International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 06 | June - 2022 Impact Factor: 7.185 ISSN: 2582-3930

# ASSESSMENT OF STEADY FLOW BEHAVIOUR OF KULSI RIVER USING HEC-RAS AND QGIS

**SHIBAM KARMAKAR[1], BHARATI MEDHI DAS[2]**

[1]*SHIBAM KARMAKAR, PG SCHOLAR WATER RESOURCES ENGINEERING & ASSAM ENGINEERING COLLEGE*
[2]*BHARATI MEDHI DAS, ASSISTANT PROFESSOR & ASSAM ENGINEERING COLLEGE*

---***---

**Abstract -** Sediment transport study is important tools of Kulsi River in the context of river bank erosion, Sedimentation, and water quality management. The initiation of computer technologies has enabled engineers to resolve sediment transport equations through computer simulations. In this study, it is intended to carry out a sediment transport study in the Kulsi River reach with the help of Hydrologic Engineering Centre-River Analysis System (HEC-RAS) and Quantum Geographic information System (QGIS). From the analysis of the model, total sediment erosion and deposition were obtained at different cross sections between the study reach. Kulsi river is Southern tributary of Brahmaputra and it's originate in Meghalaya (25°38′N, 91°38′E) and after travelling 12 km its enter Assam from the place of its origin and linked with Brahmaputra at Nagarbara in Kamrup Metro. The initial version of this sediment model will leverage the wide range of hydraulic capabilities existing in HEC-RAS to compute a series of steady flow profiles used to develop hydrodynamic parameters for sediment transport.

In this model where sufficient data is not available, So QGIS and remote sensing used as tools for extraction of bed profile of Kulsi River. HEC-RAS and QGIS are the Software used in this study. This study is carried out to simulate the process of erosion and sedimentation using HEC-RAS model to assess sedimentation and erosion processes in 2.5 Km stretch of Kulsi River from upstream to downstream. The model was calibrated manually for hydraulic parameters of river flow and then sediment transport model was simulated from January 2016 to December 2016.

***Key Words***: Steady flow, HEC-RAS 5.05, QGIS, TCX converter.

## 1. INTRODUCTION

A river is said to be stable when its bed remain for a longer period of time. An alluvial is in equilibrium when sediment load-carrying capacity of the channel becomes equal to the sediment load entering the channel at any definite period of time. All rivers conveying water contain eroded sediments in any of the three forms: bed load suspended load, or wash load. The main factor which govern the flow in an alluvial stream are bed slope of the channel, size of the sediments, bed and bank, and the velocities of water. Any changes of these factors may leads to disturb the equilibrium of the stream and results in change in bed slope, invert change and velocity of the channel. Hydraulic modelling and flood inundation mapping with the help of QGIS are performed to provide important information from a flood event including the level of inundation and water surface elevations within the study area. River modelling is a tool to study the area of a river that is very vulnerable to flood. With the help of different software

Such as QGIS, HEC-RAS, CCHE2D, MIKE we can construct the model of a river and by calibrating the model it gives output for different inputs. Prediction of river behaviors requires accurate measurement to eliminate any associated threats and, consequently improving river system. In some rivers, the river continues to erode and degrade; thus never reaching equilibrium. Generally, analysis of geometric characteristics of rivers and bed erosion is one of the most complicated, yet key topic in river engineering and sediment hydraulics. The transportation of sediment changes the capacity of the river reach. Increased soil erosion creates siltation and navigation problems in rivers. The sediment transport in rivers depends on several factors such as sediment type and particle size, size of drainage area, land use cover and vegetation adjacent to the catchment areas, climate changes pattern and temperature, flood events, and basin slope.

## 2. STUDY AREA

River Kulsi, a southern tributary of the Brahmaputra, is considered as one of the last refuges of the endangered Gangetic dolphin (*Platanista gangetica) in* Assam. Wakid and Braulik have reported a total of 29 dolphin individuals. The presence of a top carnivore and an indicator species like the dolphin, not only indicates the significance of the river, but also presents a picture of the healthy freshwater ecosystem. Dolphin is to a river, as tiger is to a forest. And indeed it is true in case of Kulsi. Kulsi originates in the Meghalaya (25°38′N, 91°38′E) and enters Assam after travelling about 12 km from its place of origin.

**Fig- 1** Kulsi River

Kulsi River, a south bank tributary of the Brahmaputra river system. It is composed of three rivers, namely Khari, Krishna and Umsiri. All of which originate from west Khasi hill range and flows north. The river is known as Khri in the upper catchments and after being joined by two other tributaries namely Krishniya and Umsiri, within the Khasi hills in

**Table -1** Different Station with Latitude and Longitude

| SL NO. | RIVER STATION | LATITUDE | LONGTITUDE | ELEVATION |
|---|---|---|---|---|
| 1. | 0 | 25.805377 | 91.398798 | 114 |
| 2. | 1000 | 25.80467 | 91.38887 | 112 |
| 3. | 3000 | 25.802145 | 91.376888 | 100.3 |
| 4. | 4800 | 25.809346 | 91.358144 | 98 |
| 5. | 6400 | 25.824717 | 91.343523 | 77 |
| 6. | 7000 | 25.839967 | 91.347634 | 69 |
| 7. | 8100 | 25.840738 | 91.357008 | 67.5 |
| 8. | 8500 | 25.853621 | 91.365549 | 67 |
| 9. | 9000 | 25.874968 | 91.385854 | 58 |
| 10. | 10000 | 25.950203 | 91.412316 | 53 |

Meghalaya it flows north-west and enters Assam at Ukium and after that it flows north up to Kulsi village through the Plains of Kamrup District of Assam. Finally it outflows into the Brahmaputra near Nagarbera.

## 3. METHODOLOGY

HEC-RAS uses a number of input parameters for hydraulic analysis of the stream channel geometry and water flow. These parameters are used to establish a series of cross-sections along the stream. In each cross-section, the locations of the stream banks are identified and used to divide into segments of left bank, main channel, and right bank. At each cross-section, HEC-RAS uses several input parameters to describe shape, elevation, and relative location along the stream such as:

- River station (cross-section) number.
- Lateral and elevation coordinates for each (dry, unflooded) terrain point.
- Left and right bank station locations.
- Reach lengths between the left bank, stream centerline, and right bank of adjacent cross-sections.
- Manning's roughness coefficients.
- Get the schematic plan, General profile plot, river upstream cross section and the perspective view of the river.

## 4. RESULTS AND DISCUSSION

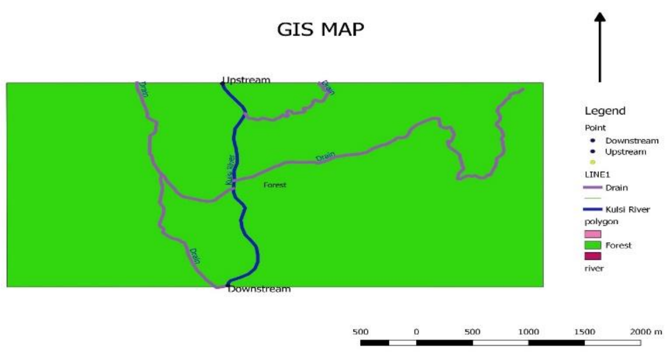


**Fig 2 -** GIS map of kulsi River

In **Fig 2** the GIS map are used to depict the Upstream and Downstream point of Kulsi River and the drainage system of that Catchment area.

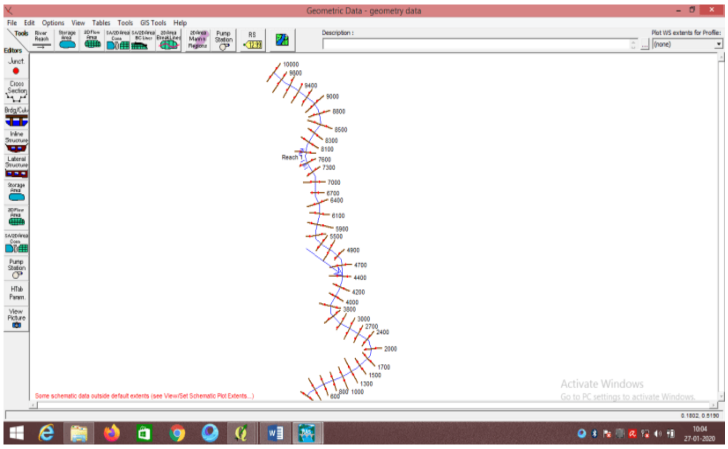

**Fig 3-** General schematic plan of the River in HEC-RAS

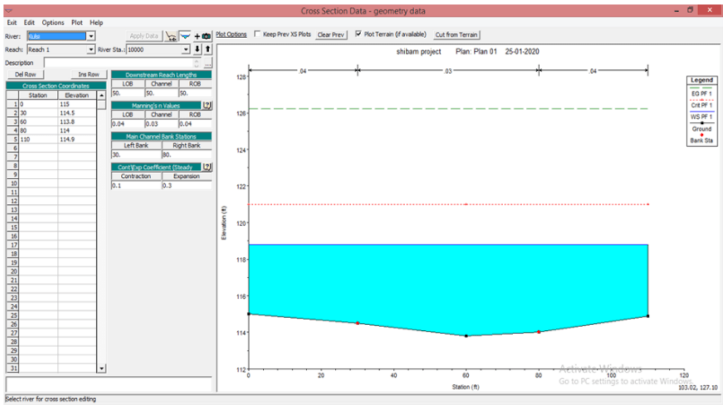

**Fig 4-** The cross section geometry data at upstream

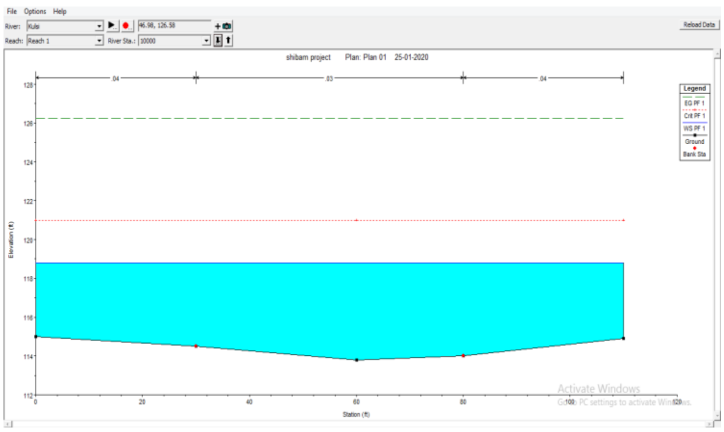

**Fig 5-** The cross section geometry data at downstream

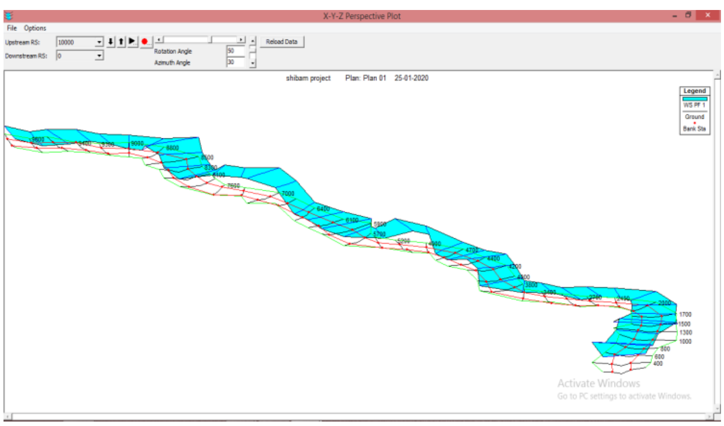

**Fig 6-** Perspective view by HEC-RAS model

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 06 | June - 2022 Impact Factor: 7.185 ISSN: 2582-3930

| RIVER STATIO N | DISCHARGE(q ) | MIN CHANNEL ELEVATIO N | WATER SURFACE ELEVATIO N | CRITICA L WATER SURFAC E |
|---|---|---|---|---|
| 9800 | 10000 | 111.50 | 116.15 | 118.52 |
| 8800 | 10000 | 104.50 | 110.25 | 111.90 |
| 8100 | 10000 | 100 | 106.64 | 108.40 |
| 7300 | 10000 | 98.50 | 108.60 | 106.24 |
| 6700 | 10000 | 95 | 104.60 | 104.60 |
| 5500 | 10000 | 82.50 | 88.62 | 90.80 |
| 4700 | 10000 | 77 | 83.31 | 84.36 |
| 4700 | 10000 | 77 | 83.31 | 84.36 |

**Table 2-** Cross section data plan of the River

| RIVER STATION | E.G ELV | E.G SLOPE | VELOCITY | FLOW AREA | TOP WIDTH | FROUDE NO. |
|---|---|---|---|---|---|---|
| 9800 | 124.36 | 0.0410 | 26.65 | 469.53 | 120 | 2.26 |
| 8800 | 116.20 | 0.0211 | 22.45 | 552.40 | 110 | 1.69 |
| 8100 | 113.03 | 0.0202 | 22.88 | 536.03 | 100 | 1.67 |
| 7300 | 110.94 | 0.0033 | 13.26 | 889.63 | 90 | 0.74 |
| 6700 | 109.38 | .00875 | 20.60 | 632.51 | 70 | 1.19 |
| 5500 | 96.23 | 0.0258 | 25.57 | 490 | 90 | 1.36 |
| 4700 | 91 | 0.0585 | 30.61 | 415.02 | 110 | 2.87 |
| 4000 | 83.31 | 0.044 | 27.63 | 430.15 | 90 | 1.59 |
| 4700 | 79.86 | 0.0304 | 26.12 | 455.20 | 100 | 2.12 |
| 2000 | 75.47 | 0.0247 | 24.83 | 432.10 | 110 | 1.03 |
| 1000 | 72.50 | 0.0223 | 24.30 | 420 | 90 | 1.80 |

**Table 3-** Cross section data plan of the River

Centre line, bank line, flow path and cross section of the river is traced and digitalized in Google Earth to get the geometric data of the river. This geometry data is exported in HEC-RAS to get the resulting profile of the cross section which is represented in fig-3 (General schematic plan of the River in HEC-RAS). Fig 4 and Fig 5 depicts the occurrence of water in the Kulsi River at upstream as well as the downstream.

## 5. CONCLUSION

HEC-RAS software was used in the simulations and in general the model executed well, once all factors input data were set within ranges. With the help of Latitude, longitude and elevation value we can find out the perspective view, General Schematic plan and cross section of the river in HEC-RAS 5.7.

### FUTURE SCOPE OF THE STUDY

1. Kulsi River modelling will help to study the effect of the various parameters of sediment transport on the catchment and we can use the model for flood mitigation planning and river training programmers.

2. Study is to be carried out for different rivers and the data is to be analyzed and compared with field data.

3. Different river model is studied with the present model and then by comparing results with field observation data it is to be found out under what circumstances the model is the most suitable to use.

## 6. ACKNOWLEDGMENT

I wish to express my deep sense of gratitude to my guide **Dr. Bharati Medhi Das** for her guidance, advice and encouragement. The confidence and firm belief that she had bestowed upon me and the amount of patience and the endurance she had, cannot be adequately expressed. The various values I have learned from her shall remain a source of inspiration for me forever.

I would like to dedicate my thanks to the entire staff members of the civil engineering department, Assam Engineering College. I would also like to express appreciation to Water Resources Department (Lower Assam Investigation Department) for providing the meteorological data.

## REFERENCES

1. **1.** Brunner, G. W. (2002). HEC-RAS river analysis system*: "User's manual.*" US Army Corps of Engineers, Institute for Water Resources, Hydrologic Engineering Centre.
2. **2.** Colby, B.R., (1964). "*Practical Computation of bed-material discharge*." Journal of hydraulic division, ASCE, Vol.90, No.HY2 pp.-217-246.
3. **3.** Coleman, J. M. (1969). "*Brahmaputra River: channel processes and sedimentation.*" Sedimentary geology. 129-239.
4. **4**. Das, B., and B. S. Sil. (2017). Assessment of Sedimentation in Barak River Reach Using HEC-RAS. In *Development of Water Resources in India* (pp. 95-102). Springer, Cham.
5. **5.** Das, P.K., B.P Duarah and D.C. Goswami. (1996). "*Channel migration of the Pagladiya River, Assam during remote sensing and field survey data*."Dept. Geol. Sci., Guwahati Univ. Jour.Geosci.V.1:38-45
6. **6.** Desai, A. J., S. D. Naik, and R. D. Shah. (2012) "*Study on the channel migration pattern of Jia-Bhareli, Puthimari and Pagladiya tributaries of the Brahmaputra River using remote sensing Technology.*"