GEOG 272 Lab 8-Precipitation and Hydrology Response

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Section: A02

Theory:

1) **Precipitations,** especially amount and intensity, affects stream discharge.
   - A greater amount of rainfall generates a greater amount of surface runoff and stream discharge.
   - The frequency of low-pressure systems and fronts largely controls the amount of stream discharge.
2) **Soil Permeability,** or drainage, also controls stream discharge
   - The less permeable the soil, the lower its ability to drain water. This leads to a greater amount of surface runoff and stream discharge.
   - Paved Surface V.S. Grass Surface
3) **Vegetation Characteristics**
   - The lower the interception (less vegetation) by the vegetation, the greater the surface runoff and greater the stream discharge.
4) **Topographic Characteristics**
   - The steeper the slope gradient, the greater the surface runoff and the greater the stream discharge.
   - The longer the slope gradient, then the greater the surface runoff and the greater the stream discharge
5) **Land Use Characteristics**
   - The less permeable the surface, then the greater the surface runoff and the greater the stream discharge.

Data:

Climate Station	Discharge Station
Shawnigan Lake	Koksliah River at Cowichan Station (08HA003)
Campbell River A	Elk River above Campbell Lake (08HD018)

Discharge Station	Coordinates
Koksliah River at Cowichan Station (08HA003)	48° 43' 44" - 123° 40' 12"
Elk River above Campbell Lake (08HD018)	49° 51' 29" - 125° 48' 18"

Stream Gradients and Lengths:

Upper Elk River- Gradient 1:27; Length 41km

Koksilah River- Gradient 1:69; Length 30km

Soil Permeability

Upper Elk River- rapidly drained to moderately well drained

Koksilah River- rapidly drained to moderately well drained

Climate Data (Daily Total Precipitation)

Date	Shawnigan Lake (mm)	Campbell River A (mm)

Jan. 26th 1992	12.2mm	18.2mm
Jan. 27th 1992	36.4mm	37.7mm
Jan. 28th 1992	17.2mm	6.0mm
Jan. 29th 1992	43.6mm	43.6mm
Jan. 30th 1992	44.2mm	36.8mm
Jan. 31st 1992	5.6mm	61.6mm
Feb. 1st 1992	4.0mm	11.6mm
Feb. 2nd 1992	10.6mm	47.5mm
Feb. 3rd 1992	0.0mm	0.6mm
Feb. 4th 1992	0.0mm	3.4mm
Feb. 5th 1992	0.0mm	0.0mm
Feb. 6th 1992	0.0mm	0.0mm
Feb.7th 1992	0.0mm	0.9mm
Feb. 8th 1992	3.4mm	1.0mm
Total	177.2mm	268.9mm

Stream Discharge Data

Date	Koksliah River at Cowichan Station (m^3/s)	Elk River above Campbell Lake (m^3/s)
Jan. 26th 1992	30.3 m^3/s	24 m^3/s
Jan. 27th 1992	50.9 m^3/s	27.7 m^3/s
Jan. 28th 1992	104 m^3/s	29.1 m^3/s
Jan. 29th 1992	118 m^3/s	46.9 m^3/s
Jan. 30th 1992	153 m^3/s	88.8 m^3/s
Jan. 31st 1992	145 m^3/s	46.2 m^3/s
Feb. 1st 1992	70.3 m^3/s	38.5 m^3/s
Feb. 2nd 1992	39 m^3/s	29.3 m^3/s
Feb. 3rd 1992	44.5 m^3/s	82.7 m^3/s
Feb. 4th 1992	24.9 m^3/s	38.8 m^3/s
Feb. 5th 1992	19.3 m^3/s	23.5 m^3/s
Feb. 6th 1992	15.4 m^3/s	16.1 m^3/s
Feb.7th 1992	11.3 m^3/s	14.9 m^3/s
Feb. 8th 1992	10.4 m^3/s	12.4 m^3/s
Total	836.3 m^3/s	518.9 m^3/s

Calculation:

Koksliah River at Cowichan Station (Shawnigan Lake) (08HA003)

30.3 m^3/s +50.9 m^3/s +104 m^3/s +118 m^3/s +153 m^3/s +145 m^3/s +70.3 m^3/s +39 m^3/s +44.5 m^3/s +24.9 m^3/s +19.3 m^3/s +15.4 m^3/s +11.3 m^3/s +10.4 m^3/s = (836.3 m^3/s)/14= 59.74 m^3/s

Average Daily Stream Discharge: 59.74 m^3/s

Elk River above Campbell Lake (Campbell River) (08HD018)

24 m^3/s +27.7 m^3/s +29.1 m^3/s +46.9 m^3/s +88.8 m^3/s +46.2 m^3/s +38.5 m^3/s +29.3 m^3/s +82.7 m^3/s +38.8 m^3/s +23.5 m^3/s +16.1 m^3/s +14.9 m^3/s +12.4 m^3/s= (518.9 m^3/s)/14= 37.06 m^3/s

Average Daily Stream Discharge: 37.06 m^3/s

Drainage Basin Observation:

Koksliah River at Cowichan Station (Shawnigan Lake): The Cowichan Valley is strongly associated with the Koksilah River. The basin of this river is heavily influenced by human activity. The downstream of the river is surrounded by clear-cut lands, construction sites, farms, and residential area. There are signs of roads, houses, land clearing, and logging along the whole river. The upstream of the river is heavily

damaged by logging and clear-cut activities. There are many huge patches of empty land around the upper stream. The vegetation density at the downstream is very low, there are little amount of trees and trees are mostly cut down to make lands for roads, farms and houses. The vegetation on farms and houses are not a good absorber of water. At the upstream of the river, although there are huge grounds of forest, most of it is being logged down. Leaving behind empty desert land.

Elk River above Campbell Lake (Campbell River): The Elk River is located at a spot that does not have much disturbance from human activity. The basin is spread through the mountain valleys. There are no signs of clear cutting or logging around the upstream of the Elk River. There is a dense amount of vegetation all around the river. However, at the downstream of the river there are signs of logging activities.

Case Study and Data Analysis:

1) The total precipitation at the Shawnigan Lake site is 177.2mm during the period from January 26th to February 8th 1992. The Campbell River site received a total precipitation of 268.9mm from the period of January 26th to February 8th 1992. Shawnigan Lake site is located at a flat land that is surrounded by mountains and higher grounds; clouds are forced to drop most of its precipitation before it reaches this area. On the other hand, the Campbell River site is located in mountain valley. This means clouds are forced upwards and as it rise, it cools and release its precipitation.

2) Koksliah River at Cowichan Station (Shawnigan Lake): There is lag time occurring between the date January 27th and 28th. On the 27th there is a large amount of precipitation being dropped at this station, but the discharge rate didn't increase till the following date on the 28th. Another lag time also occurred on the 29th; heavy rainfall occurred that day but the discharge rate did not increase till the 30th. There is a steady rising limb from the period of 28th to the 30th build up by the heavy rainfall on the 27th, 29th and 30th. There is a peak discharge occurred on the 30th and followed by the falling limb from the 31st to the 2nd. Another small peak discharge occurred on the 3rd caused by the precipitation from the 2nd.

Elk River above Campbell Lake (Campbell River): A lag time occurred between the time of Jan 27th and 28th. Heavy precipitation was dropped on the 27th, but the discharge rate did not increase till the 28th. There is a rising limb occurring from the date of 28th to 30th and leading up to the peak discharge on the 30th. Soon followed by the falling limb on the 31st to the 2nd. The large amount of rainfall on the 31st did not cause an increase on the discharge rate; this might be caused by the absorption from heavy vegetation. There is another rising limb from the 2nd caused by the heavy rainfall 31st and the 2nd. This leads to the peak discharge that occurred on the 3rd. A falling limb from the period of 4th to 8th soon occurred after the peak discharge.

Conclusion: Most of the cases show on the hydrographs tell there will be a lag time occurring first, followed by the rising limb, leading to the peak discharge and ends with a period of falling limb.

3) a. Total Rainfall: The total rainfall for the Shawnigan Lake site is 177.2mm during the period from January 26th to February 8th 1992. The Campbell River site received a total rainfall of 268.9mm at the same period of time. The Campbell River site is receiving more total rainfall than the Shawnigan Lake site. Therefore, based on the theory, the Campbell River site will have a greater average daily stream discharge.

b. Soil Drainage: The Koksilah River is strongly interference by human activities. There are signs of clear cutting, logging, roads, and constructions spread out along the Koksilah River. On the other hand, The Elk River has not much disturbance done by human and the environment is at its natural state. All these disturbance caused by human at Koksilah River made the soil less permeable and lower it ability to drain water leading to a greater stream discharge. Based on the theory, Koksilah River would have a greater average daily stream discharge.

c. Vegetation Characteristics: The Google map shows that there is lack of vegetation around the Koksilah River that is done by human activities. The vegetation on land is cleared for human activities such as construction and farming grounds. The Elk River is

flourished with vegetation and not much disturbance done by human. Based on the theory, the Koksilah River would have a greater surface runoff and stream discharge.

d. Stream Gradient: The stream gradient for the Koksilah River is 1:68. The Elk River has a stream gradient of 1:27. The gradient of 1:27 is steeper than the gradient of 1:68. Therefore, the Elk River is steeper than the Koksilah River. Based on the theory, the Elk River will have a greater average daily stream discharge.

e. Stream Length: The Koksilah River has a stream length of 30km. The stream length for Elk River is 41km. The Elk River has a longer stream length and based on the theory, the Elk River site has a greater average daily stream discharge.

Summary:

The Koksilah River has an average daily stream discharge of 59.74 m^3/s. The average daily stream discharge for the Elk River is 37.06 m^3/s. Based on the collected average daily stream discharge; the Koksilah River has a higher average daily stream discharge. However, based on few of the controls and the theory it gives a different conclusion. From the control of total precipitation, the Elk River is receiving much more total rainfall than the Koksilah River. Higher amount of rainfall generates a great amount of surface runoff and stream discharge; this means Elk River should have a higher amount of average daily stream discharge.

However, the following two controls explain why Koksilah River has a higher average daily stream discharge. The drainage basin around Koksilah River is strongly influenced by human activities. The roads, buildings, loggings and other activities made the ground less permeable and lower its ability to drain water. This leads to a greater amount of surface runoff and stream discharge; therefore, the Koksilah River has a greater average daily stream discharge.

Looking at the Google Map satellite image shows that there is a lack of vegetation around the Koksilah River. The Koksilah's drainage basin's vegetation is cleared for human activities such as logging, construction and farming. The lower the interception by the vegetation at Koksilah River, the greater the surface runoff, this means the Koksilah River has a higher average daily stream discharge. The stream gradient control and stream length control tells that the Elk River has a higher average daily stream discharge.

The Elk River has a steeper slope gradient; this means it has a greater surface runoff and a greater average daily stream discharge. The Elk River also has a longer slope gradient, which leads to a greater surface runoff and greater average daily stream discharge.

In conclusion, based on the controls and theory Elk River should have a higher average daily stream discharge, but the reality Koksilah River has a higher average daily stream discharge. This is because human activities can strongly influence the lands of the drainage basin, making the soil less permeable and lower its ability to drain water and also, the less amount of vegetation means it has a lower interception and leading to a greater average daily stream discharge.