



“ Dam Break Analysis of Dantiwada Dam using HEC-RAS ”

Submitted By

Sagarbhai Kiritbhai Padhiyar

M.E. Civil (WRE)

Enrollment No: 200280733006

Under the guidance of

Prof. Z. J. Chovatiya

Assistant professor

Department of Civil Engineering

L.D. College of Engineering

Ahmedabad

ABSTRACT

Almost all parts of Gujarat are prone to floods with the State historically recording an average of four flood events in a decade. The past decade and half has been even worse with seven flooding events, including the most recent in 2017.

The State recorded an exceptionally heavy rainfall during July 2017. This led to a very heavy inflow into the dams and consequent flooding in large parts of the State with Aravalli, Banaskantha, Morbi, Patan and Surendranagar districts among the worst affected.

A dam is Constructed for a number of purposes such as water supply, irrigation, hydroelectric power generation and flood control. In many cases flood control constitutes a secondary function of dam operation since apart from its main operation, its storage contributes to attenuation of flood peaks and that lead to dam break. HEC-RAS software is use for dam break simulation work. The maximum discharge, elevation and top width is obtained to find out the number of villages are going to affected at the downstream of the banas river of the dantiwada dam. It is easy to estimate the flood, travel time of flood wave and flood routing. Advantages of dam

break simulation which are very important from view point of planning on downstream side of the dam for assessment of emergency action plan commonly known as EAP.

CHAPTER 1

INTRODUCTION

1.1 GENERAL

Flood is one of the most destructive natural disasters of climate change effects in INDIA. The reported losses due to flood in India shows a rising trend overtime. Flood risk occurrence is a combination of natural and anthropogenic factors, which calls for a better understanding of its spatial extent. India is one of the ten worst disaster prone countries of the world (Centre for Research on the Epidemiology of Disasters CRED, 2004) due to the presence of varying degree of disaster prone areas.

Recurrent floods and resulting losses make it imperative that each of these events is studied to identify the causes, improve planning and preparedness, strengthen early warning systems, and put adequate systems in place to prevent a reoccurrence or ensure quick and efficient rescue and relief.

Dam is a barrier that impounds water that plays a vital role in the economy of the country. The water retained is generally used for irrigation, aquaculture, industrial use, human consumption, etc. However, in the unlikely and rare event of their failure, these may cause catastrophic flooding in the downstream area which may result in huge loss and damage to human life and property.

In this study the dam break analysis and flood modelling of Dantiwada reservoir is done with the help of HEC-RAS. Hydrologic Engineering Center's River Analysis System (HEC-RAS) modelling software developed by the U.S. Army Corps of Engineers, a standard for dam-breach flood-inundation models, is used to perform steady-flow simulations to model the dynamic nature of the flood wave produced by a dam breach scenario. Such studies also help us document best practices as well as identify gaps, which may come handy not only in comprehensive disaster management planning but also during rescue and relief operations in case of an eventuality. Such studies also bring out novel and innovative practices which may aid the management of such hazards in an effective and efficient manner.

1.2 NEED OF THE PRESENT STUDY

In terms of overall Global Climate Risk Index ,India has ranked third and ranks first in terms of disaster fatalities and ranks twenty six in terms of disaster losses per unit of GDP in the year 2013 (Global Climate Risk Index, 2015). A new United Nations global assessment report on disaster risk, released in 2015, says India's average annual economic loss due to disasters is estimated to be \$9.8 billion. This includes more than \$7 billion loss on account of floods.

Due to the failure of dam, great amount of water rising, swelling and overflowing with its maximum velocity up stream to downstream that lead to tremendous flood condition. Because

of heavy flood the villages, Agricultural land and the residing families are washed away and become serious threat to human being's life and property.

For flood forecast, the 1D/2D hydrodynamic model is used for approximate results in flooding areas. Now a day 1D/2D hydrodynamic models are an important tool for creating flood zones for disaster management and infrastructure development.

By the dam break simulation we can implement early warning systems and estimate damaged areas of downstream. So we can do emergency action planning by assuming worst flood condition due to causes of failure of dam

1.3 OBJECTIVE OF STUDY

The main objectives of this study are

1. To develop unsteady flow model of banas river at banaskantha Region using 2D hydrodynamic model in HEC-RAS (Hydrologic Engineering Center - River Analysis System).
2. To implement a flood modeling of banas River with the help of a two-dimensional model using RAS MAPPER with DEM and mark out the submerge or low-lying area near banas river at banaskantha Region.

1.4 SCOPE OF THE WORK

- Collect all the data of Dantiwada water resources project.
- Topographic data as DEM
- Hydrological data
- Collect census data of downstream villages.
- Analysis of downstream side river by using topographic and hydrological data in HEC-RAS software.
- find effects of flooding particularly in the low-lying areas.

CHAPTER 2

LITERATURE REVIEW

2.1 GENERAL

The following chapter gives a brief description of the literature regarding various aspects of the research field dealing with simulation of flood water using HEC - RAS at different time scale for Analysis. The literature has been presented under various sub divisions of various parameters associated with breaching and the contributions of various researchers to it

2.2 DETAILED INFORMATION OF RESEARCH PAPERS

REVIEW PAPER : 1

"Floodplain Mapping and Management of Urban Catchment Using HEC-RAS: A Case Study of Hyderabad City", Vinay Ashok Rangari¹, V. Sridhar¹, N. V. Umamahesh¹, Ajey Kumar Patel¹, Received: 21 May 2018 / Accepted: 9 November 2018, **The Institution of Engineers (India) 2018.**

Objectives : This paper explains a framework developed for flood modeling on regional scale combining GIS with a rainfall-runoff model (HEC-HMS) and a hydrologic model (HEC-RAS).

Study area : Hyderabad city of India is considered as a pilot study area as it is a region of frequent occurrences of severe flash floods. Three major flood events, viz. July 1989, August 2000 and August 2008, that occurred in Hyderabad are selected as cases to examine the modeling framework, and flood inundation maps are prepared representing area at risk and delineate the regions where the flooding is likely to occur.

Methodology : The hydraulic modeling with GIS integration makes the modeling process easy and produces more easily understandable results. The catchment runoff for study area is computed using HEC-HMS. The flood inundation maps are prepared in HECRAS model. The flood inundation maps are further processed in ArcGIS to develop flood risk map and projected on Google Earth imagery.

Results and discussions : From flood risk map and Google Earth projection, it can be easily identified that populated areas such as Begumpet Airport, Dilsukhnagar, Adarsh Nagar and Balanagar are flood-prone zones and come under medium to high risk of flooding. Results show that 25% of populated area is susceptible to floods. Thus, these zones need immediate attention during flooding situations and should be assigned high priority. The flood risk map developed can be used to develop early warning system and public awareness.

REVIEW PAPER : 2

"Flood Management in Mahanadi Basin using HEC-RAS and Gumbel's Extreme Value Distribution", Prabeer Kumar Parhi¹, Received: 24 April 2016 / Accepted: 13 June 2018 / Published online: 21 June 2018, **The Institution of Engineers (India) 2018**

Objective : The present study combines the statistical technique (Gumbel Distribution), Arc-GIS, Hydraulic Modeling (using HECRAS) to assess the risk and hazard of flooding in Mahanadi River in Orissa, India.

Methodology : Using Gumbel's extreme value distribution and HEC-RAS hydrodynamic model, the levels of peak floods at different locations of Mahanadi River reach between Hirakund dam and Naraj (delta head of Mahanadi) for 10, 25, 50 and 100 years return period are estimated. Based on the simulation study carried out considering 36 cross sections for 310 km length of river, it is observed that the heightening of embankment system for almost all the existing bank

stations both in the left and right embankments are required. In the present study, the analysis has been carried out considering 25 years return period floods (45067 cumecs), as this is considered as most significant and under changed climatic conditions.

Result : The results of the study show that out 36 cross sections, at 23 sections, heightening of embankment spanning from a minimum of 0.11 m to a maximum of 10.63 m in the left bank should be carried out. Similarly for right bank embankment heightening is needed from 0.09 m to a maximum of 9.94 m. This can very effectively minimize the flood hazard of the Mahanadi River system.

REVIEW PAPER : 3

“Dam Break Flood Risk Assessment for Laiyang City”, Li Changzhi¹, Wang Hong¹, Chi Zhixue², Yang Yongfeng², Rao Zhengfu³ and Cope Mike³, China Institute of Water Resources and Hydropower Research, Beijing 100038. **Journal of Geological Resource and Engineering** (2014) 189-199

Objective : A dam failure analysis was performed for the City of Laiyang to determine the flood inundation extents and the breach velocities of a hypothetical failure of the Muyu Reservoir Dam in Shandong Province, China.

Methodology : The study was carried out in four steps. First, the possible reasons of the dam failure were analyzed, and the extreme hydrological event was identified as the most critical cause. Second, a numerical simulation of the dam break flood was performed. The key factors considered in this simulation include the water level at the dam (the check flood water level), the inflow to the reservoir (the check flood hydrograph), and two typical structural scenarios (with/without-levees) along the river reach downstream of the reservoir. Third, based on flood simulations, flood hazard risk analysis was conducted and the results indicate that the peak discharge would be over 40,000 m³/s at the breach and over 22,000 m³/s near Laiyang City.

Results : As a result, most of the urban area would be flooded; the duration from the beginning of the dam break to the arrival of peak discharge at Laiyang City is less than half an hour. Finally, a plan for integrated dam break flood management was presented to mitigate the flood risk; both available structural and non-structural measures were proposed according to the situations in the river basin. The main strategic advises include flood emergency planning, flood risk mapping, flood monitoring and early warning system construction, reservoir regulation, and flood risk public awareness.

REVIEW PAPER : 4

“Application of 1-D HEC-RAS model in design of channels”, Darshan J Mehta et. al., **International Journal of Innovative Research in Advanced Engineering**, Aug 2014, 2349-2163, 1(7)

Objective: Studied the flood conditions of different floods of Tapi river of Surat. By the help of data from this study gained input for modelling Tapi river in HEC-RAS.

Methodology: Collected data from the flood events occurred in the year of 1883, 1884, 1942, 1944, 1945, 1949, 1959, 1968, 1994, 1998, 2002, 2006, 2007, 2006 in Tapi river. Input the data from these flood events and developed 1-D model for specific cross sections. By modelling in HEC-RAS software using major flood events of historical floods, The sections classified as highly critical (depth above water is more than 0.7 m), moderately critical(depth of water above existing bank is between 0.4 to 0.7m), critical(depth of water is up to 0.4 m).

Results : At cross section 11, 24 and 22, for flow of 3.35 and 4.62 lakh cusecs the cross section is sufficient to carry flow but when the flow is of 9.10, 6.73 and 15.6 lakh cusecs, section is not capable of carrying the flow . At Cross section 13 and 17, for flow of 3.35, 4.62, 6.73 and 9.10 lakh cusecs the cross section is sufficient to carry flow but when the flow is of 15.6 lakh cusecs, section is not capable of carrying the flow.

REVIEW PAPER : 5

“Virtual Failure Influence of Roseires Dam on Khartoum City Using HEC-RAS Hydraulic Simulation Modelling ”, Kamal edin ELsidig Bashar et.al, **Journal of Engineering and Computer Science (JECS)** , Vol. 16 , No. 3 , 2015 , 1523

Objective : This study attempts to simulate the case of dam break in Blue Nile at Roseires dam and see its consequences downstream.

Methodology : The HEC-RAS based model is calibrated and validated using observed data of the Blue Nile for several flood years. The calibrated and validated model is used to analyze the impact of flood wave due to dam break failure of Roseires dam. Several dam break scenarios that cover the possible failure modes were considered and the scenario that gives the worst situation is present in this paper.

Results : Provide the following information: the maximum discharge, the maximum water level, the maximum velocity, the velocity and depth profiles, the flooding extent, etc. It was found that failure of Roseires dam result in overtopping failure of Sennar dam due to the inability of the Sennar reservoir and dam to withstand the flood wave.

CHAPTER 3 STUDY AREA AND DATA COLLECTION

3.1 INTRODUCTION

Situated on the western coast of the country, Gujarat lies between latitude 20° 07' and 24° 43' N and longitude 68° 10' and 74° 29' E. The State has an area of 1,96,024 sq. km. which constitutes 5.96% of the total geographic area of the country. As per Census 2011, the total population of the State is 6.04 crore comprising 3.15 crore males and 2.89 crore females.

The State comprises three regions, viz. the peninsula, traditionally known as Saurashtra, which is essentially a hilly tract sprinkled with low hills; Kutch on the north-west is barren and consists of the famous Rann of Kutch; and the mainland, extending from the Rann of Kutch and the Aravalli hills to the river Damanganga, is on the whole a level plain of alluvial soil. The plains of Gujarat are watered by four major rivers- Sabarmati, Mahi, Narmada and Tapi. The average annual rainfall over different parts of the State varies widely from 300 mm in the western half of Kutch to 1500 mm in the southern part of Valsad and the Dangs. During the summer season, the temperature ranges from a minimum of 25 degrees to a maximum of 45 degrees. During winter season, the temperature ranges from a minimum of 15 degrees to a maximum of 35 degrees.

Kutch and Saurashtra are mostly arid and have small watersheds and river catchments. The lower reaches of the Sabarmati, Mahi, Narmada and Tapi river basins lie in mainland Gujarat. Since heavy rainstorms are common and the lower reaches of these basins are flat, flooding affects a number of stretches. Rainstorms are also common at the western edge of the Aravallis and the Satpuras in north and northeast, which cause flood discharge in Banas, Sabarmati and Mahi rivers. As these rivers disgorge hilly terrain to flat lands, floodwaters spread out and damage large populated stretches en route. Southern Gujarat is endowed with moderate to high rainfall, with substantial water resources concentrated in Narmada and Tapi, which have their catchments in the Central uplands of the Indian peninsula. Occasional heavy rainstorms in their middle and upper catchments can cause heavy flooding in these river basins.

3.2 STUDY AREA

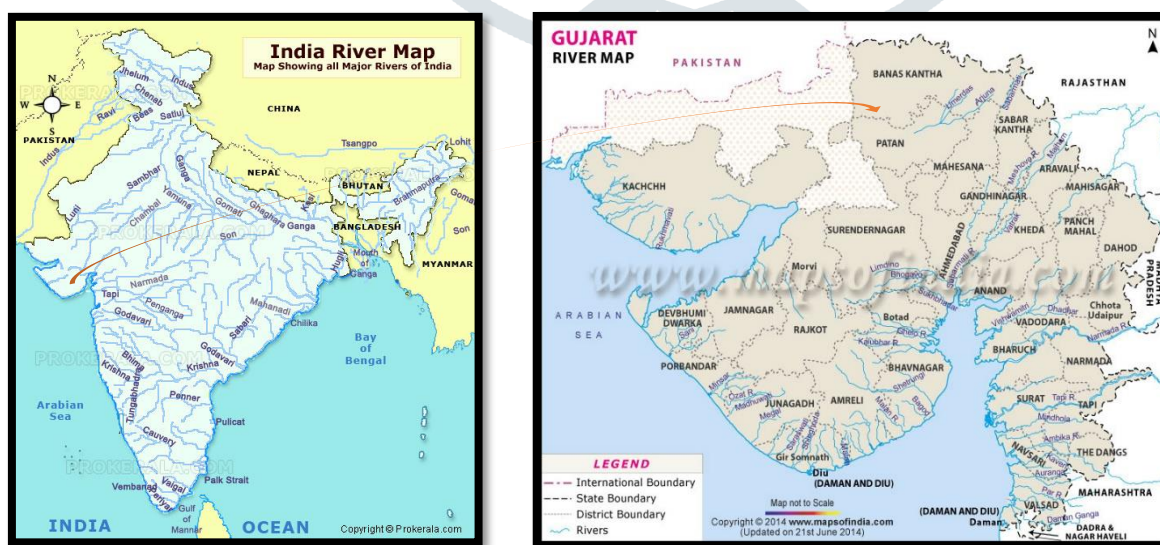


Figure 3.1 : India River Map and Gujarat River Map

Source : <https://www.mapsofindia.com/maps/gujarat/rivers>

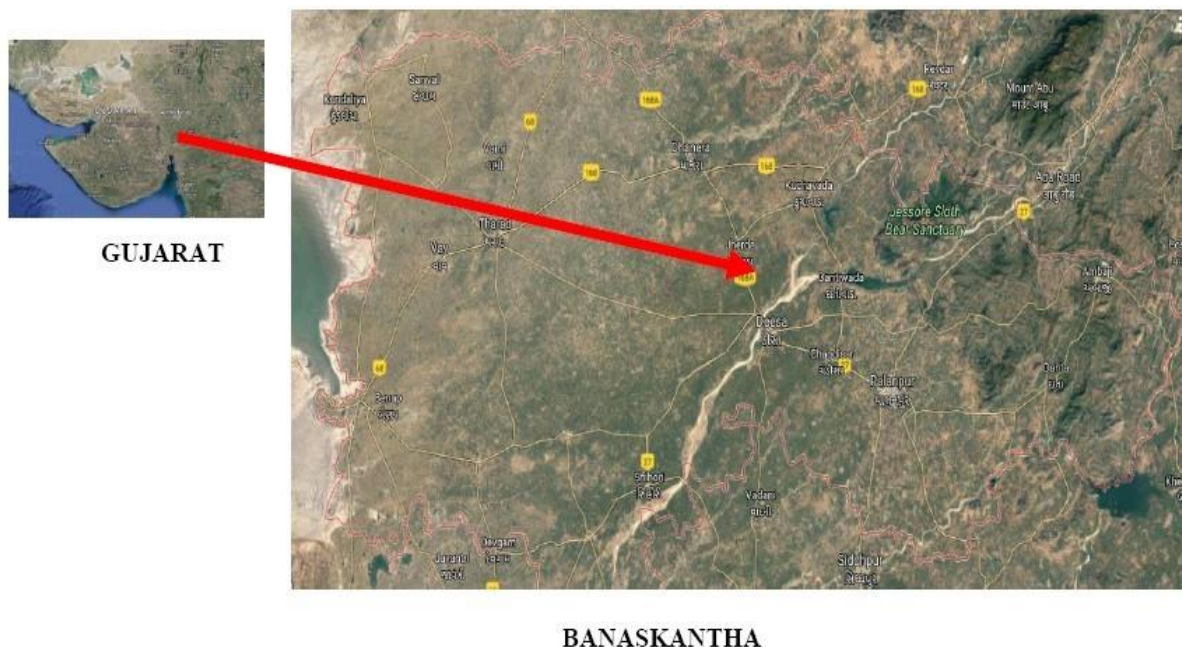


Figure 3.2 : Location of the study area

The Dantiwada Dam is a mud and masonry dam on the west banas river near Dantiwada, Banaskantha district of northern Gujarat in India. The Banas River has its origin in the Khamnor Hills, which is a tributary of the Chambal River. The river is popularly known as "Van Ki Asha" meaning hope of the forest. The river drains a basin of 45,833 km-square. It is a seasonal river that dries up during the summer months. The dam was constructed in 1965 mainly for irrigation and flood control. Total capacity of reservoir is 907.88 MCM and catchment area is 40.47 square kilometres.

111 total villages are under command of the Dantiwada Dam, of which 12 villages are partially submerged. Total land submerged under the reservoir include 1,215 hectares forest land, 810 hectares wasteland, 2,025 hectares cultivable land.

The Dantiwada Dam failed in 1973 after 8 years it was constructed due to failure of breach on account of flood. This happened because handling capacity was exceeded by one and a half time.

Table 3.1: Dam specification

Location	Dantiwada, Dist. Banaskantha
Purpose	Irrigation and flood control
River	Banas
Area of catchment	2862 km ²
Mean annual rainfall	940 mm
Type	Earthen and masonry
Bed type	Granite

Max. height above the lowest point of foundation	61m
Length of the top of the dam	4832m
Total Volume Content	
Concrete	0.394 Mm ³
Masonry	0.393 Mm ³
Earthwork	0.621 Mm ³
Area at full reservoir level	40.47 km ²
Gross storage capacity	464 Mm ³
Effective storage capacity	444 Mm ³

Table 3.2 : Spillway specification

Type	Ogee
Length	165m
Energy dissipater	Roller and ski-jump buckets
Maximum discharge	7504 m ³ /s
Type, nos. and size of gate	Radial , 11 , (12.5m* 8.23m)

3.3 Floods of 2017

Gujarat receives more than 90% of its annual rainfall during the southwest monsoon season extending from June to September. During July 2017, extremely heavy rainfall was recorded in Banaskantha, Patan, Surendranagar, Aravalli and Morbi districts. The average rainfall in Gujarat (in last three decades) ranges from less than 380 mm in Kutch to more than 1300 mm in South Gujarat. The State's average annual rainfall for the period 1987-2016 is 810 mm. By July 2017, the State had received 81.26% of the rainfall of the season.



Figure 3.3 : Contour map of North Gujarat

From the contour map it can easily understand that the area which was flooded twice in last 10 years is laying on the lowest elevation at 108m. Due to this reason it receives large amount of water when there will heavy rain at mount abu , khedbrahma and danta region and resulta in sudden flood.

In 2017, the monsoon commenced early with heavy rainfall for 3-4 days in July in north region of Gujarat. Usually, Gujarat gets its rainfall either from the system developed in the Bay of Bengal or the Arabian Sea. In 2017, both the systems got activated simultaneously. Moreover, low-pressure areas over the system emerging from the Bay of Bengal, which travelled across central India to reach Gujarat, particularly Banaskantha, Patan, Aravalli, Surendranagar and Morbi districts, aided the heavy downpour. By July 21st 2017, the State had received almost half (45.90%) of the entire season's average rainfall. In the next seven days, it received a quarter of the season's rainfall (26.57%). Surendranagar was first hit by heavy downpour that started from July 14. The district received over 110 mm of rainfall – nearly 20% of its annual average in nearly 24 hours on July 21-22, 2017. Banaskantha too recorded a whopping 257 mm of rainfall, nearly 40% of the annual monsoon rainfall in nearly 24 hours on July 24-25, 2017.

The flood situation compounded further with a major breach in the Narmada canal near Khariya village, Kankrej taluka, Banaskantha. State reservoirs, both natural and man-made, were already full. Unprecedented rainfall during July 2017 resulted into very heavy inflow into the dams such as Sipu, Dantiwada, Machhu, Dharoi across rivers such as Banas, Bhogavo, Sipu, Sabarmati etc.

Banaskantha reported 163.02% of annual average rainfall particularly during 24th-27th July, 2017. Dantiwada taluka and Deodar taluka recorded 252.55% and 226.82% rainfall respectively against their annual average rainfall during that period.

3.4 HYDROLOGICAL DATA

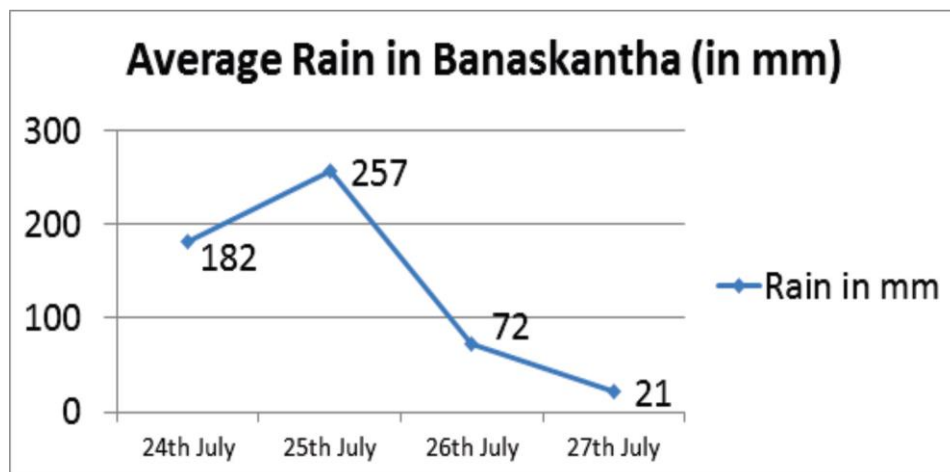


Figure 3.4 : Rain intensity readings from 24th July to 27th July 2017 of each day mentioned for Banaskantha District.

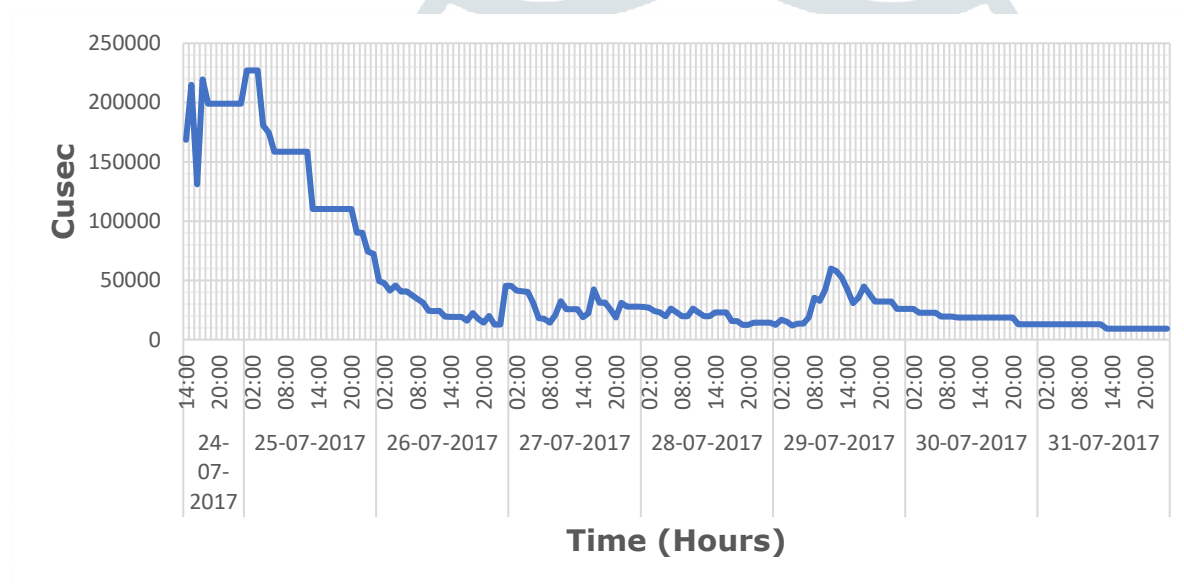


Figure 3.5 : Dantiwada Dam inflow in Cusec

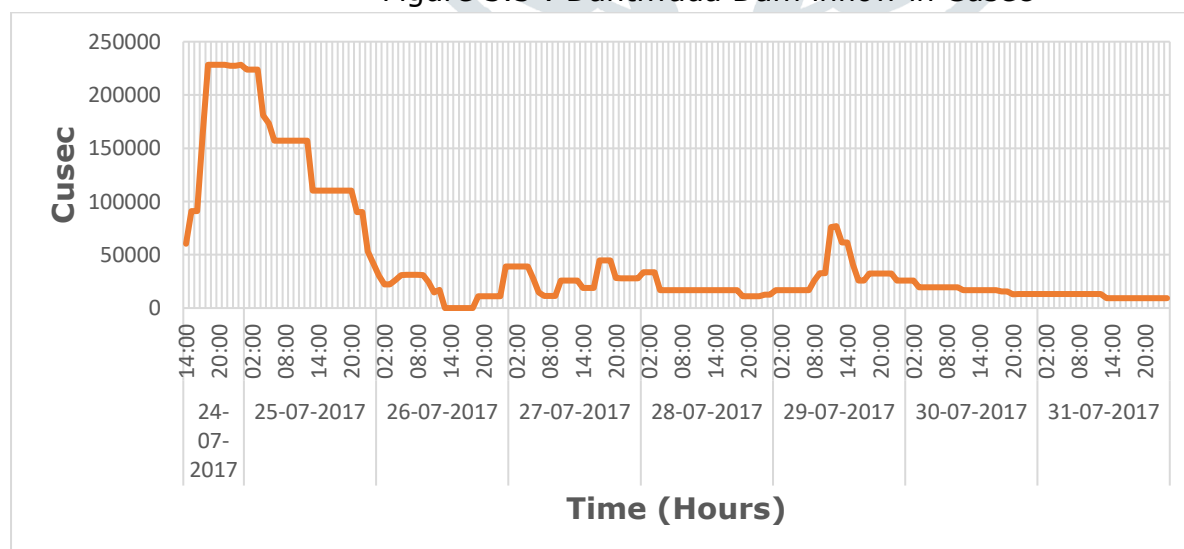


Figure 3.6 : Dantiwada Dam Outflow(Discharge) in Cusec

3.5 TOPOGRAPHICAL DATA

Topographic data representing the whole area potentially liable to flooding is required. The extent of this data should not be underestimated. Floods resulting from dam failure can be significantly larger than natural floods. Required topographic data will therefore extend widely across floodplains and up-valley slopes well above normal flood levels. Details of major structures that may form an obstruction to flow are also required, such as road and railway embankments and bridges and river control structures.

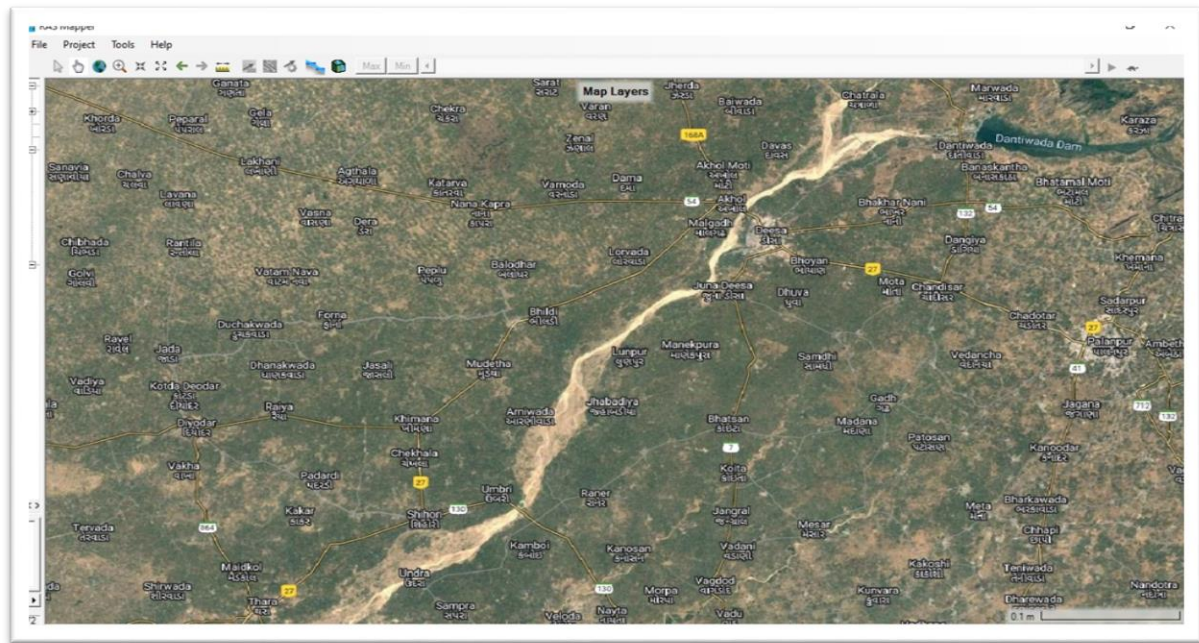


Figure 3.7 : Satellite Image of Terrain

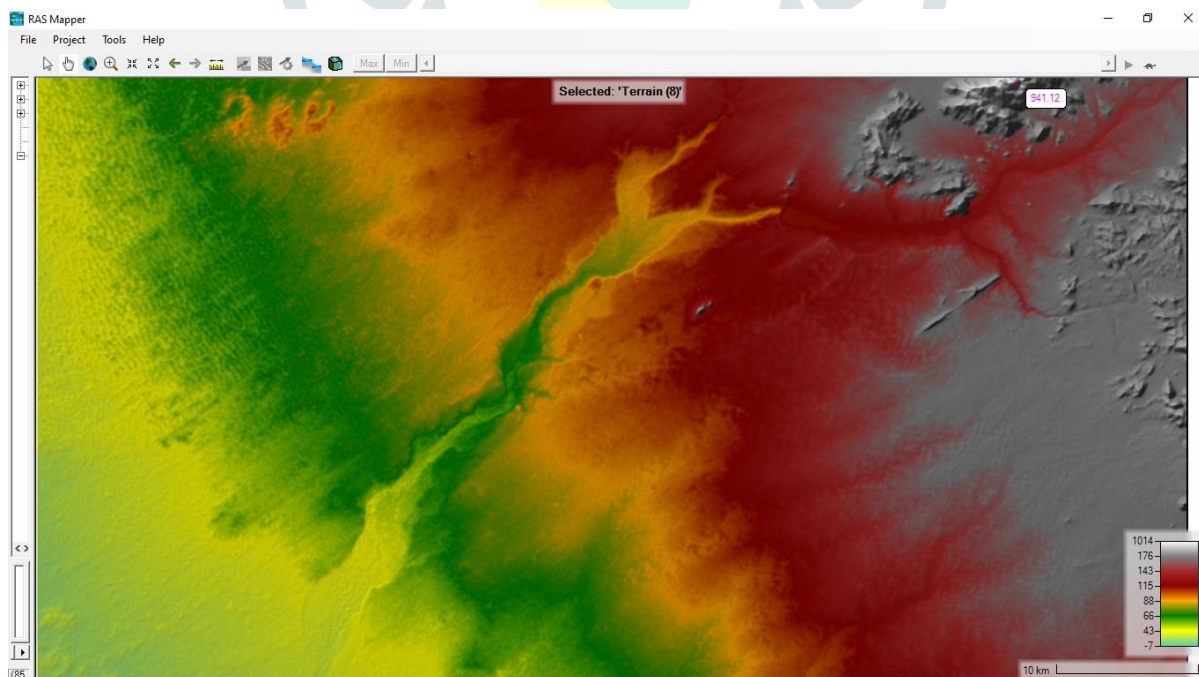


Figure 3.8 : Topographical DEM Image
Source : ALOS PALSAR – ASF (alaska.edu)

Alaska Satellite Facility (ASF) is very good resource center for providing remote sensing datasets specially SAR data and related products. It have data archives of past 25 years. ALOS PALSAR radiometric terrain corrected (RTC) high resolution (HR) product is one among the SAR data products of ASF. It's one major component is Digital Elevation Model (DEM) which have spatial resolution of 12.5m.

Digital Elevation Model (DEM) is the digital representation of the land surface elevation with respect to any reference datum. DEM is frequently used to refer to any digital representation of a topographic surface. DEM is the simplest form of digital representation of topograph. DEMs are used to determine terrain attributes such as elevation at any point, slope and aspect.

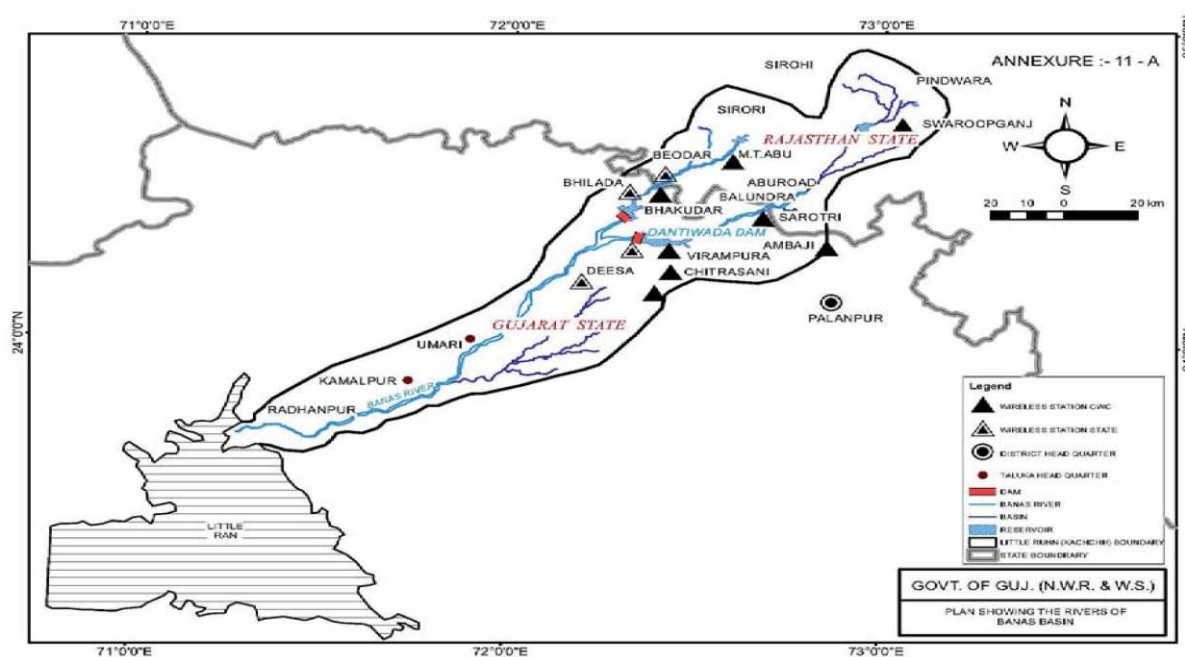


Figure 3.9 : Banas Basin

3.6 HEC-RAS SOFTWARE

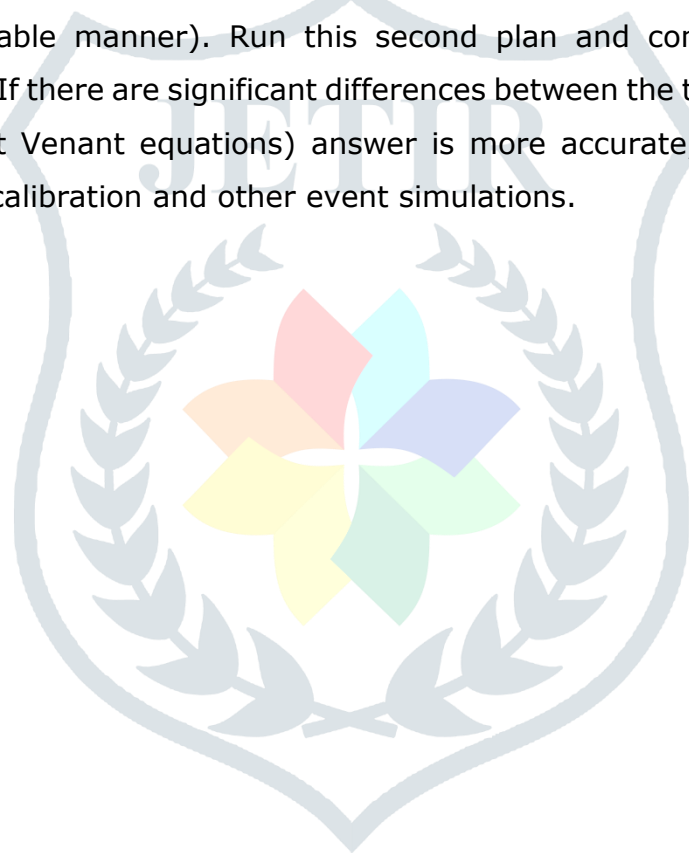
The HEC-RAS software was developed at the Hydrologic Engineering Center (HEC), which is a division of the Institute for Water Resources (IWR), U.S. Army Corps of Engineers.

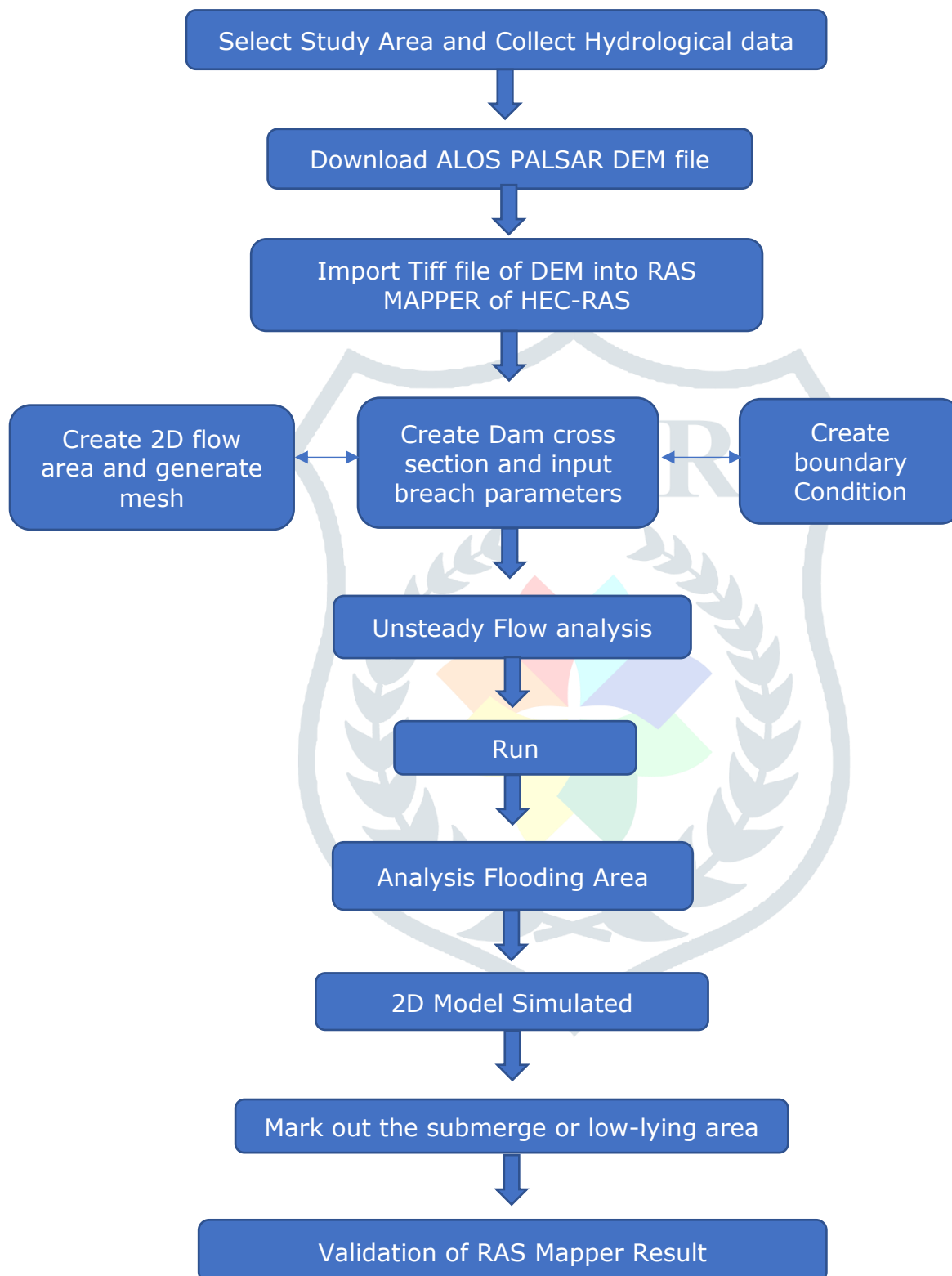
The U.S. Army Corps of Engineers' River Analysis System (HEC-RAS) is software that allows you to perform one-dimensional steady flow hydraulics; one and two-dimensional unsteady flow river hydraulics calculations, quasi unsteady and full unsteady flow sediment transport-mobile bed modeling, water temperature analysis, and generalized water quality modeling (nutrient fate and transport).

Shallow Water or Diffusion Wave Equations

HEC-RAS has the ability to perform two-dimensional unsteady flow routing with either the Shallow Water Equations (SWE) or the Diffusion Wave equations (DWE). HEC-RAS has three equation sets that can be used to solve for the flow moving over the computational mesh, the

Diffusion Wave equations; the original Shallow Water equations (SWE-ELM, which stands for Shallow Water Equations, Eulerian-Lagrangian Method); and a new Shallow Water equations solution that is more momentum conservative (SWE-EM, which stands for Shallow Water Equations, Eulerian Method). The SWE also have options for modeling turbulence and Coriolis effects. See Chapter 2 of the Hydraulic reference manual for the theory on the development of these equations for use in HECRAS. Within HEC-RAS the Diffusion Wave equations are set as the default, however, the user should always test if the Shallow Water equations are need for their specific application. A general approach is to use the Diffusion wave equations while developing the model and getting all the problems worked out (unless it is already known that the Full Saint Venant equations are required for the data set being modeled). Once the model is in good working order, then make a second HEC-RAS Plan and switch the equation set to the SWE option (SWE will generally require a smaller computation interval than the Diffusion wave method to run in a stable manner). Run this second plan and compare the two answers throughout the system. If there are significant differences between the two runs, the user should assume the SWE (Saint Venant equations) answer is more accurate, and proceed with that equation set for model calibration and other event simulations.

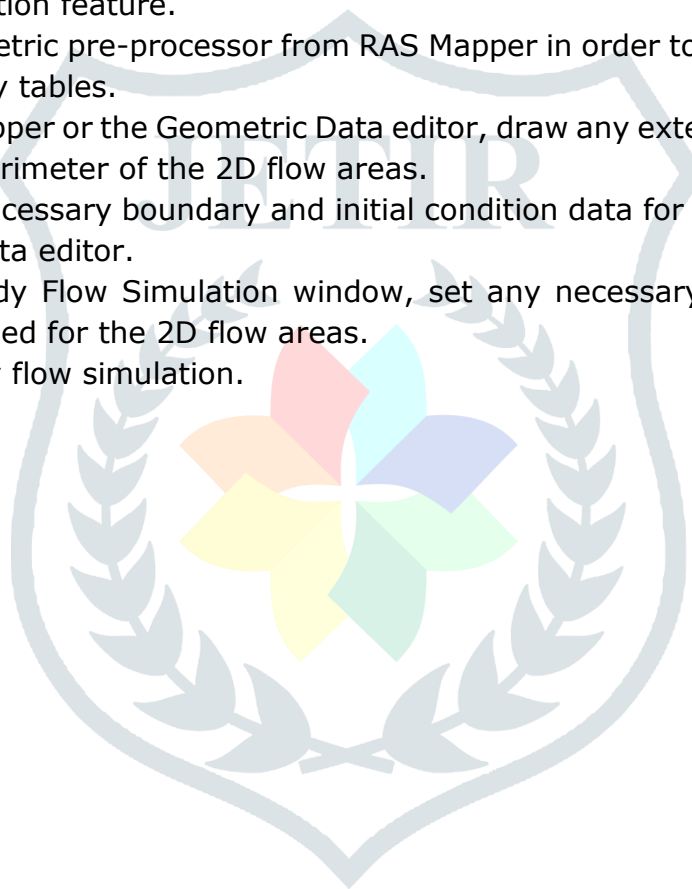


CHAPTER 4**METHODOLOGY****4.1 FLOW CHART OF METHODOLOGY**

Using HEC-RAS to perform 2D modeling or combined 1D/2D modeling is very easy and straight forward. The following are the basic steps for performing 2D modeling within HEC-RAS:

1. Establish a Horizontal Coordinate Projection to use for your model, from within HEC-RAS Mapper. This is normally done by selecting an existing projection file from an ESRI shapefile or another mapping layer.

2. Develop a terrain model in HEC-RAS Mapper. The terrain model is a requirement for 2D modeling, as it is used to establish the geometric and hydraulic properties of the 2D cells and cell faces. A terrain model is also need in order to perform any inundation mapping in HEC-RAS Mapper.
3. Add any additional mapping layers that may be needed for visualization, such as aerial photography, levee locations, road networks, etc.
4. From within the HEC-RAS Mapper draw a boundary polygon for each of the 2D Flow Areas to be modeled. Or you can import the X, Y boundary coordinates from another source.
5. Using the 2D Flow Area editor, create the 2D computational mesh for each 2D Flow Area.
6. Edit the 2D Flow Area mesh in order to improve it, such as: add additional break lines; use the refinement regions option to increase or decrease cell density as needed; Add, Move, or Delete cell centers where needed. Use the mesh refinement region tool to make a nice channel mesh.
7. Add any internal hydraulic structures inside of the 2D flow area(s) using the SA/2D Area Hydraulic Connection feature.
8. Run the 2D geometric pre-processor from RAS Mapper in order to create the cell and face hydraulic property tables.
9. From the RAS Mapper or the Geometric Data editor, draw any external boundary condition lines along the perimeter of the 2D flow areas.
10. Enter all of the necessary boundary and initial condition data for the 2D flow areas in the Unsteady Flow data editor.
11. From the Unsteady Flow Simulation window, set any necessary computational options and settings needed for the 2D flow areas.
12. Run the Unsteady flow simulation.



4.2 Procedure

Step : 1 Create new Project

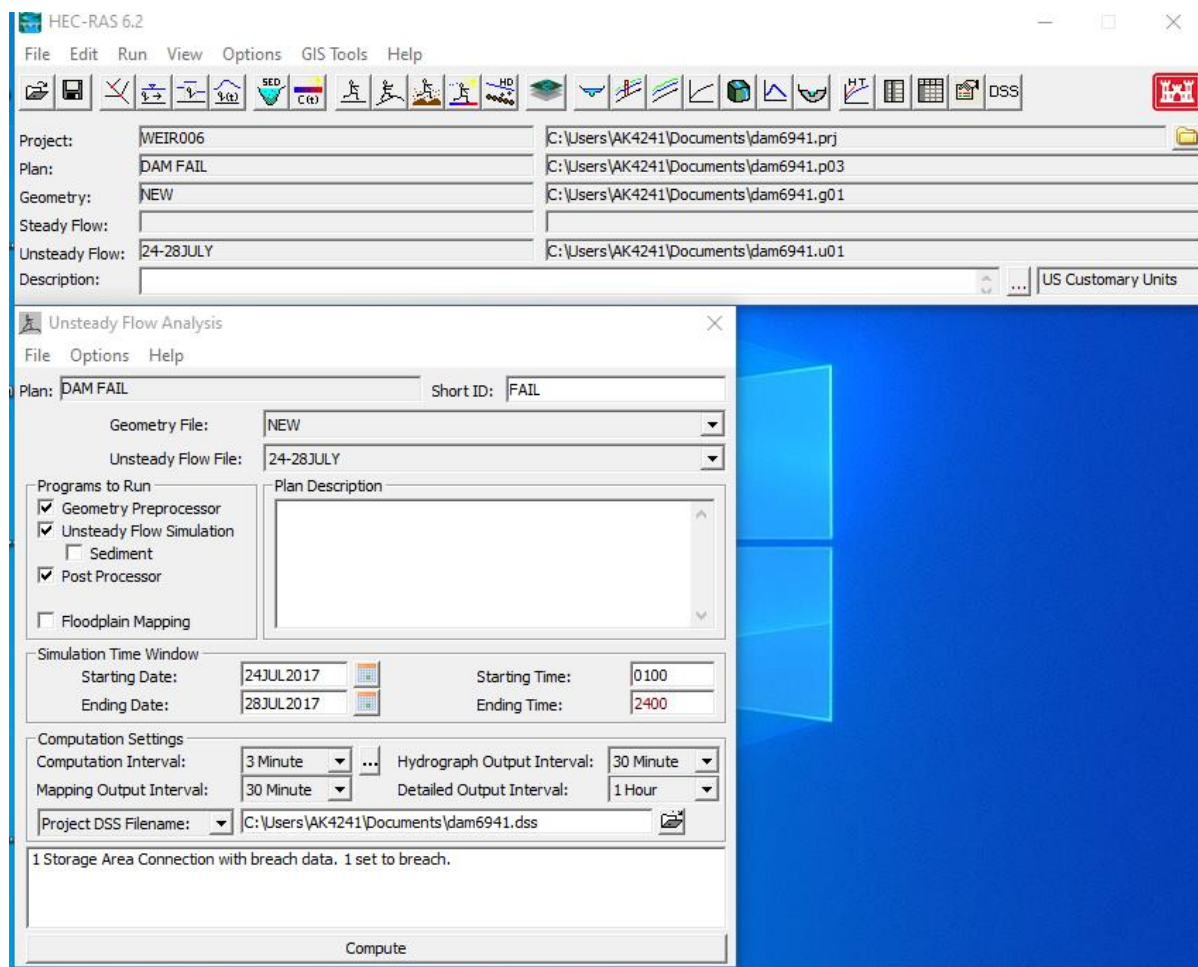


Figure 4.1 : Opening of HEC-RAS

Step : 2 Loading Terrain Data and Making the Terrain Model

It is essential to have a detailed and accurate terrain model in order to create a detailed and accurate hydraulics model. The quality of the terrain data can be a limiting factor in the quality of the hydraulics model create. Terrain data comes from many different sources, formats, and levels of detail. Currently HEC-RAS uses gridded data for terrain modeling. Gather data from multiple sources, then convert/export it into a gridded data format that can be read in by HEC-RAS. is necessary to create a terrain model in HEC-RAS Mapper before perform any model computations that contain two dimensional (2D) flow areas, or to visualize any one-dimensional (1D), 2D, or combined 1D/2D mapping results.

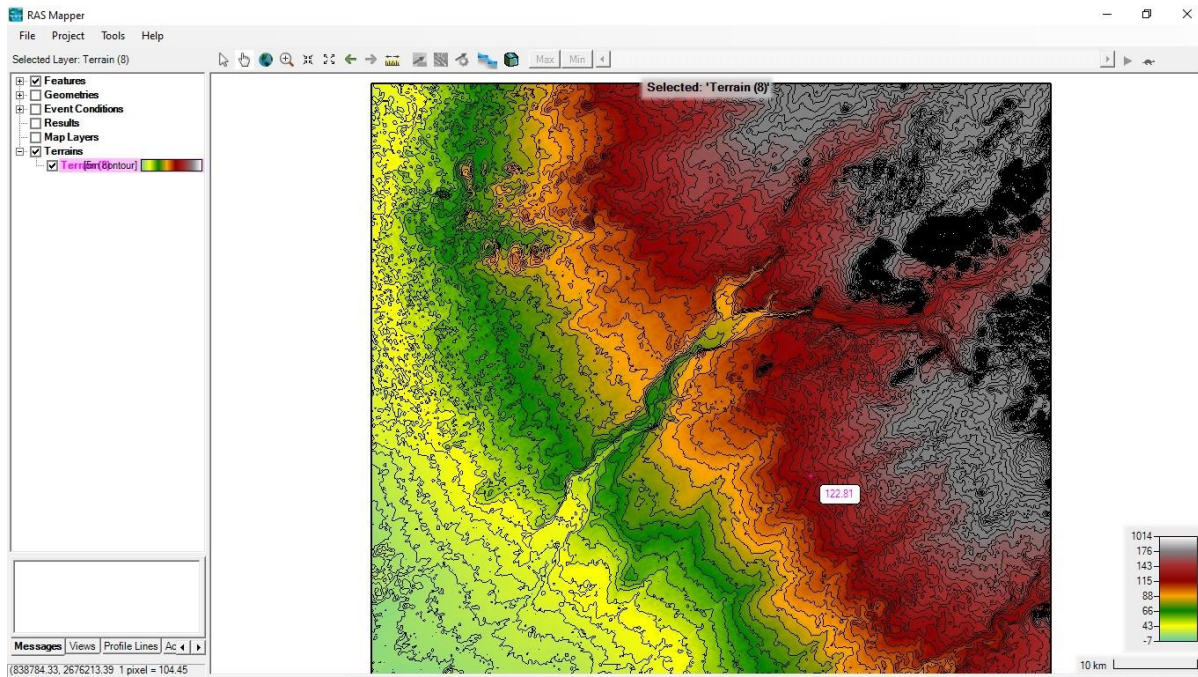


Figure 4.2 : Terrain Layer

The next step is to load the terrain data that will be used in creating the terrain model for HEC-RAS. To develop a new terrain data set (terrain model), from the RAS Mapper main window, right click on the Terrains layer and from the shortcut menu select Create New RAS Terrain. The New Terrain Layer dialog opens. This dialog allows the user to provide a name for the new Terrain Layer (Filename field, the default name is "Terrain"). Then select a directory for storing the terrain (Folder button) and define the elevation precision of the new terrain data layer.

Step : 3 Development of the 2D Computational Mesh

Add a 2D flow area polygon to represent the boundary of the 2D area using the geometry editing tools in HEC-RAS Mapper. The best way to do this in HEC-RAS is to first bring in terrain data and aerial imagery into HEC-RAS Mapper. Additionally, to bring in a shapefile that represents a protected area, if they are working with a leveed system. The terrain and background images will assist to figure out where to draw the 2D flow area boundaries.

The HEC-RAS terminology for describing the computational mesh for 2D modeling begins with the 2D flow area. The 2D flow area defines the boundary for which 2D computations will occur. A computational mesh (or computational grid) is created within the 2D flow area.

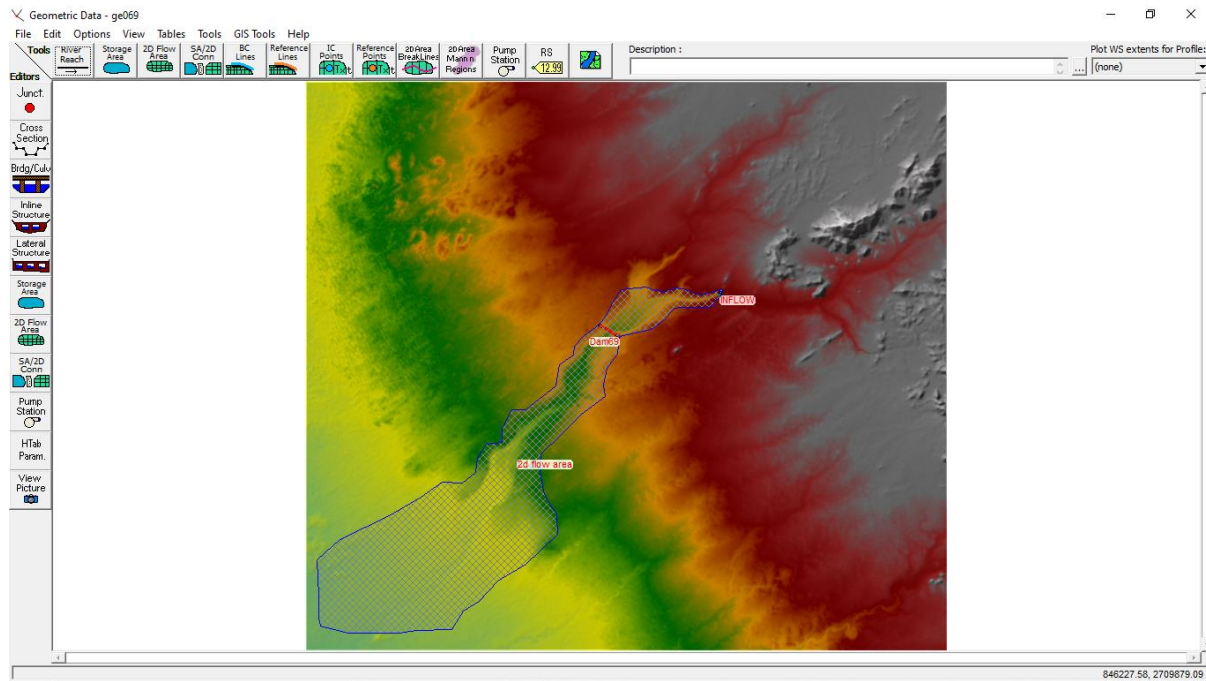


Figure 4.3 : 2d Computational mesh

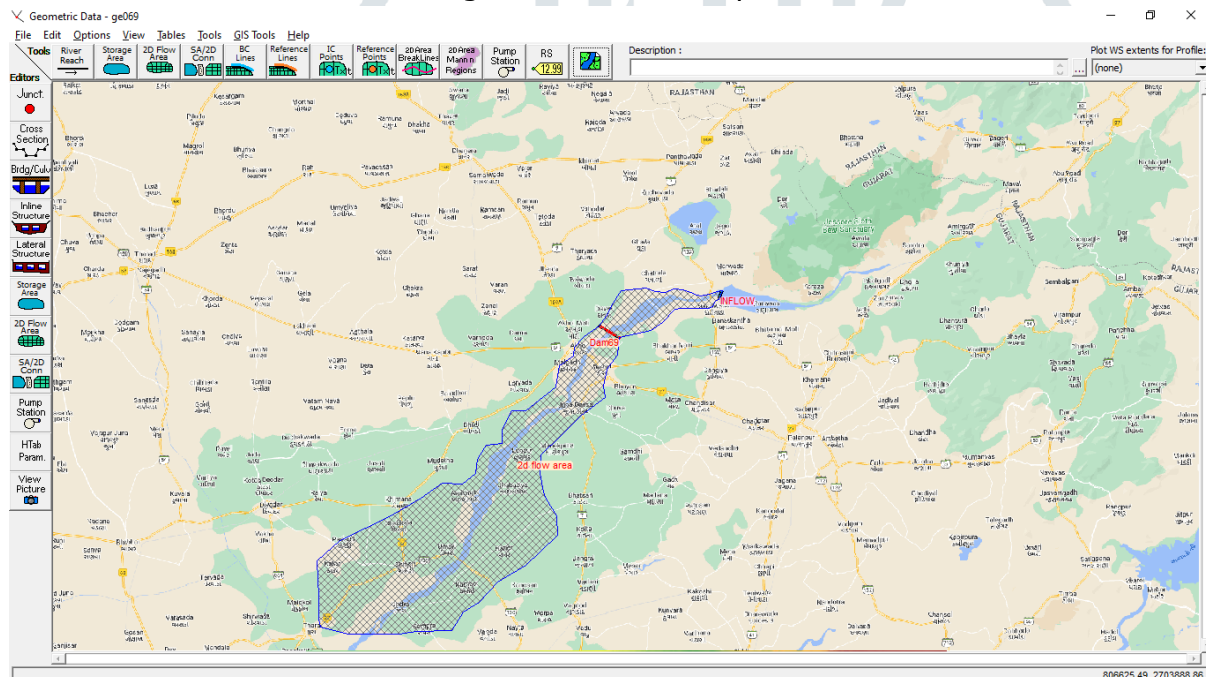


Figure 4.4 : 2d Computational mesh in Background Google map Image

The terrain and background images will assist to figure out where to draw the 2D flow area boundaries.

Step 4 : Connecting a 2D Flow Area to a Storage Area using a Hydraulic Structure.

2D flow area can be directly connected to Storage Area by using a hydraulic structure called a Storage Area/2D flow area Hydraulic Connector (SA/2D Area Conn). See the example in Figure.

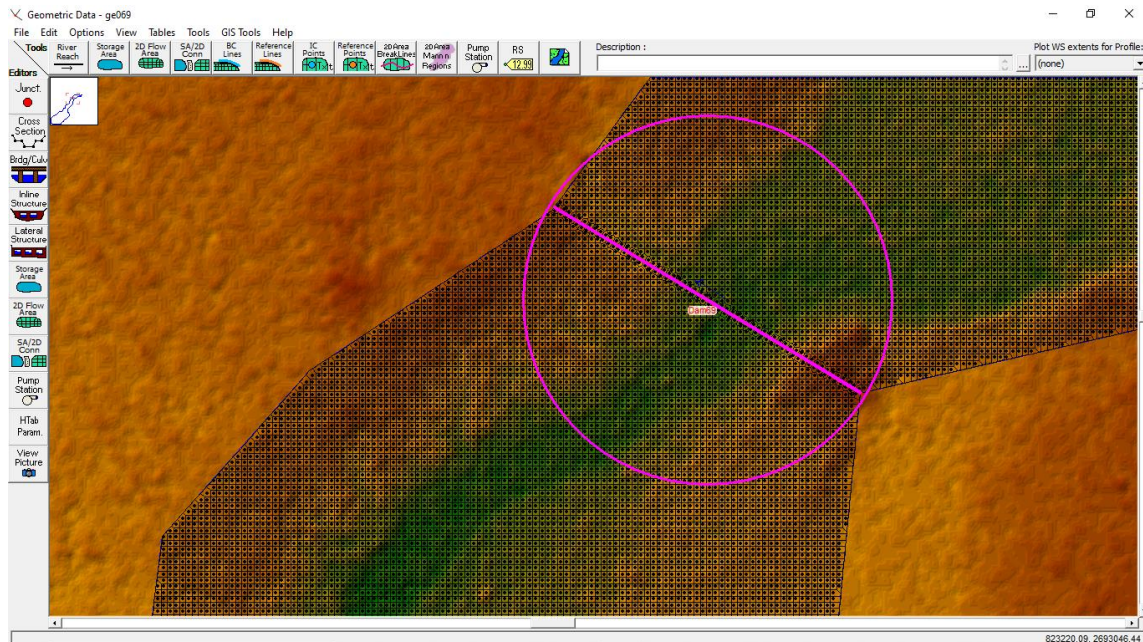


Figure 4.5 : Hydraulic structure as weir section

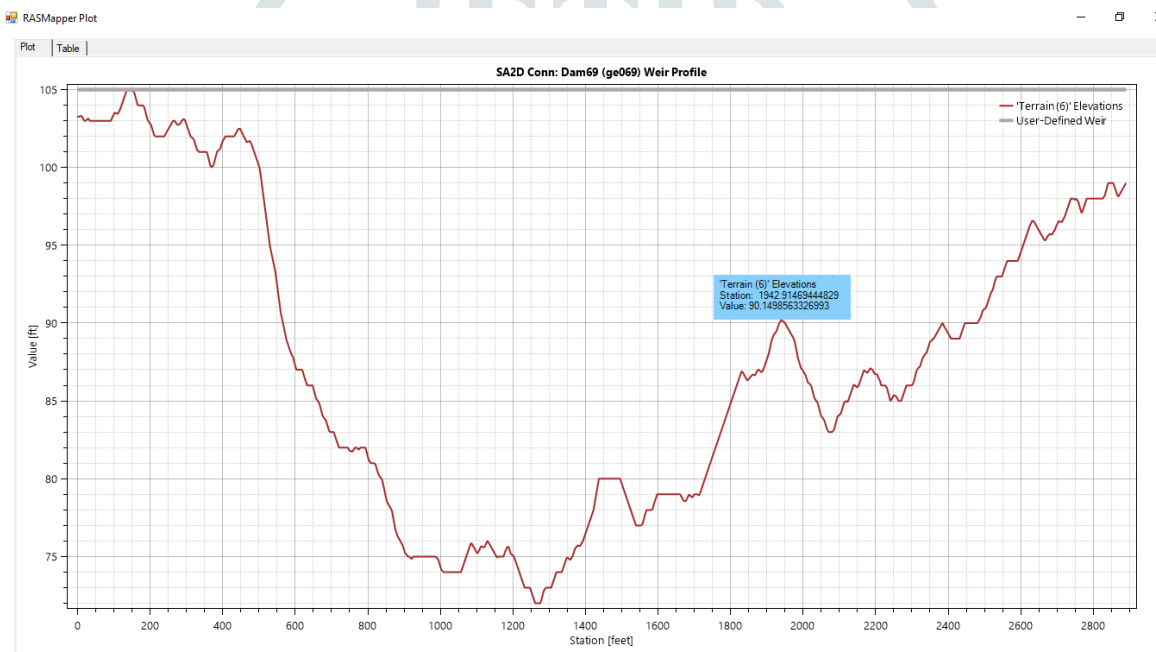


Figure 4.6 : SA Connection Profile.

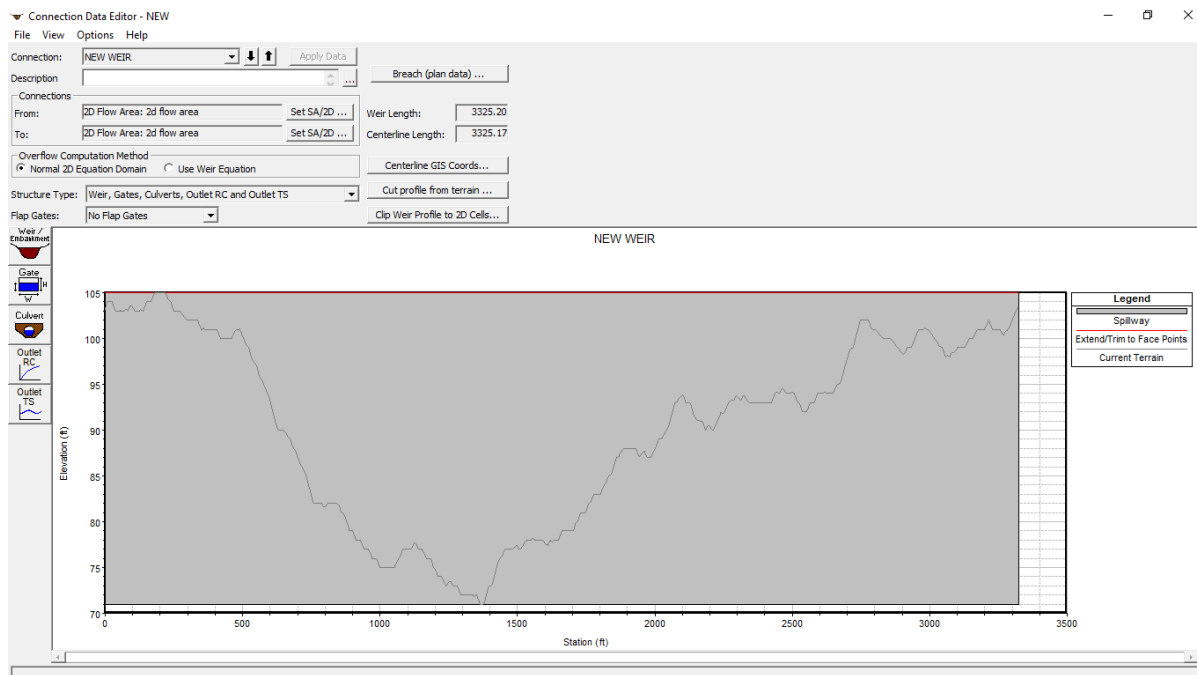


Figure 4.7 : Weir Created over SA Connection.

Enter all the hydraulic structure information for the connection. This will consist of a Weir/Embankment profile and any additional hydraulic outlets, such as culverts, gates, etc... In the example shown in Figure 43.7 there is a Weir.

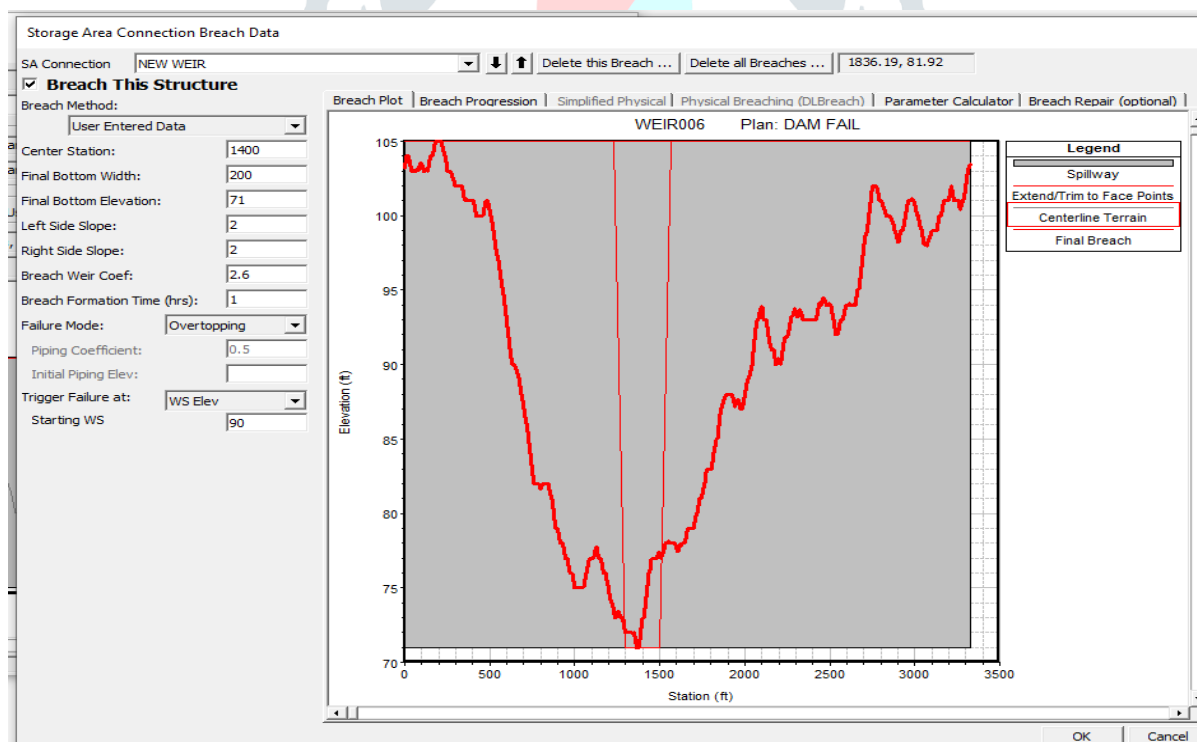


Figure 4.8 : Weir Breach Parameter

Step 5 : Boundary and initial conditions for 2d flow area

HEC-RAS has a wide range of boundary and initial conditions that can be applied to a model. Boundary conditions consist of external boundary conditions along the perimeter of the 2D area, internal boundary conditions, and global boundary conditions (Meteorological Data) that are

applied to the entire model. A flow hydrograph is generally used to bring flow into a 2D flow area; however, it can also be used to take flow out (negative flow values). The required data for this boundary condition type is: Flow hydrograph (discharge Q, versus time)

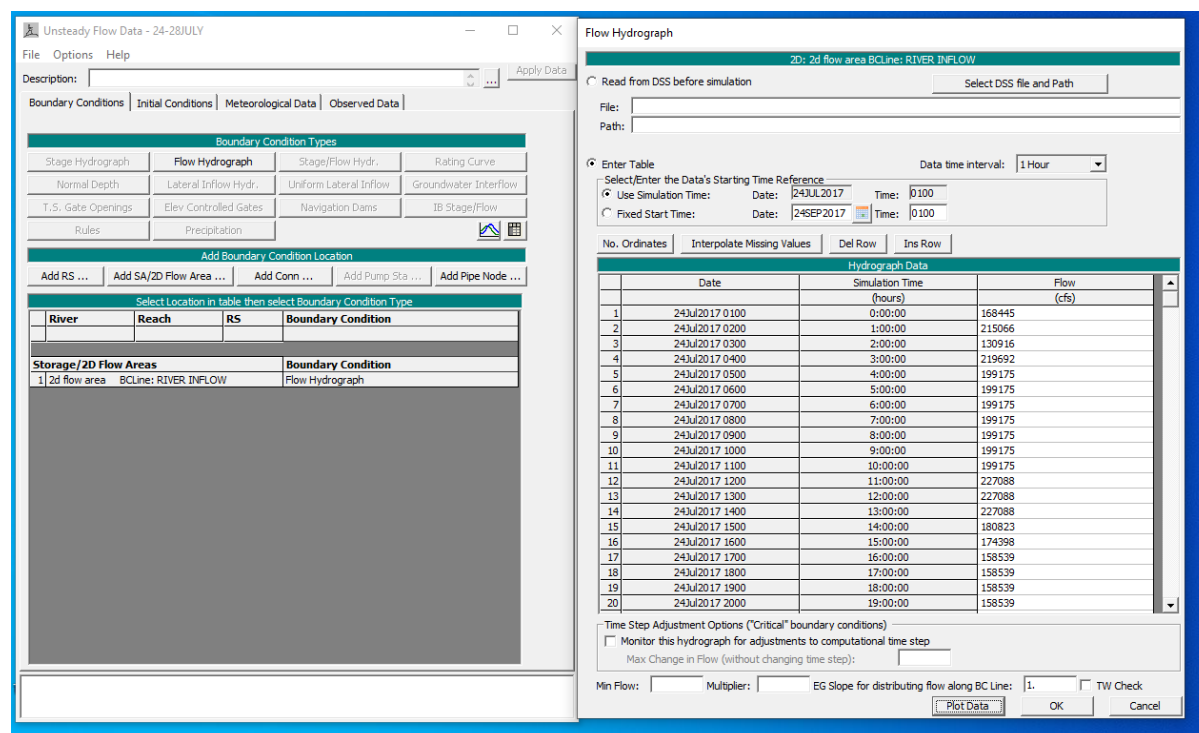


Figure 4.9 : Unsteady Flow data

As shown in Figure, the created internal BC lines will be listed in the boundary conditions table, and will allow to attach a flow hydrograph to a selected BC line. If the BC line crosses more than one cell, flow is distributed across the cells based on the percentage of the line length that crosses that cell. For example, if a cell contains 20% of the BC line length, then the cell will receive 20% of the flow each time step.

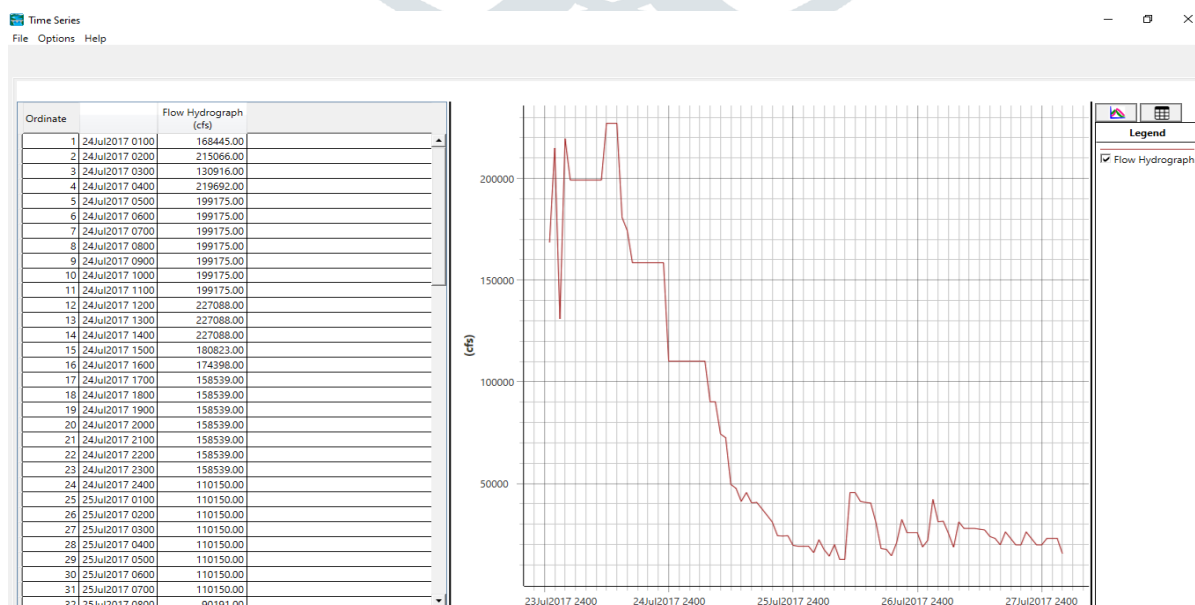


Figure 4.10 : Flow Hydrograph

Step 6 : Running a model with 2d flow area

Running a 2D unsteady flow model in HEC-RAS is no different than running a standalone 1D unsteady flow model. The 2D unsteady computational module is built directly into the HEC-RAS unsteady flow computational engine. It is not a separate program. The 1D and the 2D computations are directly coupled on a time step by time step basis (there is also an iteration option for connections between 1D and 2D elements). This allows direct feedback from 1D to 2D elements and from 2D to 1D elements for each time step. This makes the linking of the 1D and 2D very accurate when it comes to sending flow through a breach (using a lateral structure), or any other type of hydraulic link between 1D and 2D elements. This direct feedback allows the software to more accurately calculate headwater, tailwater, flow, and any submergence that is occurring at a hydraulic structure on a time step by time step basis.

CHAPTER : 5 **RESULTS AND DISCUSSION**

5.1 General

From the simulation of the dam we are getting which areas are going to be affected due to dam failure and also the depth of flow at different location.

5.2 RAS Mapper Results

When a Map Layer is being displayed in the map window, the results of that map can be queried to display the point value by simply moving the mouse over the map layer. To do this, first click on the results map layer, to make it the active layer. When a results map layer is being displayed, clicking on that layer will turn the label to magenta in the layer directory tree. Once the desired results layer is turned on, and it is set to the active layer, move the mouse pointer over that layer, and everywhere the user moves the mouse pointer the numerical value of that result will be displayed next to the mouse pointer. See the example below in Figure 5.2.

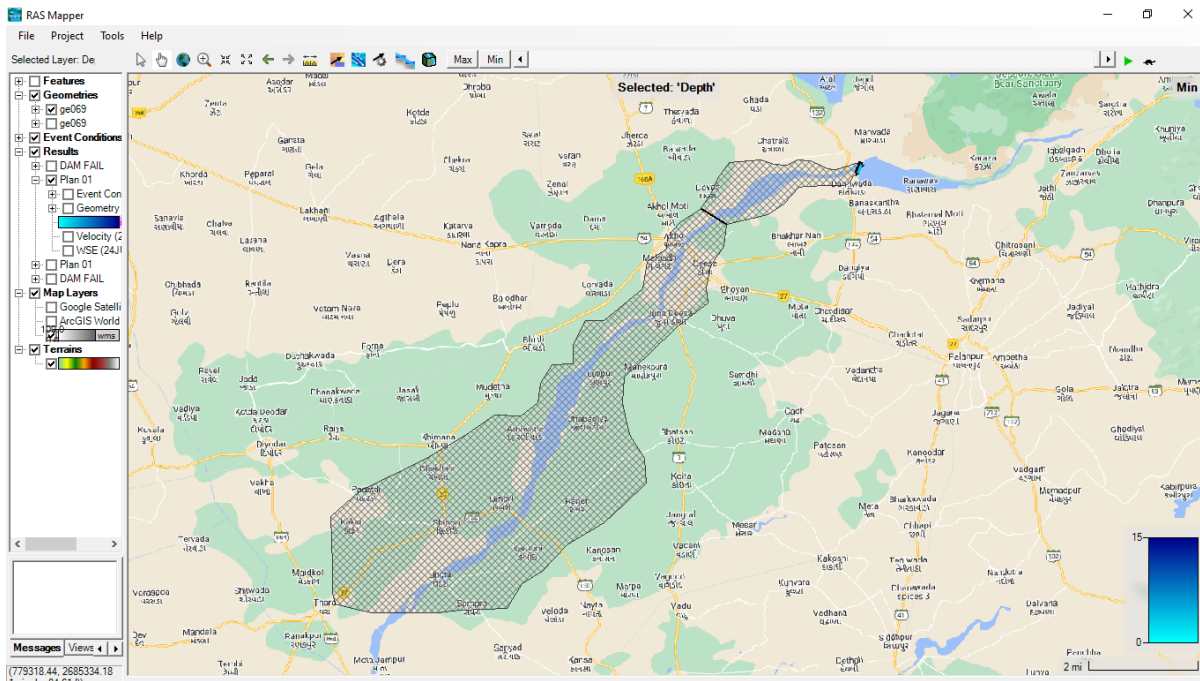


Figure 5.1 : Flow of river before dam breach condition

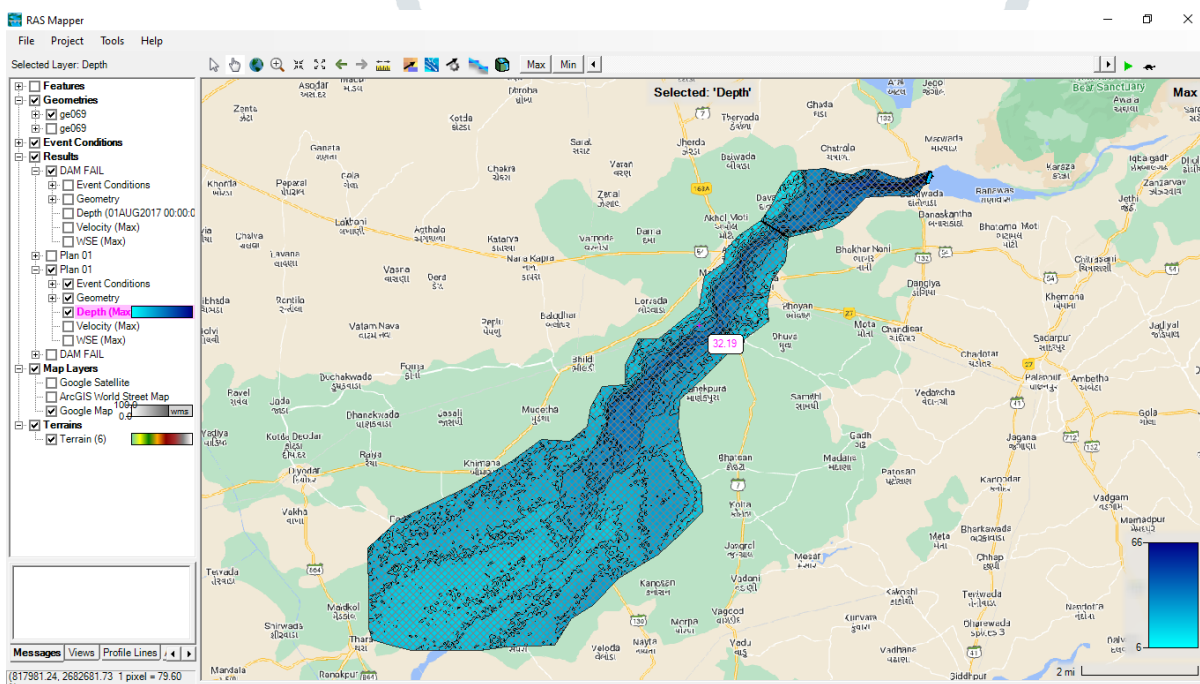


Figure 5.2 : Water flow after dam breach condition

Figure 5.2 show all the bounded mesh area fully flooded, when inflow of banas basin is from 24 july 2017 to 28 july 2017. List of villages likely to be affected by Floods in D/S of Dantiwada Dam over Banas River is shown in the Table 5.1.

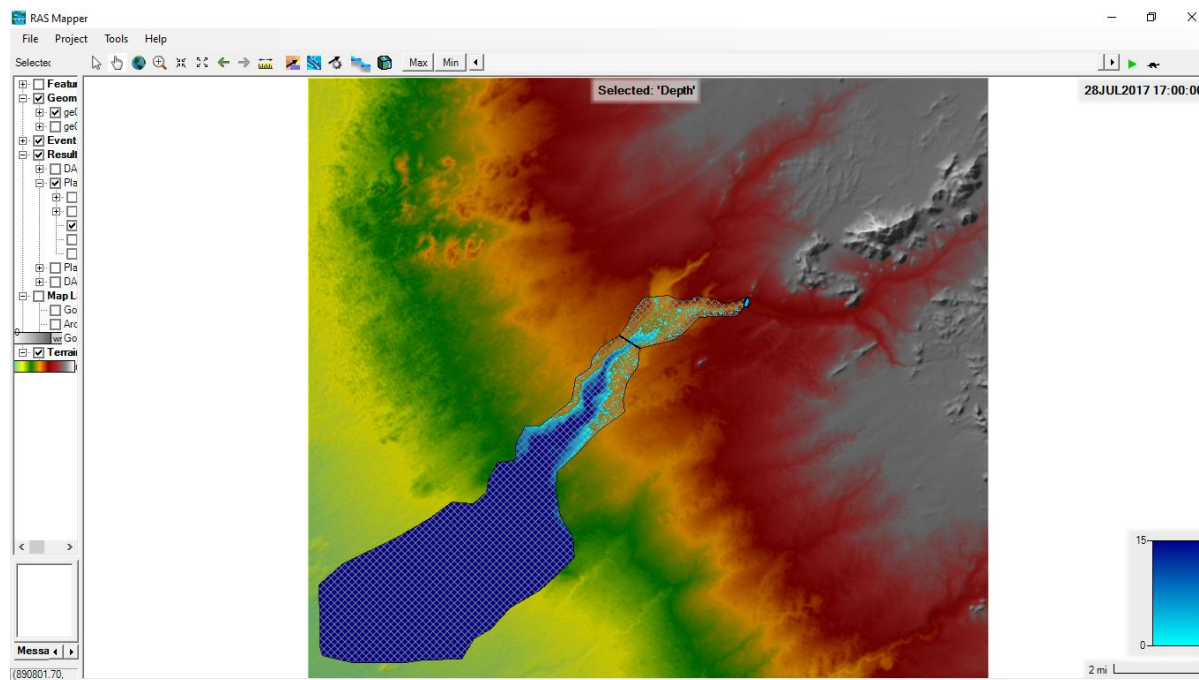


Figure 5.3 : RAS Mapper Result in Terrain Layer

Table 5.1 Villages affected by flood

BANASKANTHA DISTRICT							
No.	KANKREJ TALUKA			No.	DEESA TALUKA	No.	DANTIWADA TALUKA
1.	Lilapura	20.	Nagot	1.	Bhadath	1.	Nadotra Thakorwas
2.	Jamana Padar	21.	Mangalpura	2.	Multhar Goliya	2.	Nadotra Brahmanwas
3.	Mali Goliya	22.	Vada	3.	Chandaji Goliya	3.	Sikariya
4.	Bakoli	23.	Ranavada	4.	Vidi		
5.	Sohanpur	24.	Odna	5.	Vasada		
6.	Sakariya	25.	Kasalpur	6.	Ranpur East		
7.	Sudarsan	26.	Balochpura	7.	Ranpur west		
8.	Rupapura	27.	Belapura	8.	Akhol Moti		
9.	Sihgori	28.	Magarpura	9.	Akhol Nani		
10.	Umri	29.	Jamipura(Juna)	10.	Mahadevia		
11.	Dudosan	30.	Kamboi	11.	Malgadh		
12.	Manpur	31.	Anganvada	12.	Kupat		
13.	Shiya	32.	Abmainna	13.	Vadaval		

14.	Anandpura	33.	Jampura Mota	14.	Jabadiya		
15.	Oon	34.	Jampura Nana	15.	Bhadramali		
16.	Kharia	35.	Ganyanpura	16.	Sanath		
17.	Bhadravadi	36.	Valpura	17.	Chhatrok		
18.	Totana	37.	Avaniwada	18.	Bodol		
19.	Tana						

Villages likely to be affected by flood of Banas river on the basis of discharge available at Deesa Road Bridge gauge site.

Table 5.2 : Gauge level and Signals for Villages

Sr. No.	Discharge in River Banas (cusec)	Gauge Level at Deesa Bridge in Meter	Gauge in Meter	Name of Taluka Affected by Flood	Signals for Villages at Sr. No. of Table 5.1		
					White Signal	Blue Signal	Red Signal
1.	50006.04	123.75	2.65	Deesa	1 to 3	-	-
2.	60035.00	123.95	2.85	Deesa	-	1 to 3	-
				Dantiwada	1 to 3	-	-
3.	69994.33	124.15	3.05	Deesa	-	-	1 to 3
				Dantiwada	-	1 to 3	-
4.	100012.08	124.45	3.35	Dantiwada	-	-	1 to 3
				Kankrej	1 to 8	-	-
5.	120000.37	124.70	3.60	Kankrej	9 to 25	1 to 8	-
6.	130029.83	124.75	3.65	Kankrej	-	9 to 25	1 to 8
7.	150018.12	124.95	3.85	Kankrej	26	-	9 to 25
8.	200024.16	125.50	4.40	Deesa	4 to 18	-	-
				Kankrej	27 to 37	26	-
9.	350042.28	126.85	5.75	Deesa	-	4 to 18	-
				Kankrej	-	27 to 37	-
10	400048.32	127.25	6.15	Deesa	-	-	4 to 18
				Kankrej	-	-	27 to 37

Note- Zero level of Deesa Road Bridge is 121.10 Meter

Note :

1. White Signal : Alert
2. Blue signal : Ready for Evacuation
3. Red Signal : Immediate Evacuation

CHAPTER 6

CONCLUSION

Overtopping mode of failure of the structure was considered for the analysis. The parameters of breach selected is reasonable for the dam break flood generation. The details of water surface elevations, time of arrival of maximum flow at different locations of the valley gives an idea about extent of flooding. Many villages are severely affected due to this flood condition. From this it would be easy to prepare any emergency action plan for that area.

REFERENCES

"Flood Management in Mahanadi Basin using HEC-RAS and Gumbel's Extreme Value Distribution", Prabeer Kumar Parhi¹, Received: 24 April 2016 / Accepted: 13 June 2018 / Published online: 21 June 2018, The Institution of Engineers (India) 2018.

Abhijith R, Amrutha G et.al , "Dam Break Analysis of Idukki Dam using HEC-RAS",IRJET Volume: 04 Issue:07 , July 2017 , 3410-3415

Kamal edin ELsidig Bashir et.al, "Virtual Failure Influence of Roseires Dam on Khartoum City Using HEC-RAS Hydraulic Simulation Modelling ", JECS , Vol. 16 , No. 3 , 2015 , 15-23

Thair M. Al-Taiee , Anass M. M. Rasheed , "Simulation Tigris river flood wave in mosul city due to a hypothetical mosul dam break" , IWTC 13 , 2009 , 283 - 299

Floodplain Mapping and Management of Urban Catchment Using HEC-RAS: A Case Study of Hyderabad City, Vinay Ashok Rangari¹, V. Sridhar¹, N. V. Umamahesh¹, Ajey Kumar Patel¹, Received: 21 May 2018 / Accepted: 9 November 2018, The Institution of Engineers (India) 2018.

"Dam Break Flood Risk Assessment for Laiyang City", Li Changzhi¹, Wang Hong¹, Chi Zhixue², Yang Yongfeng², Rao Zhengfu³ and Cope Mike³ ,China Institute of Water Resources and Hydropower Research, Beijing 100038. Journal of Geological Resource and Engineering (2014) 189-199

S.N. Junkman, Global perspectives on loss of human life caused by floods. Nat. Hazards 34-2, 151-175 (2005)

M.R. Ghanbarpour, M.M. Saravi, S. Salimi, Floodplain inundation analysis combined with contingent valuation: implication for sustainable flood risk management. *Water Resour. Manag.* 28, 2491–2505 (2014)

D.K. Panda, A. Kumar, S.K. Ghosh, R.K. Mohanty, Stream flow trends in the Mahanadi River basin (India), linkage of tropical climate variability. *J. Hydrol.* 495, 135–149 (2013)

WRD DMP 2021 (Flood Warning Arrangements) Gujarat.

Gujarat Flood 2017 - A Case Study by NDMA & GIDM.

HEC-RAS 2D User's Manual-v3-20220514_2022

Software : HEC-RAS 6.2

Web-sites

1. <http://www.india-wris.nrsc.gov.in>
2. <http://210.212.135.230/fcc/frmGujNote.aspx>
3. <https://guj-nwrws.gujarat.gov.in>
4. http://bhuvan.nrsc.gov.in/bhuvan_links.php#
5. [http://ALOS PALSAR – ASF \(alaska.edu\)](http://ALOS_PALSAR_-_ASF_(alaska.edu))
6. www.Wikipedia.org
7. www.youtube.com

