

**Paper Charts to E-Hydrography
A New Zealand Perspective on 5 Years Of Change.**

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ABSTRACT

The objectives of this paper are to outline the events that have influenced New Zealand national hydrography from 1996 to the present time, to evaluate the successes as well as the areas that could have been improved and to highlight future opportunities. Particular emphasis is placed on the impact of the New Zealand Government's e-government policies and strategies on both hydrographers and mariners. A diverse range of drivers of change are drawn together and a cohesive model for progress formed.

The views expressed in this paper are the authors' own. They have been drawn from many years of involvement in the land information industry and at the centre of recent national hydrographic strategic development.

1. Background

In 1995 the New Zealand Government introduced fundamental changes to the way its land information services were to be delivered. This resulted the formation of a new department called Land Information New Zealand (LINZ) <http://www.linz.govt.nz> , a new fully commercial State Owned Enterprise called Terralink NZ Ltd and a partially commercial Hydrographic Business Unit operated by the Royal NZ Navy (RNZN). The division of responsibilities was based on a purchaser/provider split with topographic and hydrographic policy and regulatory functions moving to LINZ. Production activities such as surveying, mapping and charting were transferred to the two commercial entities.

LINZ was also made responsible for the issue and recording of land title, regulation of valuation, the national survey system, Crown property dealings and the continental shelf delimitation project. It has a national office located in Wellington and five regional offices. During recent years the department has taken a lead in the implementation of strategies to assist the wider Public Service to move into an e-government environment.

Hydrography responsibilities have been delegated to the National Topographic/Hydrographic Authority (NTHA), one of 8 corporate business units. Personnel comprise the Chief Topographer/Hydrographer, three managers and 15 technical experts. Responsibilities include the development of technical policies, standards and programmes, quality validation, audit, database stewardship and data management. External contractors provide surveys, cartography, chart maintenance and product distribution services. Contracts are negotiated and managed by another LINZ business group with specialised outsourcing expertise. NTHA personnel are active in interdepartmental and international committees concerned with the development of common standards, internet data distribution and the improvement of the emergency services geo-spatial data.

2. Situation Prior To 1996.

During the period between 1984 and 1995 nineteen reviews were undertaken on ocean matters that either directly or indirectly considered research vessels. Hydrographic survey vessels were included in the deliberations. The most influential on hydrography were “Our Oceans: A Wealth of Opportunities” (*Report of the Marine Research Vessels Needs Review Committee, 1993*) and “Review of New Zealand Hydrographic Services” (*Heath 1995*). Some of the more pertinent conclusions from “Our Oceans” were:

- The information provided by the Hydrographic Service was fundamental to New Zealand’s commercial interests and to the safe conduct of maritime operations.
- Two of the naval offshore survey vessels were at the extremes of the age/effectiveness continuum. They were old, expensive and inefficient to operate.
- Large sections of the New Zealand coastline were poorly charted.
- The cost of hydrographic surveying was a significant proportion (28%) of total research costs, and was inefficiently expended.
- The Navy, with its methods and its cost structures, was not a suitable agent to perform the task of cost effective hydrographic surveying.
- Maximum effort needed to be directed towards resolving the fundamental structural, cultural and fiscal causes of the inefficiency.

- A long-term strategic plan was needed to upgrade systematically and complete the hydrographic surveying of New Zealand's EEZ.
- A least one of any additional research vessels needed to be ice-capable to operate in Antarctic waters.

The 1995 hydrographic review noted administrative difficulties, high survey costs, limitations of existing chart production systems, and the lack of surveys over much of the EEZ. Heath recommended sweeping changes and the transfer of the Crown's hydrographic functions to another agency.

Both reports were controversial and there were many that did not agree with the conclusions. Implementation of the recommendations became a factor in the establishment of LINZ, the RNZN Hydrographic Business Unit and Terralink NZ (Ltd).

3. Subsequent Achievements.

On 1 July 1996 the NTHA had no hydrographic funding, no intellectual property rights, few policies, no standards and little knowledge of sea bed data capture. Infrastructure deficiencies were rectified and five years on the situation is markedly different. Major achievements have been:

- First national hydrographic strategy published.
- The development and implementation of standards for all aspects of surveying, charting and publishing. The task was very demanding and still requires completion for Notices to Mariners services and tidal functions.
- A clear understanding has been gained of the true market costs of producing and providing mariners and the public with hydrographic products and services. In the past costs were amalgamated with those of other military activities.
- Data and chart costs have been reduced from cost recovery levels to dissemination costs. The cost for a chart CD comprising the full set of 160 New Zealand raster navigation charts will be \$NZ35.00. There are no copyright restrictions or royalty fees.
- A viable outsourcing environment has been established that has encouraged contractors to invest in new technology and increased capacity. A new survey vessel fitted with Multi Beam Echo Sounder (MBES) technology has been purchased, another vessel fitted with MBES and digital cartographic equipment obtained. Two new inshore survey craft have been put into operation.
- Costs have been reduced from \$NZ45 million per annum to \$NZ18 million without decreasing the amount of surveys carried out or the number of charts

published.

- All New Zealand charts have been upgraded to current standards and converted to WGS 84. There were still a few in 1996 that incorporated coastlines from James Cook's surveys and others with soundings in fathoms.
- Digital conversion of chart reformat has been completed and a Raster Maintenance System (RMS) is now established for chart reprints. A Raster Chart Service (RCS) will be available soon.
- New Zealand's first ENC data is to be trialed at sea. These trials will be used to develop the data model and standards for future operational ENCs.
- A major survey of the shipping lanes around Possession Island in the Ross Sea, Antarctica, has just been completed. This required 3 years of preliminary planning by the NTHA and six months of detailed mission preparation by the contract managers and their contractor.
- A desktop study for the continental shelf delimitation project was completed. Contractors have completed much of the deep seismic and shallow fold seismic surveys.
- Preliminary plans have been developed to establish an automated national tidal recording and prediction system using web based technology.
- The NTHA has established and leads a committee of 12 departments who co-operate on the development of common geo-spatial standards, inter-operability of data, co-ordination of data collection programmes and information sharing.
- LINZ topographers and hydrographers are also leading projects to develop specifications for the emergency services in locating incidents and the development of government geo-spatial metadata standards.

4. Opportunities For Improvement.

While good progress has been made, a faster more efficient result might have been obtained, if some factors had been resolved in initial deliberations. Hindsight can, at least, help others to avoid the same problems. These were: -

- The mandate for a new hydrographic administration was a compromise between the views of those for change and those against. It sought to introduce a degree of commercialism while preserving the fundamentals of existing non-commercial infrastructures. As the two concepts are basically incompatible a more definite preference for one or the other would have been very helpful.

- Better progress would have been made in the beginning if issues such as roles, funding allocations and intellectual property rights had been resolved prior to the transfer of responsibilities.
- The extent of the human resources required to run a regulatory hydrographic authority were initially underestimated. A least one person is required in each of the major disciplines. Even this is not ideal, as it does not provide for back up and a diversity of opinion on specialist subjects.
- It is useful if changes to legislation and statutory authorities can be effected before organisational changes are made. This may not always be practical as legislation changes can take one or two years.

5. Hydrographic Data Distribution.

New principles for the provision of government held information were promulgated in 1997. These state that “departments should make information available easily, widely and equitably to the people of New Zealand (except where reasons preclude such availability as specified in legislation)”. Pricing is to be either free, set at dissemination levels, set at transformation levels or fully cost recoverable depending on the reason for collecting the data. The first digital data reviewed under the policy was the LINZ Topographic Database that ultimately reduced in price from \$NZ1.8 million to \$NZ1500 for complete national coverage. Similar rationale was applied to national hydrographic data, albeit with a much less dramatic impact as little digital information has been available so far.

The new pricing regime is very different from that of the past. Everybody is encouraged to use, add to and reproduce data with minimal licensing requirements and no copyright or royalty payments. The Government firmly believes that citizens will enjoy greater benefits from ready access to all departmental data and the ability to convert it into useful knowledge. Twelve months after the low cost topographic data was released the country has seen an explosion of new added value applications being launched onto the market. Science and education have particularly benefited through gaining access to information that could not be afforded in the past. There is a strong anticipation that the release of low cost hydrographic data will have similar benefits. Current interest is being shown in its application for inter-tidal zone coastal management and oil spill mitigation planning.

The impact of the Internet on primary information industries such as music, publishing and encyclopædias (*Evans and Wurster 1999*) is well documented and its lessons carefully assimilated by hydrographer strategic planners. As a result, the NTHA has adopted the Internet as its future primary medium for the distribution of hydrographic

data. Preliminary work has been undertaken but much remains to be completed. The first steps have been: -

- Access to free nautical information on the web. <http://www.hydro.linz.govt.nz> From 1/2/1999 to 29/2/2001 the website has received 77,184 visits. Implementation of a web version of the Nautical Almanac is well advanced.
- A Hydrotalk web site has been established to enable the NTHA regulators to consult with chart and publication users, promulgate important information and to receive the external concerns.
- Plans are in development to distribute raster charts via the web.
- Some work has been undertaken on a web-based system to receive data into the tidal database, verify accuracy, calculate constituents and distribute predictions.
- Notice to Mariners are also being distributed through the Internet.
- Very small scale topographic maps are to be distributed free of charge on the web. No paper copies will be made available in the future.

6. Hydrographic Data Standardisation.

A genuine desire has emerged from New Zealand government departments that hold geo-spatial data to improve its management, maintenance and delivery. In 1999 the Officials Committee on Geo-Spatial Information (OCGI) was established under the auspices of LINZ. It comprises 13 departments and agencies and the Association of Crown Research Institutes. An infrastructure has been established to foster collaboration and co-operation, the development of common data policies and standards, joint purchases of new data and the free exchange of data sets (*OCGI Strategic Plan 2000*). A fundamental principle is the achievement of “whole of government” benefits that are greater than can be gained from individual departmental performance improvements. The need to integrate information from several departments is critical, as is the reconciliation of data described in different ways, (for example, cadastral and topographic roads, mean sea level on topographic maps and hydrographic charts).

OCGI is likely to change the way LINZ and other departments establish, manage, maintain and use hydrographic data. It is anticipated that collective efficiencies will be obtained that will provide long-term sustainable benefits. Success has yet to be assured but small gains are starting to be made. These include:

- General agreement that data will be purchased once only and shared with other OCGI members. Departments may pool their funding to purchase littoral data for

hydrographic charts, coastline management and wildlife management. Formerly each could have independently purchased very similar data.

- Desire for co-operative ventures for projects being undertaken by several departments in the same area. For example, science and continental shelf projects undertaken in conjunction with a vessel in transit to an Antarctic hydrographic survey area.
- Common set of format, content and accuracy standards, based on ISO TC 211 and the Open GIS Forum, will be established for hydrographic databases and 22 other core government databases. Common metadata standards will be established to facilitate data sharing.
- Common set of data access policies will be developed as departments move to adopt the principles of open access to government information.
- Wider use of hydrographic data for purposes other than the navigation of vessels. There are likely to be linkages to the definition of seabed property rights, management of the marine environment, and search and rescue using GPS and remote sensing techniques.

It can be argued that the aims of OCGI are the same as centralised administration philosophies popular 15 or 20 years ago. This is not the case as all members co-operate because they wish to do so. Their resolve stems from the need to solve complex problems that cannot be effectively tackled on an individual basis.

7. E-Hydrography.

New Zealand is following other countries in introducing e-government policies and principles. This aims to harness people and technology to revolutionise the delivery of government services. It will service people better, faster and cheaper than in the past (*NZ E-Government Vision, SSC 1999*). As a core government service, hydrography is required to contribute to the overarching philosophy, and actively work towards the achievement of intent. Fortunately NTHA hydrographic data dissemination and standardisation strategies have already established the foundations of “e-hydrography”.

While electronic hydrography has specific characteristics defined by IMO and IHO standards it is not dissimilar to other types of geo-spatial data. Many of the distribution issues are the same as those faced by other intellectual knowledge based industries such as music recording and book publication. At its most fundamental level, hydrography can be considered as a process of converting facts about the seabed into knowledge about safe navigation. There is a need for the Hydrographic Authority to distribute the facts to individual mariners so they can be amalgamated their experience and other knowledge to establish safe passages. Lessons can be learnt from broadly similar industries to better understand how e-hydrography might work. Some early New Zealand trends are:

- Evidence of a shortening of supply chains between LINZ and data users is emerging. In the past data moved through stewards, custodians, distributors, warehouses and retailers. As more and more charts and publications are distributed via the internet it can be expected that paper stocks in warehouses will fall, there will be less physical handling of material and print runs will diminish. Whether or not warehousing, retailing and printing will continue to be viable in the long-term is questionable.
- In the past, the private sector has added value to source products such as tide tables, manual to vector conversion etc by making them easier for mariners to use. For example by transforming into other formats or integrating with additional information. The product that users receive may be quite different to the one that left the Hydrographic Authority. This form of added value depends on the source data being difficult to access and understand by those without expert knowledge. It is likely that in New Zealand this segment of the market will diminish as the open access policies of e-government and e-hydrography are implemented.
- E-hydrography will hasten the conversion of data from manual and limited digital formats to web enabled capability. It can be expected that as more digital data becomes available then the application of fully automated cartographic techniques will grow. Some early systems have been trialed using the NZ Topographic Database.
- Concepts for accessing federations of hydrographic and other databases linked through the Internet are being established. In principle a user with a good PC and web software will be able to access a range of databases operating on common standards. It will be possible to select specific classes of information, overlay data from different databases and undertake a variety of straightforward applications. It is interesting to speculate on the extent that the concept will affect traditional GIS thinking. Arguably there will be an impact on the lower end of functionality with GIS retreating towards the more complex tasks.
- A simplified electronic chart database may become a web portal into general marine information. There is some evidence to suggest that as much as 80% of this may rely on location as a key identifier. Reference may not be confined to the sea as a query might seek the location of the nearest Ministry of Fisheries office or the address of a ships chandler. Those who deal with maritime emergencies are equally interested in accurately locating both vessels at sea and the home address of the crew. The old adage “a picture is worth a thousand words” applies just as much to a location reference viewed on the web as it did to one of Captain Cooks charting masterpieces. Web charts may provide a simple way of accessing complex geographical information without the need for a high level of cognisance.

8. The Future For Hydrography In New Zealand.

The development of hydrography is far from complete. As advances are made, often with painful slowness, new directions emerge with astonishing speed. These throw into doubt

the very fundamentals of the profession and much that hydrographers hold dear to their hearts. For example the current chart was designed many tens of decades ago to convey a picture of location to sailors who may not have had a high level of reading skills. Is it likely that the same format will be useful in 10 or 20 years time? It seems possible that in the future: -

- There will be an increasing need to specify and standardise hydrography. Fundamental standards for surveys and charts will be augmented by others concerned with data management, integration, corporate appearance, version control, security etc.
- Conventional outsourcing opportunities will reduce but those related to new methods of seabed data collection and e-hydrography will grow. Data conversion will be an important requirement during the next five years.
- The need to complete the charting of the New Zealand EEZ and the Ross Sea will grow as attention moves to the use of seabed resources and safe, but adventurous, tourism opportunities.
- Data prices will continue to gradually decrease as more organisations distribute through the internet.
- There will be an increasing need for global standardisation of all forms of hydrographic data;
- The responsibility for chart accuracy will be moved to contractors or specialist QA agencies. The NTHA does not have the resources to exhaustively check work normally undertaken by carefully selected, skilled cartographic firms. Audit of their QA systems will become a critical element in deeming data to be authoritative and suitable for insertion into Crown databases.

Conclusions.

The formation of LINZ and the NTHA was a radical change from traditional concepts of a National Hydrographic Authority. At the time the model was developed there were few other known examples that could be used to guide the implementation process. Difficulties were encountered and overcome at a relatively rapid pace. A new infrastructure has been established that has enabled data capture, maintenance and delivery programmes to be provided through external providers. Good progress has been made and New Zealand hydrography is more advanced than it would have been if the changes had not occurred. Significant benefits have been delivered to the public in the form of lower taxpayer appropriations, more charts, better access to data and reduced prices.

E-government policies and the Internet will have a significant affect on hydrographic information. Changes to the way data is being distributed and its impact on warehousing and retailing are already evident. The NTHA, as an information agency expects to feel the greatest impact of the technology. Rather than resisting change, New Zealand hydrographic regulators are actively involved in the establishment of LINZ as a near virtual agency, and the undertaking of two interdepartmental e-government projects. Strategies are being developed to steer hydrography through the next decade. It is anticipated that by 2010 most data will be captured, stored, maintained and disseminated by electronic means. It is recognised that paper products will still be in use, albeit at a reduced level. An amalgamation of topographic and hydrographic databases seems likely. The dream of seamless coverage from the centre of New Zealand to the extremities of the EEZ is beginning to become reality.