City of Greater Geelong

GIS Extension to 2011 Annual Geotechnical Inspections for Clifton Springs, Bellarine Peninsula

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Contents

1. Introduction and Background 1
2. Development of Web Page Structure 2
3. Updating of Existing CoGG GIS Mapping Resource 3
4. Integrating Web Pages and GIS Mapping Resource 4
5. Discussion and Recommendations 7
6. Information about this report 8

Figures

1. Study Area Location Map
2. Figure 2 – ArcMap Interface with HTML Popup Tool
3. Figure 3 – Layer Properties dialog box
4. Figure 4 – Web Page access from GIS feature within ArcMap application

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1. Introduction and Background

This project details the development of an extension to the existing a GIS-based web resource established by A.S. Miner Geotechnical (ASMG) for the City of Greater Geelong (CoGG) and previously discussed in the report entitled “Bellarine Coastal GOS Data Compilation and Mapping Project. (ASMG Report Mo 577/01/11 3rd Oct 2011)”. A number of detailed inspections were carried out in 2011 across a study area located on the Bellarine Coast at Clifton Springs as part of a revised annual inspection program. These inspections were described in the report entitled “2011 Annual Geotechnical Inspections for Clifton Springs, Bellarine Peninsula” (ASMG Report No. 591/01/12).

A significant amount of data was gathered in this study area and documented in the annual inspection report, most of it being location-based. It became apparent that there would be a distinct advantage in being able to review, analyse and utilise this information through interaction with the existing GIS desktop mapping.

To accomplish this interaction, a series of web pages were developed around the contents of the GIS desktop mapping resource mentioned above. These web pages were organised around the seven management zones that have been used across the study area. These zones are generally the same as those adopted in the Clifton Springs Coastal Management Plan (2007) and provide areas of similar management objectives and geomorphological features.

The revised GIS/information resource that has been developed in this project will be an important management tool to assist with future risk assessment planned to be undertaken as part of the upcoming Bellarine Peninsula Future Coasts Third Pass assessment. It will allow the user to view descriptive textual information, site photographs and graphs relating to management zones while at the same time providing access to GIS features within that zone. These GIS features include coastal infrastructure assets, monitoring points, geohazards, geomorphology, geology as well as base mapping data such as aerial imagery, elevation, parcels, roads etc.

This report details the development of the web structure and content as well as the process of integrating with the existing GIS mapping resource.

Figure 1 Study Area Location Map
2. Development of Web Page Structure

This process was aligned around the need to spatially link specific reporting information to its corresponding management zone. To accomplish this, a series of web page groups were developed for each zone. In each zone group, a web structure was created to allow a user to click on a GIS feature representing that zone and access a “home” web page for that zone.

Each zone group (zone1 through zone7) contains the following web-page elements:

- **Home landing page** which contains the “Introduction and Background” text from the inspection report as well as the “Description” and “Known Hazards” text from each respective management zone chapter. Management Zone Area maps in PDF that were provided as part of the inspection report are also linked to this page.

- **Regional Information page** which is common to every zone grouping. It contains text from the “Regional Information” chapter of the inspection report.

- **Other Reports page** which lists all relevant previous reports in chronological order. These reports may differ in content and nature from the inspection report that this project is based upon, which is specifically an annual geotechnical inspection reporting document type.

- **Zone-specific page** which contains the content of each zone chapter within the inspection report, namely:
  - Current Site Observations
  - Groundwater Monitoring and associated appendix information depicting monitoring graphs
  - Surface Movement Monitoring and associated appendix information depicting monitoring graphs
  - Subsurface Movement Monitoring and associated appendix information depicting monitoring graphs
  - Comments and Recommendations
  - Site Photos – which appear as an appendix in the source report

- **Disclaimer page**

The pages are designed to operate in a standard web browser window that is launched from within the GIS mapping resource. (See section 4)
3. Updating of Existing CoGG GIS Mapping Resource

This process involved the incorporation of the most recent spatial data that has been captured in the study area since the development and delivery of the “CoGG Bellarine Coastal Mapping” resource in October 2011. This resource is based upon an ESRI ArcGIS 9.3 map document format. Specifically, the features that have been added to the existing map document resource include:

- **Management Zone layer** – this is in the form of a series of seven polygons representing the spatial extent of each zone. Importantly, these features are used as the initial point of reference for the user of the web resource since they are linked to the relevant zone Home page.

- **Additional coastal extensometer monitoring points** – this information consisted of:
  - Four GIS point features that represent existing extensometers at Griggs Creek that were not included in the original version of the GIS resource
  - Six GIS point features representing new extensometers at Old Edgewater
4. Integrating Web Pages and GIS Mapping Resource

As described in the previous section, the existing GIS Mapping resource (ArcGIS “CoGG Bellarine Coastal Mapping”) is now enhanced through the linking of relevant textual information (contained in the web pages) for each management zone to the corresponding GIS feature in the management zone layer.

The process of accessing web pages through the GIS Mapping resource is achieved using the HTML Popup Tool in this ArcMap GIS software application (see below).

![Figure 2 – ArcMap Interface with HTML Popup Tool](image)

The first task in this process is to configure the source of the web pages that are to be referenced to the Management Zone layer (CoGG_Bellarine_Management_Zone). To accomplish this, the following steps need to be undertaken in ArcMap:

- Right-click on the layer name (CoGG_Bellarine_Management_Zone) in the Table of Contents within ArcMap – a new “Layer Properties” dialog box will open.
- In this Layer Properties dialog box, undertake the following:
1. Select the HTML Popup tab
2. Check on the “Show content for this layer using the HTML Popup tool” option
3. Check on the “As a URL” option
4. Enter the specific path to the directory where the web pages are stored in the Prefix area.
5. Ensure that the correct field in the CoGG_Management_Zone is selected (i.e., “web”). This is the field that contains the names of the individual Zone Home pages (e.g., zone5.htm)

Figure 3 – Layer Properties dialog box

It is important to note that when the “CoGG Bellarine Coastal Mapping” is copied to any new location (such as from the DVD supplied as an output of this project), the specific path to the location of the CoGG_Annual_Inspections_Reporting directory must be defined in the box above (see the Prefix area).
In order to access each of the web page groups that relate to a management zone, the user simply clicks on the management zone polygon feature using the HTML Popup Tool (see example below). The page group opens within a new browser window and is referenced to the zone by a pointer.

![Figure 4 – Web Page access from GIS feature within ArcMap application](image)

Note that the user can open multiple page groups each within its own browser window as required.

Within each browser window, standard web page operations can be undertaken such as:

- Linking between pages with the web page group browser window
- Jumping to reference points within the same page
- Opening new browser windows to view:
  - Graphs as a PDF document
  - Other reports as PDF documents
  - Site Photos
  - External web pages
5. Discussion and Recommendations

Based on the information reviewed and additional understanding gained from this study, the following comments are made:

- This project provides the first spatially-enabled monitoring resource for the Bellarine Coast.

- There would be value in maintaining this GIS extension element to the regular annual geotechnical inspection program through a coordinated update to the GIS database that records the locations of all existing and new monitoring points, inspection points and coastal infrastructure assets that are referred to within an annual inspection reporting report.

- Similarly, any textual, graphical and site photography that is produced as part of an annual inspection program report should also be converted in conjunction with an annual GIS update into a web-page format that links to the spatial representation of coastal management zones.

- This spatial information resource will be a valuable tool in a future Third Pass Coastal Study. It will provide a platform for undertaking new data capture, analysis, reporting and mapping/presentation. Any resulting outputs that may be undertaken by CoGG as a result of a future study such as this will be easily stored and maintained in this format.

- A significant amount of existing reports, photographs and other documentation can easily be stored in this resource once digital copies have been identified. A number of documents have already been input and can be reviewed through the "Other Reports" tab on the web resource, but this number can be expanded based on additional resourcing.

- The GIS resource can also be extended to other parts or even the entire City of Greater Geelong local government area. As such the resource can serve as a spatially based data repository for a wide range of information over a wide spatial area.
6. Information about this report

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Statement of Limitations – GIS/Mapping

Sources of Data and Confidence

The essential feature of all GIS/mapping data is that there is a recognition of the spatial attributes of the data presented allowing natural features to be treated as part of a spatial system, rather than as an isolated object. This capability enables the spatial system, (i.e., the environment of any given region) to be built within the computer project environment using often disparate data sets. The data used in this project comes from a variety of sources that can be related or contribute to mapping of natural phenomena (geological and engineering geological mapping, landslide mapping, traditional surveys, GPS surveys, drilling of boreholes, test pits etc.). In addition, other data is used for reference purposes and comes from a variety of sources including: government organisations and authorities, private companies and other spatial organizations (in the form of digital elevation models, cadastre, contours, aerial photography, land usage, vegetation etc.)

Note that mapping any phenomena, whether natural or anthropogenic must take into consideration the dynamic nature such elements. In this regard, data can only be mapped at any point in time. The user needs to be aware of the temporal element of sources of data used in that they are based on a period of data capture. Even where predictive modelling is to be the nature of the mapped output and therefore may be used to estimate how something may be characterised at another point in time, the underlying data and expert judgement used to create them will be based on certain assumptions that are valid at a fixed point in time.
Accuracy measures, when applied to source data and mapping from a single survey, are a valuable way to indicate how well a map performs as a predictive tool. However it should be clear that there are often difficulties in interpreting accuracy measures. These difficulties are compounded when maps have been derived from data from many different sources (e.g. landslide susceptibility mapping). It might be possible to assess the accuracy of the contributory maps, but accuracy measurements do not always accompany published maps and may not even have been undertaken as part of the mapping process. It may be possible to test the accuracy of a final broad-scale map by testing its predictive power against a test data set. However, the results may not be particularly meaningful or easy to interpret.

Confidence assessments provide an alternative way of judging the usefulness of a source mapping data and related information. Confidence is a more subjective form of assessment and is derived from a number of different criteria. In general, this assessment can be completed by a map-user simply by checking a map and any accompanying report and supporting maps for criteria that indicate the standard of source mapping/information. This might take the form of a check-list of questions. For example does the published source map show basic information about the origins of the map and its datum? If there is a report accompanying the map, does it show clearly how the map was derived?

Source mapping data and related information used in this report has been subjected to a subjective form of assessment derived primarily from reviewing the available metadata for each data layer. Specifically, metadata elements relating to spatial data accuracy have been examined. Metadata generally contains information in some or all of the following categories relating to its spatial accuracy:

- Positional Accuracy – Amount that plotted features are within their true position
- Relative Accuracy – Shifting of data as a means of cartographic enhancement to facilitate presentation for real world features
- Feature and Attribute Accuracy – the degree to which features and attribute values of spatial objects agree with the information on the source material
- Logical Consistency – The measure of the degree to which data complies with technical specifications
- Completeness – Amount that the dataset covers in recording a specific real-world phenomenon

In some instances, metadata has not been provided and so, expert judgment has been applied as to the data confidence.

Confidence may also relate to the processes by which a data set has been assembled. In the initial phase of assessment, attributes may be assigned through judgment and knowledge obtained from experienced practitioners (a heuristic or knowledge based approach). Later stages of assessment may use more deterministic or computational methods to combine parameters and datasets using a variety of statistical approaches. Whilst generally more rigour is implied in this assessment process, this does not always necessarily mean greater confidence should be attached to the outputs as this relies on verification and evaluation processes. Confidence is highest when any process used to produce a result that is calibrated, verified and then re-calibrated as a result of extensive and iterative field observations.
Scale of Data Use

Note that data provided as part of this report should not be used at scales greater than the stated intended use (as is indicated in metadata associated with a supplied data set which also corresponds with the scale of any published maps depicting data that may be included as part of this report). Data can be used for scales less than that stated here. For example, property boundary data can be used appropriately at Local Scale but can also be used at Regional Scale if desired.

Assessments made at State-wide or Small scale is generally intended to inform policy makers and the general public of the overall context of a hazard and is a tool for more strategic use. Regional or Medium scale allows a preliminary assessment for development and resource planning and is most suited to desk top-type analysis without the user being swamped by too much detail. On-ground works priorities may be assessed in a preliminary sense using such data but with confirmation then needed at a local or site scale. Local or Large scale allows for advanced planning for structures and remedial works and can provide better definition and clarity of assessment at a desk-top study phase if it is available. Site or detailed scale is required for detailed design and on-site implementation of proposed works.
References

ASMG. (2011). *Bellarine Coastal GIS Data Compilation and Mapping Project*, ASMG Report No. 577/01/11