Problem 1 : Canned Pineapples

Pine Works is a company that manufactures canned pineapples. They try to guarantee that the quality of pineapples used is consistent, however it is driven by financial matters in that the purchasing cost must be kept as low as could reasonably be expected.

The buyer selects from one of two grades; the larger size has an average diameter of a cm, and the smaller size has an average diameter of b cm ($b < a$). There are m large pineapples per kg, at a cost to Pine Works of RMP/kg. The cost of small pineapples is RMQ/kg ($Q < P$). The useable part of a pineapple is the portion remaining after the waste, comprising the core and skin, is removed. Whatever size of pineapple is used, the core may be assumed to be w% of the volume of the apple, and the skin may be assumed to be of constant thickness d cm, with $d \ll b$.

The factory manager prefers the larger size since it infers less waste in general, together with the fact that the overall processing time is shorter. However, they must meet the economic constraint of purchasing the most economical pineapples.

Assuming that only one size of pineapple is purchased, which size should it be? Develop a model to determine the optimal size of pineapple that gives the minimum cost. There are some geometry that can be considered, as well as some assumptions that can be made.

Prepare a report within one week time to be given to the factory manager, to help them in making their decision.

Problem 2 : Surface Water Pollution

Surface water pollution that occurs due to sudden road or industrial accidents is a major type of environmental problems. This pollution does not only affect the water quality and reduce the usage of water resources but also affects the normal economic and social activities and threats the marine life in the area.

Traffic accidents can happen anywhere, and government should be ready to respond. For example in August 2013, the Selangor river water pollution accident happened due to a tanker lorry carrying diesel which skidded into the river and steadily leaks its load of a toxic chemical (pollutant) into the lake through a stream.

The incident forced the closure of four treatment plants. Astro Awani reporter's visit to the site showed that there is no more oil spillage detected but the drain is closed to avoid further residues. This closure has caused more than a million residents in Selangor and Kuala Lumpur to suffer from water shortage.

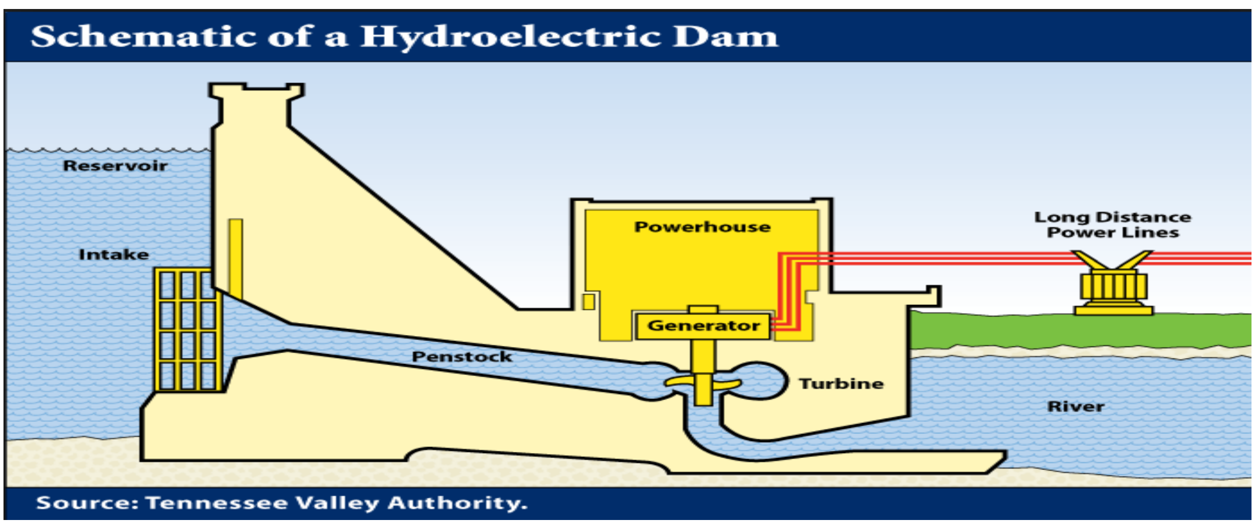
The pollution stayed in the lake for a period of time after a water pollution incident occurs in the lake. Then the pollutant migrates together with the water current through another stream. During the transportation process of the contaminants, several hydraulic, hydrological, physical and biological factors are affecting the contaminations. So, it is very important and useful to estimate the contaminant concentration and time taken for contaminant concentration to reach safety level. The lake contains a volume of 2000 m^3 of water. Water is flowing in one end of the lake through stream A of Selangor river at the rate of 6 m^3/min and out at the other end of the lake through stream B of Selangor river with the same rate. An environmental science researcher wishes to

1- predict the concentration of pollutant at any time after the accident occurs.
2- determine the maximum pollution level in the lake and time at which this maximum is reached.
3- calculate the time taken for the concentration to fall below the safe level (in this case 0.1%).

These information need to be presented to the Environment, Health & Safety Council in a week time. Based on information given by the environmental engineer, the leakage rate is 10 m^3 per 30 minutes.

Problem 3 : Hydro-Electric Power Generation

The energy potential of water is used for hydro-electric power generation. When this potential is available from more than one source, **how should these sources be used to optimize the system?**



This problem involves investigating different ways of using a system of 2 hydroelectric power stations namely Station A and Station B with several different water sources.

Station A is immediately downstream of a dam, which form a reservoir. Station B has no storage capacity. For a given demand, Station A attempts to meet it. Station B generates power dependent on the inflow, so does not service a specific demand. If the dam above Station A is full, and power is not required, excess water is spilled, bypassing Station A. If the flow through Station B is excess to power needs, excess flow is spilled. Data of water flows, as well as the capacities of the power stations are available in finding the operation procedure that could be used to fulfill the demand and maximizing the total power generated.

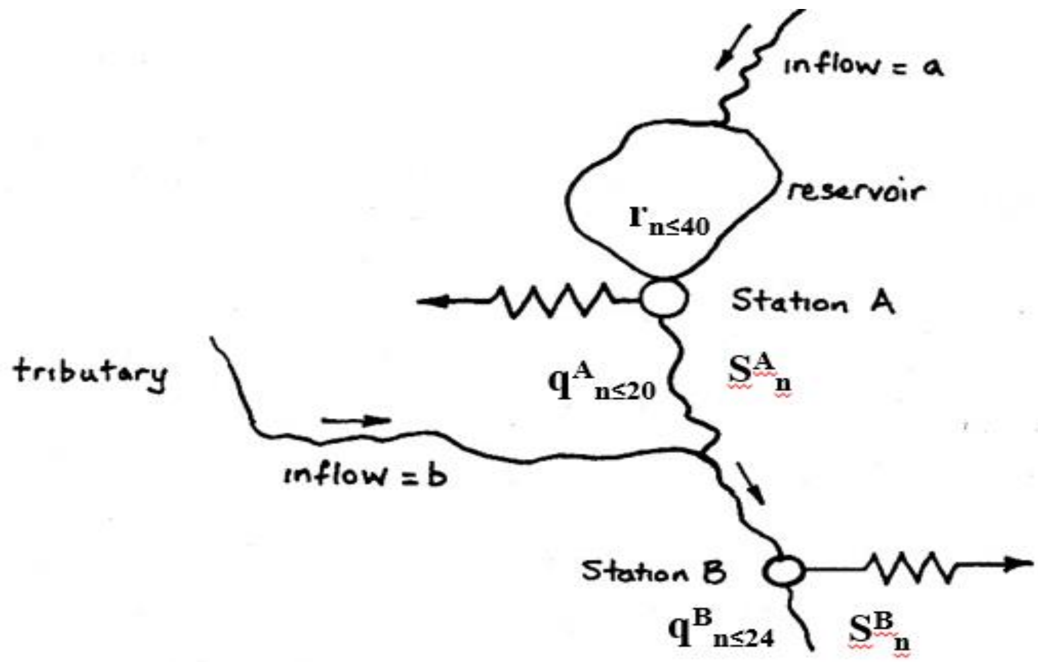
Sample input data:

1. At the beginning of period 1, reservoir contains 12×10^6 m^3 of water.
2. a_n is the river flow to reservoir at A during period n.
3. b_n is the tributary inflow during period n.
4. P_n is energy demand from Station A during period n.

Period (n)	$a_n(10^6 m^3)$	$b_n(10^6 m^3)$	$P_n(MWh)$
1	12	4	100
2	20	7	100
3	28	12	120
4	26	5	140
5	11	3	200

	Station A	**Station B**
Reservoir water capacity ($\times 10^6 m^3$)	40	-
Electricity generation capacity (MWh/$10^6 m^3$)	10	5
Water throughput ($\times 10^6 m^3$/period)	20	24

Model the system with the input data. Note that Station A attempts to supply the demand, with Station B contributing if and when possible. Decision variables are the spillage that determines generation, and the current reservoir capacity. Applicable laws would be the balance of water flows. The following schematic diagram shows the setup.



Prepare your report for Project Director of Sarawak Energy within one week time to assist them in the optimal operation of their reservoirs.