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Factors Affecting the Discharge Capacity of Shahi Katta Drain, Peshawar City Pakistan

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ABSTRACT:
The research aim to study the hydrologic and hydraulic conditions of Shahi Katta, a case study for major drains in the Peshawar City. It is a major drain with a length of 4.1 Mile or 6.56 Km approximately. The growth pattern observed along the drain is complex and so the exact study of Shahi Katta becomes much more complicated. This study was performed for a section of Shahi Katta with using uniform flow technique for calculation of Peak Discharges in different months of the year for 30 years of data. A section for the study was selected which was flooded in the 2010 major storm event. It was found from analysis that even after hundreds of years, Shahi Katha still has the capacity to carry the present discharge including both sanitary and storm water, however, the presence utility lines, encroachment and solid dumps inside the drains offer resistance to the flow. The maximum capacity shown by the drain section was 57 cumecs. Shahi Katta has still the capacity to accommodate the present discharge, if maintained properly.

KEYWORDS: Hydrologic and Hydraulic, Shahi Katta, Peak Discharge, 30 years data, 2010 Storm event, Sanitary, Storm, Maximum capacity

I. INTRODUCTION

Major Cities in most of the third world countries face the problem of drainage and sewerage, due to rapid increase in the population and lack of planning of population distribution and infrastructure. The construction activities in such cities block the path of flow of drainage and sewage in some parts while divert in other parts. The illegal construction vanishes small drains and so the discharge of these small drains is diverted to the main channel or drain. Such abnormal activities of the drains cause overflow and prevents from any future intervention in the drainage system. Peshawar is an old and historic city of great geographical and administrative importance. Shahi Katta is one of the most important and major drain that conveys waste water including both storm and sanitary sewage across the most commercial and crowded part of the city. It originated from Saddar near Deans Trade Center and passed through Shuba Bazar, Qissa Khwani Bazar, Shabistan Cinema Chowk, Arbab Niaz Stadium and finally through Faqir Abad drops in Budni Nulla (Fig 01).It also passes under the irrigation Channel near Faqir Abad without any syphoned structure. Most of the drain is paved and channelized. About 52% of the drain is hidden under structures including shops, malls, hotels, worship places, culverts and slabs. The population censes of 1998 is projected for the estimation of city's population on 3% annual growth rate [1]. The rain fall in most of the cases and specifically in the storm event 2010 showed abnormal behavior by overflowing in most of its parts. The survey of whole Shahi Katta was not possible due to the facts mentioned above, so a section was selected owing to the ease and possibility of physical survey and flooding of the reach in past few years. The section does not reflect the whole of Shahi Katta, however, it gives an idea of the overall behavior of the drain.

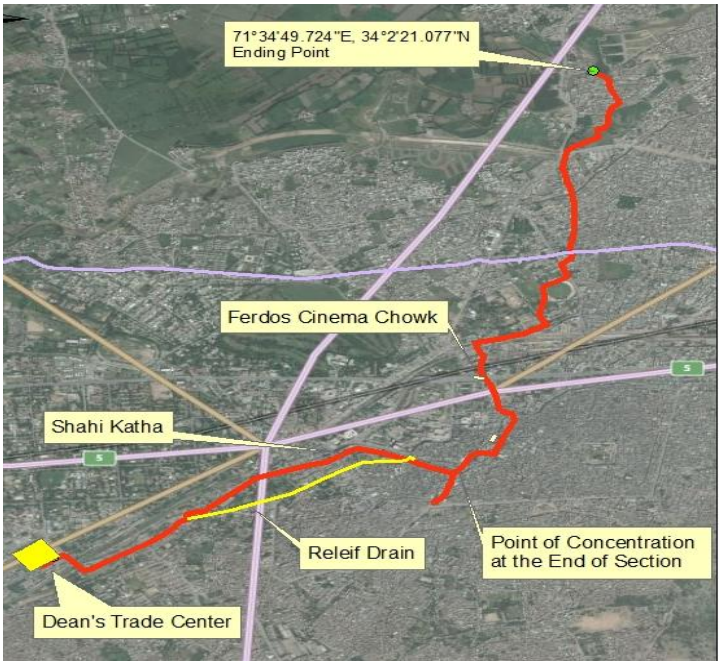


Fig 01: Location of Shahi Katta Drain

II. METHOD AND PROCEDURE

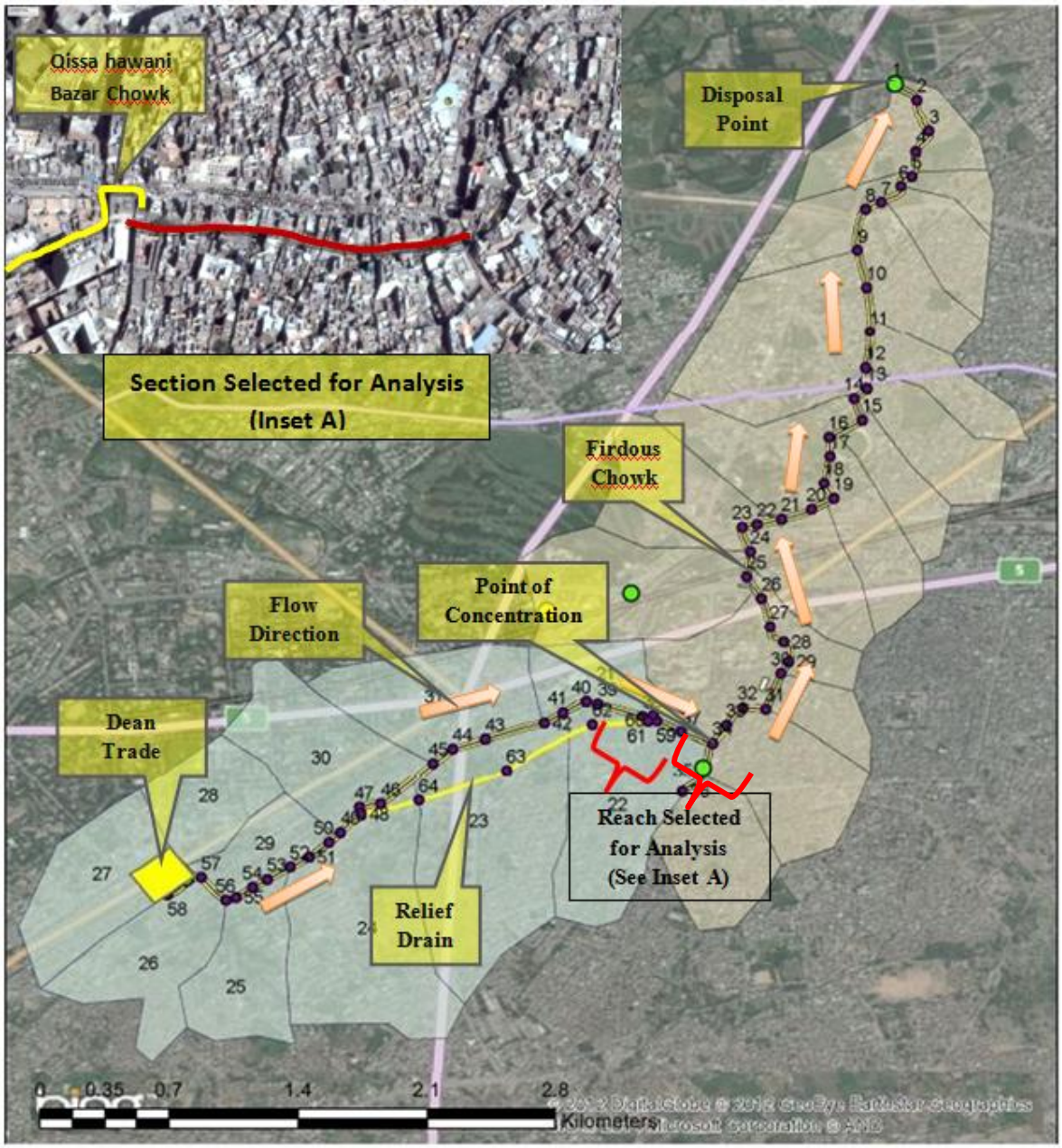
The topographic survey of the catchment area was carried out with GIS, using the SRTM Imagery and Arc Map Extension, to analyze the contours of the area and the surface type of the land parcel contributing to the flow[2][3][4][5][6][7]. The reconnaissance survey was carried out for verification of ground information to be used as an input to the model which resulted in composite values of runoff coefficient and SCS runoff curve numbers. Different models were studied, selected and applied keeping in view the availability of source and input parameters. Two models including rational procedure was applied using the IDF curve developed for Peshawar [4] [8] and SCS Run-off curve number procedure [9]. The rainfall data on daily basis was for 30 years storm period. The data on monthly basis was observed and SCS model was applied both for the peak value of discharge and the average flow. To apply the flow on Shahi Katta, a section was selected which was visible and survey could be carried out since the survey of whole of Shahi Katta was not possible because of the encroachment issues. The discharge values were applied using HEC-RAS 4.1 to find out hydraulic parameters of flow in the channel [10] [11].

III. RESULTS AND DISCUSSION

The present demography and land parcels in Peshawar are changing rapidly due to unstable political, law and order situation. The lack of enforcement on existing and new urban infrastructure laws and regulations has made the future projection of the demography and infrastructure development cumbersome. This future projection of the city from present condition requires a complete study which was out of the scope of the research. The drainage area of Shahi Katta contributing was calculated. The discharge from the catchment area of Shahi Katta based on Rational and SCS Curve Number methods are given in Table 01 whereas Table 02 summarize the result of the analysis for Reach Section (RS1 and RS2) selected for analysis of the drain. The rational method resulted with a value of 2545.48 cusecs for the overall drainage area of Shahi Katta [12] and a value of 1297 cusecs for the section. The SCS Runoff curve number procedures showed the values in table 01. The values of flow are shown in table 02 for the selected reach (section).

Rational Method	Discharge 2546.48 Cusecs	
SCS Curve Number Method	Discharge (Cusecs) based on Maximum rainfall values.	
	Minimum	Maximum
	446.4	1173.5

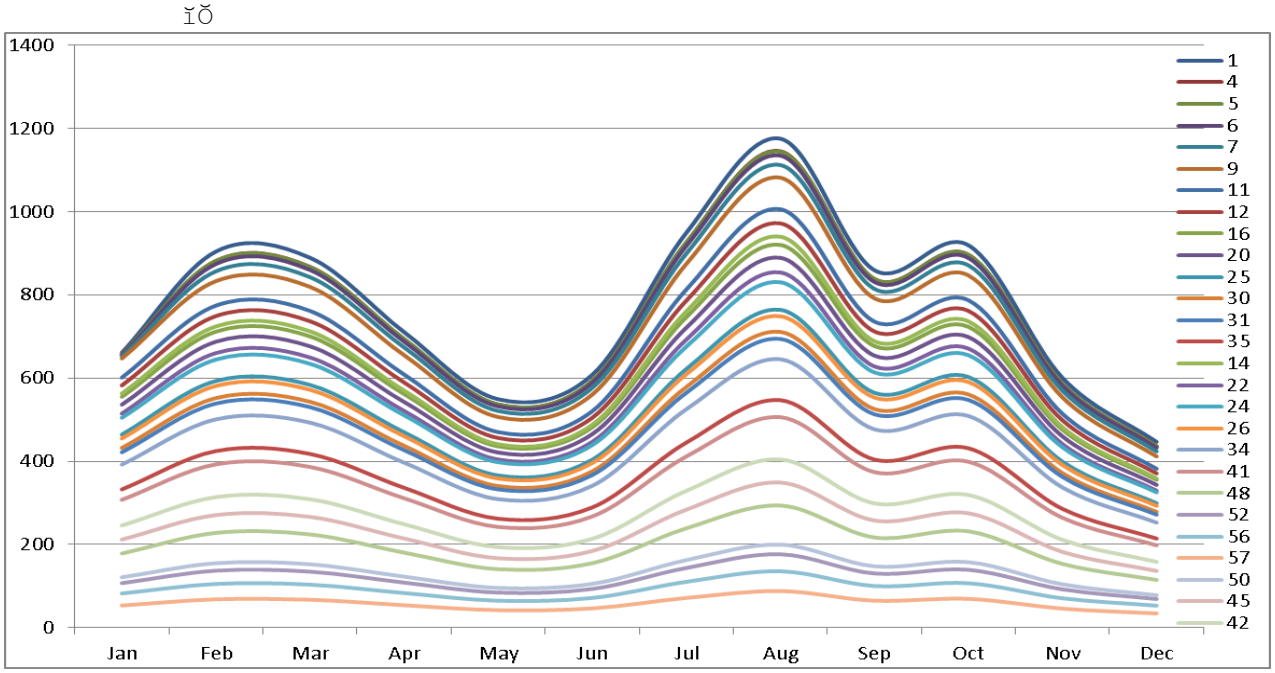
S #	Reach Section	Procedure	Discharges in Cusecs	Flow Velocity(ft/sec)	Flow Depth(ft)
01	Reach Section RS1	Rational	1297	13.41	5.54
		Maximum Rainfall Discharge (August)	645.55	10.63	3.48
02	Reach Section RS2	Rational	1297	13.41	5.54
		Maximum Rainfall Discharge (August)	645.55	10.63	3.48



* All the data are in SI Systems (metre) and the map is drawn in ArcMap 10

The behavior of rainfall directly impacts the discharge in the channels flow. The drainage area contributing to the Shahi Katta in Peshawar City shows its peak discharge in the month of August. This indicates that most of the chances of heavy discharges (Flooding) in Peshawar City occur in the month of August causing a peak flow of 1175 cusecs with a drop in the coming months as evident from the past 30 years

data from ranging from 1978 to 2007. The flow in the month of May drop to a value of 549 cusecs which then again rises to a value of 1175 cusecs in the month of August. The lowest discharge is observed in the month of December as 447 cusecs as shown in Fig 03. The flow variation show less intensity and remain inside the drain without overflowing.



The results make it evident that even after passing hundreds of years of Shahi Katta drain, it is still in the position to take the discharges that flow inside the drain in most of its sections. The variation of flow in the drain was changed with the Metrologic conditions of the area. The storm sewage in the section was quite less than the capacity at present. It was revealed from the flow values and the calculations that Shahi Katta can be better expressed by Rational method. The value of discharge from the rational method was about 1297 cusecs. The depth of flow during storm event, as derived from the personal interviews was about 6 ft, while that from the calculation was 5.4 ft. The discharge capacity in most of the sections was low. The obvious reason was no proper solid waste management system for Peshawar City. Most of the part of Shahi Katta drain is chocked by the waste generated by nearby area. In some places the small sections are followed by large sections which caused ponding effects thus causing sedimentation in the flow and the solid part to accumulate. The flow in most of the parts of drain is obstructed by the utility lines passing through the drain and the encroachment in the drain.

IV. CONCLUSION AND RECOMMENDATIONS:

No authentic drawings were found during the research. The authority may carry out the complete survey as it requires a lot of resources and is a difficult job. It will not only define the right of way for Shahi Katta but will also help in cleaning and maintenance plan.

Three different encroachments are present in and along Shahi Katta that are as follows:

[1] The structures that are used to support the slabs of shops built over the drain (Fig 04) i.e. columns etc.
[2] Construction of brick walls inside the drain thus reducing the sections size (Fig 05).
[3] Shops and other market with their floors as slab over the drain thus converting the drain into a box culvert shape (Fig 06).

The concerned departments are advised to remove these encroachments to make able Shahi Katta to regain its capacity.

a. It is recommended that the Curve Number for Peshawar should be made on current maps since the one developed for Peshawar was quite older and since lot of changes have occurred in the past two decades, so a fresh study should be carried out.

b. The population censes in Peshawar was carried out in 1998. All of the government departments use a standard of 3 percent increase in population for the projection of population for any project. This procedure

is used in areas where no major changes had occurred regarding demography and relocation of population. The native areas of Peshawar are undergoing stresses which lead to a major displacement inside the city, there is an enormous intake of population from country side. As such the projection of 1998 population censes to 2014 and onward for the 20 years becomes unreliable and so there is a dire need to carry out censes for present conditions study and future population project.

c. Absence of complete manual for design, implementation and relocation of utilities has not been defined so far. It is recommended that such manuals be established and published specifying the codes for installation of the utilities. The utilities offering obstruction to the flow of Shahi Katta need to be relocated on emergency basis as soon as possible.

d. A regular practice for cleaning of the drain needs to be carried out to keep the drain flowing smoothly.

e. Building of a proper solid waste management system is a need of Peshawar City. It is not possible to keep Shahi Katta clean until and unless the solid waste management system is defined. Since there is no proper system of disposal of wastes, the inhabitants throws their wastes inside the drain as shown in Figure 07. Such practices makes problem in flow of drain, generates diseases and are drained off as water bodies causing a threat to the aquatic life. Proper education and rules enforcement will help to prevent the inhabitants from throwing wastes

REFERENCES:

[1]. Population Density and Demographics from official website www.nwfp.gov.pk accessed on 23rd April 2013
[2]. Drachal J., "Striking variety of the mountain chains appearance on satellite images provided by google earth", 2006.
[3]. H.M. Ragunath, "Hydrology, Principal Analysis and Design", Revised 2nd Edition, 2006.
[4]. Zubair K., "Intensity Frequency Duration curves for NWFP", 2007.
[5]. Kirpich, Z.P., "Time of concentration of small agricultural watersheds: Civil Engineering, American Society of Civil Engineers", 1940
[6]. Sailendra N. S., "Ancient Indian History and Civilization", January 1999
[7]. Adornado, H. A. and Yoshida, M.: "GIS-based watershed analysis and surface run-off estimation using curve number (CN) value, J. Environ. Hydrol.", 2010
[8]. Kousari, M.R.. "Sensitivity analysis and impact quantification of the main factors affecting peak discharge in the SCS curve number method: An analysis of Iranian watersheds", Quaternary International, October 15, 2014.
[9]. USDA, Soil Conservation Services, "National Engineering Handbook, Section 4: Hydrology, Soil Conservation Service", 2004.
[10]. Victor M. P. "Engineering Hydrology, Principal and Practices" 1989
[11]. A. Osman Akan and Robert J. H., "Urban Hydrology, Hydraulics and Stormwater Quality", 3rd Edition, 2003.
[12]. David B. Thompson, "The Rational Method", January 2007.