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# Design of Storm Water Network for Nagala Village, Tharad Taluka, Banaskantha

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***Abstract-***As India is agriculture based country, the problem of climate change act major as globally. It may lead to increase temperature day by day, which causes unpredictable heavy rain in short duration. Due to short period heavy rain water logging become a serious problem. This problem badly affects People, crop production, Infrastructure Facility, socio-economic growth of country. Water-logging is one of the major environmental problems and challenges of socio-economic development in the western part of Banskantha. In month of July, 2015 heavy rain occurs of 48 inch in 3 days. Due to this many of area is submerged and act like a lake up to several month particularly in Nagala village, Banaskantha district. Main focus is on removing that water easily and effectively. This study mainly comprises removal of excess water and provides effective and efficient drainage system in western part of Banaskantha mainly focuses on designing of storm water drainage for Nagala village.

***Keywords: Water logging, Drainage, Runoff, Storm water***

## I. INTRODUCTION

The Indian subcontinent is characterized by a tropical monsoon climate which means that India is among the countries which receive seasonal rainfall in contrast to countries like Germany where precipitation occurs throughout the year. The monsoon is highly important for India as it fills up water reservoirs, replenishes ground water and is essential for the Indian agriculture of which around 70% are rained. But the monsoon also causes problems in India's cities.

Water-logging is emerging as a pressing concern at the backdrop of climate change in recent years in Gujarat also. A global report on climate change has projected 0.5-1.20 $^0$C rise in temperatures by 2020, resulting in unpredictable and excessive rains. Globally, more than 40 m ha area is estimated to be affected by water-logging. In India about 8.53 m ha area is affected by water-logging with an estimated crop loss of greater than 2 m tons each year.

Due to this heavy and unpredictable rain in India, now a day's water logging becomes one of serious problem. To overcome this water logging problem, provision of storm water drainage is must in affected area, which are heavily flooded as well as not having existing drainage system over there. To understand and analyse this problem, Nagala village took as Study area and Proper design of storm water is calculated by using GIS as well as Microsoft Excel.

## II. BANASKANTHA AT A GLANCE

Banaskantha is one among the thirty-three districts of the Gujarat state of India. The administrative headquarters of the district is at Palanpur which is also its largest city. Banaskantha District situated between latitude 24.1731° north and longitude 72.4314° east. The district is located in the Northeast of Gujarat and is presumably named after the West Banas River which runs through the valley between Mount Abu and Aravalli Range, flowing to the plains of Gujarat in this region and towards the Rann of Kutch. The geographic area of Banaskantha District is 10,400 sq.km. It contributes to agriculture Product of states and Ranks No. 1 in Production of Potatoes in India.

### 2.1 Location of Study area

The study area falls in Banaskantha district, Nagala Village of Tharad taluka. Total area of Tharad is 1358 km$^2$

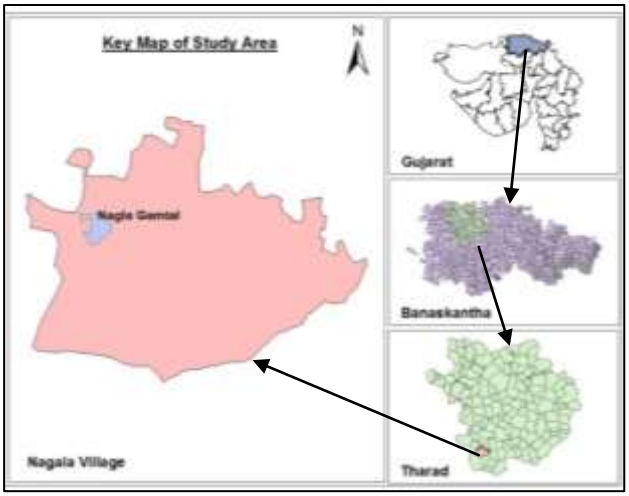


***Figure 1. Key Map of Nagala Village***

### *2.2* Geographic Profile of Study Area

*Table 1 Geographic Profile Data*

| Taluka/Village Name | Population | | | Household |
|---|---|---|---|---|
| | Total | Male | Female | |
| Tharad | 3,27,289 | 173732 | 153557 | 39,314 |
| Nagala | 2276 | 1325 | 951 | 233 |

### 2.3 Climate

It is too hot in summer. In summer highest day temperature is in between 30 ° C to 43°C. Average temperatures of January is 21 ° C , February is 23 ° C , March is 28 ° C , April is 32 ° C , May is 35 ° C.

## III. NEED OF STUDY AREA

Recently major part of Banaskantha district experienced heavy rain in the month of July, 2015 of dated from 26 to 30 resulting in water logging most of the area. It is disturbing day to day activity of the human being and causing lot of damage to the property, agriculture and animals needing detail study of the area to prevent and manage such type of disaster in future.

## IV. AIM OF STUDY AREA

The main aim of the study is to design suitable storm water drainage system to prevent water logging in future. Solving problem of waterlogged are will lead to a significant increase in quality of life, maintain hygienic condition and regional development take place. Geo-informatics techniques are used for identification of depression area as well as generation of maps become easy. Designing part is calculated by using Microsoft Excel Sheet.

## V. METHODOLOGY

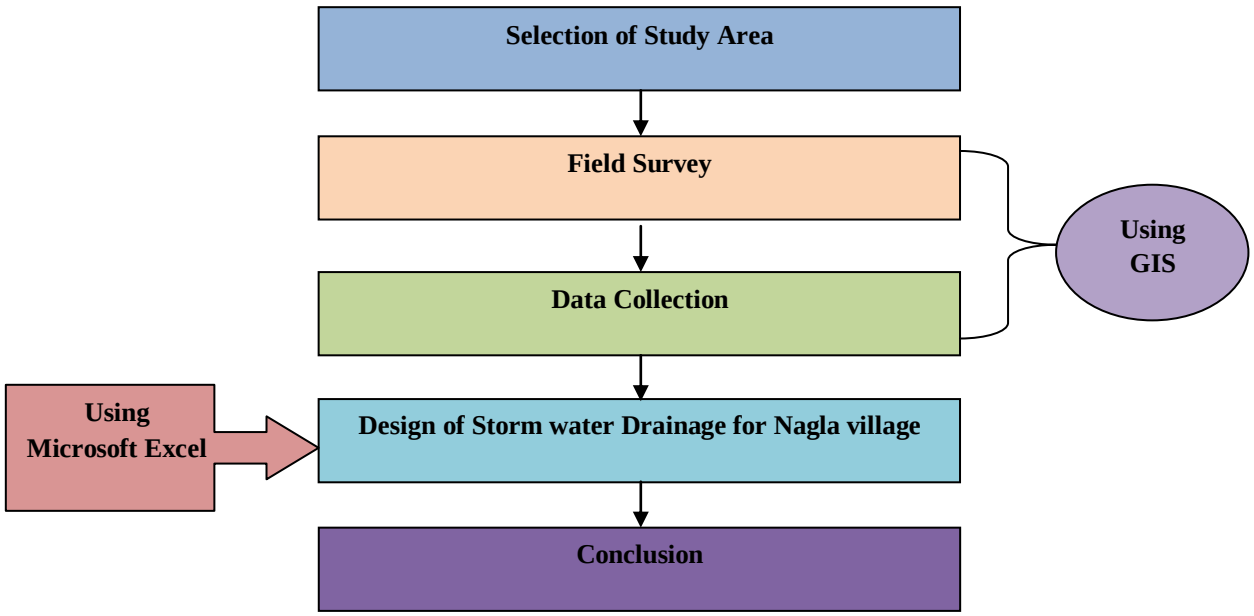


*Figure 2. Chart of Methodology*

## VI. FIELD SURVEY

Recently major part of Banaskantha district experienced heavy rain in the month of July, 2015 of dated from 26 to 30 resulting in water logging most of the area. Overall 100 villages are affected in Banaskantha and Patan. There were 55 villages which affected more. Within this four day duration average 1040 mm and maximum 1195 mm rain occur in Dhanera, Vav and Tharad villages. From which accumulated water was pumped out within approximate 20 days from 51 villages. But in Nangla, Dodgam, Khanpur villages were suffered due to their topographical condition and law laying area for more than three to four months.

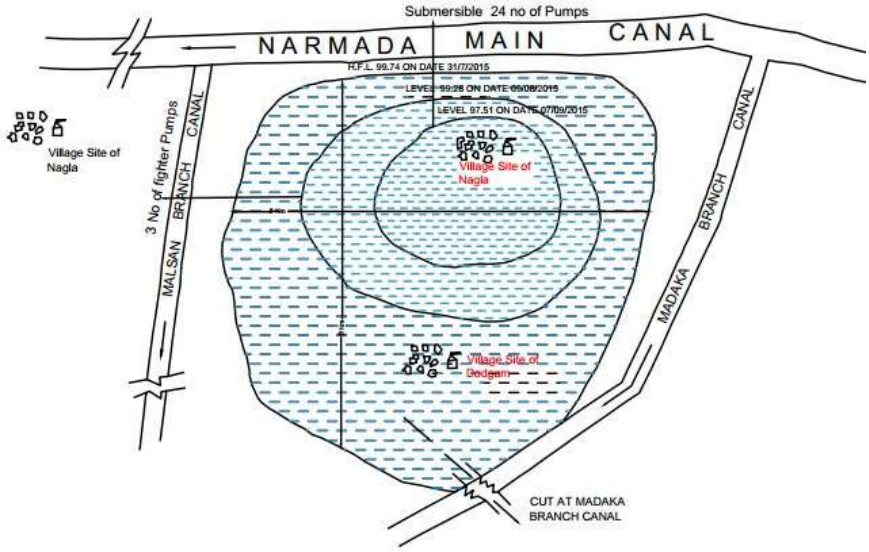


***Figure 3. Location Site of Nagala Village***

As shown in Fig.3 Nagala village is surrounded by three side canal network namely Narmada Main canal, Madaka canal, Malsan canal. Due to such site conditions it is clear that elevation of canal structure is comparatively higher than the village site location, which is one of reason to accumulate water over that area.

Initially removal of water is carried out by making cut in Madaka canal, but water not removed completely. Afterwards 3 No. of Fighter pumps are provided on Malsan canal but situation is almost same. Finally 24 No. of Submersible pumps are used and water is pumped out from village site only.

***Figure 4. Accumulated water in Nagala village***

***Figure 5. After Pumped out water in Nagala Village***

## VII. DATA COLLECTION

### 7.1 Population Data

Tharad population has grown from 1,90, 058 in 1971 to 3,27,289 in 2011. For design purpose only Nagala village is considered as pilot project. Population growth of Nagala Village is 937 in 1971 to 2276 in 2011.

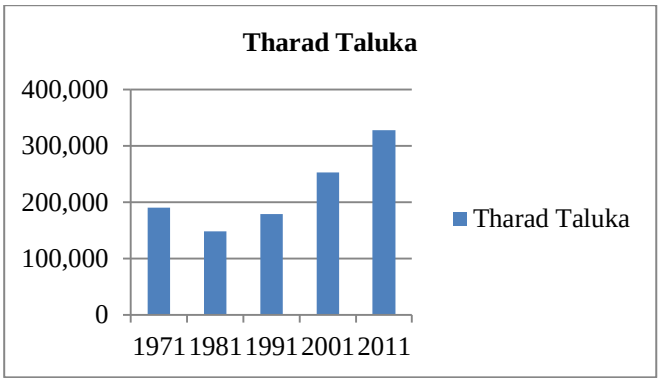


***Figure 6. Population of Tharad Taluka***

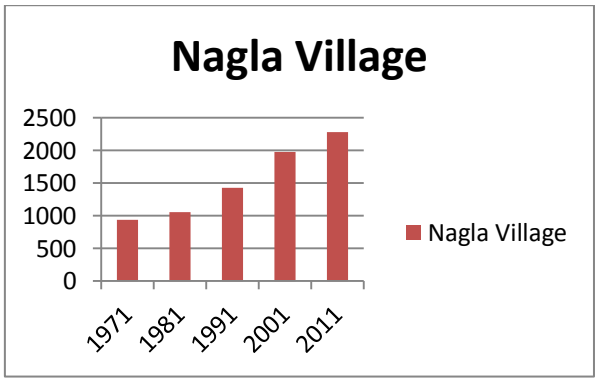


***Figure 7. Population of Tharad Taluka***

### 7.2 Rainfall Data

Heavy Intensity of rain the main reason of water logging, Tharad village has maximum rainfall on 27th July, 2015.

***Table 2. Rainfall Data***

| Rainfall in mm | | | | |
|---|---|---|---|---|
| **Sr No.** | **Taluka** | **25/07/2015** | **26/07/2015** | **27/07/2015** |
| 1 | Tharad | 2 | 105 | 112 |

### 7.3 Topographic Data

3-D Surface Relief Map shows contours and slope direction of Nagala Village.

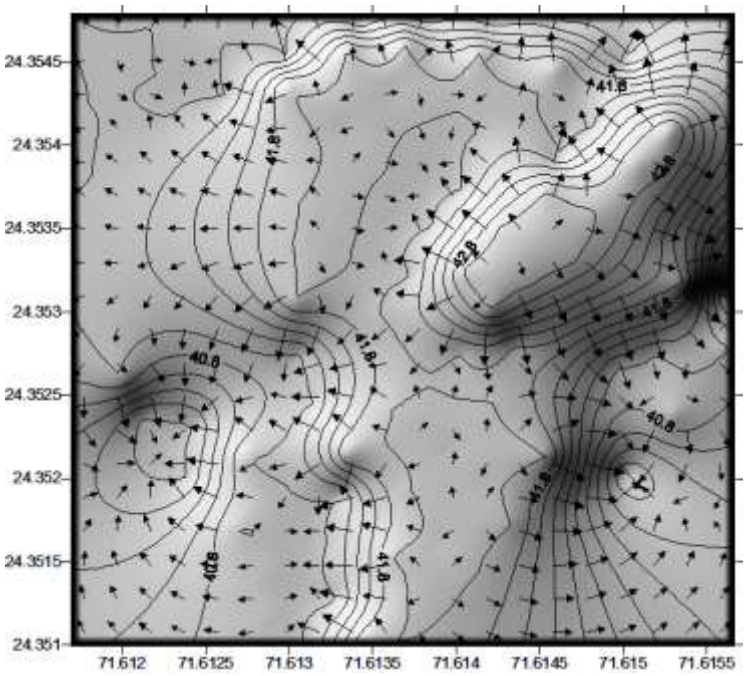


***Figure. 8 3-D Surface Relief Map of Nagala Gamtal showing contours (m) and slope directions***

## VIII. DESIGN OF STORM WATER DRAINAGE FOR NAGALA VILLAGE

### 8.1 Estimation of Storm Runoff

For estimating the flow to be carried in the storm sewer, the intensity of rainfall which lasts for the period of time of concentration is the one to be considered contributing to the flow of storm water in the sewer. Of the different methods, the rational method is more commonly used.

$$Q=10\ CiA$$

Where,

Q : Runoff in $m^3/hr$
C : Dimensionless runoff coefficient
i : Intensity of rainfall in mm/hr
A : Area of drainage district in hectares

### 8.2 Factor of Imperviousness:

It may be reiterated that Q represents only the maximum discharge caused by a particular storm. The portion of rainfall, which finds its way to the sewer, is dependent on the imperviousness and the shape of the drainage area apart from the duration of storm. The percent imperviousness of the drainage area can be obtained from the records of a particular district. In the absence of such data, Table .4 below may serve as a guide.

***Table 3. Runoff coefficients for stated surfaces***

| Sr. No. | Type of Area | Percentage of Imperviousness |
|---|---|---|
| **1** | **Commercial and Industrial Area** | **70-90** |
| **2** | **Residential Area**<br>**- High Density**<br>**- Low Density** | <br>**61-75**<br>**35-60** |
| **3** | **Parks and undeveloped areas** | **10-20** |

### 8.3 Design Area:

A schematic drawing is one in which pipe lengths are entered manually. Nagala Village, Tharad Taluka has designed for the network of 2389 meters, in that 279 meters of storm water network can be shown Fig.10 and the design is tabulated in table 4.

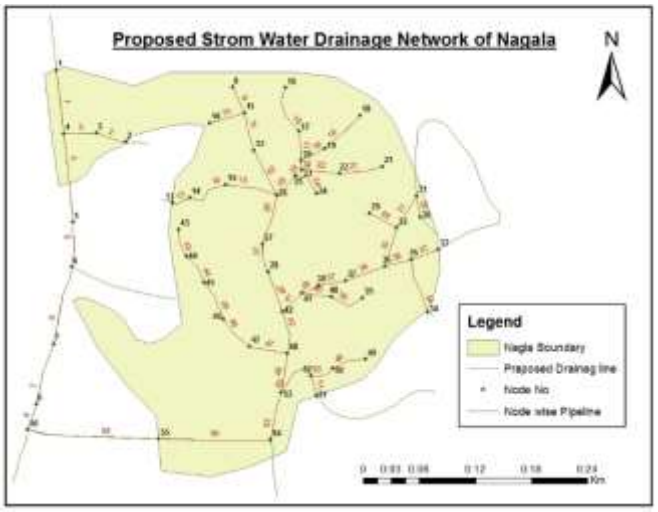


*Figure. 9 Design Area with Detail Networking*

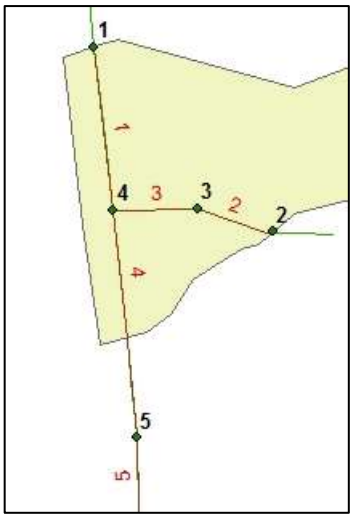


*Figure. 10 Focus for Design on Node 1 to 5*

*Table. 4 Analyses and Final Strom Water Design Sheet for Node 1 to 5*

| Location of drain | | Total cummulative area | Time of Concentrate -Tc | | | Runoff | | Flow | Design | | | | | | | | | | Profile | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| From Node | To Node | | inlet time- ti | Travel time - tr | Tc | Runoff 10ci | Total Runoff | Total Flow Q | Section | | Hydraulic parameter | | | Slope | Manning's coeeficient - "n" | Capacity of the Drain- Qd | Velocity - V | Length | Existing Ground level | |
| | | | | | | | | | Section Width - b | Water Depth - d | Wetted area - "A" | Wetted perimeter - "P" | Hydraulic radius - "R" | I in L | | | | | From node | To node |
| | | ha | Minutes | | | m3/hr/ ha | m3/hr | lps | m | m | m2 | m | m | | | lps | mps | m | m | m |
| 1 | 2 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | | 24 |
| 1 | 2 | 0.0628 | 10 | 4.07 | 10.00 | 1892.41 | 118.79 | 33.00 | 4.00 | 0.150 | 0.60 | 4.30 | 0.14 | 2000 | 0.0200 | 54.85 | 0.28 | 68.29 | 33.00 | 33.00 |
| 2 | 3 | 0.1806 | 10 | 1.73 | 14.07 | 1731.85 | 312.73 | 86.87 | 4.00 | 0.150 | 0.60 | 4.30 | 0.14 | 2000 | 0.0200 | 89.20 | 0.32 | 32.79 | 33.00 | 33.00 |
| 3 | 4 | 0.2496 | 10 | 1.66 | 10.00 | 1892.41 | 472.40 | 131.22 | 4.00 | 0.150 | 0.60 | 4.30 | 0.14 | 2000 | 0.0200 | 134.55 | 0.35 | 34.85 | 32.00 | 32.00 |
| 4 | 5 | 0.3574 | 10 | 4.14 | 11.66 | 1826.94 | 652.95 | 181.38 | 4.00 | 0.150 | 0.60 | 4.30 | 0.14 | 2000 | 0.0200 | 192.10 | 0.38 | 95.07 | 32.00 | 32.00 |
| 5 | 6 | 0.3802 | 10 | 2.10 | 15.80 | 1678.29 | 638.04 | 177.23 | 4.00 | 0.150 | 0.60 | 4.30 | 0.14 | 2000 | 0.0200 | 192.10 | 0.38 | 48.16 | 34.00 | 34.00 |

## IX. CONCLUSION

1) Banaskantha's Nagala village need storm water network to overcome water logging condition in future, if heavy rain occur.
2) Nagala village's Gamtal is act as a piloted area, where new storm water line will be proposed.
3) Rational method is very useful and appropriate method for estimating storm water runoff discharge.
4) Arc GIS and Auto CAD are used for Network Planning.
5) Designing part is calculated by using Microsoft Excel.

## X. ACKNOWLEDGEMENT

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