Requirements : pandas and shapefile

Video : https://youtu.be/evn53nk6Gt8

Scheduling the Irrigation Canal

- Distribution of water in the canal network is one of the prominent task
- Hear we will find the solution for the distribution of water in a canal network which will increases the efficiency of water usage.

Why we are doing ?

- Water is one of the most important inputs for agricultural production, but due to the wide variation in availability, it is not always possible to apply it to the crop when it is essentially required

- Sometimes, in spite of sufficient water availability in the reservoir, water is not released, distributed and allocated timely, and equitably among the farmers due to many technical constraints.

- This leads to gap between water supply and water requirement in the canal command, resulting in low water use efficiency either due to wastage or inadequacy, both conditions affect the crop yield and its water use efficiency

- So we need a proper plan for the distribution of water in a canal network i.e. Scheduling.

What we are doing ?

- Based on the available water at the reservoir, we will schedule the canal in two seniors.

- Senior 1 : when the water available at reservoir is more then the requirements and canal losses

$$V_{reservoir} > (V_{requirement} + V_{losses})$$

- Senior 2 : when the water available at reservoir is less then the requirements and canal losses

$$V_{reservoir} < (V_{requirement} + V_{losses})$$

- In Scenario 1 we will supply the total amount of required water to all outlets including canal losses

- In Scenario 2 , Based on available water at reservoir we will supply only some percentage of required water to all outlets including canal losses

What we are doing ?

- For better understanding, let's see an real life example, whare we would like to provide the apples to the three hungry people, 1st person need 4 apples, 2nd person need 6 apples and 3rd person need 2 apples to reduce there hunger, total we need 12 apples to make them full.

- If we have more then 12 apples, then we will give 4,6 and 2 apples to the 1st, 2nd and 3rd person, so every person get the total requirement like Scenario 1 of canal scheduling.

- If we have less then 12 apples, for example we have only 5 apples, then we give 2,3 and 1 apples to the 1st, 2nd and 3rd person so that every person get the 50 percentage of requirement, like Scenario 2 of canal scheduling.

What we required for Canal scheduling?

- canal losses and volume of water required at outlets

Canal losses :

- While the water is travelling from reservoir to outlet, it is lost from the canals through seepage over the sides and bottom of the canals and by evaporation from the top of the canals

- The loss due to evaporation is generally a small percentage of the total loss in canal. It hardly exceeds 1 to 2 percent of the total water entering into the canal, and you can chose the percentage based on your canal

- The loss due to seepage is the one which is most significant in a canal, Seepage losses are obtainable either by direct field method or by some empirical formulas and this will depends on canal properties like length, width, lining material, bed slope etc…..

Volume of water required at outlets :

- Volume of water required at outlets can be measured based on the command area of the outlet and field irrigation requirement

$$Volume = Outlet\ commend\ area\ x\ Field\ irrigation\ requirement$$

- Field irrigation requirement depends on the crop type and crop stage in the command area

- For example an outlet is having 4 differ crops cultivated in different amount area as shown below

Crop	Area(ha)	FIR(mm)
Paddy	2000	5
Sugar cane	1800	8
Cotton	2300	4
Chillies	600	7

- Volume of water required for paddy (m^3) = 2000 x 10^4 x 5 x 10^{-3}
- Volume of water required for sugar cane (m^3) = 1800 x 10^4 x 8 x 10^{-3}
- Volume of water required for cotton (m^3) = 2300 x 10^4 x 4 x 10^{-3}
- Volume of water required for chillies (m^3) = 600 x 10^4 x 7 x 10^{-3}

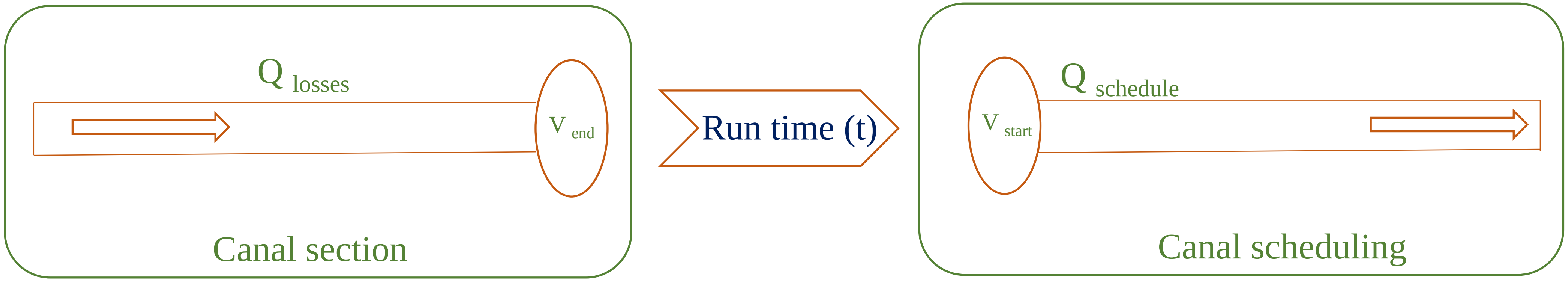
Total volume of water required at outlet = 37800 m^3

- In case if you don’t have any information about crop type and crop area in the command area then just multiply the outlet command area with an average FIR

Canal scheduling

- Scheduling means deciding the discharges of the canal section
- Discharge of canal section is obtained from volume of water it is carrying and it's run time
- Hear we will run every canal section for same period of time, because most of the canals have manually controlled gates, so it was difficult to operate gates for different period of times.
- Different canal section carry different volumes of water with various discharge capacity for a same period of time, so getting canal run time will help us in getting remain two variables.

Run time (t) $\xrightarrow{V_{carrying} = V_{end} + (Q_{losses}\ x\ t)}$ Volume of water carrying $V_{carrying}$ $\xrightarrow{Q_{schedule} = \frac{V_{carrying}}{t}}$ Discharge ($Q_{schedule}$)



Finding Canal run time

- If the volume of water available at reservoir is not known, then we assume that volume at reservoir is more then the requirement, then we will run the canal in scenario 1 and canal run time is calculated as shown

$$V_{reservoir} = V_{requirement} + V_{losses}$$

$$(Q_{main} \, x \, time) = V_{requirement} + \Sigma \, (Q_{losses} \, x \, time)$$

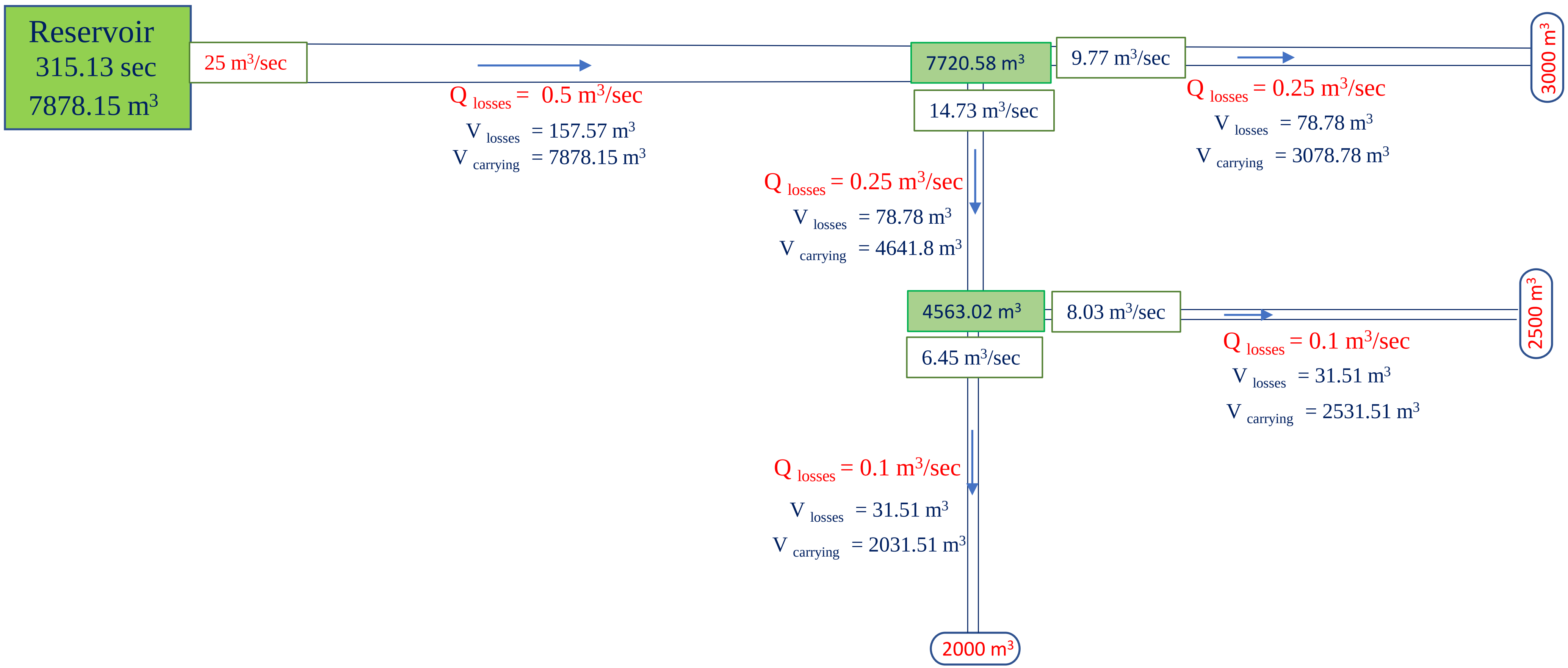
$$time = \frac{V_{requirement}}{Q_{main} - \Sigma \, (Q_{losses})}$$

- If the volume of water available at reservoir is known, then we will run the canal in scenario 2 and canal run time is calculated directly from reservoir volume

$$time = \frac{V_{resarvior}}{Q_{main}}$$

- And this time is compared with the maximum canal run time to satisfy the outlet requirement(from scenario 1) and by comparing both times, we can reduce the outlet volumes in scenario 2

For an example, we have a canal with 5 sections and 3 outlets as shown



$$time = \frac{V_{requirement}}{Q_{main} - \Sigma\,(Q_{losses})}$$

$$V_{losses} = Q_{losses}\ x\ time$$

$$V_{carrying} = V_{end} + V_{losses}$$

$$Q_{schdulied} = \frac{V_{carrying}}{time}$$

Canal run time → Canal losses → Carrying volume → Scheduled Discharge

- Finally we get know the 2 scenarios of scheduling for small canals having less number of sections and outlets
- But, in practically irrigation canal has more number of canal sections and outlets, where scheduling becomes complicated
- For this problem, we developed two python codes for scheduling, where it will useful for any number of section with immediate outputs.

  - main.py
  - pre_main.py

About main.py

- It will take the canal losses and volume of water required at outlets as the input and gives the volumes and discharge of the each canal section along with canal run time
- It also required previous and post junctions of the every canal section, so that it will get to know the flow pattern to outlets from reservoir

About pre_main.py

- It will gives the requirements of main code, where it will take canal shape file with the attributes that helps in finding canal losses along with main canal id and it will gives a junction shape file, canal losses, previous and post junctions.
- Junction shapefile is useful in viewing the water distribution in the canal network