

Case Study of Real Time Hydro-meteorological Data Acquisition System Installed In Krishna and Bhima River Basins in Maharashtra



The Project Background

- ❖ The geographical area of Maharashtra state is 308 Thousands Km².
- ❖ Major river basins in the state are the Krishna river with its major tributary as Bhima, Godavari, Tapi and the West flowing rivers of Konkan strip.
- ❖ Maharashtra receives rainfall from both south-west and north-east monsoon.
- ❖ The state has very highly variable rainfall ranging from 6000 mm in upper catchments to 400 mm in shadow areas of lower catchments.
- ❖ Majority of rainfall mainly occurs in a four months period between June to September with the number of rainy days varying between 40 to 100 .
- ❖ The state experiences flash floods particularly in Western Ghats including Krishna and Upper Bhima basins. For instance, Sangli and Kolhapur districts in Krishna Basin and Pune and Solapur districts in Bhima basin experienced severe flood several times during recent decade.



The Project Background



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The Project

- The work under this project includes measurement of meteorological parameters like:
 - rain precipitation,
 - temperature,
 - humidity,
 - barometric pressure,
 - wind direction and speed,
 - solar radiation
- The work under this project includes measurement of hydrological parameters like:
 - water level,
 - discharge,
 - gate positions
- The collected data under this proposed system will be used as 'Input' to the Decision Support System for basin wide flood regulation.
- Correctness and real time availability of the data from remote stations has paramount importance.
- The data from wide spread remote stations will be received at Data Center through various communication media like GSM/GPRS or VSAT.



SCOPE OF RTDAS FOR KRISHNA & BHIMA BASIN

- Project comprises of real time data acquisition from 249 designated remote stations which include:
 - Automatic Weather stations (AWS),
 - Automatic Rain Gauge Stations (ARG),
 - Gauge discharge (GD) stations,
 - Reservoir level & Discharge stations
- *Co-operator stations:*
 - IMD, ISRO, CWC are the government entities who have established their own ARG, AWS and GD Stations in the project area with real time data dissemination facilities to their respective Data Centers. It is proposed to have the data of these 29 co-operator stations through internet from the co-operator data centers.



SCOPE OF RTDAS FOR KRISHNA & BHIMA BASIN

- **Automatic Rain Gauge (ARG) Stations:** It is proposed to install new ARGs at **127** locations in the project area
- **Full Climate Stations (FCS):** In the project area it is proposed to install FCS at 42 locations
- **Gauge Discharge (GD) Stations:** Along the river Krishna, Bhima and its major tributaries, it is proposed to install 37 gauge discharge (GD) stations out of which 2 GD stations have ARG and 2 GD stations have FCS combined at these locations.
- **Reservoir Level and Outflow Stations:** There are 46 Reservoir level and outflow stations in this project out of which 17 have ARG combined and 6 Reservoir level and outflow stations have 171 gate sensors.
- In addition to the above categories, combination of the GD and ARG, GD & FCS and Reservoir & ARG is also proposed in the contract agreement. Reservoir stations at all reservoir locations will have gate sensors interfaced with the DCP for measurement of outflow discharge through spillway, irrigation and power outlets.



SCOPE OF RTDAS FOR KRISHNA & BHIMA BASIN

- ❖ Establishing Hybrid Data communication network of VSAT and GSM/GPRS.
- ❖ Satellite data communication network along with the **VSAT MASTER station** at Sinchan Bhavan Pune and 93 remote stations
- ❖ Establishing **GSM/GPRS** data communication network with the GSM/GPRS receiving center at Sinchan Bhavan Pune and 156 remote stations
- ❖ **Out put** the Real Time Data in required format for further Analysis and flood estimation.
- ❖ **Operation & Maintenance** for 5 Year Period.



Remote stations in the proposed system have following categories-

Category-I : Co-operator stations

Category-II :Automatic Rain gauge stations (ARG)

Category-III : Full Climate Stations (FCS)

Category-IV : Gauge Discharge Stations (GD)

Category-V : Reservoir Level & Outflow Stations

Category- VI : Reservoir level & outflow station with Gate Sensors



CATEGORY-I (Existing Co-Operator Stations)

Data for co-operator stations (29 Nos.) like ARG, FCS and GD stations already established in the project area i.e. Krishna and Bhima River Basins in Maharashtra by Indian Meteorological Department (IMD), Indian Satellite Research Organization (ISRO) and Central Water Commission (CWC) with wireless data communication facilities will be collected through the Internet from the existing IMD/CWC/ISRO data servers /websites in Coma Separated Variable (CSV) or any other mutually agreed data exchange format.

The co-ordination and permissions from the co-operators to access the required data in mutually agreed data exchange format will be opted by the WRD.



CATEGORY-II (AUTOMATED RAINFALL STATION)

Rain precipitation sensors at 127 locations installed and measuring data using tipping bucket (with siphon arrangement) type rain sensor interfaced with the data logger.

Collected data at 89 stations transmitting periodically to Data center through GSM/GPRS network. Identified 38 stations in this category which do not have the GSM/GPRS connectivity transmits the data through satellite data communication network.

Remote stations in this category have solar power supply with 10 days battery backup. Power budget for each category is included in the report.

Installation of this category stations done as per the World Meteorological Organization (WMO) norms and requirement specifications in the tender document.



CATEGORY-II (AUTOMATED RAINFALL STATION- Installed System)



Gauge Room



Solar Panel



Data Logger



Rain Bucket



CATAGORY-III

(AUTOMATED FULL CLIMATE STATION)

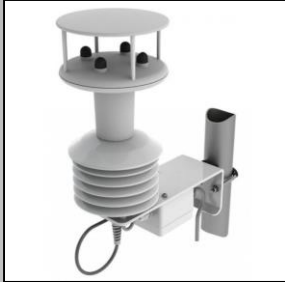
Full Climate Stations automatically measure, temperature, relative humidity, barometric pressure, wind speed, wind direction, solar radiation & rain precipitation at 42 identified locations.

39 stations communicate through GSM/GPRS network.

3 station through Satellite communication network.



CATAGORY-III (AUTOMATED FULL CLIMATE STATION- Installed System)



FCS Sensor



Tipping Bucket



Full Climate Station



Data Logger



CATAGORY-IV

(RIVER LEVEL AND DISCHARGE STATION)

River Gauge Discharge stations measures river level/discharge using shaft encoder / Bubbler / Radar type water level sensors interfaced with the data logger.

Collected data transmitted to data center through GSM/GPRS and Satellite data communication network.

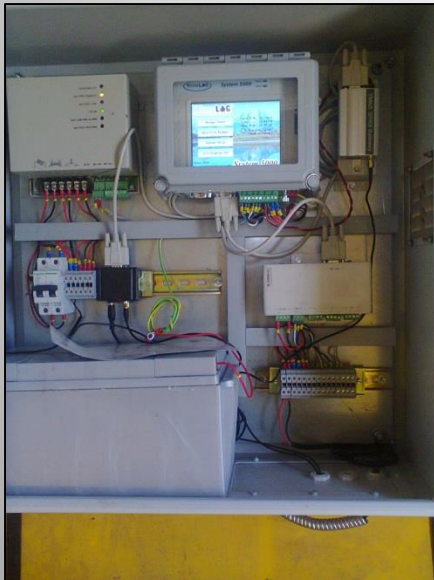
Gauge discharge curves for all the GD sites will be provided by WRD and periodically calibrated using actual ADCP measurements.



CATAGORY-IV (RIVER LEVEL AND DISCHARGE STATION – Installed System)



Level Sensor



Data Logger



Level Sensor



CATEGORY-V

(RESERVOIR WATER LEVEL & OUTFLOW DISCHARGE STATION)

Reservoir water level and outflow discharge stations comprising of Radar / shaft Encoder/ Bubbler type water level sensor and data logger which measures reservoir water elevation and transmit this data to Data Center.

Out of these reservoir stations 17 stations have additional rain precipitation sensor for measurement of rainfall.

All reservoir in this category also have gate sensors (171 Nos.) interfaced with the same data logger for measurement of gate opening and calculation of the discharges.

Reservoirs with gated spillway, irrigation and outlet gates play vital role in the stream flow regulation and hence the data for these stations is very critical and of utmost importance.



CATAGORY-V (RESERVOIR WATER LEVEL– Installed System)



Level Sensor



Gauge Room



Data Logger



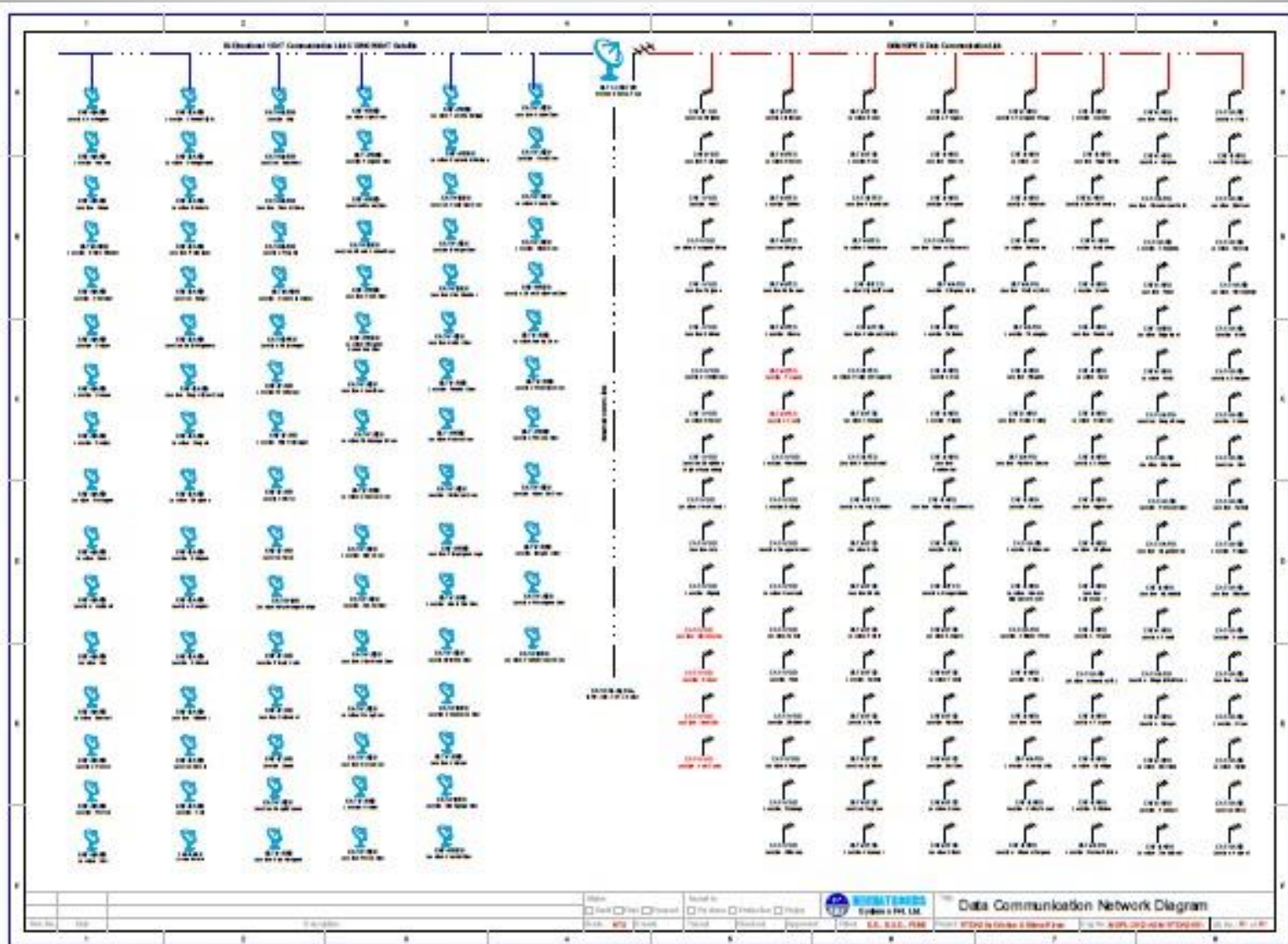
Gate Measurement System

Reservoirs with gated spillway, irrigation and outlet gates play vital role in the stream flow regulation and hence the data for these stations is very critical and of utmost importance.

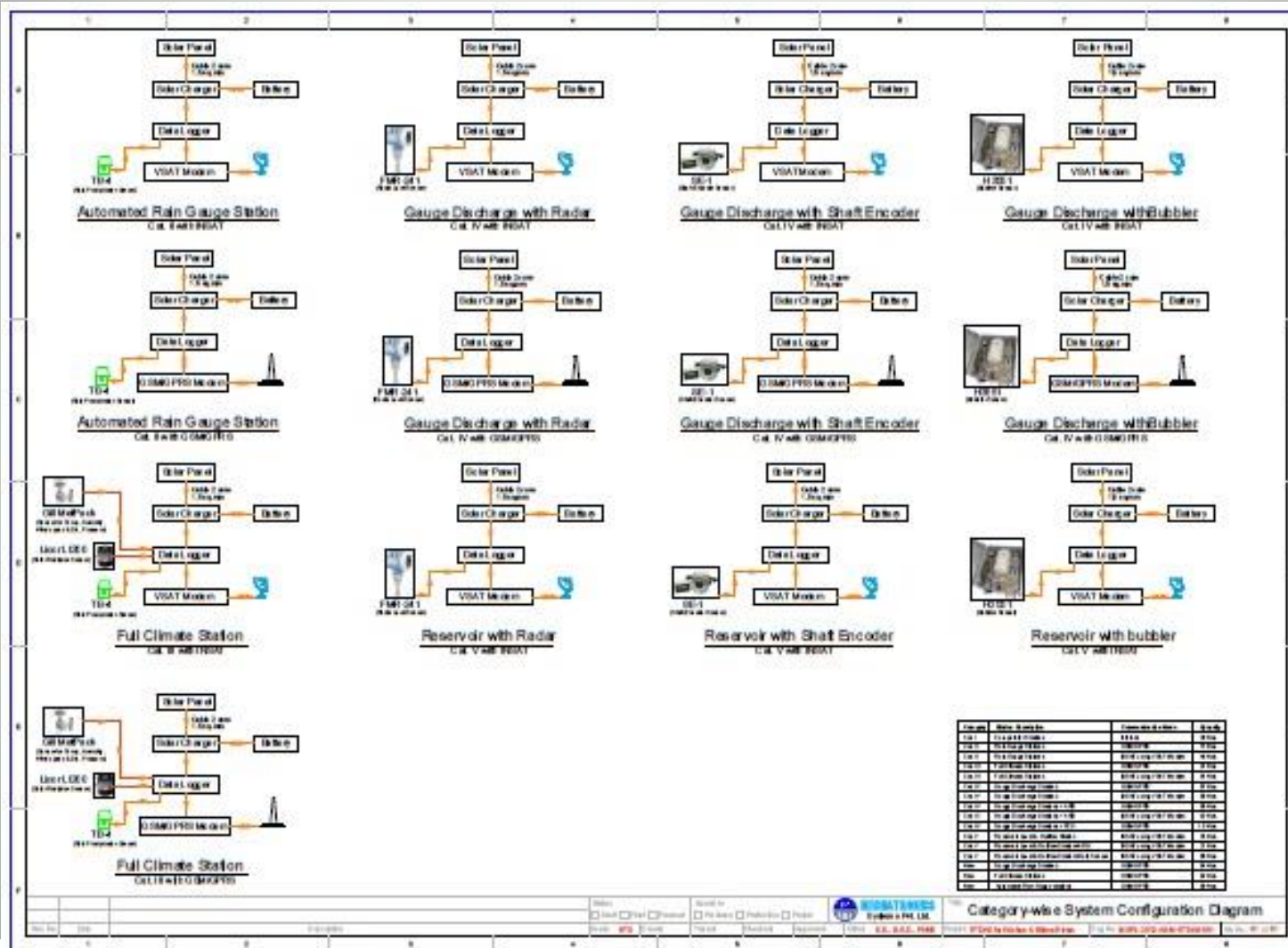
To measure reservoir discharge, real time gate measurement is required at each gated reservoir station.



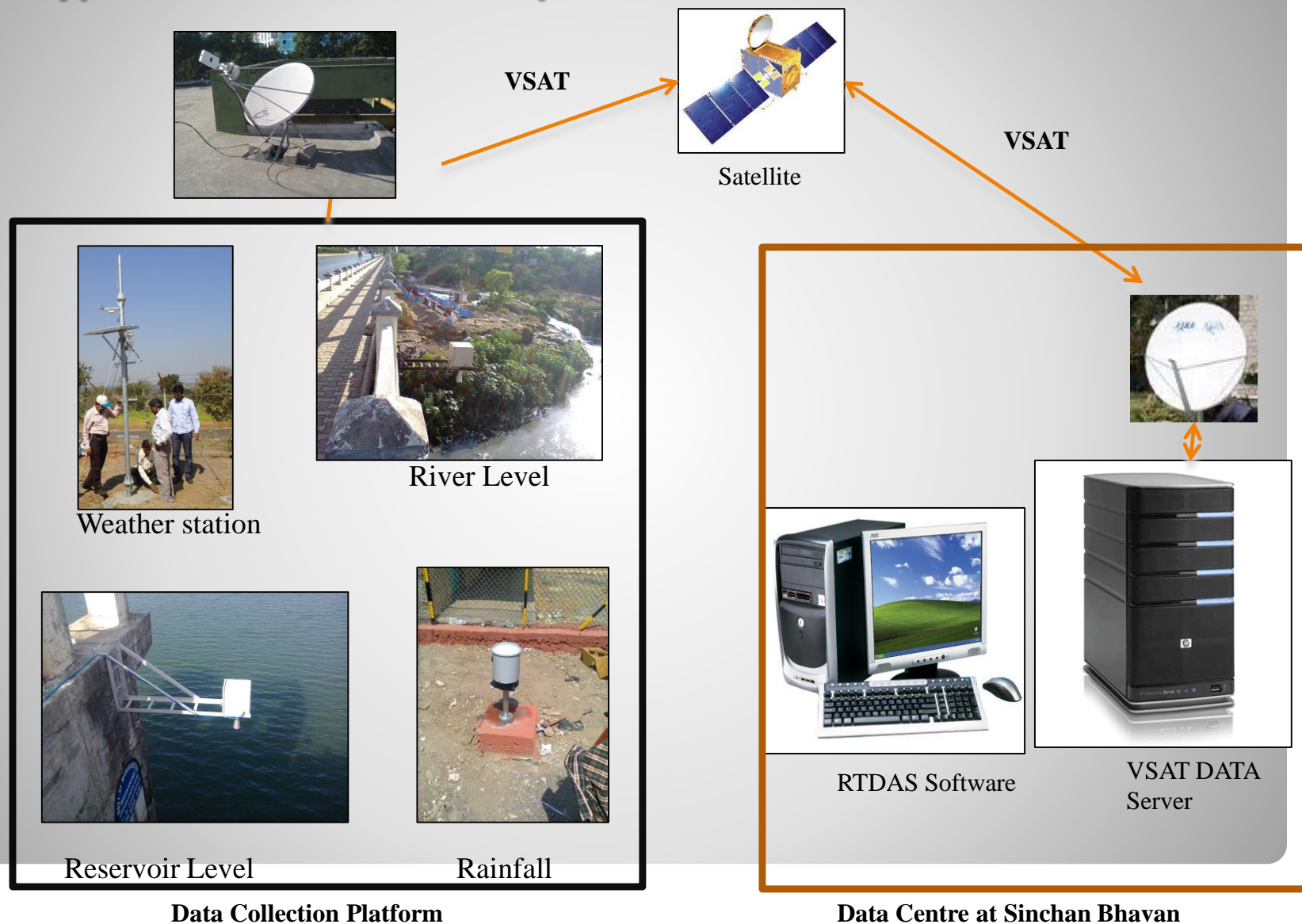
Communication Network



Communication Network



Typical Data collection system-Satellite Communication



Typical Data collection system- GSM/GPRS

**GSM/GPRS
Modem**



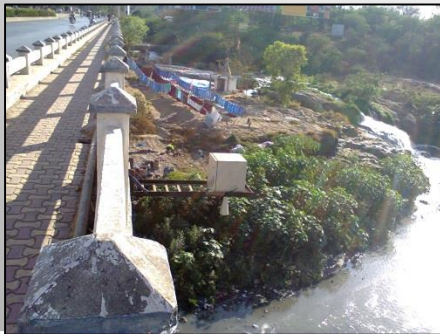
**GSM/GPRS
Network**



Weather station



Rainfall



River Level

Data Collection Platform

**GSM/GPRS
Modem**



RTDAS Software



**GSM/GPRS
Data Collection
System**

Data Centre at Sinchan Bhavan

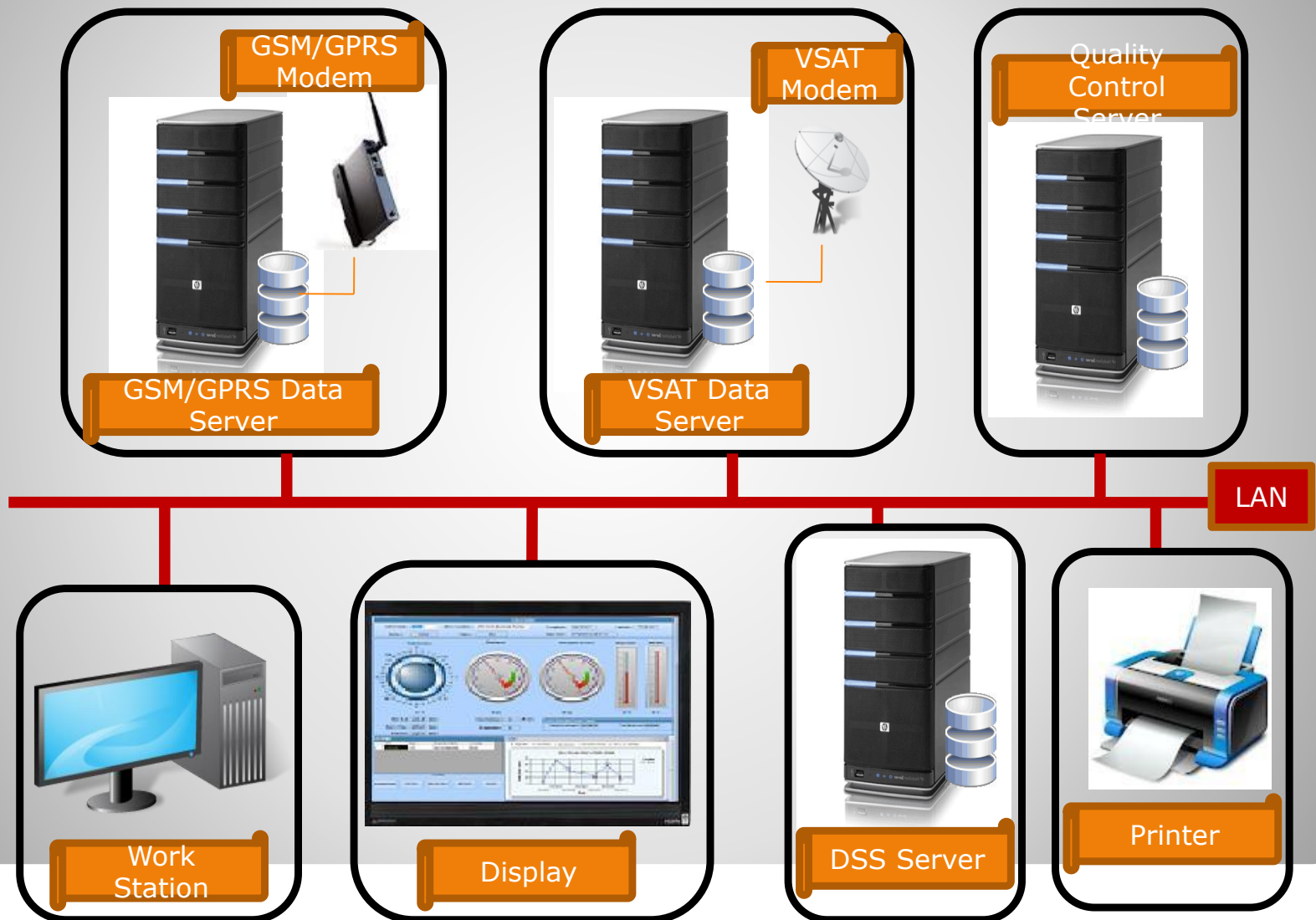


Scope of Data Center

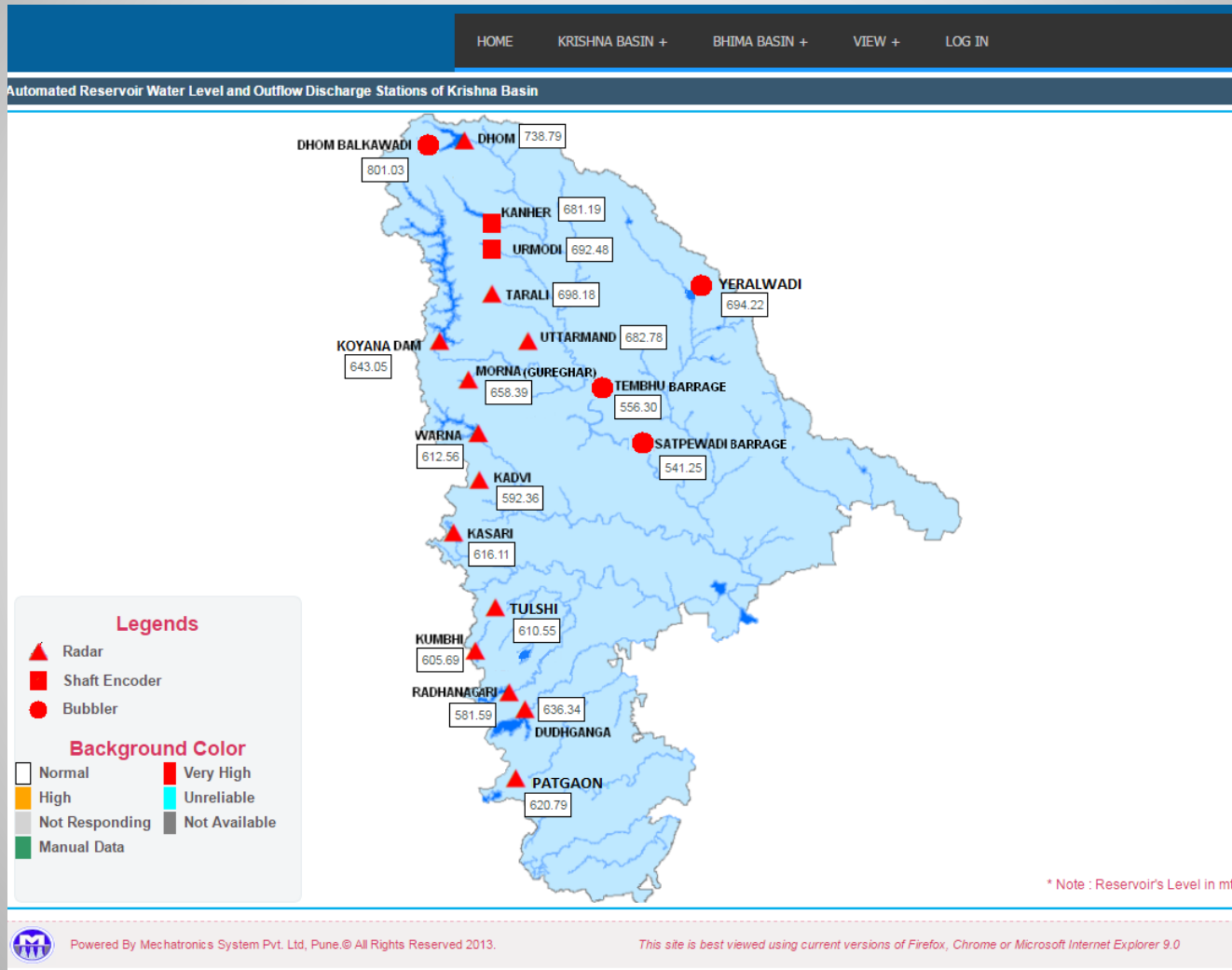
- Data Center is the core of the whole system and responsible for collection of the data from all remote stations, validation of the received data, display and store valid data in the database and providing access to the database for DSS and stream flow forecasting.
- It comprises of the communication equipments for satellite and GSM/GPRS data communication network along with instruments & antenna etc., communication servers, Quality control servers, operator work stations, UPS for power backup and printers for generating hard copies of the reports.
- Application software running on the communication servers collect the data from the remote stations, validate the received data from its upper, lower and delta limits.
- Based on the received data alarms and events generated and displayed on the screen.
- Database management software running on the Quality control server manage the database.
- Data from the co-operator stations (29 Nos.) is collected through internet and will be stored in the database.



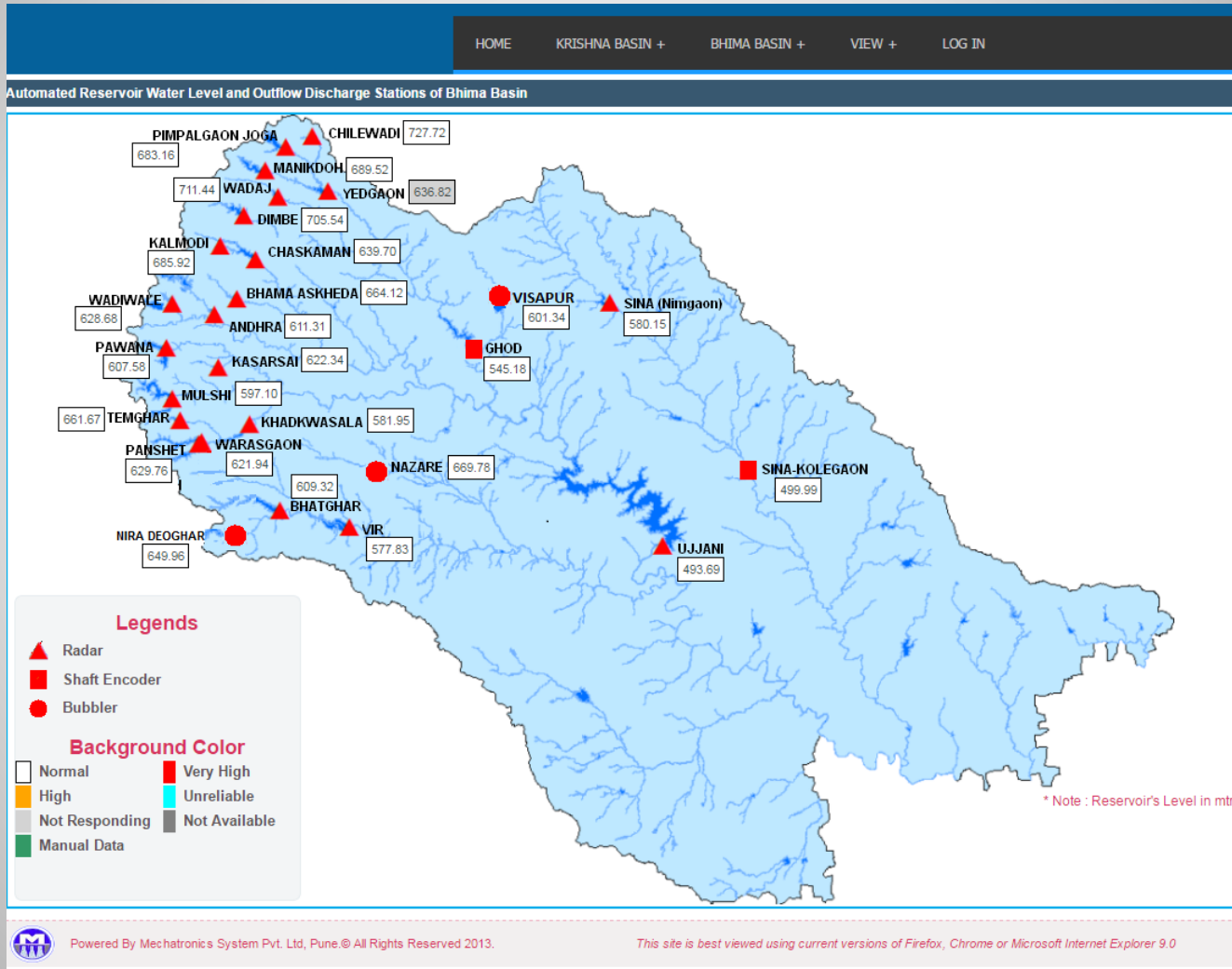
Data Centre



Application Software- Screen Shots

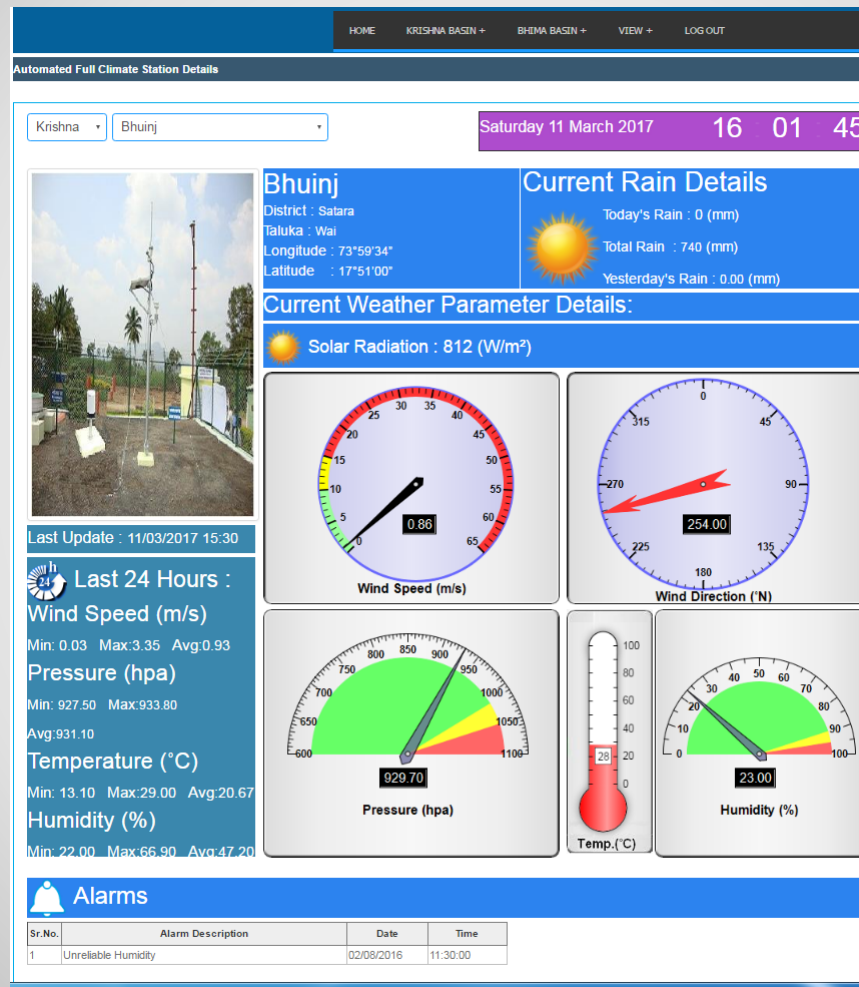


Application Software- Screen Shots

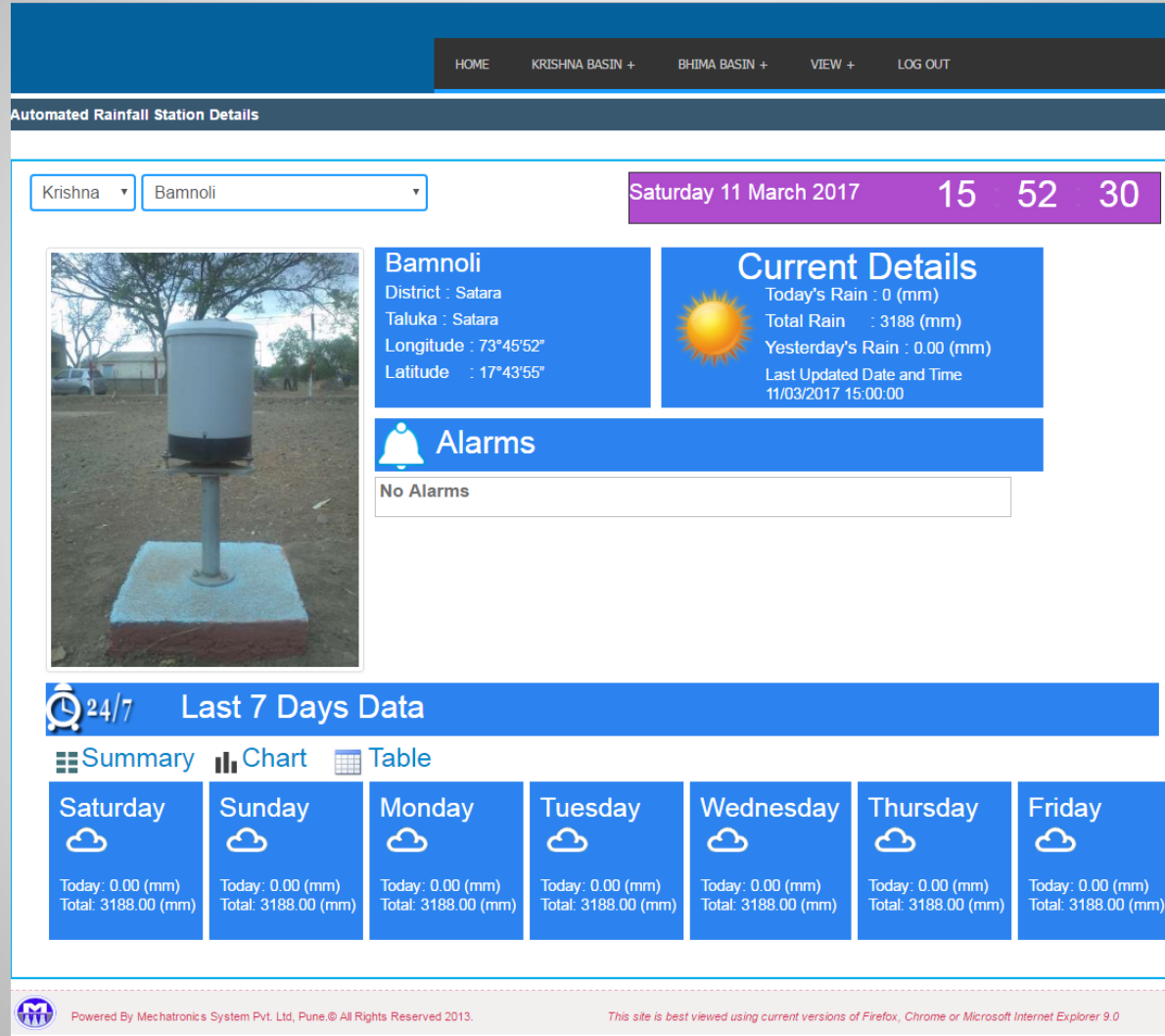


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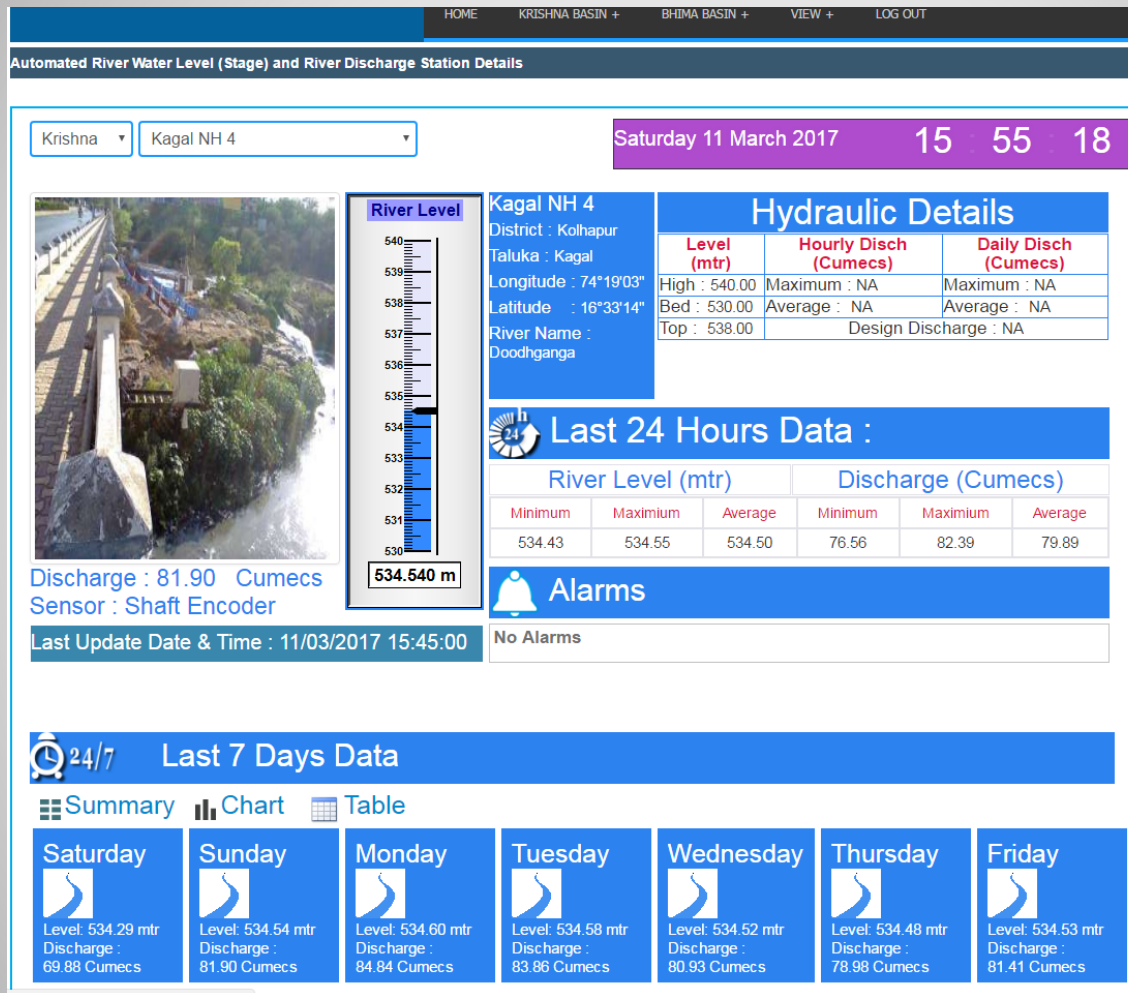
Application Software- FCS Screen Shots



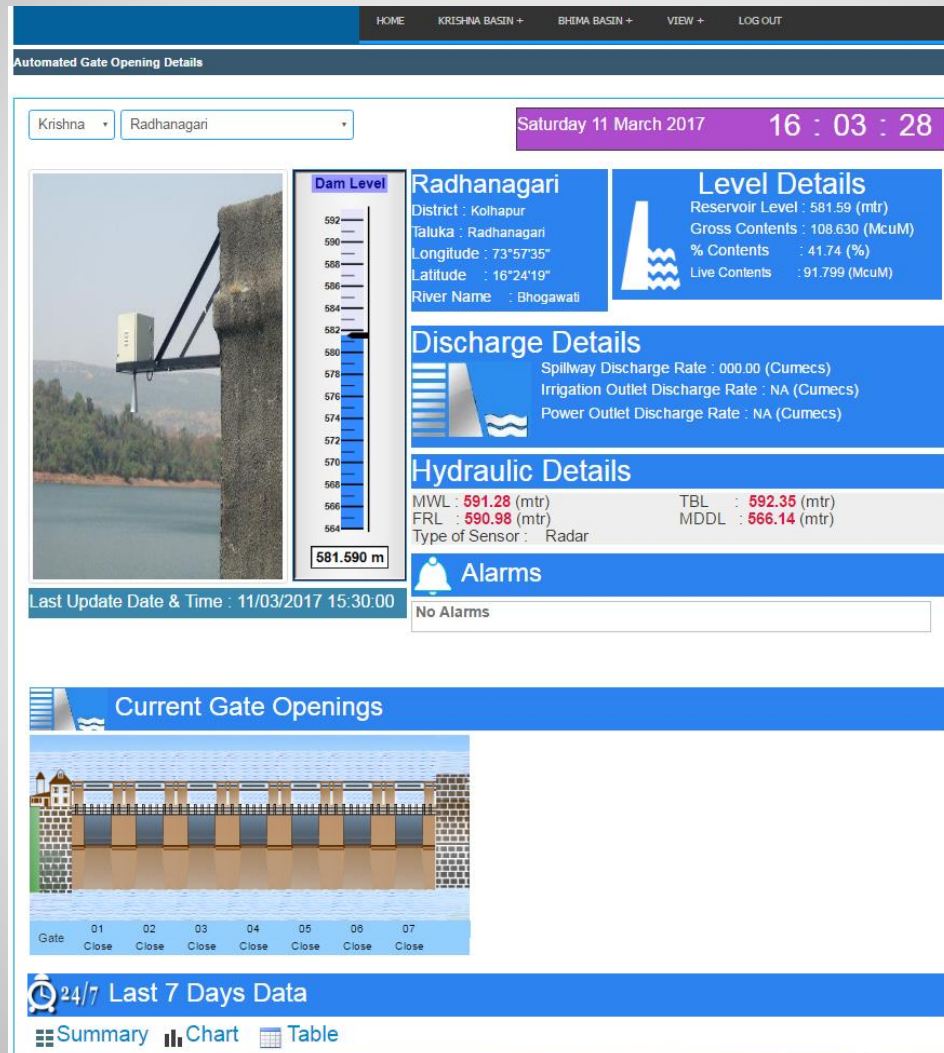
Application Software- Rainfall Screen Shots



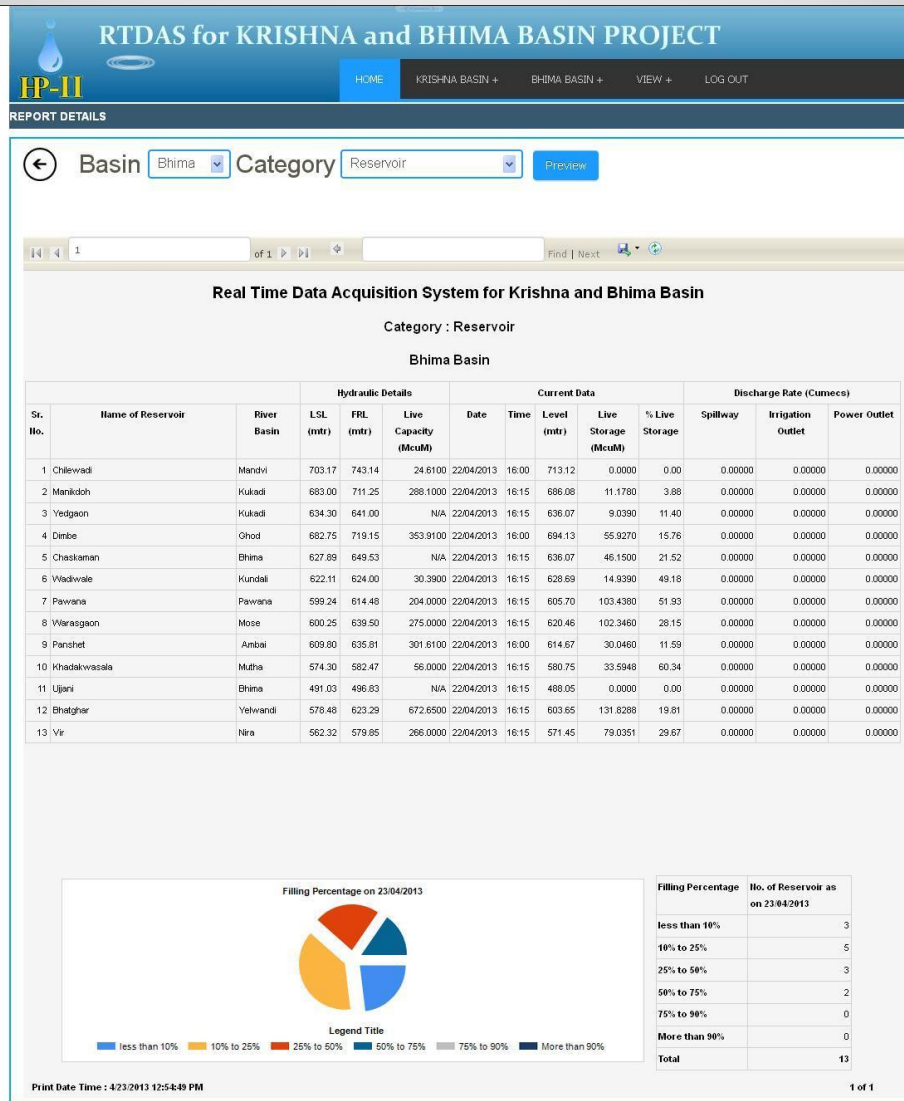
Application Software- River Guage Screen Shots



Application Software- Reservoir Screen Shots



Application Software- Reservoir Summary Reports



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Application Software- FCS Summary Reports

HOME KRISHNA BASIN + BHIMA BASIN + VIEW + LOG OUT

SUMMARY REPORT DETAILS

Basin Krishna Category AFCS Current Daily Preview

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Real Time Data Acquisition System for Krishna and Bhima Basin

Name of Basin : Krishna

Automated Full Climate Stations

Sr. No.	Name of Automated Full Climate Stations	Date	Rainfall in (mm)	Cummulative Rainfall in (mm)	Current Rainfall		Current Data						
					Time	Rainfall from 8:30 AM in (mm)	Total Cummulative Rainfall in (mm)	Temperature (°C)	Humidity (%)	Wind Speed (m/s)	Wind Direction (°N)	Atmospheric Pressure (hpa)	Solar Radiation (w/m²)
1	Ambale	11/03/2017	0.00	1102.00	14:30	0.00	1102.00	28.30	29.60	1.81	322	938.90	1053
2	Bhuinj	11/03/2017	0.00	740.00	15:30	0.00	740.00	28.40	23.00	0.86	254	929.70	812
3	Chandgad	11/03/2017	0.00	1827.00	15:30	0.00	1827.00	29.70	21.50	0.85	299	932.20	625
4	Gudhe	11/03/2017	0.00	630.00	15:30	0.00	630.00	29.60	22.70	2.77	257	940.10	763
5	Islampur	11/03/2017	0.00	720.00	15:45	0.00	720.00	30.30	24.70	0.92	231	950.00	699
6	Kavate Ekand	11/03/2017	0.00	565.00	15:30	0.00	565.00	30.80	20.40	1.86	270	947.00	759
7	Khanapur	11/03/2017	0.00	412.00	15:30	0.00	412.00	27.30	22.80	3.83	296	921.30	923
8	Kuchi	11/03/2017	0.00	489.00	15:30	0.00	489.00	29.70	20.40	1.70	296	937.90	799
9	Mhaisel	11/03/2017	0.00	585.00	15:00	0.00	585.00	31.20	17.10	1.90	307	955.40	900
10	Parali	11/03/2017	0.00	1530.00	15:30	0.00	1530.00	28.80	29.40	2.51	293	931.60	846
11	Patrayachiwadi	11/03/2017	0.00	2628.00	15:30	0.00	2628.00	29.10	29.90	1.93	255	947.80	801
12	Rahimatpur	11/03/2017	0.00	779.00	15:45	0.00	779.00	30.10	19.00	4.05	280	943.30	686
13	Rukadi	11/03/2017	0.00	833.00	15:30	0.00	833.00	31.80	16.50	0.25	168	951.70	749
14	Sarud	11/03/2017	0.00	1522.00	14:30	0.00	1522.00	29.50	25.80	1.93	255	944.70	932
15	Shivade	11/03/2017	0.00	744.00	15:30	0.00	744.00	30.10	22.20	1.46	250	946.20	644
16	Wangi	11/03/2017	0.00	524.00	15:30	0.00	524.00	30.30	0.00	0.64	233	940.30	721

Print Date Time : 11/03/2017 16:04:54

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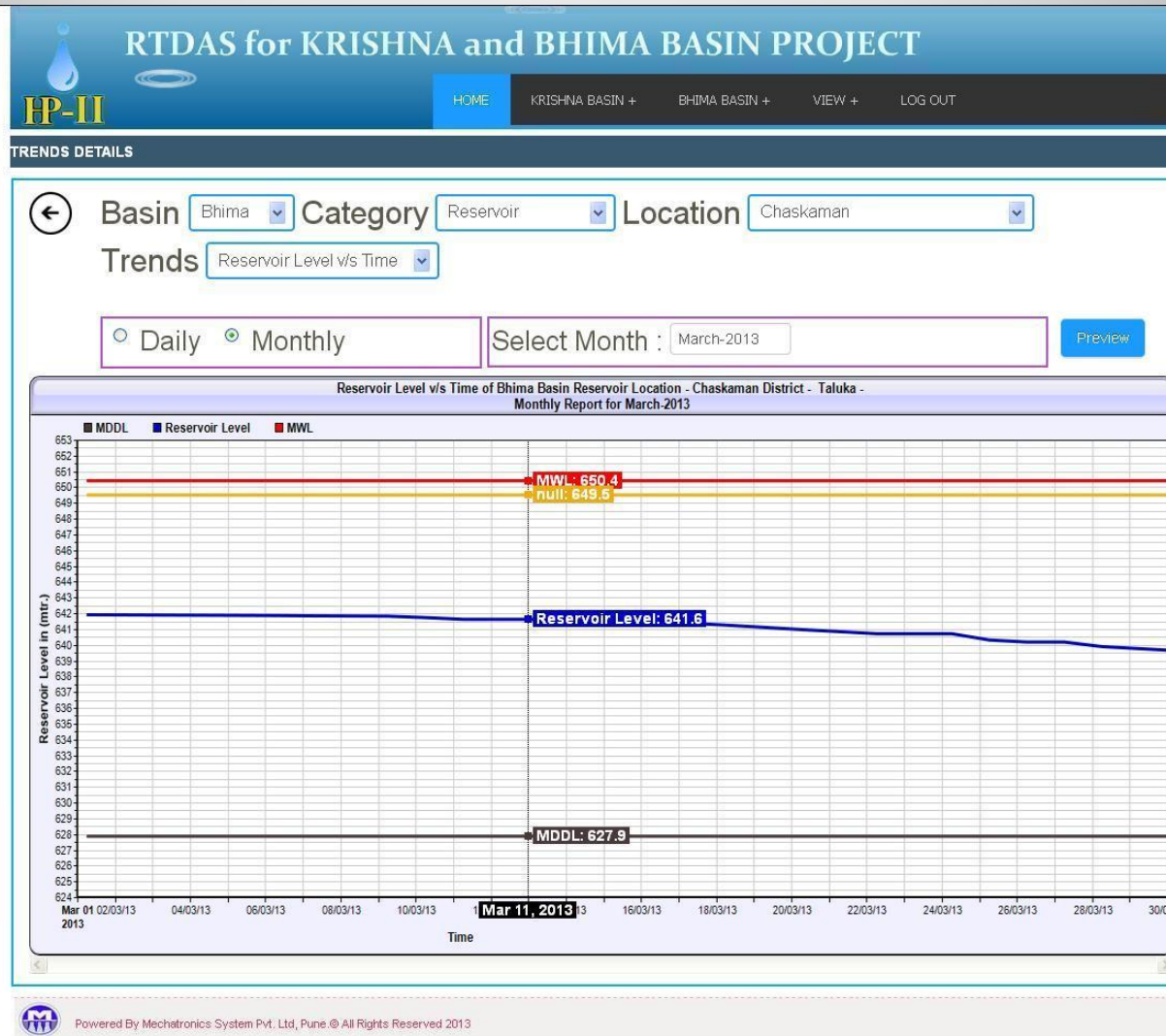
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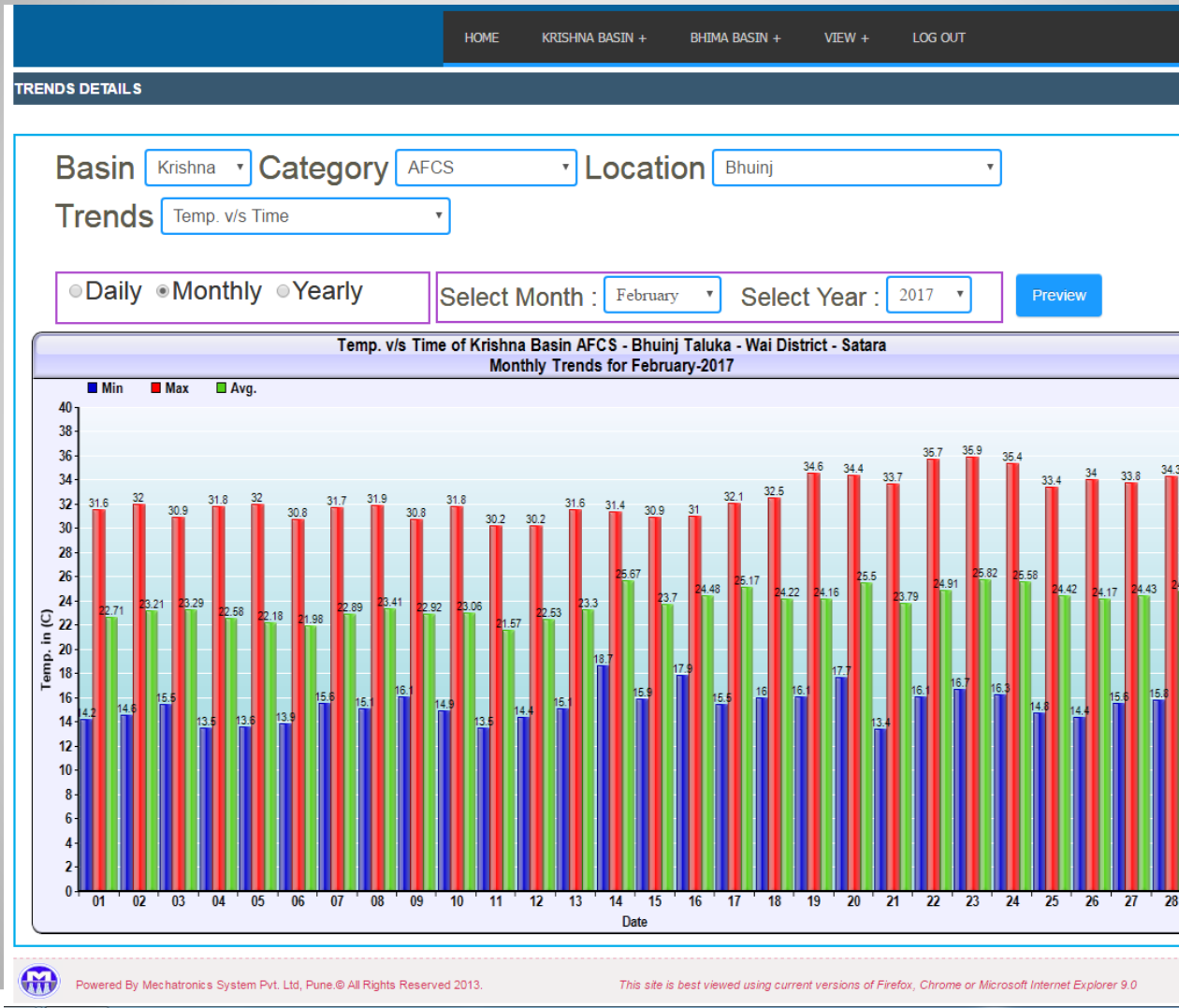


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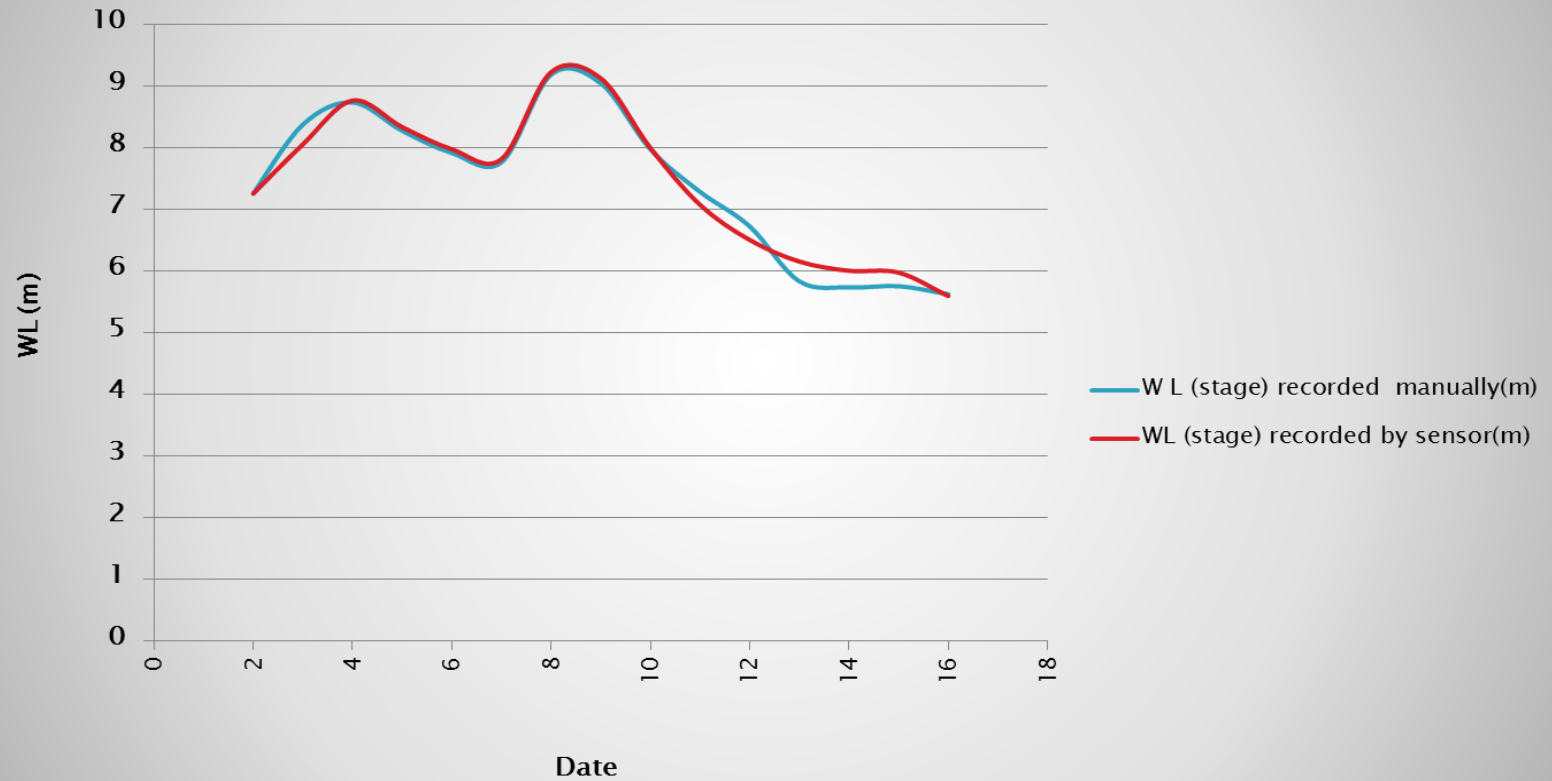
Application Software- Reservoir Trend



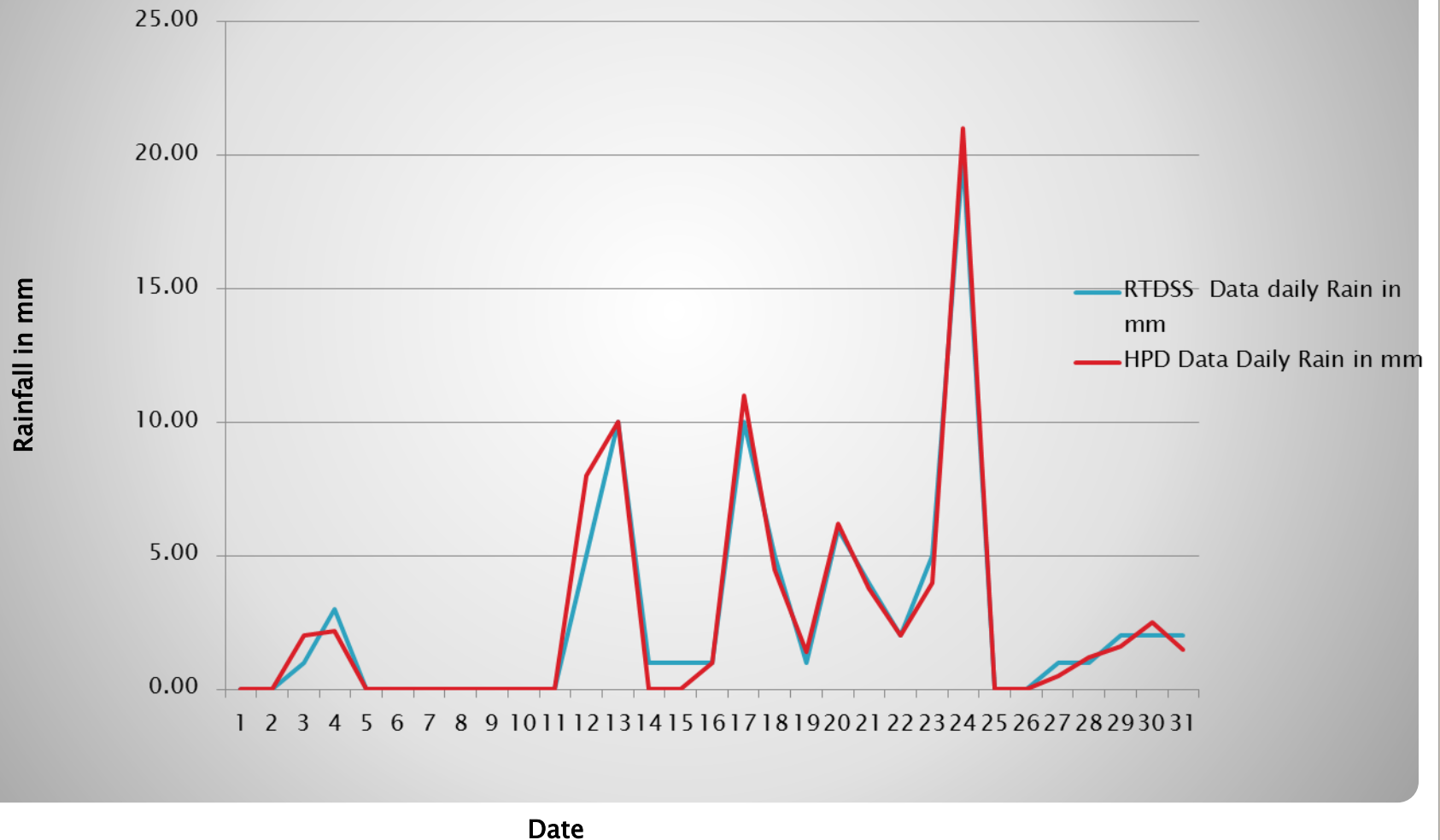
Application Software- FCS Trend



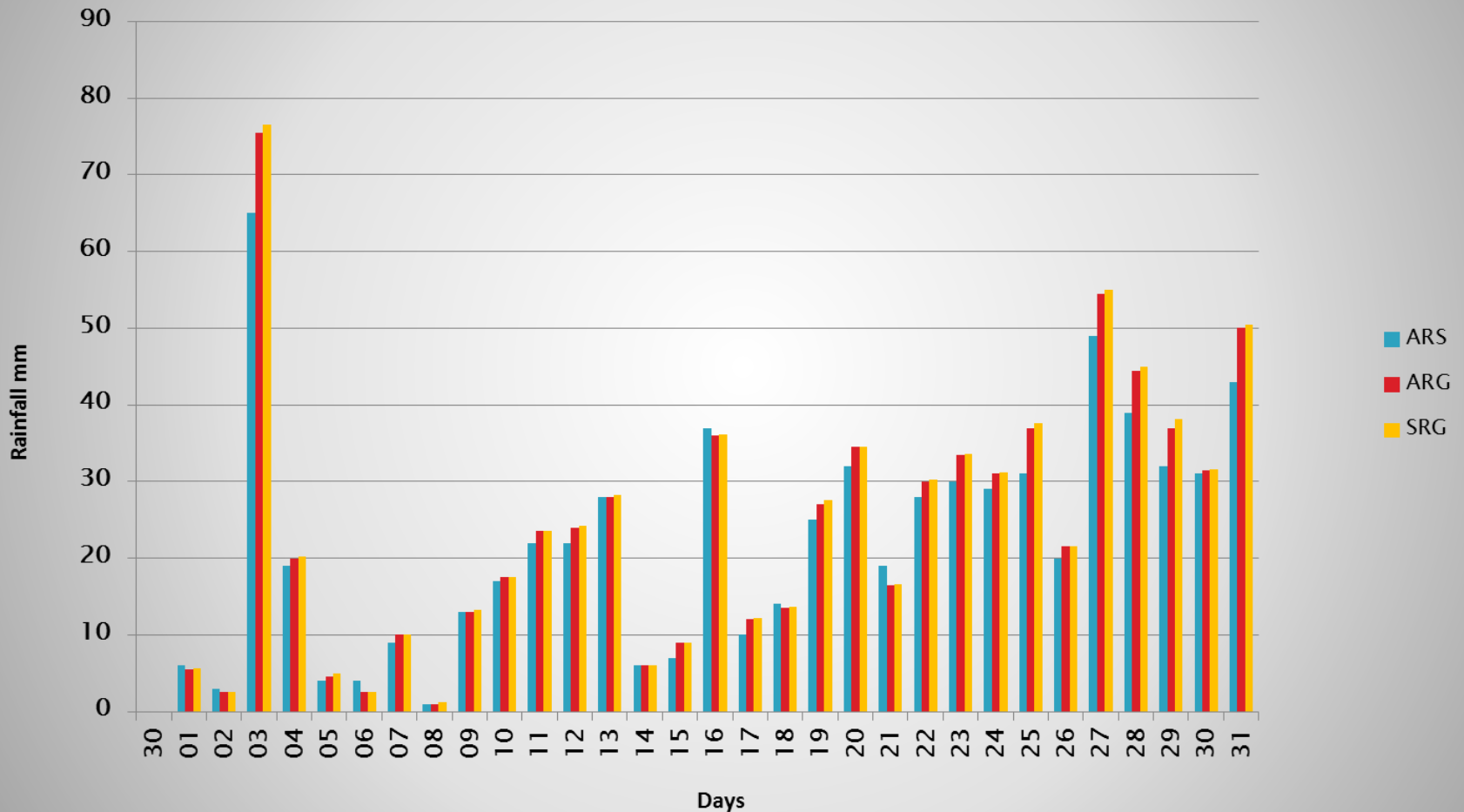
Ichalkaranji : River Water Level Comparison (Manual & Sensor)



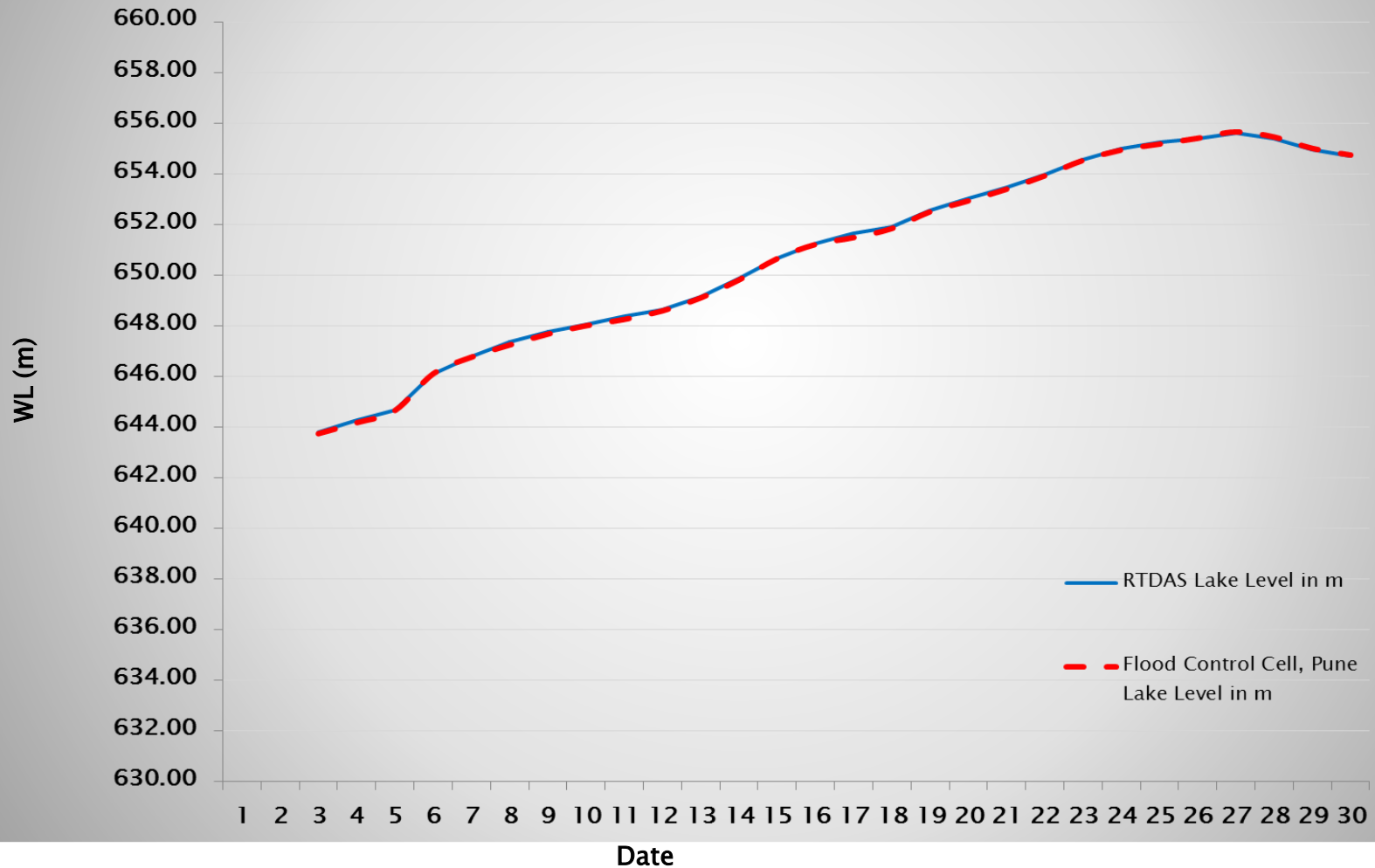
Daily Rainfall Comparison (Sensor and Manual) July Month: Khamgaon



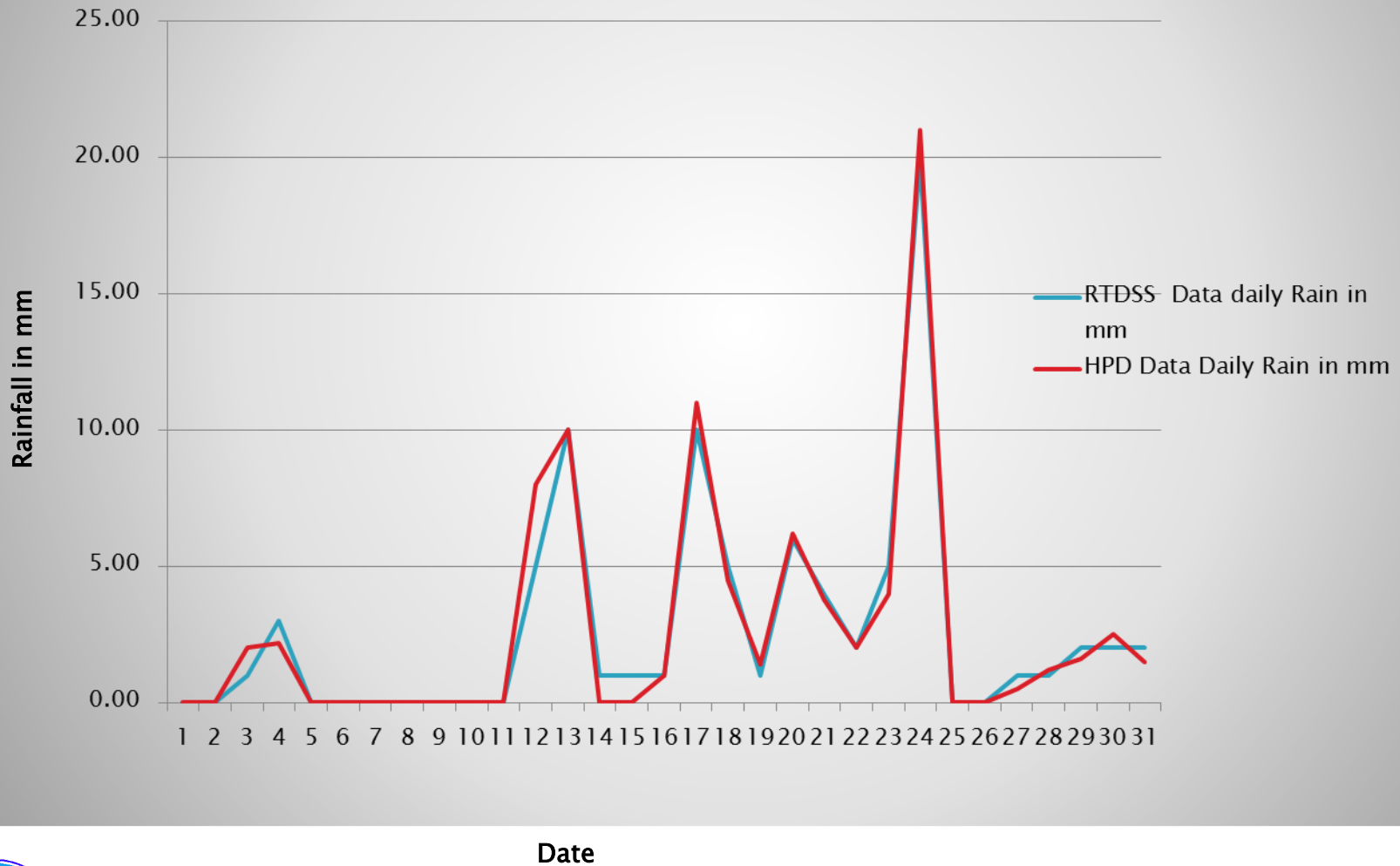
Ambeghar: Comparison of Daily Rainfall –ARS & ARG & SRG for July 2013



Reservoir Water Level Comparison (Manual and Sensor) : Koyana (July 2013)



Daily Rainfall Comparison (Sensor and Manual) July Month: Khamgaon



Hon. Chief Minister's Visit at Bhuinj



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World Bank specialist Visit at Site



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Thank You



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