Connection*	100
Padi-Swamphen-Connection	100
Swamphen-Lotus-Connection	100
Lotus Outlet (SWL2)	100
Outlet	6500
Visitor-Main-Connection	40
Main-Palm-Connection	1000
Croc-Hippo Lake	500
Cyberjaya canal	4050
Main Lake	1845
Chalet Lake	890

*Functionless due to drying-up of Padi Lake

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1.1.3 Groundwater status

There are two different aquifers within the catchment area which includes, shallow and deep aquifers. (Bachik and Hatta, 1998) the quaternary alluvium consists of gravel, sand, silt and clay. These alluvial sediments occupied the lowland areas and areas along the coastal fringe. At the Brookland Estate well field, fresh groundwater from this alluvium is being pumped at an approximately 15,000 m^3/day, which in turn has reduced the water demand from the Semenyih Dam. However, the groundwater from other alluvium aquifers, close to the coast, is mostly saline or brackish in nature. The salinity of the groundwater is mainly caused by a connate water origin rather than due to seawater intrusion (Ismail, 1998). Groundwater recharging areas are in the upstream mountains and hilly areas, and an aquifer distributes widely in the flat lowlands (Minerals and Geoscience Department, 2001).

An extensive groundwater abstraction takes place within the Paya Indah Wetland catchment by the Mega Steel Company. The actual volume that abstracted by them is questionable. However, past groundwater pumping record showed that average 23,300 m^3/day being abstracted from five wells at the Megasteel Company (Minerals and Geoscience Department, 2001).

1.2 OBJECTIVES

Integrated water resources management has become imperative not only as a means of implementing a long-term vision of the basins, but also as a means for taking immediate day-to-day planning decisions. Elements to be taken into account include flood control and management, allocation of water among provinces and user sectors, surface water and groundwater interaction, water quantity and quality, and risk management for all the regions of the watershed. Thus, the overarching science complex question to be addressed by this thesis is how hydrological modifications affect the Paya Indah Wetland catchment and what are the consequences of those modifications for the catchment-scale hydrology. Answering this question requires fulfilling three objectives. These include:

i. To model hydrological processes and establish the role of land-cover change in altering watershed function.

ii. To estimate the parameter values in a physically based hydrological model that integrates three-dimensional groundwater flow and surface water flow in order to investigate the interactions between surface water and groundwater systems.

iii. To drive simulations of the hydrological model output to predict the effects on the hydrology of the study area under different relevant scenarios.

1.3 SCOPE OF THE STUDY

Due to the integrated nature of the surface water and groundwater resources, an integrated approach has been adopted to conduct a hydrological study on the impact of adjacent developments on the designated Paya Indah Wetland catchment. The model must have the capability of simulating the major flow processes within the modeled area. To cover all processes with one model the MIKE SHE modeling system was selected. The model is an integrated and distributed, physically based, finite difference model. MIKE SHE comprises a number of flow modules, which can be combined to describe the water flow within the entire land based part of the hydrological cycle or tailored to studies focusing of areas of particular interest.

1.4 IMPORTANCE OF THE STUDY

The Paya Indah Wetland catchment has undergone dropping of the shallow groundwater table and water level at the Paya Indah lakes. Consequently two of the lakes (i.e. Padi and Swamp-hen) dried-up already and some periodical fires tend to hit the peat swamp forest within the catchment during dry seasons. Hypothetically three factors were taken into considerations which include unlicensed abstraction of groundwater at the Mega Steel property, landuse and climate change. Thus, estimation of total water balance for the Paya Indah Wetland catchment became a crucial requirement which in turn required a sound knowledge of the hydrogeologic setting and the surface water hydrology. Conversion of all these data into a detailed local-scale provides an efficient water management tool to estimate the total water balance and predict future development scenarios within catchment area.

1.5 MODELING APPROACH

The MIKE SHE model has the ability to simulate the total streamflow that includes direct flow and baseflow (Figure 1.4). Many models either do not simulate, or use simplistic methods, to determine the baseflow. The model also considers various land uses and soil types in the simulation, allowing evaluation of different management scenarios. In addition, MIKE SHE considers all other major hydrological components as well. Since this study was directed to the simulation of surface runoff including baseflow, MIKE SHE appeared to be suitable model. Due to the integrated nature of the surface water and groundwater resources an integrated approach has been adopted to simulate a complex hydrologic regime such as the Paya Indah wetland. The Model simulates all the major flow processes within the Paya Indah wetland catchment, including:

i. Overland sheet flow and depression storage
ii. Infiltration and storage in the unsaturated zone
iii. Dynamic exchange between unsaturated zone-groundwater (recharge)
iv. Dynamic exchange between aquifers-rivers/canals (seepage)
v. Groundwater flow, storage and potential heads
vi. River/canal flow and water levels
vii. Evapotranspiration losses

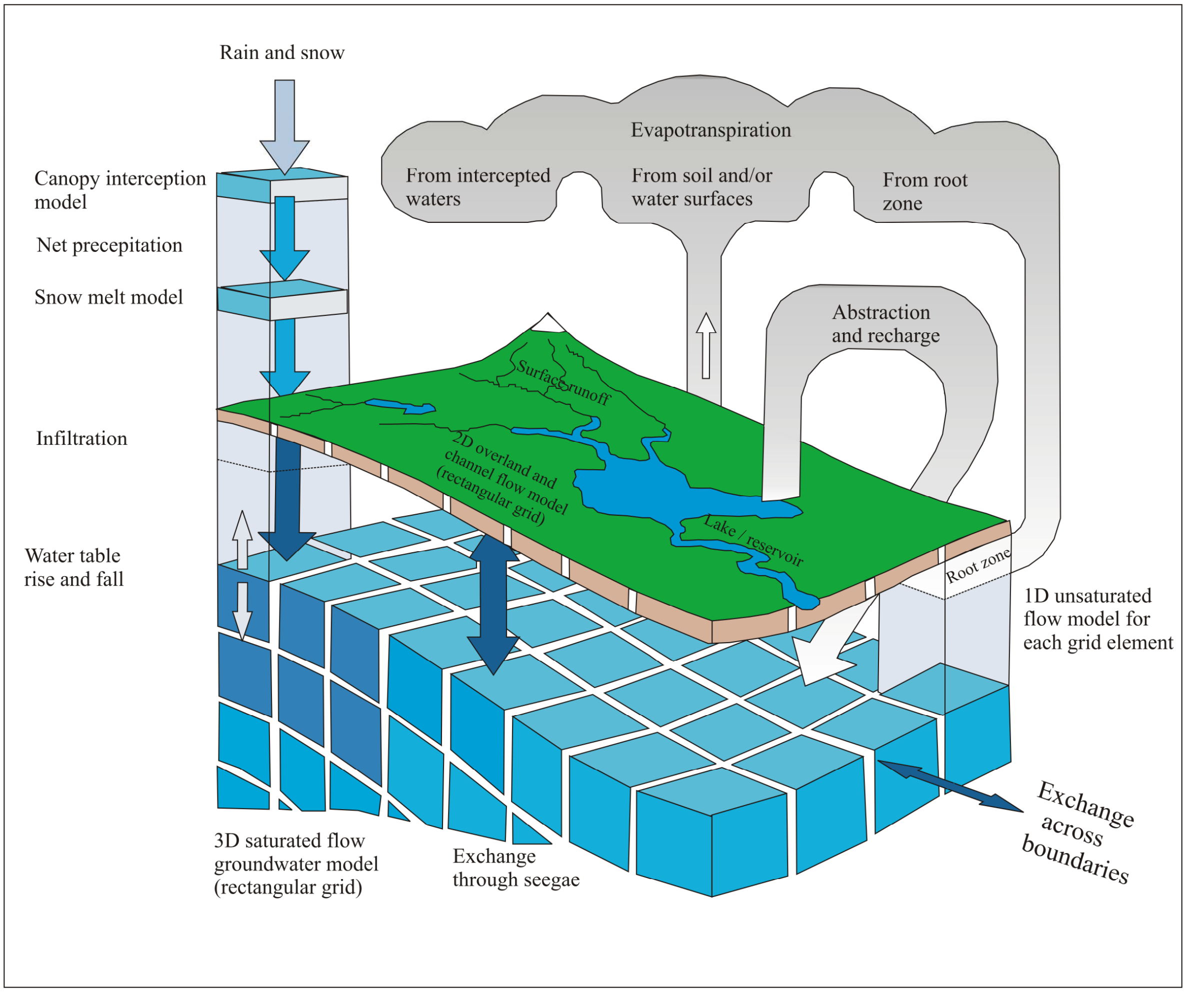

FIGURE 1.4
Land Phase Components of the Hydrologic Cylce (Modified after Graham, 2004)