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ANALYSIS OF A ANTROPIC INFLUENCES IN A FLOODPLAN

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ABSTRACT: Floodplain are lateral areas that receives the excess of rivers during floods and were, originally occupied by vegetation or dunes. In the urban environs, those areas were replaced by buildings and other impervious structures, converting natural events in source of losses and public calamity

This paper presents a case study where changes in the river behavior in terms of water level, caused by antropic influence as civil works, dredging and urban occupation are correlated. The study area is located on the left bank of Turvo River, São Luís do Paraitinga / SP - Brazil and the interventions that affected the river behavior were generated by the use the floodlain areas to store civil works disposals in the city rebuilding process, after the rainfall events that caused critical flooding in January 2010 and devastated the city.

Analyzing resulting water profiles computed through an hydrodynamic model, it was possible to verify the influence of the disposal areas in river runoff and establish the maximum area that could be used for that activities to avoid damages. This way, this study concludes with and remarks the need for preservation of floodplains or valley bottom of urban water bodies.

Key Words: Floodplain, Water Bodies, Antropic Influence,Hydrodynamic Model

1. INTRODUCTION

The problem of floodplain areas uses is due to the fact of the space allocation. In urban area where there are already an established urbanization it is historically known that this organization took place around the main bodies of water, considering that next to these floodplain areas it was flat for which the villages were expanding. With population growth and occupation stabilization, it occurs the increasing of population density and urban area expansion. These factors with the new territorial development and the use of floodplain arise consequences to water resources planning system. Thus it became very important to experts in the field of urban drainage and water resources, and everybody who is working with issues related to the use and occupation of land and its relationship to areas of flood risk, be alert to any human action that may interfere the flow condition of water bodies.

In this article an analysis of anthropogenic interference is in the larger bed of the Turvo River where posting send-outs are on its left bank. This analysis was motivated by the desire of the population of São Luís do Paraitinga, afraid with a possible change in the flow of rivers in the region, due to the disaster in the city in January 2010 caused by the passage of a historic flood, causing severe damage forcing the municipality to enact "State of Public Calamity." Damage caused by heavy rain in the floodplain of the river can be seen in Figure 1.

Figure 1 – São Luís do Paraitinga after rain in January of 2010. Source: Terra

For this analysis the results of the "Estudo da Intervenção de Bota-fora na Elevação do Nível D'água na Várzea do Rio Turvo" made in September 2010 by the Fundação Centro Tecnológico de Hidráulica . The send-outs analyzed were posted on the left bank of the Turvo river, to attend the demand for housing construction during the reconstruction of the city of São Luís do Paraitinga after the flood occurred in January 2010. Through this reconstruction it was cut sections of land generating send-out material.

1.1 Study area

The study area corresponds to the extension of Turvo river basin located in the Paraíba do Sul river, in the countryside of São Luís do Paraitinga. The stretch of canal considered is an extension of 4,780 m and is located in geographic coordinates system between latitude south 23.19 ° -23.21 ° and longitude north 45.35 ° -45.31 ° W, and is shown in Figure 2.

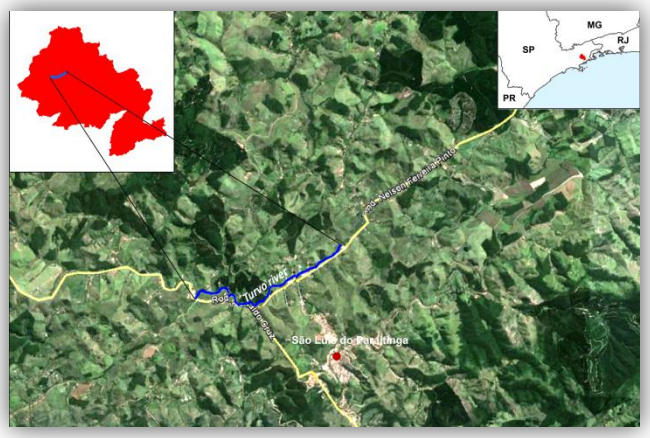

Figure 2 – Study area

The basin of the Paraíba do Sul River is located in the southeastern region of the states of São Paulo, Minas Gerais and Rio de Janeiro, it has a drainage area of approximately 55,500 km^2. The Turvo river is a tributary of the River Paraitinga, born in the northern zone of the countryside of São Luís do Paraitinga and flows in the southwestern part.

2. MATERIALS AND METHOD

To check the influence of "send-outs" in the water level of the Turvo river in "Estudo da Intervenção de Bota-fora na Elevação do Nível D'água na Várzea do Rio Turvo" flow for the period of 100 years return and its variation of 50 m³ / s to more and to less was adopted. The flow rate of 170 m^3/s, is related to TR 100 years obtained from hydrological simulation conducted by the Departamento de Águas e Energia Elétrica - DAEE. The figure below shows the hydrograph for the TR 100.

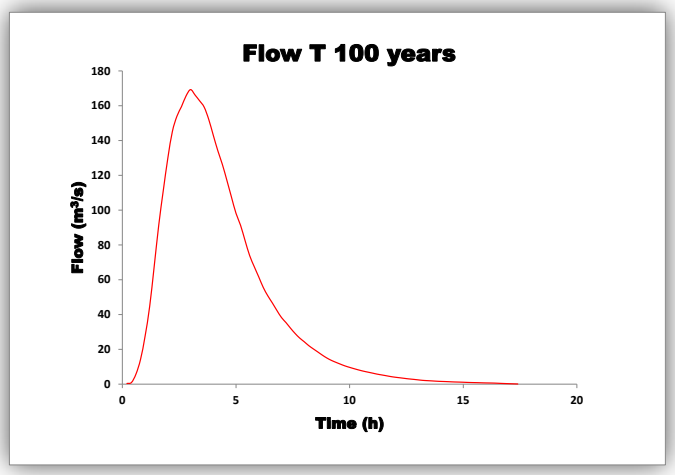

Figure 3 – Hydrograph T 100 years (Source: DAEE)

The value of the Manning roughness coefficient is n = 0.04, according to the characteristics of the river and according to Porto, 2004. Scheme of calculation used was the permanent and the type of boundary condition used was the downstream rating curve (quota-flow curve) of section 1, control of the water level is conducted by the riverbed. The upstream boundary condition was placed on the section 238 + 19 and are inserted into pre-established hydrograph.

The topographic data used were the following:

• Topobatimetric Survey:

- Stroke the Turvo river shaft;
- The cross sections of the Turvo river;

• Level contours obtained the document from IGC (Instituto Geográfico e Cartográfico).

With these data the cross sections were obtained in pairs of points and topographic basis for generation of Digital Terrain Model (DTM).

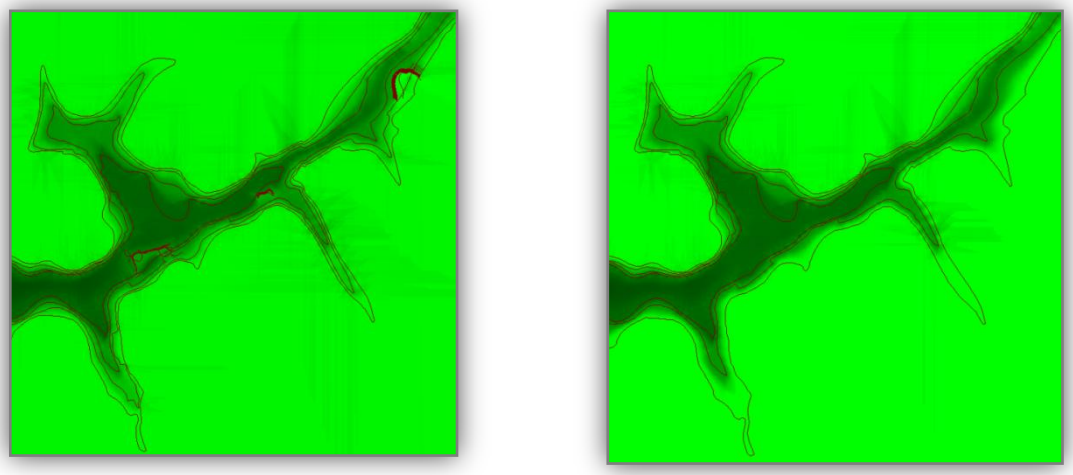

Figure 4 – Digital Terrain Model – with and without send-out

Those data were inserted in Cliv software, which is a mathematical model for the simulation of one-dimensional hydrodynamic flow in channels. This model has a graphical user interface for data entry and viewing results. Its features include the calculation of permanent and transient flow regimes in channels, listing the waterline and visualization of inundation map layers. It also allows the use of standard image files or DXF files for input topographic data and export of flood lines, providing full compatibility with CAD and GIS systems (FCTH, 2002).

As a result of hydrodynamic simulations this products are obtained:

- Water level in each of the selected sections;
- Velocity of flow in each section;
- Inundation map layers.

The topobatimetric survey provided by DAEE was made in April 2010. This survey has analysed longitudinal profile of the river and 156 cross sections related to staking of 20 to 20. Of the 156 cross sections 79 sections were selected. This selection considered the sections that show changes in the pipeline, sections that had similar characteristics were not considered. Table 1 shows the sections selected and included in the model.

Table 1 – Sections selected

Selected sections							
1	41	73	109	143	179	201	223
3	43	75	113	149	182	203	225
7	45	81	115	155	184	205	228
11	51	85	117	157	186	208	231
15	55	89	119	161	188	210	233
19	59	91	123	165	190	212	236
23	63	95	127	169	193	213	237
27	67	99	131	172	195	217	238
35	69	101	133	173	197	219	238+19
38	71	105	137	176	198	221	

3. RESULTS AND ANALYSIS

The results shows the waterline of the Turvo river in the stretch profiles studied, with and without the send-outs to the flow of 120 m³ / s, 170 m³ / s and 220 m³ / s, as shown in Figure 5 below.

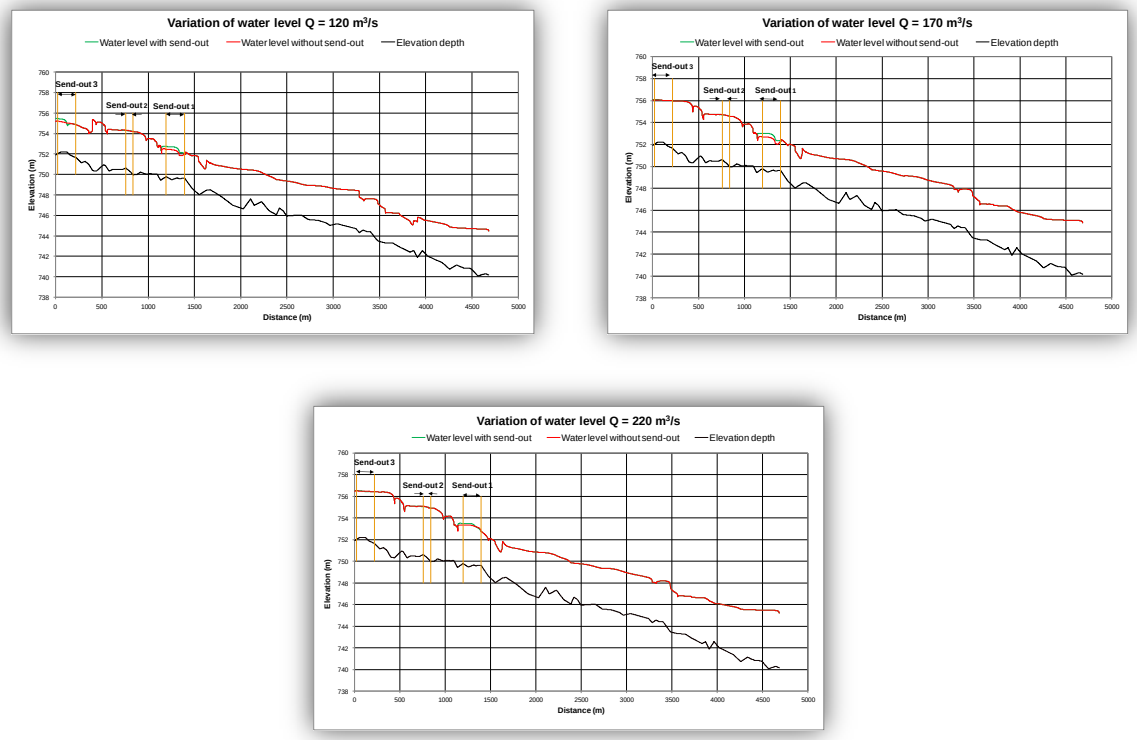

Figure 5 - Change of water level for flow of 120, 170 e 220 m3/s, in analyze stretch.

It was found that there is a difference between the profiles of the water lines before and after the release of send-outs, which occurs mainly in the first 1500 meters of the river where human action with the disposal of land in the floodplain of Turvo river occurred. The biggest differences between water levels were 31 centimeters to the flow of 120 m³/s in sections 173 and 179; 35 centimeters for the flow of 170 m³/s in sections 173 and 179; and 17 centimeters for the flow rate 220 m³/s in section 179. Table 2 shows the results for the flow rate of 170 m³/s for which the largest differences occurred.

Table 2 - Water level of sections selected for the flow of 170 m3/s, in stretch with send-out.

Send-out	section	Water level (m)		Variation of water level (m)
		with send-out	without send-out	
1	172	752,38	752,10	0,28
	173	752,83	752,49	0,35
	176	753,00	752,67	0,33
	179	753,02	752,67	0,35
2	198	754,64	754,60	0,03
	201	754,70	754,73	-0,03
3	231	756,01	756,01	0,00
	233	755,99	756,02	-0,03
	236	756,09	756,06	0,03
	237	756,08	756,06	0,02
	238	756,12	756,08	0,05

The Figure 6 shows the send-out localization and its sections.

Figure 6 – Location of send-outs and sections.

It is important to show that in some sections the velocity is above 1.5 m/s, which is the maximum velocity recommended by DAEE to ground channels. This send-outs were launched and maintained without protection, where ground are show without any protection erosion, some are critical velocities observed. Figure 7 below shows a picture of the Google Street View of September 2011 where erosion can be observed in the send-out 1.

Figure 7: Erosion in send-out 1

4. CONCLUSION

After analyzing the results, it can be seen that the change in water levels in the presence of send-outs was not significant, with a variation in water level with and without the send-outs, which was average of 11 centimeters.

The "Estudo da Intervenção de Bota-fora na Elevação do Nível D'água na Várzea do Rio Turvo" concluded that, with respect to the variation of water level, the anthropogenic activities in the floodplain of the Turvo river references release three send-outs does not change significantly the natural flow of the river in the stretch and flow rates studied.

It is shown that in sections 173 and 179 there was an increase in water level in 35 centimeters to the flow of 170 m^3/s caused by send-outs. This change in water level can become significant if analyzed from the perspective of classification of risk zones according to depth, where from 50 centimeters deep already considered area risk of self defense zone. The Risk and Vulnerability Zone presented studies are the action to be taken in the self defense zone consists of direct warning to the population so that it is responsible for the evacuation of the site itself (Radesca et al., 2013).

The study analyzed is of importance for their contribution to demonstrate that there are always environmental impacts when the environment is changed by human action. Concluded that the release of send-out on the left bank does not alter significantly the natural flow of the river in the stretch and flow rates studied, but always when there is a human action on natural riverbeds (main channel and larger bed/floodplain) studies for the evaluation of impacts must be taken. Care should be taken to preserve the floodplain area because it serves as a preventive measure for non-occupation of the area that is occupied by the floodplain when rain occurs with a recurrence period 100 years and studied.

5. REFERENCES

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