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A GIS Approach to Conflict Minimization in Strategic Domestic Wastewater Management Planning - A Case Study

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EXECUTIVE SUMMARY

Historical planning decisions that led to the creation of unsewered subdivisions with land parcels too small to dispose of liquid wastes on-site have left a legacy that present day planners must deal with. It is not uncommon for planners to resort to rescinding development rights, or to put in place policy that encourages the consolidation of small parcels into larger ones that are capable of on-site wastewater disposal. Such situations commonly lead to conflict between planners and ratepayers, and community planning forums are guaranteed high rates of participation by anxious ratepayers whose life-plans may be affected. In the absence of appropriately scaled spatial information showing themes relevant to on-site wastewater disposal, it can be assumed that an entire area is subject to planning conflict. Often it is not. In Victoria, Environmental Protection Authority (EPA) guidelines set environmental constraints such as watercourse setbacks, slope extents and soil suitability that must be observed in the determination of a parcel's suitability for on-site disposal of liquid wastes. When these constraints are mapped against subdivision patterns, areas display as being developable, undevelopable, and somewhere in between and requiring closer scrutiny.

In this paper we describe a planning review process that used GIS maps of themes relevant to domestic wastewater disposal as its basis. Produced by a team of independent consultants, the large scale GIS maps demonstrated to stakeholders the extent to which each parcel was (and was not) affected by environmental constraints, and that the developability of the study area changed under Council's parcel consolidation policy. While on the one hand the GIS mapping partly validated to Council its planning response to an environmental health concern, in a manner that was defensible, repeatable, spatially consistent and fair, it also served to show ratepayers that there were clear technical and scientific reasons why the existing subdivision pattern was unsuitable in their area.

INTRODUCTION

The Tambo Bluff Estate covers 130 hectares on the edge of Lake King on the Gippsland lakes, near the township of Metung, Victoria. During the 1960's, the area was subdivided into 1195 residential allotments of less than $500m^2$ and 33 commercial allotments of around $200m^2$. The subdivision complied with all of the legal requirements of the time.

In the early 1970's it became apparent that full development of the subdivision would have a serious detrimental impact on Lake King. In 1973, intervention by the then Town and Country Planning Board led to a Restructure Plan for the estate in which 319 blocks were assigned to low intensity use areas and public open space. The Shire purchased many of these. The remaining 908 lots were amalgamated into 328 Restructure Lots.

In 1998 a planning Panel (Rooke *et al*. 1998) heard 18 submissions and was told that there were 43 dwellings on the estate, that around a quarter of potential Restructure lots were still in divided ownership, and that a recent review had recommended that the 117 privately owned low intensity use lots be acquired by the Shire. While all submitters seemed to acknowledge that the subdivision was inappropriate, it was debatable as to which lots could adequately deal with septic wastes, and exactly how the layout of the estate should change in response to the Restructure Plan. The Panel, concerned that there was no clear statement of policy regarding development on the estate, recommended that the shire undertake a study that paid close attention to environmental constraints, particularly those relating to on-site wastewater disposal.

In 2001 van de Graaff and Associates were engaged to undertake a study to determine the capability of the restructured estate to dispose of waste water onsite using onsite water storage, and in a manner that would provide a scientific basis for determining appropriate courses of action to address any present or potential problems identified through the analysis.

In this paper we describe a novel approach to satisfying the aims of the consultancy. We began with the knowledge that many of the ratepayers were anxious about the status of planning on the estate and that it would be necessary to convince a public meeting of ratepayers as well as the project steering committee that our study was not only scientifically rigorous, but it was repeatable. We chose to do this by GIS mapping for the entire estate themes that were relevant to onsite wastewater disposal such as soils, slopes and watercourses, and relate these to the pattern of subdivision on the estate. It was our belief that all stakeholders would be more likely to accept a project outcome that was demonstrated to them in this manner.

MAPPING THE EPA CODE OF PRACTICE

The Victorian EPA code of practice prescribes constraints that relate to slope, proximity to water features, and soil suitability for the disposal of septic tank effluent (EPA 2003a, EPA 2003b). Although designed for rural subdivisions rather than dense subdivisions, the guidelines were important firstly because they provided a justifiable starting point for our assessment, and secondly because each of the three factors were relevant to the estate. The EPA requirements were GIS mapped in the following manner:

1. A three class slope constraint map was derived from a digital terrain model (created from a five metre interval contour map). The broad classes (0-15% developable, 16-25% uncertain and >25% undevelopable) were intended to reflect the dubious quality of the source contours.

2. A water features map for the estate was on-screen digitized using an air photo backdrop and then buffered sixty metres to represent an undevelopable area.

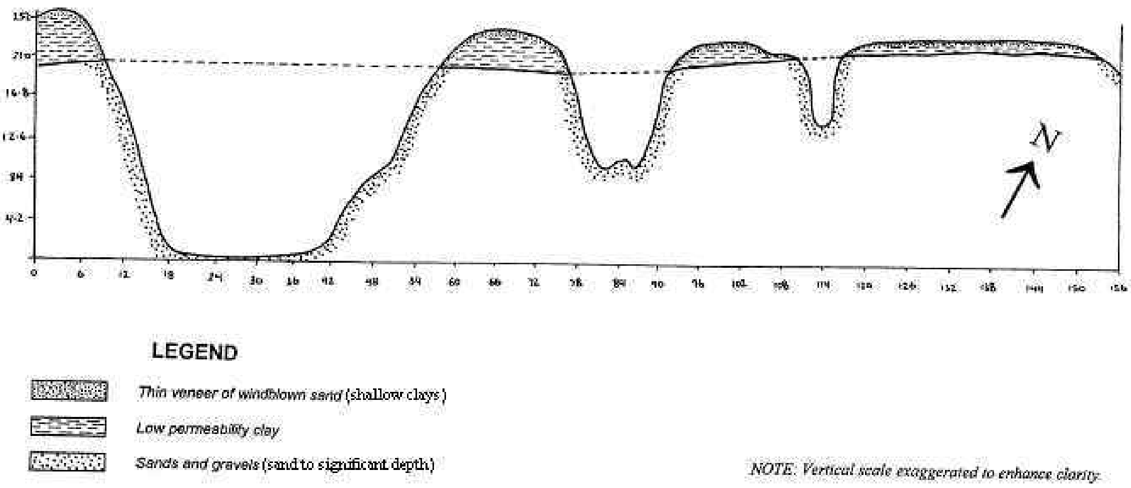
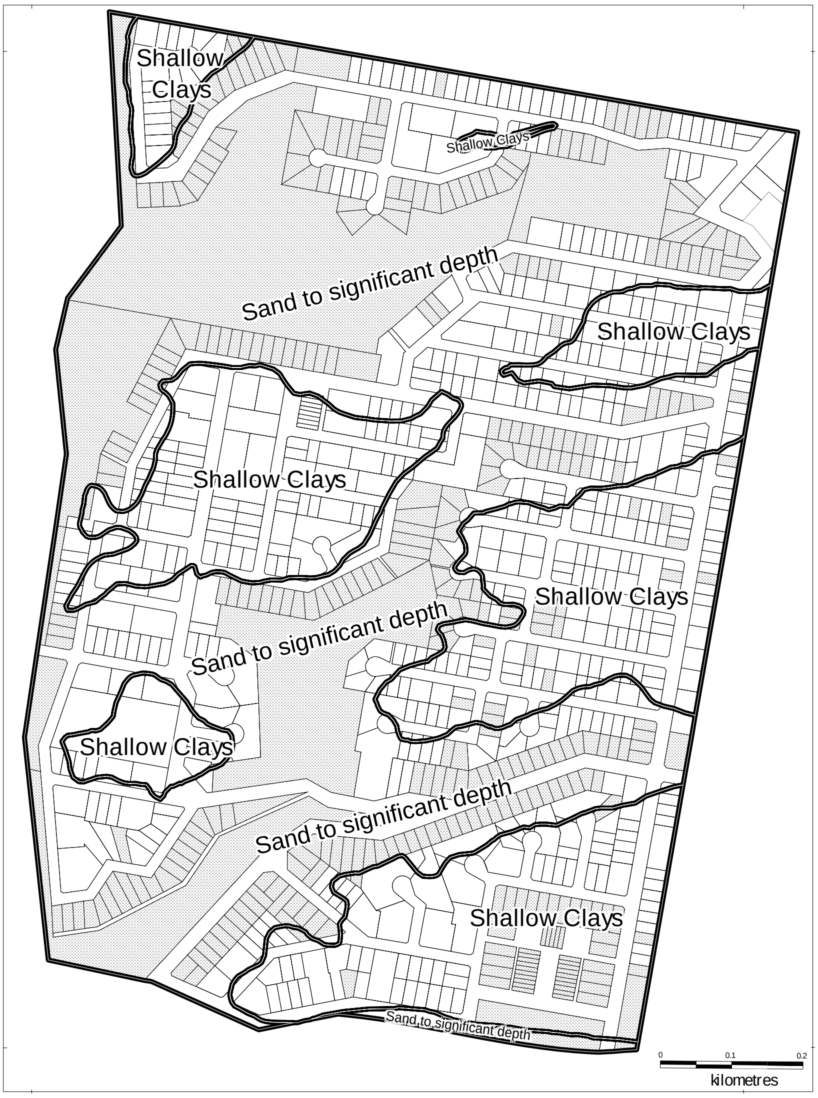


Figure 1: Representative cross section through the land at Tambo Bluff Estate. Measurements are in metres.

3. A large scale soil map was surveyed for the project. Detailed soil maps are rarely available and the effort involved in producing this one proved to be well worthwhile. The map showed that the estate was covered by a shallow sandy topsoil on a clay subsoil of very low permeability, probably around 5 metres deep. The clay overlaid deep sandy and gravelly soils (Figure 1). Major erosion along the gullies had uncovered the buried sands along the steep gully slopes and the escarpment along the foreshore of Lake King, creating two contrasting soils types that we labeled as being "shallow clays", and "sands to significant depth".

We found, in August 2001, large areas in the Estate covered with stagnant surface pools of rainwater. The hydraulic conductivity of the upper layers of clay subsoil measured at 4 sites, resulted in an average of 0.014 m/day. The lower subsoil strata would be much less permeable. Water balance modeling then provided minimum effluent disposal fields for selected daily effluent design flows.



Map 1: Current and proposed public open space, low intensity use area, and land owned by the Shire.

Allowing for impermeable surfaces, it was calculated that for a typical three bedroom house relying entirely on tank water, on the clay soils an allotment of at least 1100 m^2 would be required for the effective disposal of septic tank effluent, and on sands at least 650 m^2. The lot sizes recommended here both fall well short of the minimum lot size of 4000 m^2 (1 acre) assumed by the Victorian EPA Code (EPA 1996). On such small allotments, there were risks associated with both soil types. Shallow clay soils had a clay subsoil that formed a severe obstacle to vertical drainage. Under the provisions of the EPA Code of Practice, soils with such low permeability are unsuitable for disposal of septic tank effluent using traditional absorption trenches. The concern here was that there was no room for design or installation mistakes, unexpected peak flows, abnormal rainfall events, or poor septic tank maintenance. The sands to significant depth were restricted to the steeper slopes around the plateau and along the depressions that had eroded below the clay capping. With a permeability of around 1.4 metres per day, these soils were about a hundred times more permeable than the clay soils, meaning that although the risk of surface emergence of effluent was small, the risk of groundwater contamination was increased in an invisible manner.

In addition to the water, slope and soil related mapping, four other GIS maps were included. The first was an airphoto map overlaid with five metre contours, the second a map of land controlled by the Shire in terms of a low intensity zoning, public open space zoning, and ownership (Map 1). The third and fourth were maps of existing and restructured subdivision patterns.

MODELLING THE IMPACT OF THE EPA CODE OF PRACTICE

With the maps created, we were in a position to relate the environmental maps to the pattern of subdivision within the GIS. GIS is an ideal tool for undertaking such a task because the allotment sizes, water feature buffers, slope constraints and the soils ability to absorb the effluent all vary spatially, as do their relationship to each other. The rules we adopted for the project are summarized in Table 1.

Table 1: Constraints relating to the Tambo Bluff estate. It was considered to be appropriate to include an on-site inspection category.

Theme	Rule	GIS interpretation
Watercourses and bodies constraint	Development prohibited within 60m	60m buffer: Development unacceptable
Slope constraint	Development prohibited on gradients exceeding 20%	>25%: Development unacceptable
		16-25%: On-site inspection recommended
		<15%: Development acceptable
Sands to significant depth	> 650m^2 required	Unconstrained parcel area <600m^2: Development unacceptable
		Unconstrained parcel area 601-700m^2: On-site inspection recommended
		Unconstrained parcel area >700m^2: Development acceptable
Shallow clays	> 1100m^2 required	Unconstrained parcel area <1050m^2: Development unacceptable
		Unconstrained parcel area 1050-1150m^2: On-site inspection recommended
		Unconstrained parcel area >1150m^2: Development acceptable
Shire owned land, Low Intensity Use zone, Existing and Proposed Public Open Space	Development prohibited	Development unacceptable

Applying the rules to the existing pattern of subdivision (Map 2) shows that only a small number of parcels are likely to be capable of adequately disposing of liquid wastes on-site. In contrast, Map 3 shows the pattern of subdivision as it would look if ratepayers were to embrace the Shire’s restructure plan in a way that would lead to its full implementation. Clearly, in parts of the estate a fully implemented restructure plan would lead to many more developable parcels than is currently the case, so the Shire was close to getting it right on its own. However, in the central-north and north-east, two areas of shallow clays are not extensively owned or zoned by the Shire (Map 1), suggesting that the Shire did not get it right everywhere.

In the planning forums, stakeholders were shown the series of maps discussed in point 3 above. Each map was discussed in terms of important features within it, and in terms of important relationships between it and other maps. Aside from the obvious unease when being shown Map 2 (and relief at seeing Map 3), at all forums, stakeholders seemed comfortable that the process was open and the outcome justifiable.

Map 2: Overall constraints based on the present pattern of subdivision. Taking into account minimum area requirements prescribed for each soil type, slope and water buffers, and Shire owned land, there are only a small number of privately owned allotments (shaded white) that may be developed. Grey areas are roads or those where on site inspection would be required. Black areas are undevelopable.

Map 3: Overall constraints based on the Shire's desired subdivision pattern as expressed in its Restructure Plan. Taking into account minimum area requirements prescribed for each soil type, slope and water buffers, and Council owned land, there are many more restructured allotments (shaded white) that may be developed. Grey areas are roads or those where on site inspection would be required. Black areas are undevelopable. Reference to Map 1 shows that the Shallow Clays in the mid-east and north-east are not extensively owned by the Shire, suggesting that the Restructure Plan's aims would not be fulfilled everywhere (label A).

CONCLUSION

When a series of relevant high quality GIS maps based on well-supported physical data are brought to a domestic wastewater planning process, it is possible to model the effectiveness of various subdivision configurations as they relate to environmental constraints. Stakeholders are more likely to be relaxed by a planning process that is scientific, repeatable and defensible. However, such maps, while ideal for strategic decision making, should not be seen as a substitute for site level decision making because the technique does not assess whether the unconstrained parcel area is contiguous, or in the most appropriate position within the parcel.

In this instance the consultants were able to demonstrate to stakeholders (at steering committee meetings and at public meetings) that the estate could not sustain development at the density anticipated by the present plan. Better informed by evidence based information, the steering committee resolved to pursue provision of reticulated sewer to Tambo Bluff, and redesign the restructure plan having particular regard to development density and land suitability considerations.

The study is presently being used to inform the development of design and development guidelines and overlays, and a new Restructure Overlay for the Estate. In the future it will be used to communicate the rationale for these design outcomes to a range of stakeholders.

REFERENCES

EPA, 1996, Code of Practice – Septic Tanks, Publication 451, March 1996

EPA, 2003a, Septic Tanks Code of Practice, Publication 891, March 2003;

EPA, 2003b, Land Capability Assessment for Onsite Domestic Wastewater Management, Publication 746.1, March 2003

Rooke R, Jacka E and Harper B, 1998, East Gippsland New Format Planning Scheme. Report of the Panel and Advisory Committee November, November.