

MODERNIZATION OF THE MUNICIPAL MAPPING USING HIGH END GNSS SYSTEM AND GIS SOFTWARE

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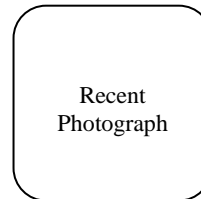
Abstract

The objective of this paper is to explain how the design and implementation of a GIS order to efficiently manage their utility distribution systems and replace the existing system based on Paper Maps Etc. Urban areas are served with various utilities which helps in better living standards of inhabitants by providing appropriate services.. In case this infrastructure fails to meet these basic objectives, the result will turn endanger the wellbeing and life of inhabitants. The Municipal departments have relied on Paper data for years.

SUMC in MCGM is Going to use High End GNSS and Digitized Base map with GIS Software in sewer network design and analysis processes, in establishing network analysis tool enables identification of flow direction, selection of best route and/ or best location of pumps, determination of service area etc. In addition how GPS and GIS provides user-friendly working environment and powerful tools for mapping and display of results.

This establishment will also help MCGM to provide single Reference point to all the Utility survey and data updating in GIS. The Conclusion of the Paper will demonstrate that how the implementation of this this setup will improve the efficiency from the earlier system.

About the Author



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Introduction

Municipal Utilities throughout Mumbai are planning automated mapping-facilities management-Geographic Information System (GIS). Over the years MCGM have come to realize that GIS not only helps manage the existing infrastructure, but can also help aid in the design for future. In Today's Scenario GIS is the Special need for Each and every Utility as all can be spatially referenced. Many Department not only use GIS for the spatially referenced data, but also for any information that could be used to help carry out further analysis if needed. GIS technology not only allows MCGM departments allow utility contractors to not only determine where their assets are located but analyze attributes about those assets. The majority of the contractors reside in municipal Departments. Traditionally, all this departments and contractors managed their systems by paper maps.

MCGM provide its citizens with public utilities. The size of the utility system depends on the size of the area and the population it serves. The local governments over the years have typically managed these utility systems by hard copy paper maps. These maps are updated manually but the department persons or the contractors. This old system has helped the department throughout the years to manage their utilities, but lacks the ability to provide the correct measurements and other aspects. GIS has greatly extended the ability to effectively manage the Municipal utilities. Many municipalities are drawn to a GIS because it has the ability to combine large amounts of Spatial and Non Spatial data order them into layers or themes, and analyze or display various relationships.

The MCGM is using Mumbai Base Map Digitized by NIC with ArcGIS system to manage their utilities .MCGM departments realized that this Map has to be updated time to time using the Real Time System i.e. GNSS. MCGM started researching ways to update their data and efficiency within the departments and wanted a centralized system that could be accessed across all departments in the city. While researching, the MCGM decided to go with Permanent Reference System and Real time Rovers of Trimble to update the Database.

Objective

The primary goal is to develop a system that would allow Municipal Departments i.e. Sewerage and Water Supply to find, evaluate, prioritize and increase hydraulic performance in the most economically, beneficial manner possible. The program would have to document 'before' and 'after' conditions. The survey and inventory data determine attribute locations of the sewer system components and to superimpose the same on the existing GIS Map. System maps provide operators and maintenance personnel a better understanding of their system.

The implementation of GIS for a municipal Department can be very complex, expensive, and time consuming, depending on the work Department want to do. The above implementation will help MCGM to review, explain, and provide an example of the implementation process for the Utilities in the MCGM area. The implementation process involves determining the needs of each department and constructing an implementation plan to help track and determine the outcome of the overall system. The research also reviews the database development process for each of the utility departments.

Study Area

As per the Surveyor General of India, the geographical area of Mumbai is 603.4 km² (233 square miles). The city extends from Colaba in the south to Mulund, Mankhurd, and Dahisar in the north. Below Figure shows the location of Mumbai City.

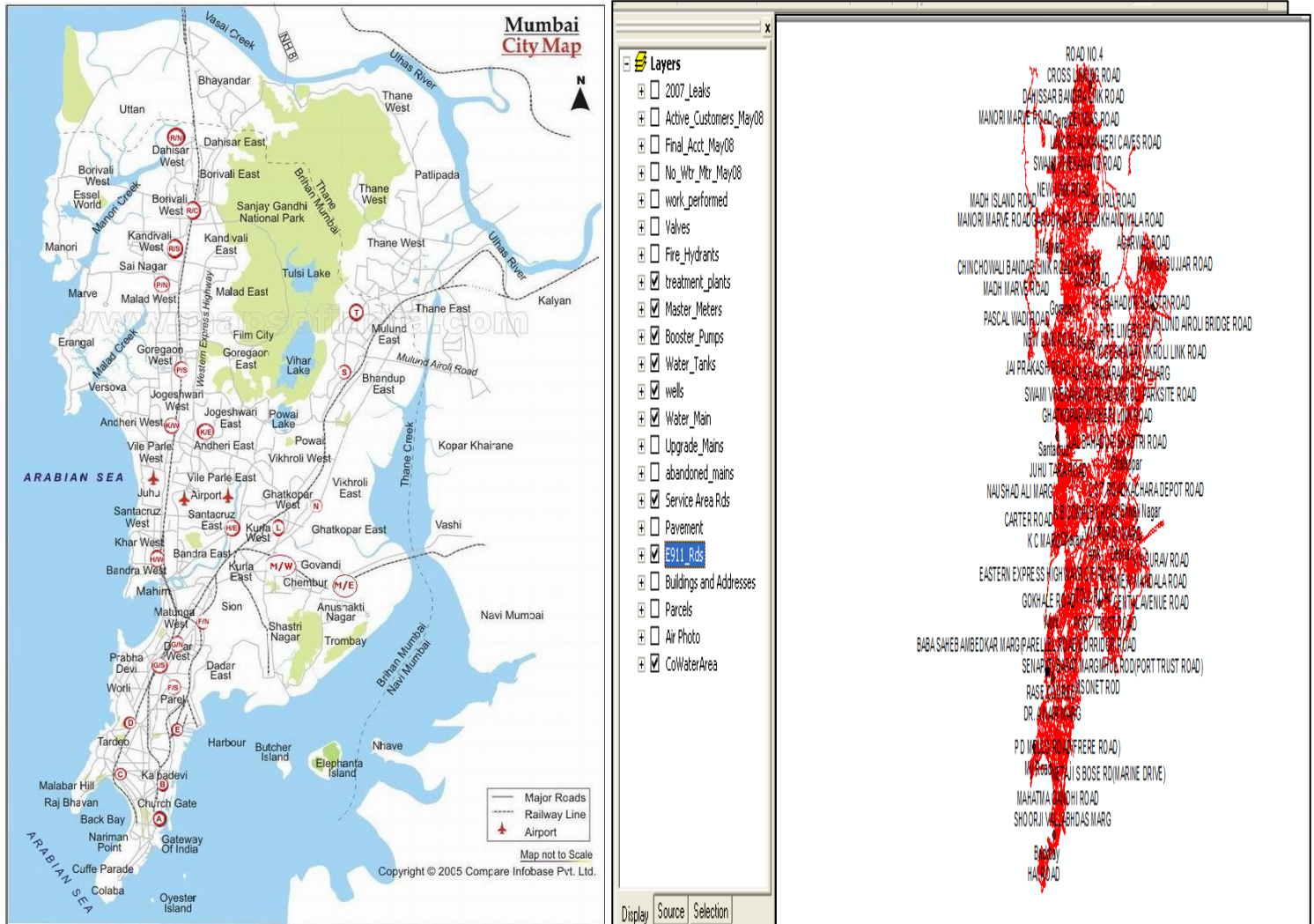


Fig 1: AREA OF MCGM

The Implementation of the High end GPS and GIS will be developed and implemented by following three phases. The first phase of the project will be completed by the sewer department by collection of the data and superimposing of the data on the existing GIS Map of the Mumbai City. For the collection of the data Two Permanent Reference station (Trimble NetR9) have been installed and the utility data will be collected by the High end GNSS Rovers (GeoXH 6000 with floodlight Technology) With Real Time correction. The second phase will be geodatabase design. The third phase is data development and conversion. The phases used for the project will be performed once the hardware and software were installed and configured. The MCGM is already using ESRI software that was installed for the implementation in each department. The advance version of ArcGIS Server provided the ability to develop a web mapping application that each department can easily access and use.

Field Survey and data collection

The assessment for the Sewer Department identified a number of functions that could benefit from the implementation of a High end GNSS and GIS. The list below shows give an idea on the number of features that make up the sewer system.

- Access to accurate system mapping
- Integration of billing data
- Work order mapping
- System modeling

- Crew scheduling
- Inflow and Infiltration planning
- Planning future expansion of system
- Maintenance tracking and inventory
- Sewer distribution analysis
- Inspection reporting tools
- Web mapping application for easy access to data

The sewer data will be mapped using real-time kinematic global positional system (RTK GNSS) by the SUMC. The attributes of the manholes and pipes are in the form of labels in the present GIS Maps. A number of the GIS Maps will be uploaded in the rovers as the reference map. All lift stations and wet wells will be located using GNSS. The manholes and pipe data are not accurate and manually marked using Paper Maps. The department uses ESRI software for all of their mapping and information needs. The Sewer Department would like access to updated data for the other Departments in Municipal Corporation. MCGM is also looking for the Centralized system to have access to parcel information for easement purposes in every department. The department would like to have the data updated daily as projects are completed in the field. The data will be maintained and edited by various departments in single platform and accessed by a number of people within the city. The overall goal is to have centralized and accurate set up and up to date data on MCGM system and easy and quick access to the data.



Fig-2 Reference Station and Rover Setup

Geodatabase Design

The sewer geodatabase design has already been developed based on data. The new attributes for each of the feature classes in the sewer geodatabase will be determined by examining the existing layer labels. Attributes will be added to the features in the areas where the department wants to focus more.

The geodatabase (e.g., roads, buildings, parcels and bridges) that each municipal department uses is available from main GIS Department. The map has already been created by NIC using Aerial Photography. The spatial reference of each dataset is based on the existing plan metric and aerial photography data. The coordinate system used for the geodatabase is WGS 1984 and the projection used is the Transverse Mercator.

Data development and conversion

The third phase of this project is data development and conversion. Mumbai City already have Digitized map Developed by NIC using the aerial photography as the base map foundation for the GIS. The MCGM GIS Department has already completed the majority of the base map dataset work with the construction of the parcel data and attributes associated with the data.

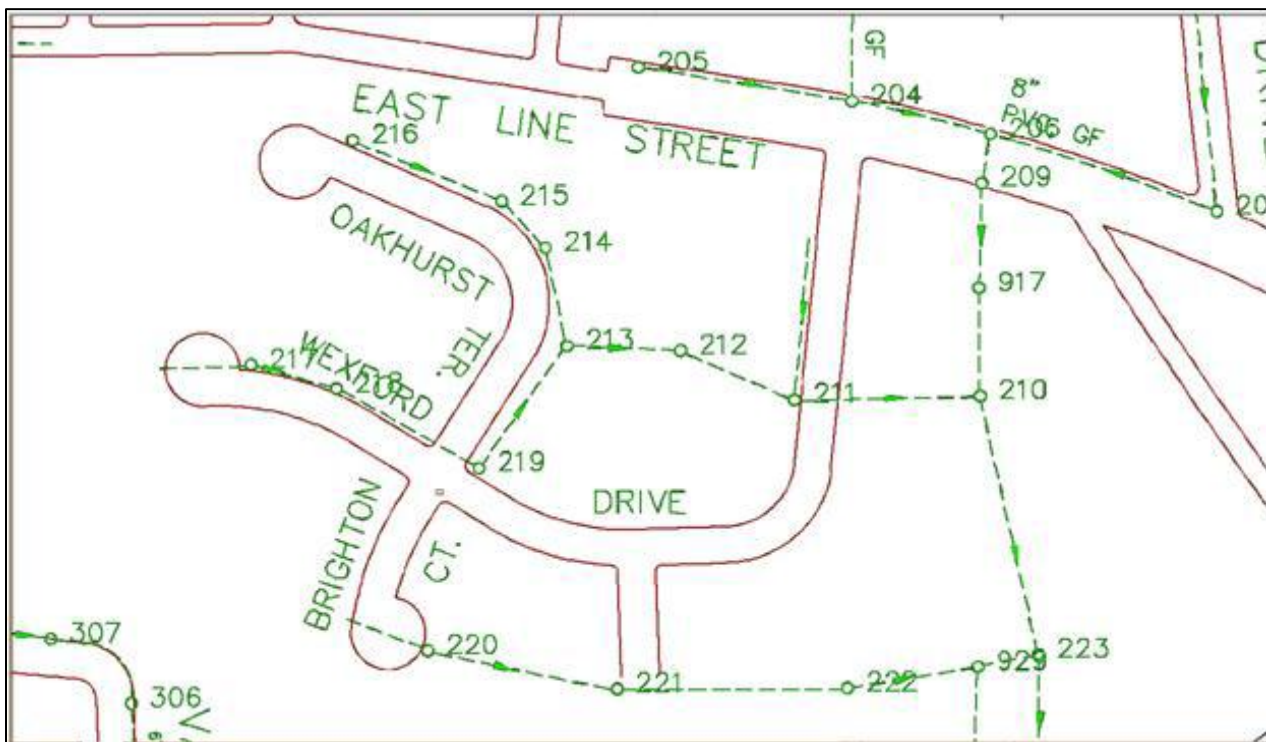
The MCGM GIS Cell has already completed a number of feature locations throughout the city. The SUMC department has 2 Permanent Reference GNSS base station installed for locating utilities with RTK GNSS. By using the RTK GNSS, the features located will be highly accurate to within a few inches. The features located by the SUMC include wastewater manholes, utility poles, and street centerlines. The features were located with RTK GPS on WGS1984 Coordinate System. The Sewer and Water Departments have already begun using the location data. This data will be very helpful in referencing other data throughout the city for the GIS.

Sewer System Data Conversion and Development:

All sewer manholes will be located using RTK GPS and attributed by the SUMC GIS Department. Also a number of points located using Paper Maps over the past few years have submitted drawing plans showing the location of the sewer installed.

A field inventory will took place that locate and attribute the manholes to actual location. During the field inventory each manhole will be located with RTK GPS which provided accurate and precise location and elevation. The elevation data for each manhole had to be accurate for modeling purposes in the future. The material of the pipe and condition of the manhole will also be attributed during this time.

The figure shows an example of a sewer drawing. The CAD Drawing show the Manholes and the Flow analysis. The GIS Map shows the exact location with the Route analysis.



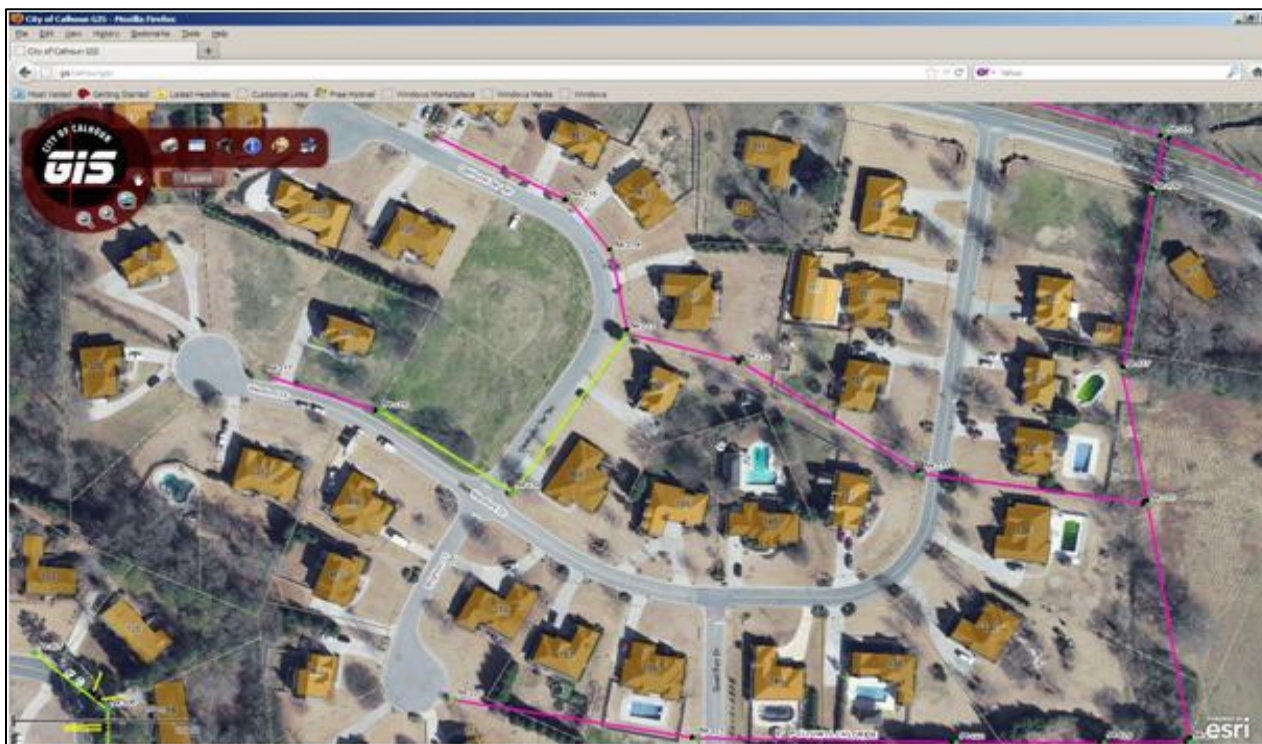


Fig-3 Sewer Mapping Example

Results and Conclusion

The implementation and development of the utility GIS in Bigger Municipal Corporation like MSMG is Very Important. The Single Point Reference system is useful for the departments of MCGM, so that the database can be used by every department in easy possible way. The Data collection done by various departments in various reference plains create problems for the GIS Department to merge the data in single Geo Database.

This 2 Permanent reference stations installed by SUMC will be used by every department in the future to come under a single platform and will helpful for a single point of data updation. The system will be continuously being updated with new layers of data. The development of the GIS is a never ending, ongoing project because of the applications, tools, and analyses each department requests. The GIS today is being used by all departments on a daily basis. The system has become a tool that the departments depend on to carry out their daily functions and decision making. The GIS provides these departments with the ability to analyze and manage their entire infrastructure. The locations of the features are very accurate and precise compared to the old mapping techniques used. The data is now stored in a geodatabase which provides an unlimited amount of information to be linked to the features in their infrastructure.

The two main types of benefits gained from the GIS are efficiency and effectiveness. Efficiency benefits occur when a GIS is used to do a task that was not previously done with GIS and the output quality is same, but done at a lower cost. The effectiveness benefits result when a GIS is used to improve the quality of an output or to produce the output that was not previously available.

Compared to the old mapping system, the GIS have improved the efficiency of the municipal departments greatly by reducing the amount of time needed to carry out daily processes. A few examples of the time saved by using the GIS are listed below by departments.

The focus of this research has been to review, explain, and show an example of how MCGM is Trying GNSS and GIS for the City of Mumbai utility departments. This setup will help us to improve the efficiency within each of the utility departments. The implementation process can provide other cities and municipalities with the knowledge and foundation to develop their own GIS. This research can provide individuals with a reference to implement a utility GIS from the beginning to the end.

References

1. Implementing a Utility Geographic Information System for Water, Sewer, and Electric: Case Study of City of Calhoun, Georgia, Davie Crawford, Ming-Chih Hung