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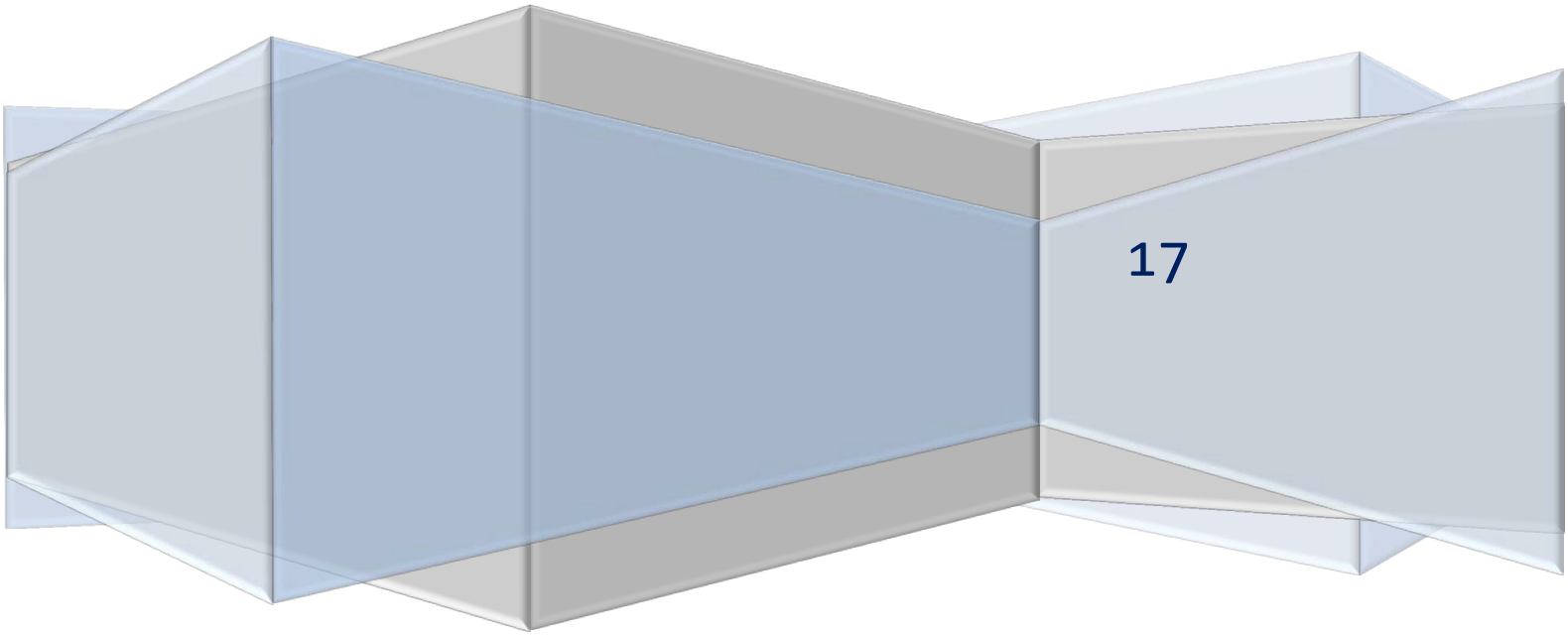
HEC-RAS ANALAYSIS

River: L'Aïre

Mesfin Tewolde



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PREPARED BY

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HEC-RAS ANALYSIS

[January- March 2014]

River: L'Aïre

Country: Switzerland

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Location: Geneva, Switzerland

River Reach: L'Aïre

Period of Analysis: January- March 2014

Enterprise: Secteur dynamique de l'eau et métrologie (SECOE), Geneva

Flooding can happen whenever flowing water surpasses its bank full stage and eventually inundate the surrounding adjacent areas. These may perhaps take place during the course of intense rainfalls and when a significant amount of snow melts. In conjunction with inundation, the increase of flow velocity may possibly erode and cause damage to fragile riverbanks resulting into more devastating damages. For this reason, it is best to consider proper protection measures along the vulnerable banks before the arrival of extreme flows.

Along the river Aïre many stabilization measures exist. For instance, one can see biological or organic protection as a measure to protect further degradation of banks. Moreover, certain gabion protections exist. Nevertheless, there are still spots where bank stabilization is needed. As it is pointed out in Figure 5 and 6, river-bank curvatures are prone to erosion and require protection. Construction of levees, temporary or provisional flood storage basins, and sometimes elevating the village above the flood line are some of the precautions that need to be implemented to alleviate future potential mishaps.

To demonstrate the impact of various time period discharges such as *10 years of recurrence time period (Q10)*, *30 years of recurrence time period (Q30)*, *100 years of recurrence time period (Q100)* and *300 years of recurrence time period (Q300)* HEC-RAS model can be employed. In this analysis, the discharges for four recurrence time periods assessed and the findings of the analysis and the proposition of the result stated in the following paragraphs.

1.1 THE RIVER AÏRE

The river Aïre originates at the outskirts of the villages of Presilly, Beaumont, and Feigéres in France. The diverse branches of the watercourse confluence at the small town referred as St Julien en Genevois then simply carries on flowing in the direction of Geneva city, traversing along the parts of the city that includes Confignon, Lancy. Eventually, the river unites with another river known as L'Arve right underneath the Saint-Georges Bridge. The origins and the course of the river are shown below in figures 1, 2, and 3.

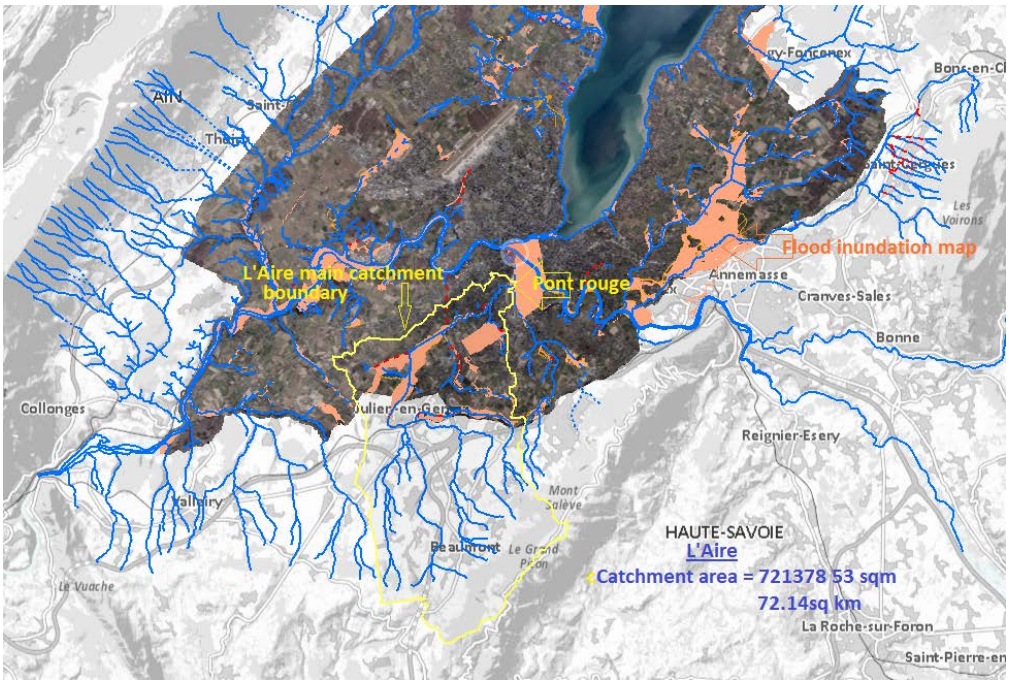

Figure 1 Catchment and watercourse of L'Aïre

Figure 2 The river reach (5.36km)

Figure 3 Newly constructed diversion structure and tunnel

Figures 4, 5, and 6 demonstrate the representation of banks along the given reach.


Figure 4 Vegetation covers around 2.8 km of the Pont-Rouge,
(Photo was taken on 4.03.2014)

Figure 5 Eroded bank at around 4km upstream of the D/S end
(Photo was taken on 4.03.2014)

Figure 6 Unstable bank at around 4km of the D/S end
(Photo was taken on 4.03.2014)

1.2 GIVEN DATA

To run the HEC-RAS model, cross-sectional and hydrological data were provided. However, there was no description about the origin of the data. No information was given whether the data was a recollect of surveying data or ArcGIS extraction or any other software product. Certain cross-sections were modified. Therefore, corrections as needed were made in order to run the model. The overall length of the reach considered in this analysis was 5363.91 ms. On average there was a 23.5ms distance in between the cross-sections, there exist five bridges along the reach as well. The central waterway had cobbles and roughly 70% of the right and the left bank had vegetation covers as shown in Figures 7 and 8. Consequently, the roughness coefficient assumed to be 0.05 and 0.1 for the beds and for the banks respectively. Besides, there were lateral concrete structures and tributaries along the

stream.The flow fluctuates along the river and supplementary lateral flows pointed out at around 1690m of the downstream of the river. Flows for the given recurrence time periods are presented in Table 1.

Table 1 Flow measured for four return periods

Q (m^3/s)	Ouvrage détournement	Autoroute	Pont des Marais	Pont Rouge
Q10	**avant 3ème étape**	**63**	**18**	**28**
	après 3ème étape	63	33	42
Q30	**avant 3ème étape**	**80**	**35**	**45**
	après 3ème étape	77	36	45
Q100	**avant 3ème étape**	**102**	**57**	**67**
	après 3ème étape	84	39	48
Q300	**avant 3ème étape**	**120**	**75**	**85**
	après 3ème étape	98	46	56

Figures 7 and 8 indicate representation of the riverbed, the right and the left banks of the river.

Figure 7 Cobbles along the main river bed

Figure 8 Vegetation covers along the river (represent 60-70%)

Running the model using the data given above shown step by step in this video link

1.3 THE RESULT

The Following Figures 9, 10, 11 show the result of the analysis.

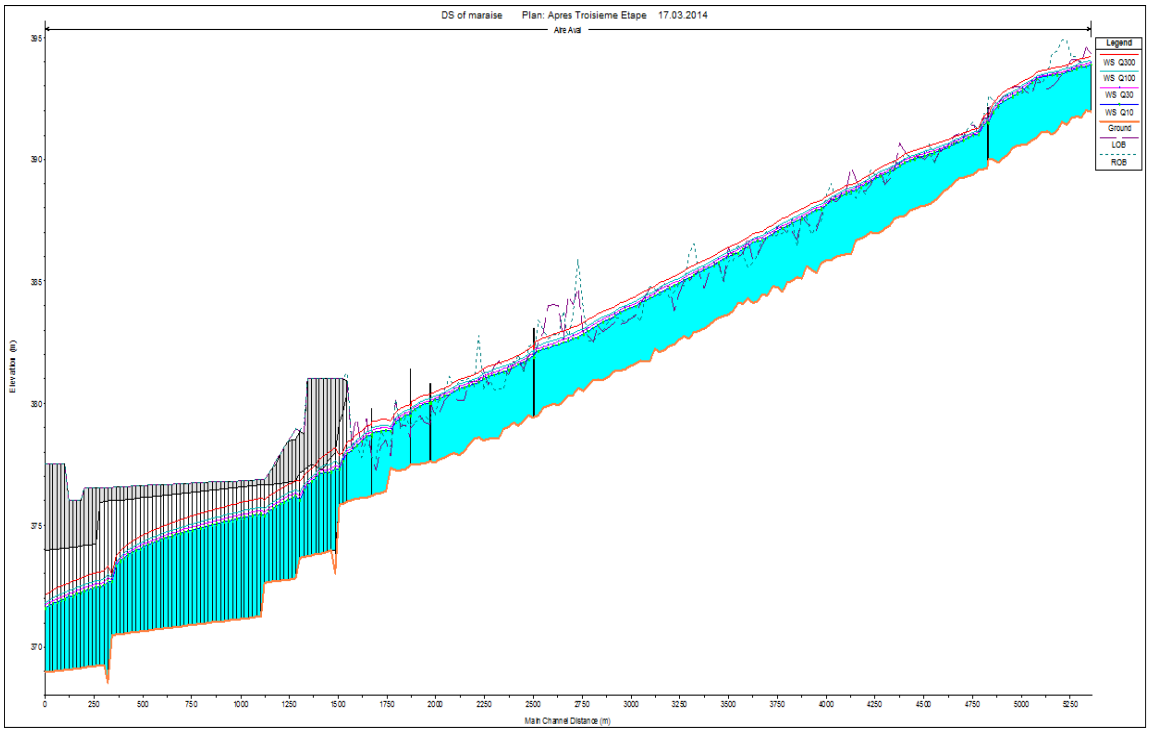

Figure 9 Longitudinal profile of the river for each return period

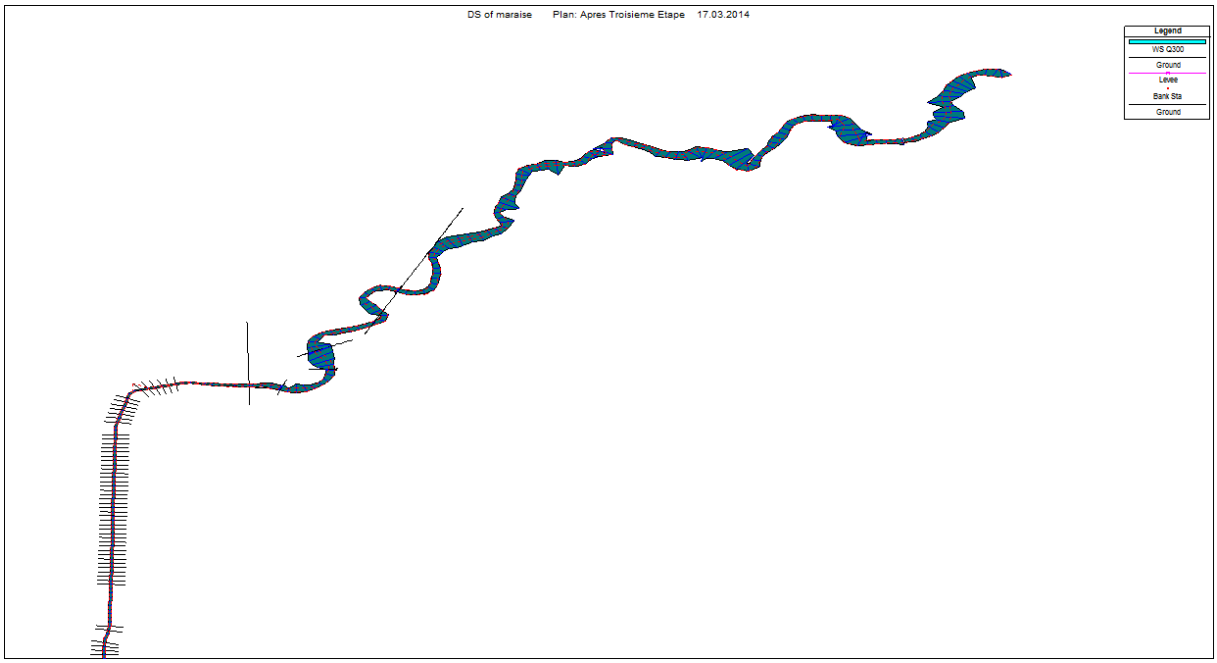

Figure 10 Plan view

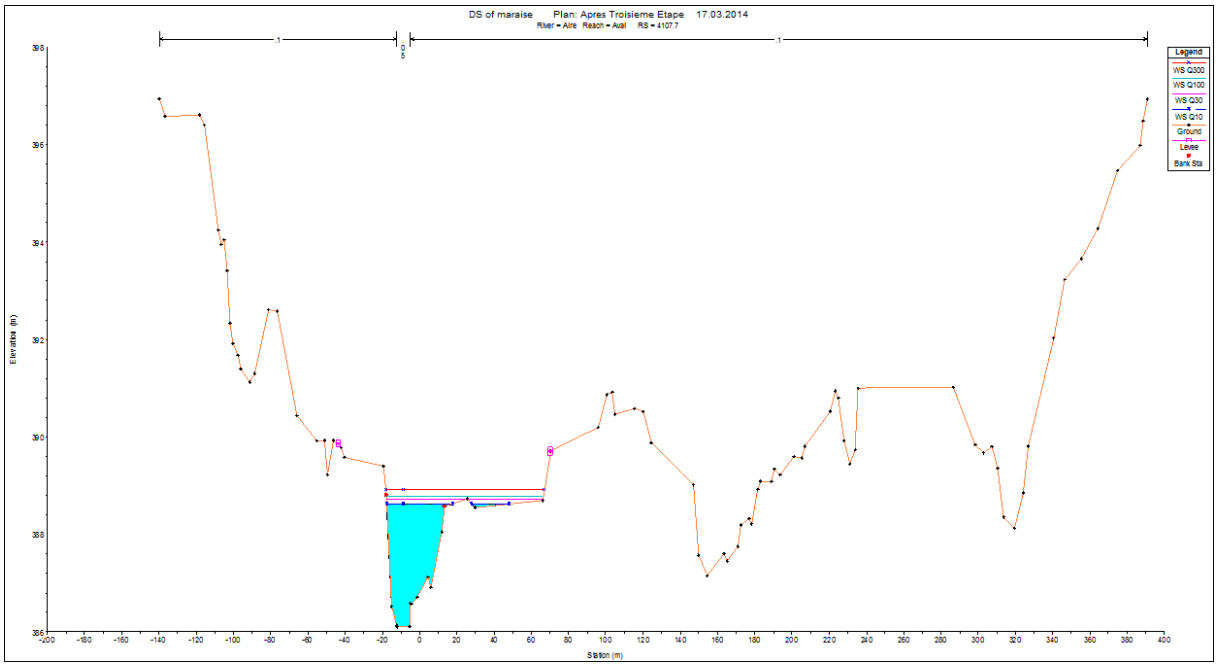

Figure 11 Cross-section at station 4107.7m

1.4 RESULT ANALYSIS

The provided flow data for 100 years of return period at **Pont des Marais** and at **Pont Rouge** equals 39 Cumec and 48 Cumec respectively. The HEC-RAS simulated velocities along the river are in the range of 0.63 – 3.95 m/s. In this regard, it is important to check out particularly the higher velocities mainly because the rise in velocity along the channel may easily erode the banks. 3m/s velocity has the ability to erode natural ground and can carry even bigger objects along its path. For instance, throughout the regular flow periods, the velocity at **Pont du Centenaire** is about 0.25m/s for a discharge of 0.745Cumecs. This velocity is much less than the scouring velocity. Nevertheless, 39 Cumec discharge is capable of generating somewhat higher flow velocity in the channel causing erosion along the

banks. As a result of higher flows such as Q100 and Q300, overflowing and inundation may occur. Therefore, precautionary measures are necessary to have certain kind of protection from potential future damages.

As the highest possible discharge that can be taken care of at the Pont Rouge (tunnel entrance) is 60 Cumec, lowering the discharge below 60 Cumec is essential. The new construction work of the diversion structure reduced effectively the amount of discharge at the Pont Rouge. The result of this HEC-RAS analysis has also demonstrated the same.

1.5 PROPOSITIONS

Once the banks are eroded the water gets an easy way to spread out over the banks inundating the village and the surrounding vicinity, particularly the left and right side of the bank where there exist adjacent dwelling premises. Subsequently, precautionary measures such as gabion wall or concrete retaining wall assist to offer protection to the banks throughout the flooding periods. Moreover, inundation of the village can also be eliminated by setting up temporary detention basins at the upstream side of the river. Temporary detention dam contributes greatly to reduce the possible hazard of future harm to the downstream villagers.

The following video link shows how to prepare HEC-RAS data using ArcGIS. Flood mapping analysis using HEC-RAS also shown in this video link, Video link of the reach considered for this analysis

Other useful videos can also be accessed at this link

1.6 POINTS TO HIGHLIGHT

Location: Geneva
Reach length: 5.36km
The principal Catchment area of L'Aïre: 72. Sq km