



Comparison of proposed canal alignments in a command area using buffer analysis and BIM tools

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ABSTRACT

With the rapid technological growth in the computer industry over the last decades, spatial related problems and issues have found their way into computer-based systems used to store and manipulate geographically referenced data, these systems which are commonly referred as Geographical Information Systems (GIS) have become widely established in many disciplines. GIS is a powerful software tool, by using this technology it is very convenient to assemble maps quickly from predefined layers, add data from coverage, shape files, geo databases, preparation of models etc. The GIS can be used for identifying suitable locations for buffers. The use of technologies such as GIS can also be very effectively used for fixing the canal alignment. A buffer analysis tool in GIS is a proximity analysis used to create polygons based on a specified distance from the original geometric feature and the output is a large zone or region that surrounds and encompasses the feature. The Buffer output is often used to determine any feature that are within a specified distance of a point, line or polygon. Building Information Modeling (BIM) tools is an intelligent model based process which is very helpful for planning and designing purpose. The aim of this study is to present the applications of buffer analysis which is basically a GIS software tool along with BIM tools for comparing the proposed canal alignments in Somnala Minor Irrigation Scheme of Gosikhurd Indira Sagar Project.

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Introduction

An irrigation canal is a structure which is constructed to convey the water from the sources to a required point. The canal alignment should be fixed and designed in such a way that the conveyance of water and sediments should take place without erosion at the bottom and canal banks, any sediment that enters the system should not settle in the network. It should also avoid cutting and filling, steep turns, permeable soil etc.

The buffer analysis is a GIS software tool which is used for identifying areas surrounding geographic feature. This tool is used for marking or selecting the area along the canal alignments which can be used for further analysis.

The buffer analysis tool is also very helpful in generating the necessary analysis and statistics in a short time, whereas the same task may take few days to weeks through the other convenient methodology.

In this paper three canal alignments are taken into consideration and by using the GIS applications and BIM tools the comparison of the proposed canal alignments is carried out and the best alignment is selected.

Description of study area

The Somnala Minor Irrigation Canal at RD15560M comes from Mokhabardi Main canal of Gosikhurd Indira Sagar Project, at tahasil- Bhivapur, Dist- Nagpur(M.S). The study area is situated between latitude 20° 40'N and longitude 79° 20'E and encompasses a total command area of 275.47 Hect. The maximum and minimum elevations in the area varies from 272.95 to 257.00M from MSL. The region is

having two type of soil formation which is clayey and silty clay loam.

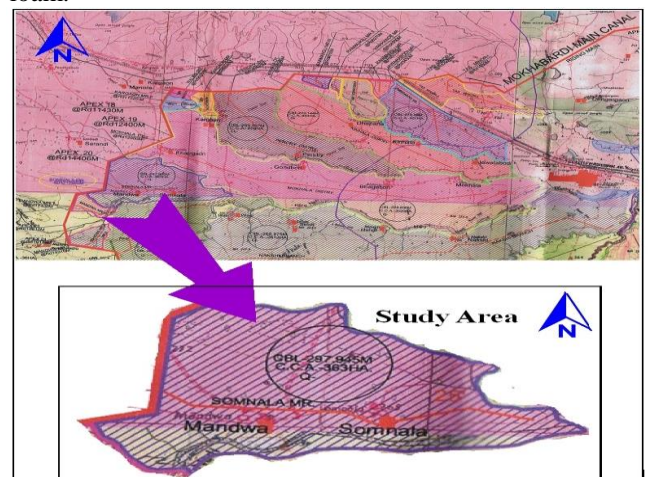


Fig1. Location Map of Somnala Minor Irrigation Canal Design steps

The BIM tools are used for creating TIN surface and by using buffer analysis tool of GIS software the following characteristics of the proposed canal alignments can be fixed which are given below :

- 1) Creating TIN surface using Topographical data.
- 2) Generating elevation plan from TIN surface.
- 3) Overlay soil map, GWP zone map and elevation plan for fixing the canal alignment.
- 4) Buffer analysis on soil map and GWP zone map

- 5) Buffer Overlay Intersect analysis on soil map and GWP zone map.
- 6) Fixing the best canal alignment by comparing (a) soil map (b) GWP zone map (c) Topography, by using Buffer Analysis Tool.

Methodology

Input Method and Models

For the study, a part of Gosikhurd Indira Sagar Project situated near Bhandara District of Maharashtra State has been taken. A part of the project named “Somnala Minor Irrigation Scheme” has been considered as an illustrative example to explain the concept of Buffer Analysis tool of GIS Software and BIM tools for the comparison of proposed canal alignments.

Following models and plans have been prepared for the selected area which will be common for the three proposed canal alignments.

- TIN Surface (Model) which is shown in fig no.2
 - Elevation Plan which is shown in fig no.3
- For the study three alignments are considered and based on models and plans all the three alignments are compared and best one is recommended, these are
- Soil Map
 - Ground Water Potential zone map
- These are represented in fig no.4 & 5.

The flowchart for this models and plans is also prepared which is represented as chart no. 1
 These plans are shown in following figures :

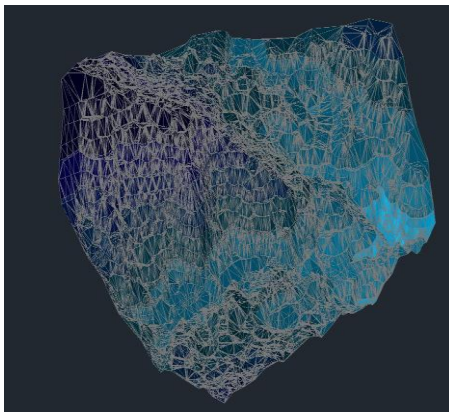


Fig 2. TIN Surface of Somnala Minor Irrigation Scheme

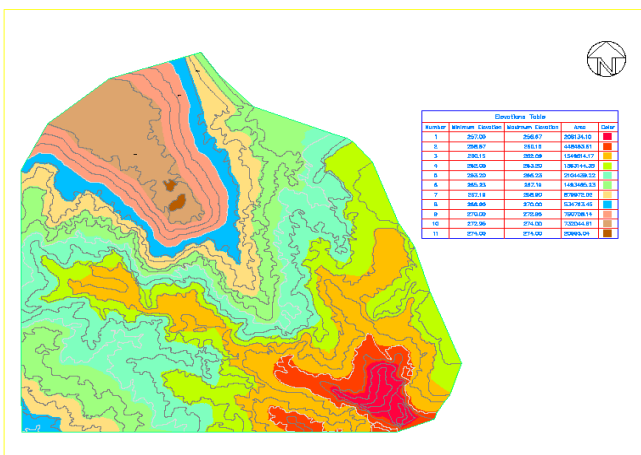


Fig 3. Elevation Plan of Somnala Minor Irrigation Scheme

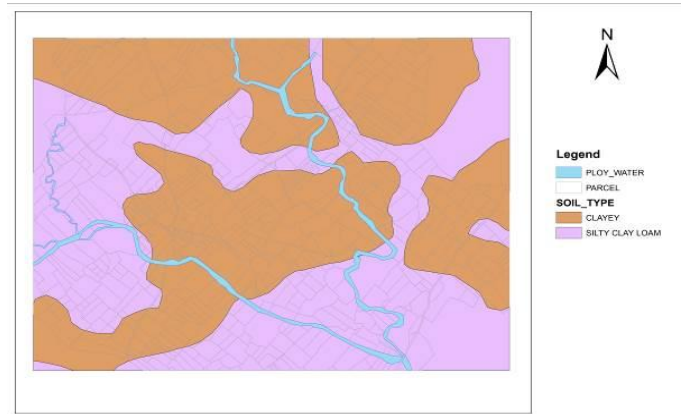


Fig 4. Soil Map of Somnala Minor Irrigation Scheme

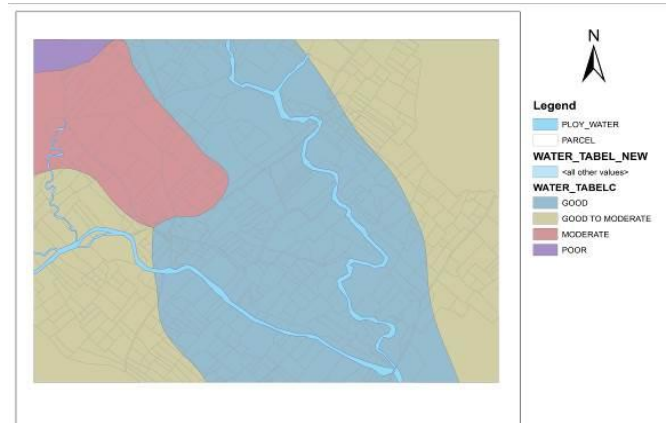


Fig 5. Ground Water Potential Zone Map of Somnala Minor Irrigation Scheme

Fixing of proposed canal alignments and comparison

For the study, three alignments are considered and based on the models and plans, all the three alignments are compared and the best one is recommended.

Various models and plans have been prepared for the three alignments

- Elevation Plan
- Soil Map
- Ground Water potential Zone Map

These are prepared by GIS tools and comparison have been indicated in the following figures.

- a) Canal Alignments are proposed based on elevation plan

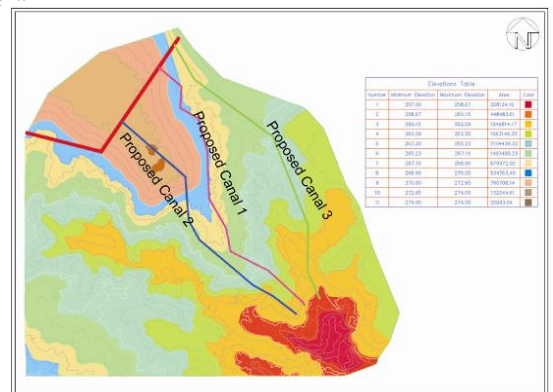


Fig 6. Elevation Plan of Somnala Minor Irrigation Scheme

b) Canal Alignments are proposed based on soil type

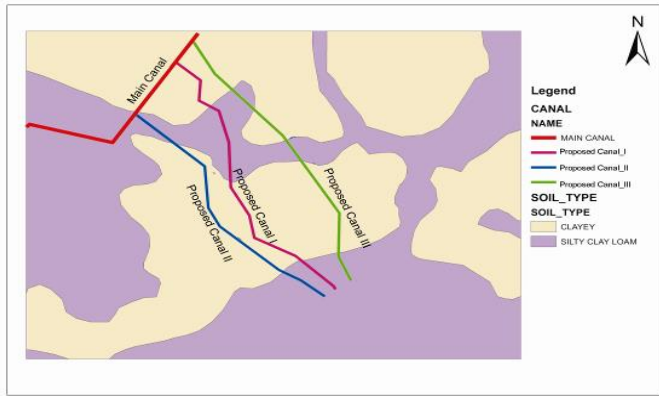


Fig 7. Soil Map of Somnala Minor Irrigation Scheme

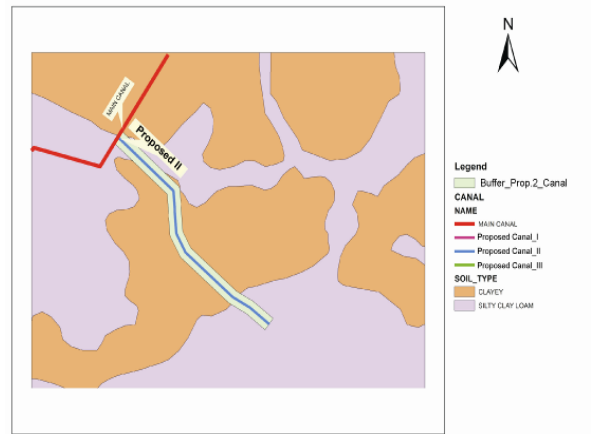


Fig 10. SOIL MAP (Buffer Analysis of Proposed-II Canal) Somnala Minor Irrigation Scheme

c) Canal alignments are proposed based Ground Water Potential



Fig 8. Ground Water Potential Zone Map of Somnala Minor Irrigation Scheme

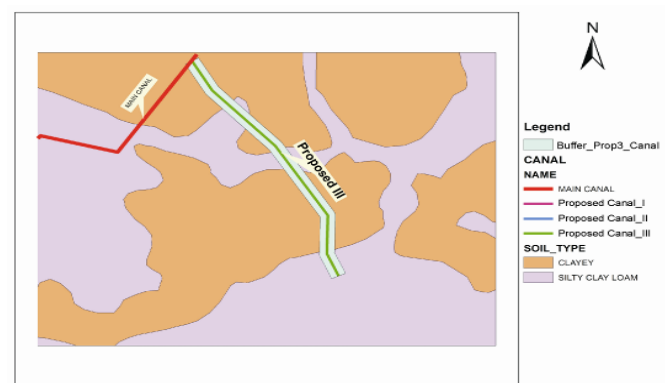


Fig 11. SOIL MAP (Buffer Analysis of Proposed-III Canal) Somnala Minor Irrigation Scheme

Output and results

In all the three alignments Buffer Analysis tool is applied for comparison purpose and which are shown in the figure no as indicated below, these maps are

- Buffer analysis on soil map
- Buffer analysis on GWP zone map
- Buffer overlay intersect analysis on soil map
- Buffer overlay intersect analysis on GWP zone map

For the better comparison purpose all the above characteristics are represented by Bar charts which are given in figure no. 15(a), (b), (c) and 22(a), (b), (c) respectively.

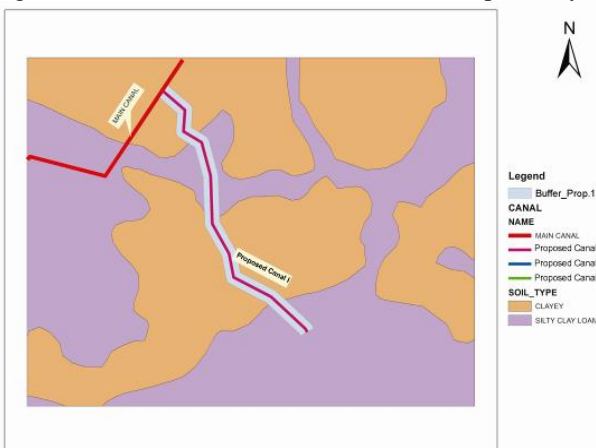


Fig 9. SOIL MAP (Buffer Analysis of Proposed-I Canal) Somnala Minor Irrigation Scheme



Fig 12. SOIL MAP (Buffer Overlay Intersect Analysis of Proposed-I Canal) Somnala Minor Irrigation Scheme

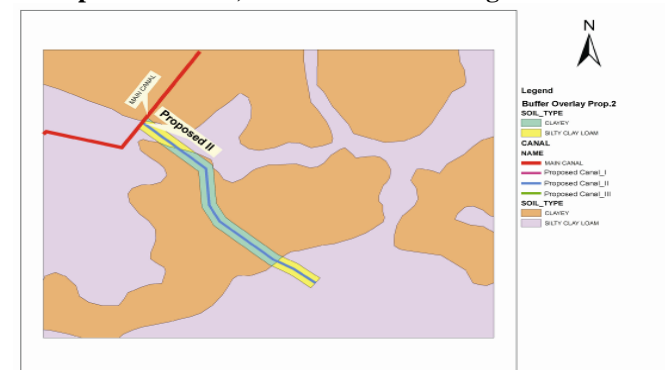


Fig 13. SOIL MAP (Buffer Overlay Intersect Analysis of Proposed-II Canal) Somnala Minor Irrigation Scheme

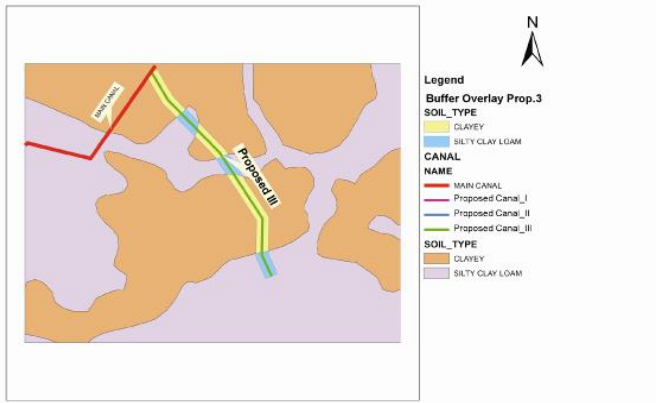


Fig 14. SOIL MAP (Buffer Overlay Intersect Analysis of Proposed-III Canal) Somnala Minor Irrigation Scheme



Fig 16. GWP ZONE MAP (Buffer Analysis of Proposed-I Canal) OF SOMNALA MINOR IRRIGATION SCHEME

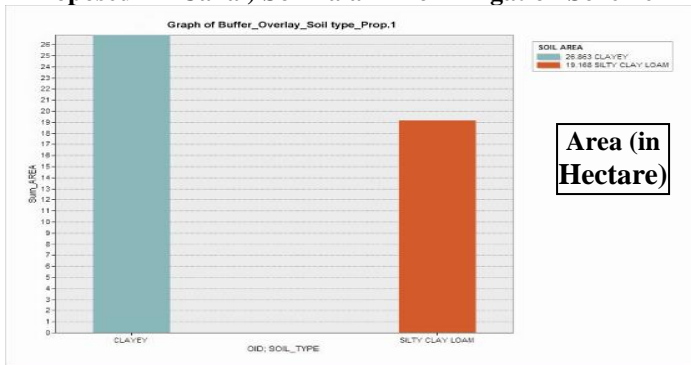


Fig 15(a). Soil Type Vs Area (Proposed-I Canal as per Buffer Overlay Intersect Analysis)

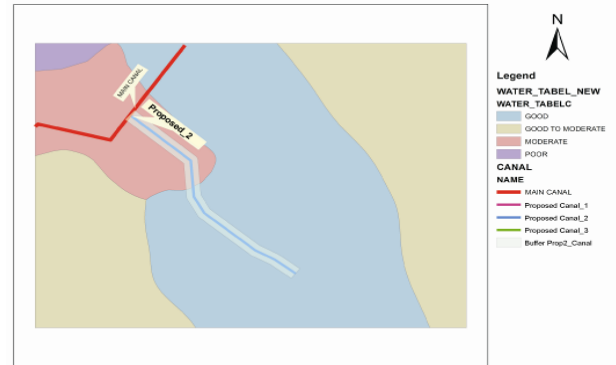


Fig 17. GWP ZONEMAP (Buffer Analysis of Proposed-II Canal) of somnala minor irrigation scheme

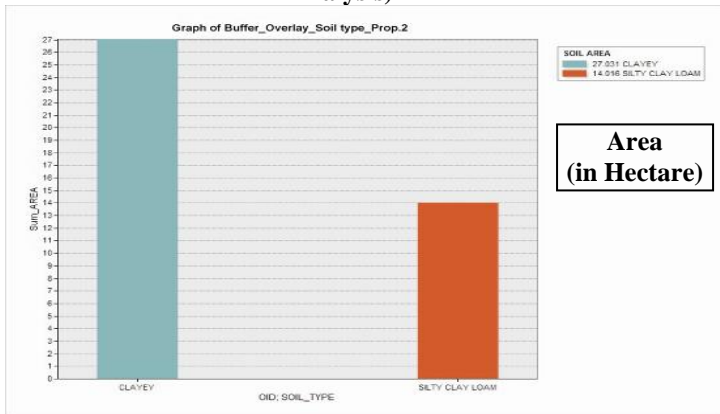


Fig15(b). Soil Type Vs Area (Proposed-II Canal as per Buffer Overlay Intersect Analysis)

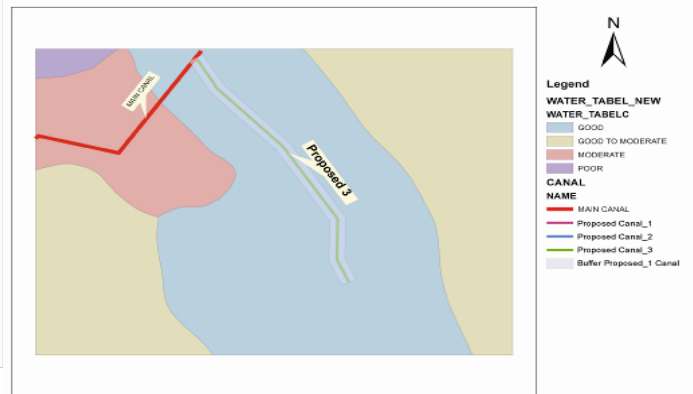


Fig 18. GWP ZONEMAP (Buffer Analysis of Proposed-III Canal) of somnala minor irrigation scheme

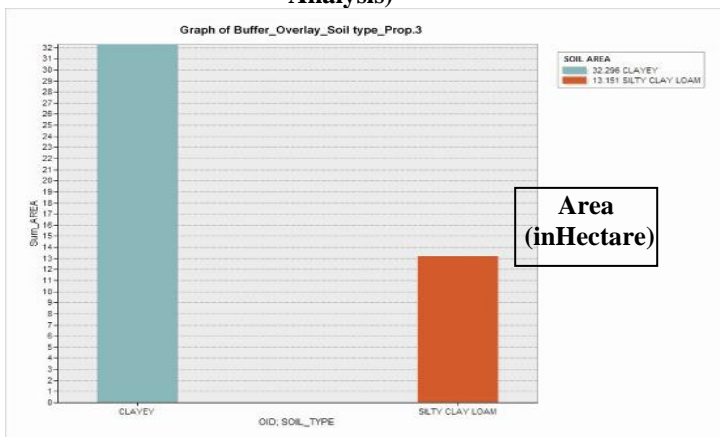


Fig 15(c). Soil Type Vs Area (Proposed-III Canal as per Buffer Overlay Intersect Analysis)

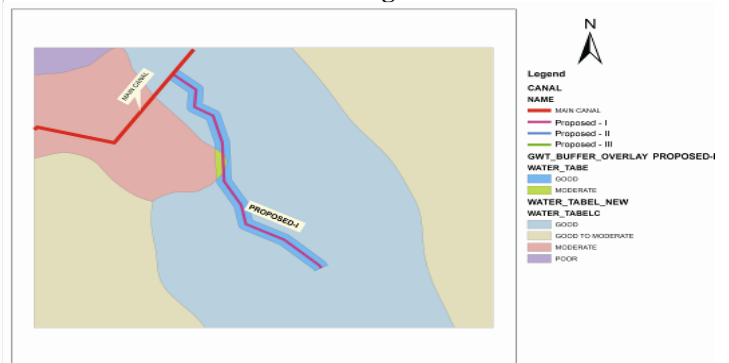


Fig 19. GWP ZONEMAP (Buffer Overlay Intersect Analysis of Proposed-I Canal) of somnala minor irrigation scheme



Fig 20. GWP ZONEMAP (Buffer Overlay Intersect Analysis of Proposed-II Canal) of somnala minor irrigation scheme



Fig 21. GWP ZONEMAP (Buffer Overlay Intersect Analysis of Proposed-III Canal) OF SOMNALA MINOR
Graph of GWT_BUFFER_OVERLAY_PROP.1

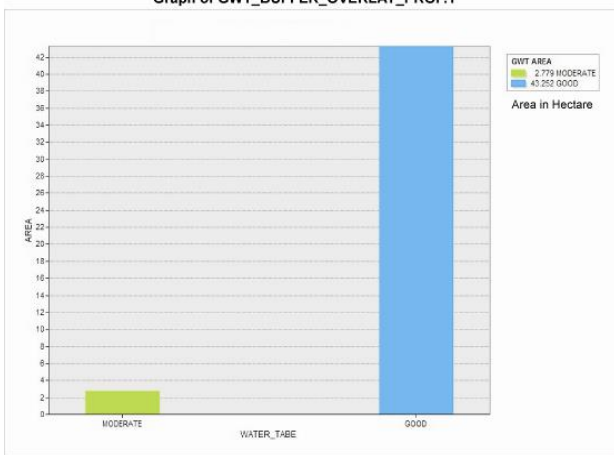


Fig 22(a). GWP Vs Area (Proposed-I Canal as per Buffer Overlay Intersect Analysis)

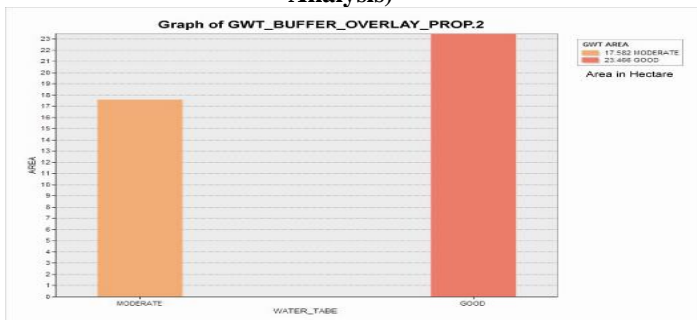


Fig 22(b). GWP Vs Area (Proposed-II Canal as per Buffer Overlay Intersect Analysis)

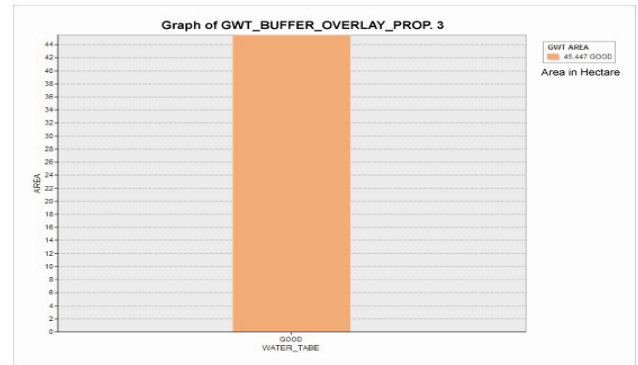


Fig 22(c). GWP Vs Area (Proposed-III Canal as per Buffer Overlay Intersect Analysis)

Flow Chart

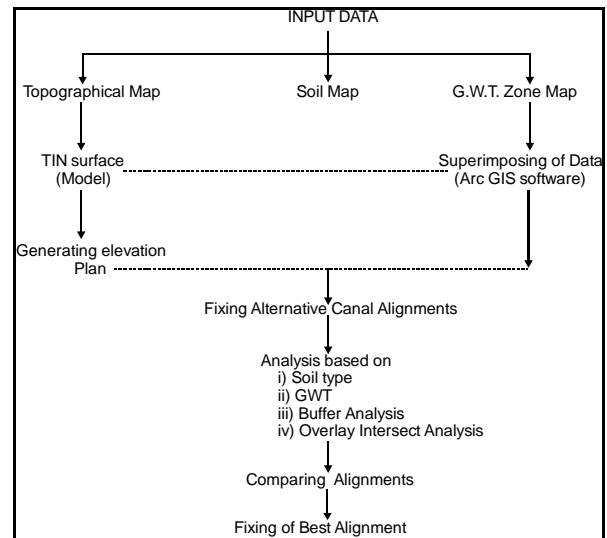


Chart No. 1

Recommendation and Conclusion

- GIS is useful and appropriate tool for spatial calculations, manipulation of data and map generation.
 - With the use of Buffer analysis tool the Arc GIS software, it is possible to fix a canal alignment more favorably and economically.
 - The TIN model developed by BIM tools will be very helpful for GIS calculation and canal investigations.
 - The elevation plan can be easily generated from the TIN model which is very useful for fixing the canal alignment.
 - By using Buffer overlay intersect analysis tools the best canal alignment can be fixed by considering various parameters such as elevation, soil type, ground water potential zones etc.
- Based on the outcome of study of the alignments 1, 2 & 3 the proposed alignment no.2 is recommended based on the following reasons
- As shown in fig. 13 the canal alignment covers the maximum area of clayey soil and minimum area of silt clay loam which ultimately having less seepage loss.
 - It covers the Maximum area of moderate zones of Ground Water Potential, hence irrigation to this area is more feasible.
 - The alignment passes from the Maximum Elevation zones, which is helpful for carrying water with the appropriate velocity.

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