

Introducing the Revolution in New Zealand Paper Chart Production

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Key words: Paper Charts, Electronic Navigational Charts (ENCs), S-57, Single Source Database, Cartography

SUMMARY

Historically Electronic Navigational Charts (ENCs) have been sourced from existing paper charts. However, Land Information New Zealand (LINZ) Hydrographic Services have now introduced a new approach by producing future paper charts and electronic products from a single source database.

LINZ's new suite of software stores New Zealand's hydrographic source data in a single database in the international standard S-57 format. This database approach revolutionizes paper chart cartography.

This paper outlines how LINZ produce paper charts from the single source database. A real example is used to illustrate the chart compilation efficiency gains from the new system. The paper will also cover the impact and challenges faced by the new approach. The significance of this paradigm shift on the LINZ Hydrographic Services Team is also discussed.

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1. INTRODUCTION

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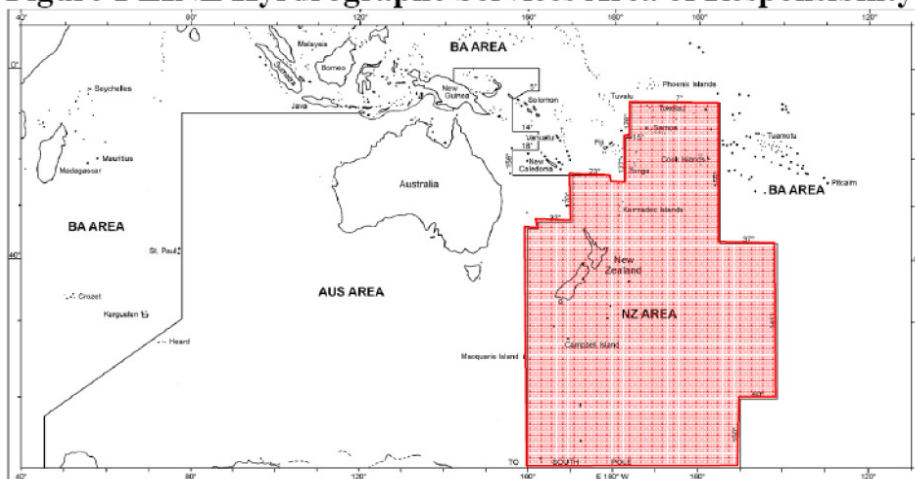
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2. LAND INFORMATION NEW ZEALAND HYDROGRAPHIC SERVICES

Land Information New Zealand Hydrographic Services (LINZ) is the authoritative provider of New Zealand's hydrographic requirements. The major role of this government department is the provision and maintenance of nautical charts and publications to meet carriage requirements for safety of life at sea. Figure 1 shows LINZ area of responsibility.

Figure 1 LINZ Hydrographic Services Area of Responsibility



3. LINZ CHART CATALOGUE

LINZ produces official nautical charts to aid safe navigation in New Zealand waters, areas of Antarctica and the South West Pacific. LINZ provides charts in a range of formats: paper charts, digital images that may be printed or viewed onscreen, and digital images designed for use in electronic navigation systems. These are described in more detail below.

3.1 Paper Charts

Currently there are 180 paper charts in LINZ paper chart portfolio. These charts are produced and maintained to strict international standards. Paper charts are available to purchase from chart retailers.

3.2 Raster Digital Charts

The majority of the paper chart catalogue is also available in raster HCRF format. Known as *NZMariner* it represents New Zealand's official RNC folio which can be used in Electronic Charting Systems (ECS) or Electronic Chart Display Information Systems (ECDIS). *NZMariner* RNCs are created from scanned, raster copies of paper charts.

3.3 Electronic Navigational Charts (ENCs)

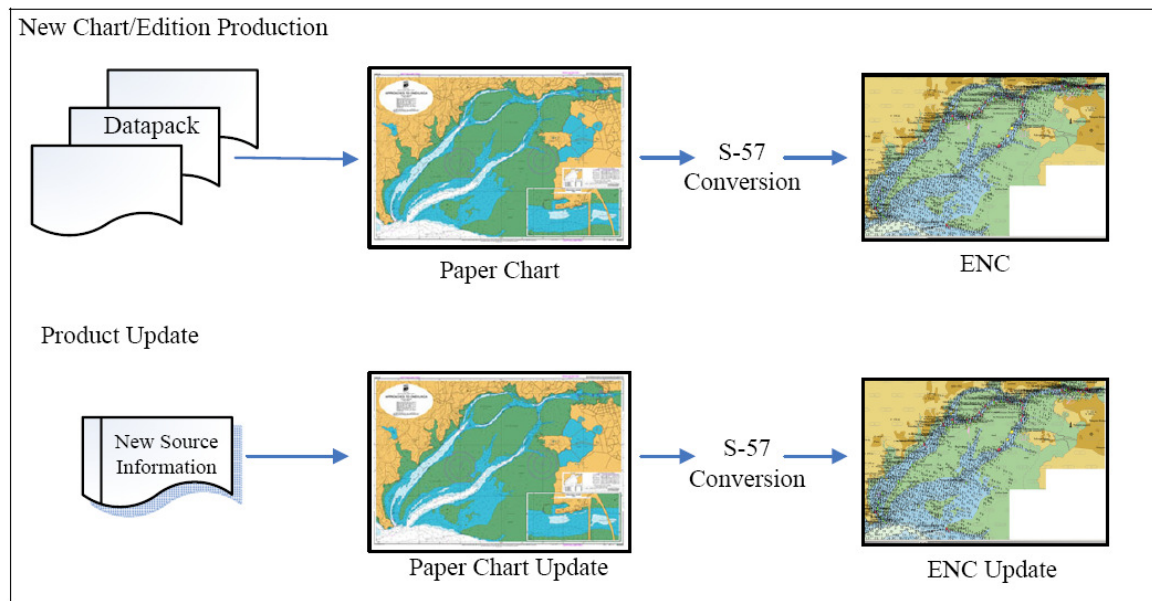
LINZ is responsible for creating and maintaining the official set of ENCs for New Zealand's area of charting responsibility. Since November 2008, LINZ has published over 50 ENCs with a full national set of ENCs expected to be completed by the end of 2010. ENCs are specifically designed for use in ECDIS onboard ships, using the international S-57 vector format.

4. TRADITIONAL CHART AND ENC PRODUCTION

LINZ's paper chart catalogue has evolved over time and has been produced using traditional cartographic tools or older legacy software. Traditionally paper chart compilation has always been carried out from a data pack of source material for the individual chart. Subsequent updates to paper charts are ad-hoc via Notices to Mariners.

Traditionally ENCs have been created and maintained using the paper chart as the source. The paper chart image is digitised and converted to S-57 vector format. Updates to the ENC follow the paper chart update i.e. by Notices to Mariners. Figure 2 shows the traditional paper chart and ENC production model.

Figure 2 Traditional Paper Chart and ENC production Model



This production model has differing sources. The new paper chart/edition is sourced from the data pack and the ENC is sourced from the paper chart. Converting the chart image after its creation into S-57 format for the ENC is inherently inefficient and prone to error. This is not ideal and an obvious risk. Updates to the paper chart and ENC follow the above model and are also prone to the risks and error of the multiple source/two stage approach.

With the aim of producing a full national set of ENCs in-house, by the end of 2010 and the desire for in-house paper chart production, LINZ required a better solution. The Caris HPD Single Source Database approach has been introduced by LINZ and as a result, will revolutionise LINZ's paper chart production.

5. THE CARIS HPD SINGLE DATABASE APPROACH

5.1 The Transition to Full Single Database Approach

LINZ introduced the Caris Hydrographic Production Database (HPD) software in July 2008. HPD represents a complete paradigm shift at LINZ by managing all source data in a single database in S-57 format, prior to any product being created.

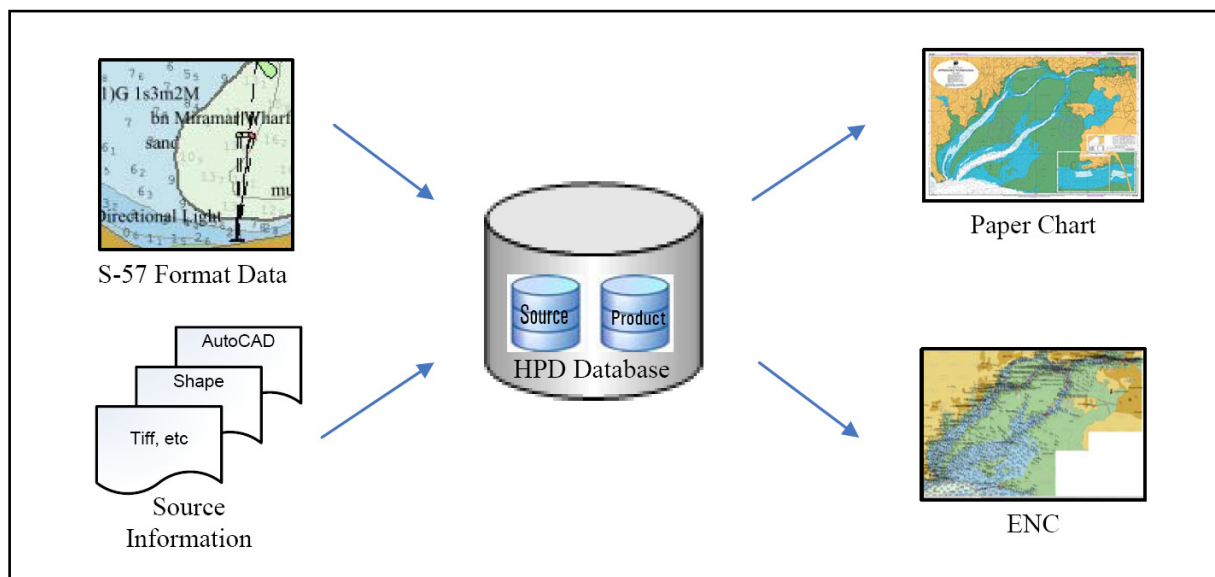
A paper chart is created from the same S-57 source data as the ENC, thereby eliminating the duplication of data compilation and maintenance as described earlier. Efficiency is maximized for data storage with features being stored only once, whilst allowing the creation of multiple representations for different products. In addition, updates to the source are carried automatically to the ENC and Paper Chart products, further enhancing the efficiency gains of the single database approach.

Once source data is converted into S-57 data, it is subjected to strict quality control prior to being loaded into HPD. LINZ has undertaken a major project to capture the majority of the chart catalogue in S-57 format. This S-57 conversion has taken several months to create and QC. When loaded into HPD, source data is stored in scaleless and scale dependant usage bands. Overall the result is a quality, reliable and accurate S-57 source database.

5.2 Full Single Database Approach

Once the database has been fully populated with S-57 data, it will remain dynamic and constantly up-to-date. Updates and new information (via data packs) can be imported either in S-57 format or a in a choice of other formats (such as Tiff, Shape, ASCII, AutoCAD). The support for a multitude of different formats of data ensures HPD can act as a true single source database. Figure 3 outlines the HPD production model.

Figure 3 The HPD Concept

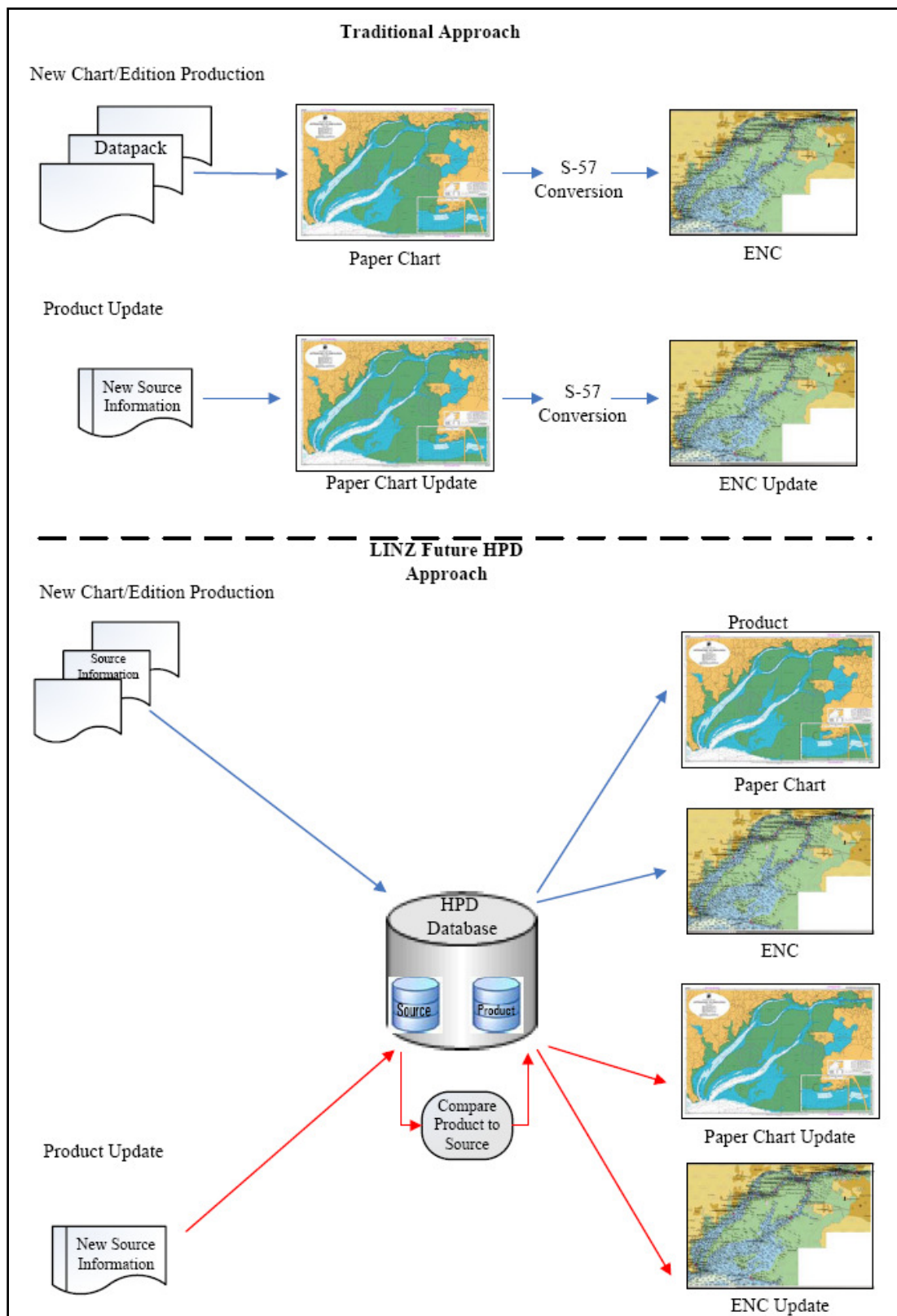


6. THE REVOLUTION IN PAPER CHART PRODUCTION - THE HPD APPROACH

To create a new product the S-57 data is cut/copied from the source database to create the paper chart or ENC product. The product is also stored in HPD and specialised software tools allow for the conversion of S-57 to the paper chart product or ENC product.

Changes to the source due to a Notice to Mariners (for example) are made in the source database first. To update the ENC and paper chart products, the software compares the product to the source and identifies the change, thus accurately updating the paper chart and ENC. Figure 4 represents an overview of the traditional production model and the new model.

Figure 4 The Revolution in Paper Chart Production



7. EXAMPLE OF NEW PAPER PRODUCTION FROM HPD

The first paper chart to be created by LINZ using HPD was a Limited New Edition of NZ4315 ‘Approaches to Onehunga’ in October 2009. The chart represents a main plan at 1:18000 with a wharf inset at 1:2500. The source data had previously been converted into S-57 format and stored in the HPD database.

To create the paper chart, the S-57 data was cut from the source database at the required scale bands. The data was then processed to meet established international charting convention and standards. Cartographic features not stored in the database such as border marginalia, graticules, title blocks and corner co-ordinates were also added. The chart was then subjected to the usual cartographic presentation, masking and checks prior to publishing. Figure 5 shows the S-57 source data prior to paper chart creation and figure 6 shows the final NZ4315 paper chart.

Figure 5 S-57 Source Data from HPD used for NZ 4315 ‘Approaches to Onehunga’

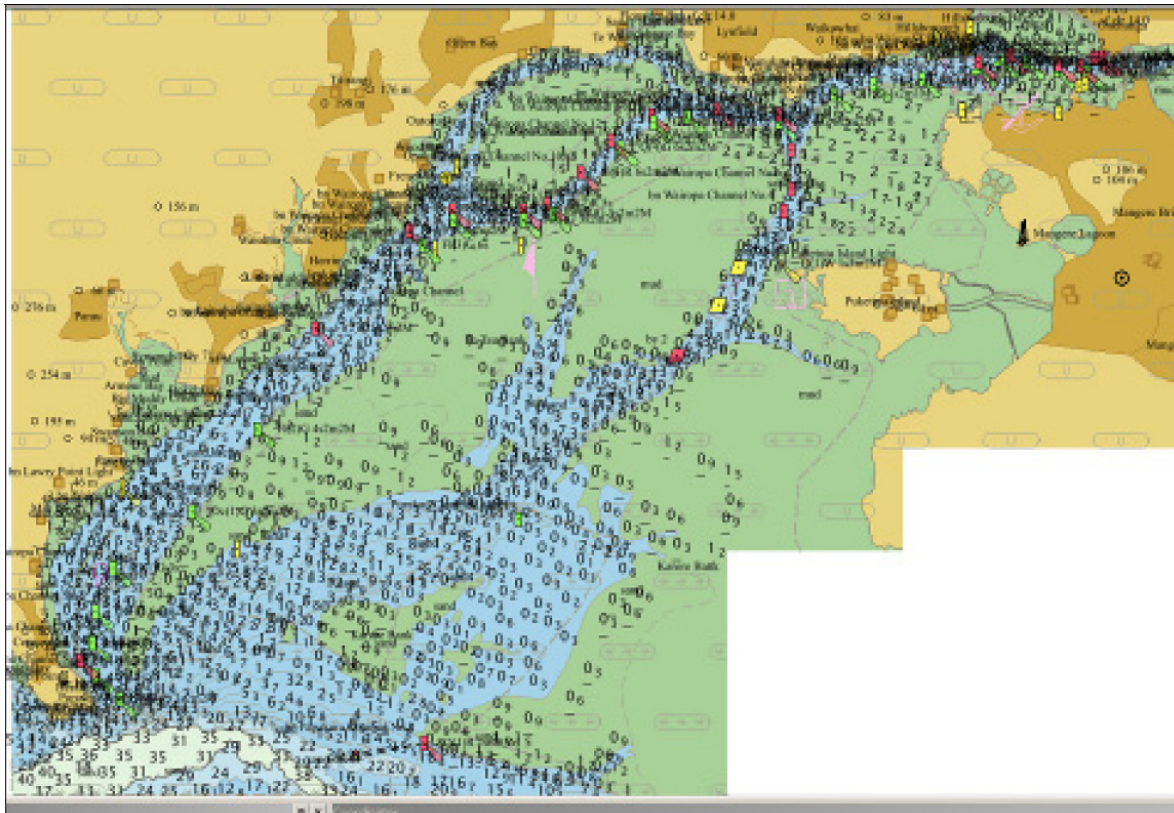
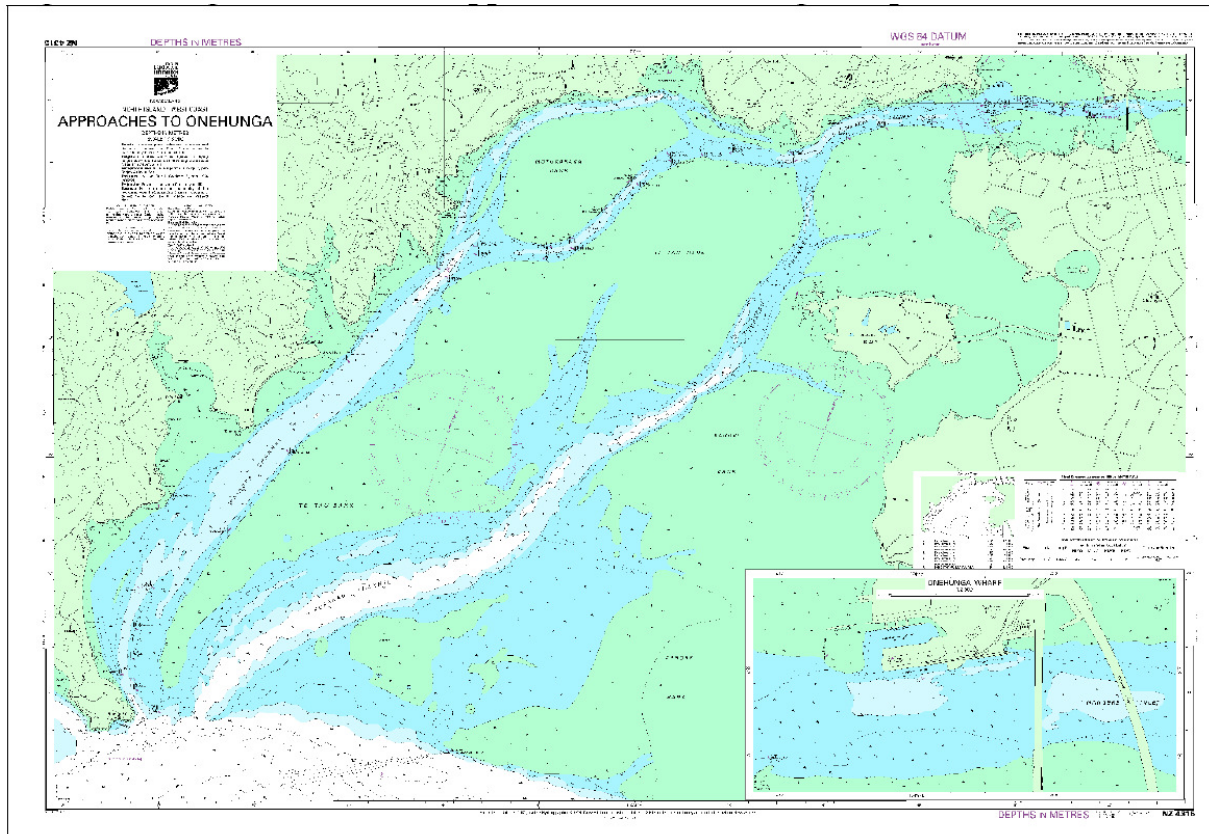


Figure 6 Image of NZ4315 ‘Approaches to Onehunga’ Paper Chart Produced in HPD



The efficiency gains experienced in paper chart production are yet to be fully realized. The software converts S-57 to INT 1 with little manual intervention required. For example, S-57 attribution such as light characteristics, buoy descriptions and tidal stream information is automatically presented in INT 1 format. Line work detail for features such as inter tidal rocks and sandy shores are automatically brought through into the paper chart. Contour labeling is automated and depth areas and land tints are coloured with no need for raster manipulation of coloured areas. Figure 7 shows a detailed area of the chart area in the database in S-57 format. Figure 8 shows examples of automatically and manually added cartographic objects for the same area.

Figure 7 Detail of S-57 Source Data Displayed in HPD Ready to be used for Paper Chart Production

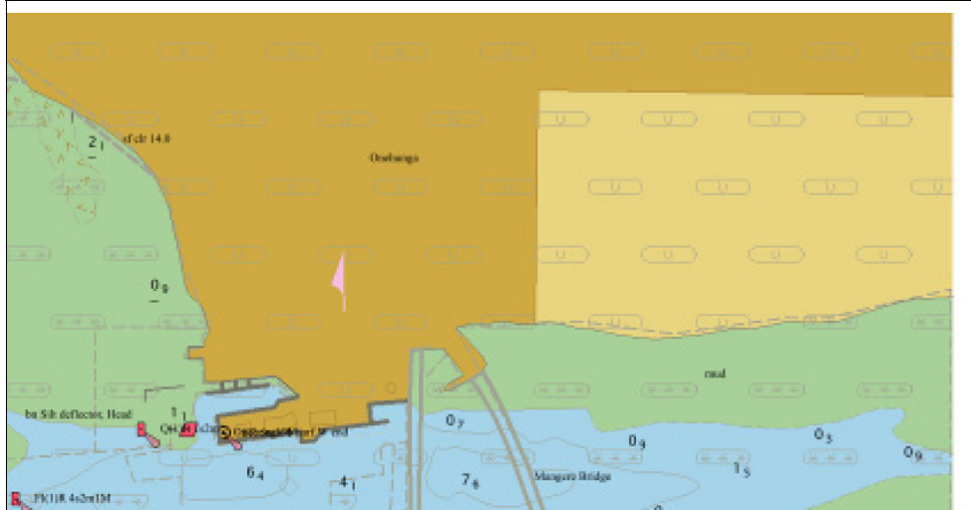
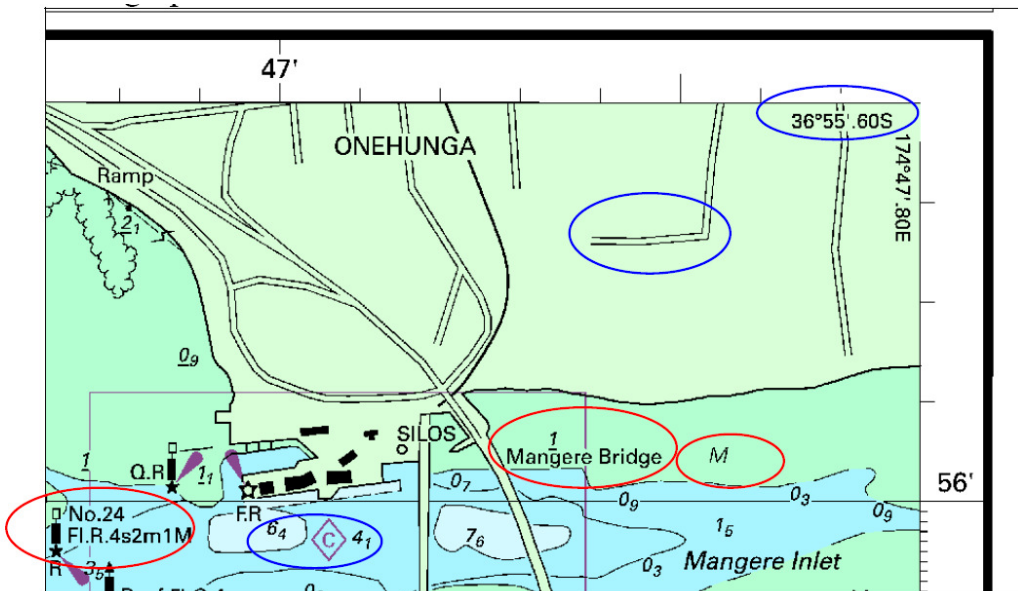



Figure 8 Detail of the Final Paper Chart with Examples of Automated and Manual Cartographic Edits



 Automatic conversion from S-57 to INT 1

 Manual conversions/additions

8. IMPACT AND CHALLENGES OF THE LINZ HPD APPROACH

The main impact of the LINZ HPD approach has been the paradigm shift of thinking necessary to adopt the new production method. The radical new approach has meant a shift from *product-centric* thinking to *source-centric* thinking. Paper chart and ENC products are dependant on the source. Ensuring the source is correct and up to date, ensures the end products are correct and up-to-date. The mantra of '*one source - multiple products*' summarises the efficiency gains available with the new approach well.

Creating the valid and accurate S-57 database is an on-going process requiring many hours of compilation and quality control. Customising the HPD software to meet LINZ's paper chart style and INT 1 standards also created major challenges. Ensuring that *NZMariner* raster nautical charts can still be produced from HPD created paper charts was equally challenging.

Despite the overall efficiency gains from the automated tools, paper chart production requires significant cartographic attention to meet international standards. The HPD solution speeds up production but paper charts cannot be cut from the database as readily as ENCs. Experience has shown that adding features such as roads, compass roses and title blocks, which are not stored in S-57, still require many man-hours. Masking features such as line work beneath text and the ends of contour lines where they join the coastline (for example) has also proved very labour intensive with no automated process available in the software at this time.

Overall, despite the revolution in production methodology and the expected efficiency gains of the new approach it is becoming apparent that bringing paper chart production in-house will require greater capacity and resourcing in the LINZ Hydrographic Services team.

BIOGRAPHICAL NOTES

Gareth Hodkinson graduated from Hull University (UK) in 1996 with a Masters Degree in Environmental Analysis. Professionally Gareth has always been involved in cartography, spending several years surveying and mapping road networks in Europe and the UK before specialising in hydrography. Working at the United Kingdom Hydrographic Office as a Nautical Cartographer for 7 years provided excellent experience which Gareth has developed further working at Land Information New Zealand since 2007. At LINZ Gareth is responsible for developing the new paper chart production system, as well as chart maintenance, cartography and the publishing of Notices to Mariners.

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