Cardno LawsonTreloar

Shaping the Future

CABOOLTURE RIVER SILTATION STUDY

Northeast Business Park

January 2008
Job No. 790033/003 R3

Northeast Business Park Pty Ltd

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1. INTRODUCTION

This report has been prepared by Cardno Lawson Treloar (CLT), specialist coastal and hydraulic engineering consultants, for Northeast Business Park Pty Ltd, to provide an assessment of siltation within the Caboolture River following capital dredging. As part of the proposed development it is proposed to dredge the navigation channel from the proposed Northeast Business Park to Moreton Bay. The assessment also provides an estimate of maintenance dredging requirements in relation to timing and quantities.

Northeast Business Park (NEBP) is a multi-use marina and business park concept that will integrate marina facilities, appropriate business, residential, heritage and recreational greenspace precincts providing a place to live, to work and to play in a master planned riverside precinct on the Caboolture River.

The NEBP site is located approximately 10km upstream of the mouth of the Caboolture River. To facilitate safe navigable access to the NEBP, a capital dredging program will be undertaken within the designated navigation channel of the Caboolture River. The designated navigation channel of the Caboolture River is approximately 6.5km in length and will be dredged to an approximate depth of -4.25m AHD, providing a draft of 3m below Lowest Astronomical Tide. The remaining section of the river between the upstream extent of the proposed capital dredging and the site will not be dredged.

This report details a siltation investigation for the dredged navigation channel within the Caboolture River. It also provides an estimation of the extent and timing of maintenance dredging required for a navigable passage between the site and Moreton Bay.

2. SITE DESCRIPTION

Northeast Business Park (NEBP) is a multi-use marina and business park concept that will integrate marina facilities, appropriate business, residential, heritage and recreational greenspace precincts providing a place to live, to work and to play in a master planned riverside precinct on the Caboolture River.

The site is situated on the southern bank of the Caboolture River approximately 8km inland from the coastline, adjacent to the Bruce Highway and 43km north of Brisbane CBD, the NEBP site encompasses 769 hectares of property. The site extents are shown on Figure 1 and include the following seven land parcels:

- Lot 2 on RP902075
- Lot 10 on RP902079
- Lot 24 on SP158298
- Lot 7 on RP845326
- Lot 15 on RP902073
- Lot 12 on RP145197
- Lot 17 on RP902072

The following components are incorporated into the NEBP development.

- Marina basin.
- Marine industry.
- Shipyard.
- Mixed Industry Business Areas.
- Marina Village.
- Marina Residential.
- Hotel.
- Marina Pavilion.
- Golf Residential.
- Residential.
- Hotels.
- Environmental open space.
- Golf club and golf course.
- Recreational areas and sporting fields.
- Heritage Park.
- Environmental Centre.
- Community Nodes.
- Educational and Training Facility.

The NEBP marina will be excavated to a depth of RL -1.0m AHD. The marina basin will be constructed using dry excavation techniques. Following excavation of the marina basin, a lock will be established to connect the marina basin to the Caboolture River. Fill obtained from the excavation of the marina basin and additional cuts within the property bounds will be used to raise ground levels within residential precincts to protect against flooding and storm surge.

The entrance of the proposed marina is approximately 10km upstream of the mouth of the Caboolture River. To facilitate safe navigable access to the NEBP, capital dredging will be undertaken within the defined navigation channel of the Caboolture River. Approximately 600,000m^3 of material will be removed from the bed of the Caboolture River during the capital dredging program. The navigation channel will be dredged to an approximate depth of -4.3m AHD, providing a draft of 3m below Lowest Astronomical Tide.

2.1 The Existing Site And Influences On Siltation

The Caboolture River adjacent to the site is a well defined, tidally dominated waterway with a main channel approximately 70 metres in width. Downstream of the site the channel meanders towards the mouth for approximately 4.3km whereupon the river widens to a maximum width of 400m. This area is dominated by sand banks either side of the main channel. The river entrance to the bay is approximately 280m wide.

Tidal details are presented in Table2-1 for the Caboolture River Mouth Tide gauge.

Table 2-1 Tidal Planes at Mouth Caboolture River

Tidal Plane		Level (m AHD)
Highest Astronomical Tide	HAT	1.34
Mean High Water Springs	MHWS	0.81
Mean Sea Level	MSL	-0.05
Mean Low Water Springs	MLWS	-0.92
Lowest Astronomical Tide	LAT	-1.26

Tidal velocities adjacent to the site are up to 0.3 to 0.5 m/s on flood and ebb tides.

Bed sediments in the lower Caboolture River comprise fine to course grained sands and clayey sands. Towards the site fine to coarse sand with silt and clay fines are prevalent. Coffey Geotechnics Pty Ltd report, “Caboolture River Dredging. Geo-Environmental Investigations”, May 2007 contains a detailed investigation of the river sediments.

Under tidal action alone (in the absence of river or creek flooding), adjacent to the site, a stable tidal channel forms in the creek. Bed Shear stresses are less than 0.005 Pa and therefore very little mobilisation of sediment occurs.

Within the wider estuarine portion of the river however, elevated bed shear stresses (<0.5 Pa) are high enough to mobilise medium grain sands and therefore in this area, erosion accretion and shifting of sand banks is common. During river floods, velocities are much higher (between 1.5m/s to 3m/s), and under such events, a greater amount sediment movement is likely to occur.

3. DATA

The siltation assessment within this report has been based on:

- Detailed bathymetric survey of the Caboolture River supplied by Queensland Transport and Mapping and Hydrographic services Pty Ltd;
- Geotechnical investigation by Coffey Geotechnics Pty Ltd entitled, "*Caboolture River Dredging Geo-Environmental Investigations*" dated May 2007;
- Navigation channel alignment prepared by Cardno and shown on drawing numbers 7900/33/01 100 to 117, included as reference drawings in this report;
- Caboolture Shire Council's EXTRAN hydrologic model;
- Tidal constituents supplied by Maritime Safety Queensland; and
- Site Inspections conducted by CLT.

The modelling has been based on the proposed navigation channel alignment shown on Cardno drawing numbers 7900/33/01 100 to 117. This alignment is based on a modification of the current location of the channel markers in order to smooth out sharp bends. It is understood that subsequent to this analysis, meetings were held with the Harbour Master which resulted in further alignment changes in 3 locations. These changes are not anticipated to significantly impact on the results of the morphologic modelling as the modelling provides an assessment of general erosion and accretion trends within the dredged navigation channel. Further discussion on the navigation channel alignments is presented in the Cardno Report, "Dredging Site Based Management Plan" for Northeast Business Park Pty Ltd, November 2007.

4. SCOPE OF WORK AND METHODOLOGY

The scope of this investigation has been to undertake full two-dimensional numerical modelling of the Caboolture River to assess siltation within the navigation channel following capital dredging and to estimate maintenance dredging requirements in relation to timing and quantities.

In particular, the methodology of the analysis is described below:

- Develop an existing DTM of the modelled area based on the most recent available survey information.
- Construct a full two-dimensional (2D) model of the Caboolture River calibrated to measured tidal flows.
- Incorporate boundary conditions based on tidal flows into the Caboolture River.
- Analyse tidal hydrodynamics and morphology changes of the Caboolture River following capital dredging works.
- Undertake assessment of siltation within the dredged navigation channel following a 100 year ARI flood event.

5. MODEL DETAILS

5.1 The Model Software

In order to tidal flows a high-resolution Delft3D 2D hydraulic model has been constructed. The Delft 3D modelling software was chosen to undertake the assessment due to its ability to handle both the hydrodynamic assessment and morphologic changes.

Delft3D applies an alternating direction, implicit finite-difference scheme to the solution of the equations of mass and momentum conservation. Density is included through an equation of state for salinity and temperature, as well as suspended sediment concentration. Model forcing can be by tides, winds, inflows, air pressure and density gradients. An accurate, stable wetting-and-drying algorithm is included to describe wetting and drying of inter-tidal and storm inundation areas. Boundaries can include a Thatcher-Harleman algorithm that allows the inflowing sediment concentration to be based on the time series of the previous outflow. A lateral erosion algorithm is included.

Delft3D includes a range of modules that are dynamically linked through a common communications file. For morphological transport calculations there are four modules that are applied. They are FLOW (currents and water levels), SWAN (wave module), TRANSPORT (sediment transport) and BOTTOM (morphological changes). Up to five separate sediment fractions may be specified in a simulation and any combination of sand and mud fractions adopted. Interaction with the bed for sand fractions is based on the sediment pick-up functions of Van Rijn; bed and suspended load transport are included. For mud fractions, the widely recognised sediment flux expressions of Partheniades and Krone are used. It is possible to include areas of non-erodible bed and to describe the initial, available depth of erodible sediment.

The model has been validated by Delft Hydraulics and applied successfully by CLT to investigations at the Murray River mouth, Lake Illawarra and Cairns. The latter study related to siltation investigations for the Royal Australian Navy. Historical siltation rates could be estimated from dredging records and some suspended sediment concentration data was available to verify the general character and variation with tidal range of that parameter.

5.1.1 General Model Setup

The topographic extent of the model is shown on Figure 3, and is such that boundary conditions are far enough away from the site that impacts and morphologic changes can be reliably determined.

The pre-dredging model has been constructed using available survey and aerial photographs in order to determine existing bathymetric details and roughness parameters. Detailed survey information obtained in 1998 and 2007 was supplied by Queensland Transport and Mapping and Hydrographic services Pty Ltd, respectively. The proposed navigation channel alignment shown on Cardno drawing numbers 7900/33/01 100 to 117 has been used in conjunction with the existing bathymetric details to construct the post-dredging bathymetric details. Figure 4 presents the pre- and post-dredging bathymetry used for the Delft3D model.

The model has been used to simulate hydrodynamics within the Caboolture River during both typical tide conditions and a 100 year ARI flood event. The tidal boundary conditions were generated for a period of 2 months from 1 January to 28 February 1998 using tidal constituents obtained from Maritime Safety Queensland. The boundary conditions for the 100 year ARI flood event simulation were extracted from Caboolture Shire Council's EXTRAN hydrologic model.

5.1.2 Morphological Model Setup

Considerable work has been undertaken by Coffey Geotechnics Pty Ltd (2007) on sediment sizes within the Caboolture River estuary. Based on this work a D_{50} sediment size of 0.3mm was used in the morphological calculations.

For calibration purposes a simulation was undertaken using bathymetry based on Maritime Safety Queensland hydrographic survey from 1998. The result of the calibration simulation was compared to the hydrographic survey obtained in 2007.

The simulations of typical tidal flows and the 100 year ARI flood event were based on the bathymetry that included the post-dredged Caboolture River navigation channel. For the tidal simulation a multiplication factor was applied to extrapolate the morphologic changes to a five year period.

The prediction of morphologic calculations for the Caboolture River is complicated by river meandering, changing sediment composition with depth of scour, bed armouring and the stabilising effects of vegetation. For this analysis a simplified approach was adopted that assumed a uniform fine grained sediment profile. Erosion hindering properties such as the inclusion of vegetation or man-made hardstand areas were also omitted.

6. SILTATION ASSESSMENT

6.1 Methodology

Hydraulic analysis was performed to determine siltation within the Caboolture River following dredging of the navigation channel. The assessment considers both the pre- and post-dredging conditions using a two-dimensional Delft3D hydrodynamic model.

The pre- and post-dredged topography conditions are based on the detailed survey provided by Queensland Transport and Mapping and Hydrographic services Pty Ltd. The post-dredging topography conditions include the proposed navigation channel alignment as shown on Cardno drawing numbers 7900/33/01 100 to 117. Further discussion on the alignment is presented in Section 3. The modelling has been undertaken using a curvilinear grid based on the topography and model extents shown in Figure 2.

Calibration of the Delft3D model by varying the Manning's 'n' roughness assumed throughout the model domain. The model calibration is detailed in Section 6.2 below.

6.2 Model Calibration

6.2.1 Water Level and Discharge Measurements

To provide calibration data for the Delft3D model, a field work campaign of ADCP (Acoustic Doppler Current Profile) profiling, water level measurements and sediment collection was conducted. The ADCP instrument records current speed and direction across the profile and through the water column and integration of this data provides discharge information for the cross-section.

The field work consisted of ADCP current profiling, collection of sediment samples for sediment grading analysis as well as collection of 'close to bed' water samples for suspended solids analysis. Field work was carried out at 4 locations within the Caboolture River and at a site within King John Creek immediately upstream of its confluence with the Caboolture River. The location of each of these sites is shown on Figure 2.

Field work was conducted on the 5 April 2006 and the ADCP transects were conducted over a full 12 hour tide cycle.

The field measurements used for calibration and validation of the tidal modelling are shown in Appendix A, along with the results of the computer modelling.

As well as current profiling, tide levels at the proposed marina site on the Caboolture River were also recorded for a period of around one month using an internal logging pressure gauge. Unfortunately this instrument was stolen while in the field and the data can not be retrieved. Consequently, the only recorded tide level information to come out of this field work campaign is a single water level spot height surveyed to enable conversion of water depths to Australian Height Datum (AHD) levels.

Field measurements of water level and discharge within the Caboolture River have also been undertaken in August 1990. The August 1990 water level and discharge measurements were recorded in the Caboolture River by WBM Oceanics and presented in the report entitled, '*Environmental Studies for the Proposed Beachmere Canals Development*' dated December 1990. The locations of all tidal field measurements are shown on Figure 2.

6.2.2 Hydrodynamic Model Calibration

Calibration of the Delft3D tidal model has primarily been carried out against the field measurements recorded in August 1990. This data was adopted as the primary calibration set for two reasons. Firstly, the water surface level measurements for the April 2006 monitoring campaign have been lost due to theft of monitoring equipment in the field. Secondly, the August 1990 field work campaign was slightly more comprehensive than the recent work.

A good calibration of Caboolture River tidal water surface levels and discharges has been achieved by adjusting model roughness values and by incorporating some additional storage area into the lower reaches of the model. This additional storage area accounts for the extensive regions of mangroves and sand flats downstream of King Johns Creek. The inclusion of this additional storage in the model resulted in a good fit of model results to recorded field measurements.

Model calibration using Manning's 'n' roughness values has been found to primarily affect timing within the model. The final adopted values are 0.014 in the Caboolture River, 0.035 in King Johns and Goong Creek and 0.15 for the overbank areas.

Results of the calibration to the August 1990 field measurements are shown in Appendix A and show a good fit of model results to both recorded water levels and flow rates. Results of the model validation to the April 2006 field measurements are also included in Appendix A and show a reasonable fit to the recorded flow rates.

6.2.3 Hydrodynamic Model Validation

The field measurements recorded in April 2006 have been used to validate the model calibrated to the August 1990 field measurements. Results of the verification to the April 2006 field measurements are shown in Appendix B and show a reasonable fit to the recorded flow rates.

6.2.4 Morphologic Model Calibration

Preliminary calibration of the morphologic model has been undertaken using the hydrographic survey from 1998 and 2007 and provides a reasonable estimation of the bed changes in this period.

6.3 Results

The modelling has considered the morphologic bed changes following typical tidal conditions and following a 100 year ARI flood event.

Figures 5 and 6 present the results of the morphologic modelling of typical tidal conditions within the Caboolture River. Figure 5 presents the bathymetry at the start and end of the simulation and Figure 6 presents the difference in bed level. This represents 5 years of morphologic changes to the bed. The morphologic changes following 1, 2, 3 and 4 years of tidal flows are provided in Appendix C.

Figures 7 and 8 present the results of the morphologic modelling of the Caboolture River 100 year ARI flood event. Figure 7 presents the bathymetry at the start and end of the simulation. Figure 8 presents the difference in bed level.

The morphologic changes of the Caboolture River during to 100 year ARI flood event estimated by the Delft3D model has shown that a navigable channel remains following this design flood event. The modelling has predicted that the main channel will scour during the flood event. In the vicinity of the proposed development minimal bed level changes are

predicted. The site is located adjacent to a meander in the Caboolture River and the modelling has shown that the majority of the flood flows bypass this meander.

7. CONCLUSIONS

The proposed development includes the dredging of the defined navigation channel within the Caboolture River between the site and Moreton Bay. The siltation of the post-dredged navigation channel within the Caboolture River has been modelled using the Delft3D modelling system.

The morphologic modelling of the post-dredged navigation channel within the Caboolture River has shown that during a 100 year ARI flood event the navigation channel or marina are predicted to remain navigable. The modelling of morphologic changes following a major flood event has suggested that maintenance dredging will not be required within the navigation channel of the Caboolture River. However, the modelling has suggested that some deposition of material may occur at the entrance to the marina. The extent of deposition is relatively limited and the modelling results suggest it is not likely to adversely impact on navigation.

The modelling also assessed the morphologic changes of the Caboolture River associated with tidal flows over a simulated 5 year period. The assessment of bed changes associated with typical tidal flows has shown that a navigable channel is maintained in the section of Caboolture River, between the site and the dredged navigation channel. The modelling also predicted minimal changes to the location of the channel through this reach of the river.

However, the modelling has shown considerable deposition through the dredged navigation channel and regular maintenance dredging will be required. On a frequency of two to three years it is estimated that minor maintenance dredging of approximately 40,000m^3 (approximately 0.5m depth of sediment accumulation within the navigation channel) will be required, particularly between chainages 4000 to 5000 as shown on Cardno's drawing number 7900/33/01-102. Additional dredging will be required on a five year frequency throughout the entire navigation channel to maintain underkeel clearance. The approximate volume of additional dredging is estimated at 220,000m^3. The minor maintenance dredging program would be intended to maintain a minimum underkeel clearance of 3m below LAT throughout the navigation channel between chainages 4000 to 5000. The major maintenance dredging program is intended to provide an underkeel clearance of 3m below LAT through the entire navigation channel. The above estimates are likely to be conservative in the longer term as the dredged navigation channel approaches a dynamic equilibrium with the adjacent banks and flow regimes.

It should be noted that the modelling predicts a navigable channel is maintained through some sections of the navigation channel throughout the 5 year period. However the channel is predicted to meander and this may need to be considered in relation to the placement of navigation markers.

In general it is expected that the material deposited within the navigation channel will initially have a relatively high percentage of sand due to the redistribution of material from adjacent banks. However in time the percentage of fine material will increase as the dredged navigation channel approaches a dynamic equilibrium with the adjacent banks and flow regimes. Flooding events are also likely to influence the deposition of fine material within the navigation channel. As such it is difficult to provide a long-term prediction on the quality of material removed from the river during maintenance dredging.

8. REFERENCE

Cardno Lawson Treloar, 2006, "*Northeast Business Park, Caboolture – Tidal Prism Assessment*"

Coffey Geotechnics Pty Ltd May 2007, "*Caboolture River Dredging Geo-Environmental Investigations*"

WBM, December 1990, "*Environmental Studies for the Proposed Beachmere Canals Development*".

9. QUALIFICATIONS

This report has been prepared by CLT specifically for Northeast Business Park Pty Ltd and specifically to provide advice on flooding to support an environmental impact study, an application for allocation of quarry material and a resource allocation authority. As such, its application is limited and may not be applicable beyond this scope.

The report relies on information by others, including:

- Detailed bathymetric survey of the Caboolture River supplied by Queensland Transport and Mapping and Hydrographic services Pty Ltd;
- Tidal constituents supplied by Maritime Safety Queensland;
- Geotechnical investigation by Coffey Geotechnics Pty Ltd entitled, "*Caboolture River Dredging Geo-Environmental Investigations*" dated May 2007;
- Navigation channel alignment prepared by Cardno and shown on drawing numbers 7900/33/01 100 to 117, included as reference drawings in this report; and
- Caboolture Shire Council's EXTRAN hydrologic model.

The accuracy of the report is limited to the accuracy of this information. In relation to this assessment it should also be noted that:

1. This morphologic assessment has assumed stable bank profiles and does not allow for sediment influx associated with bank erosion.
2. The geomorphologic assessment has not allowed for bed armouring during flood events and therefore the extent of scour estimated during the synthetic 100 year ARI flood event is likely to be an overestimation.

Whilst Cardno Lawson Treloar's report accurately assesses flood and tidal flow, and associated sediment movement including scour and siltation using industry standard techniques over the engineering life of the project, extreme flood, storm tide or tsunami events beyond this frequency have not been considered in relation to siltation impacts, in accord with current industry practice.

FIGURES

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FIGURE 1
SITE LOCATION

Rev: Orig. Date: November 2007

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Northeast Business Park
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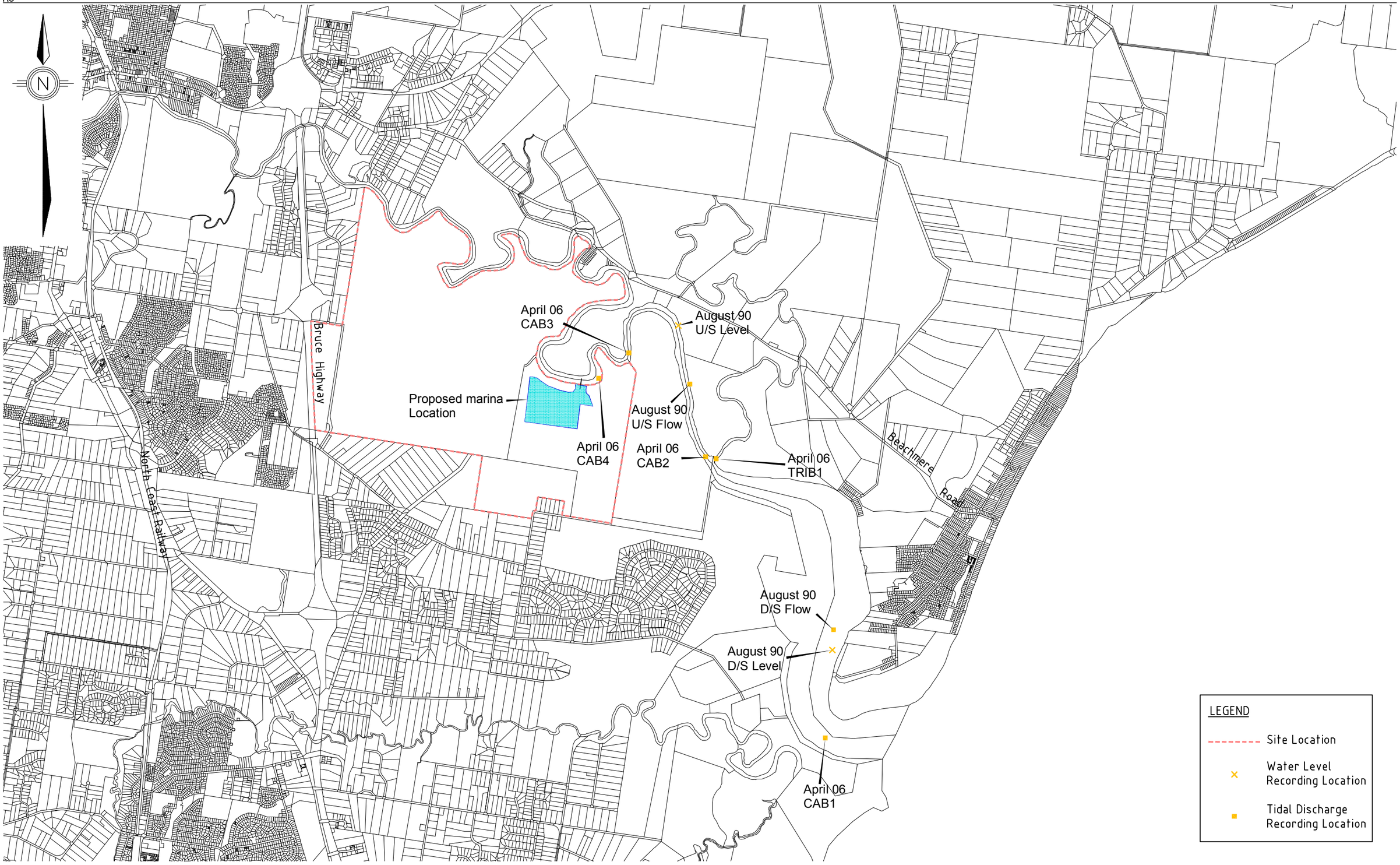

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FIGURE 2
EXISTING CASE MIKE 11 TIDAL MODEL LAYOUT

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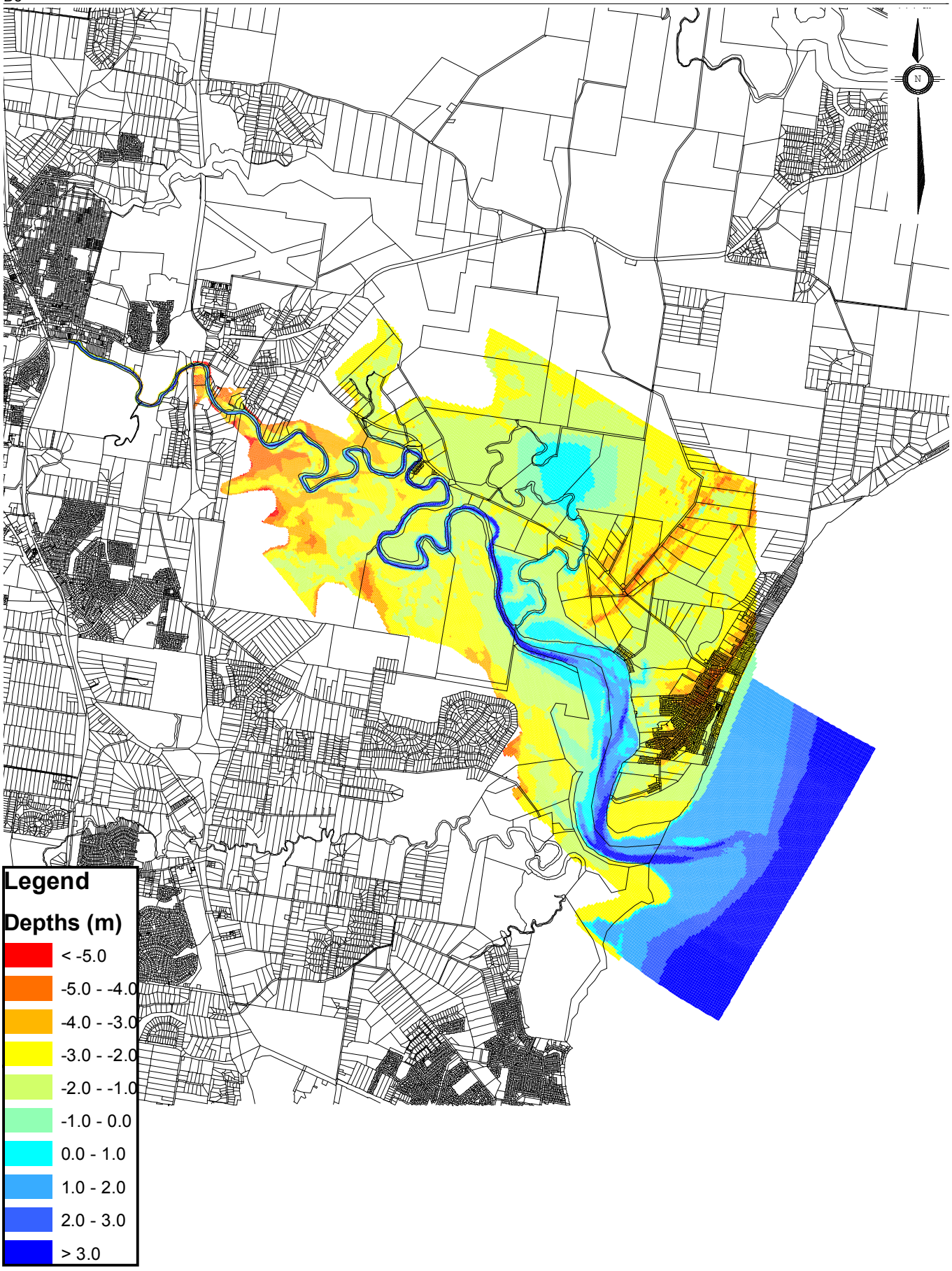

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FIGURE 3
Delft 3D Model Layout

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Base Bathymetry

Post-Dredge Bathymetry

Bed Level (mAHD)

-0.5000
-1.0000
-1.5000
-2.0000
-2.5000
-3.0000
-3.5000
-4.0000
-5.0000
-6.0000
-7.0000
-8.0000

0 500 1,000
metres

Scale: 1:50,000 (A4)

Figure 4
Model Bathymetry

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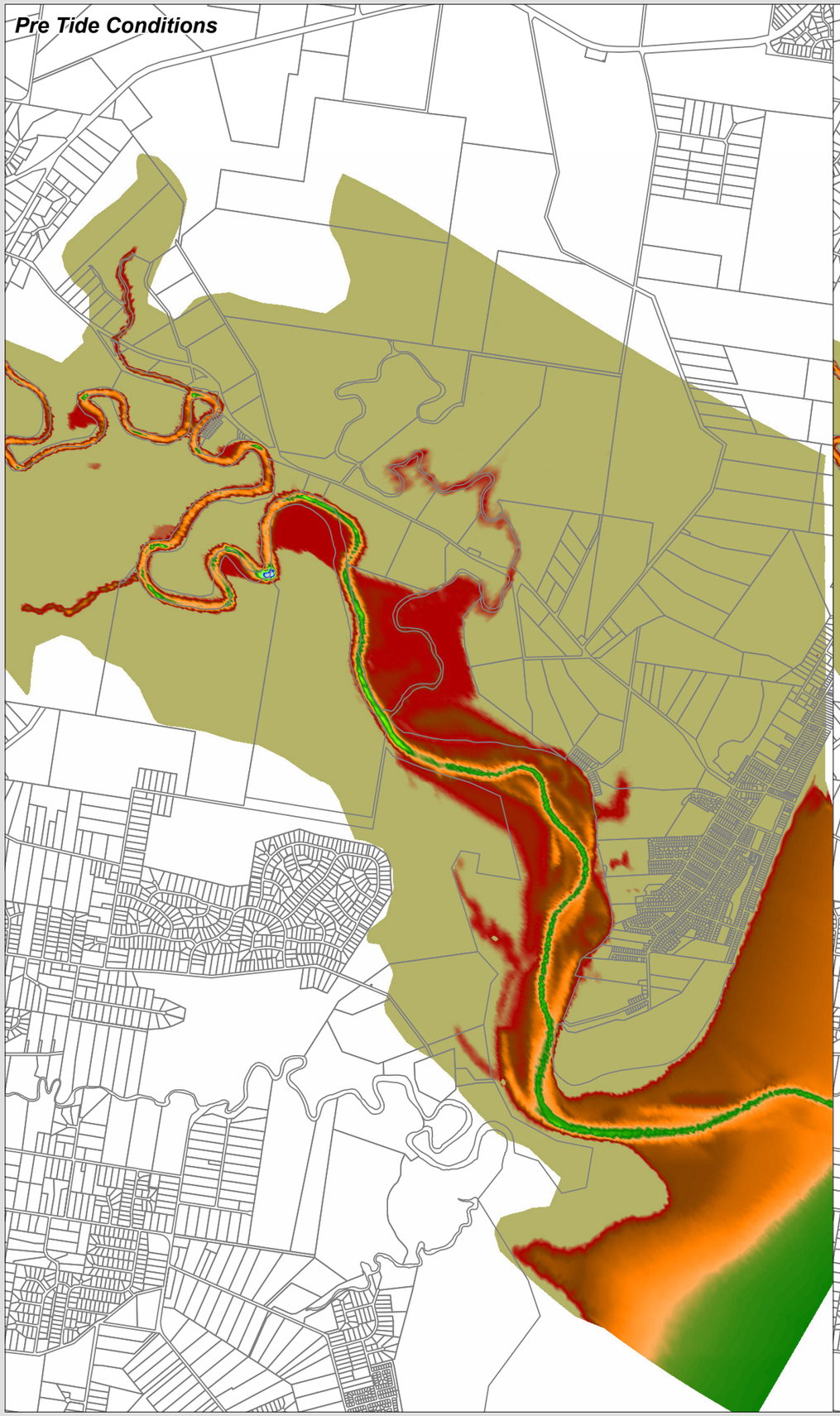

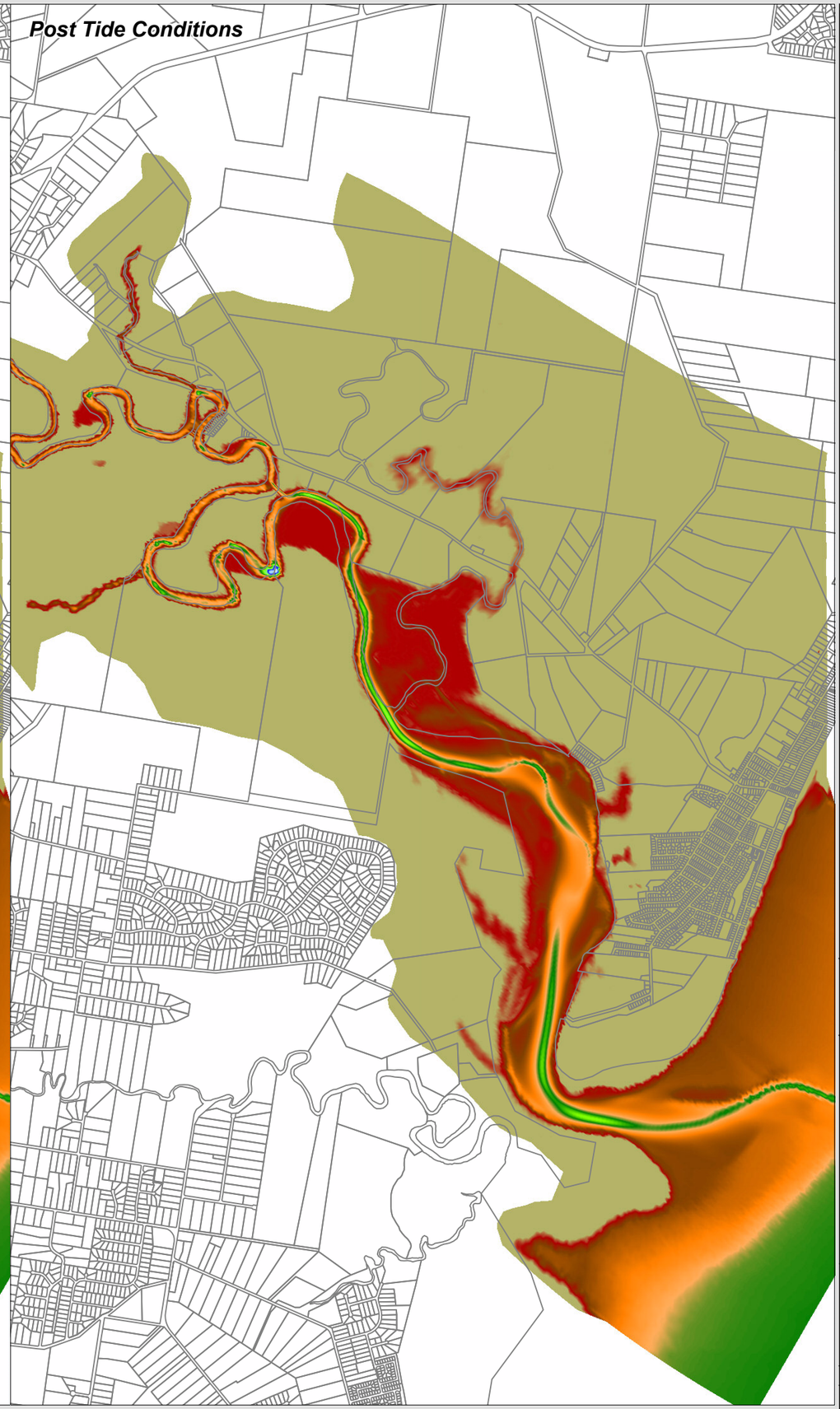

Figure 5 Post - Dredging Bed Levels - Tidal Conditions

North East Business Park

LEGEND

Bed Levels (mAHD)

- -9.0000
- -8.0000
- -7.0000
- -6.0000
- -5.0000
- -4.0000
- -3.0000
- -2.0000
- -1.0000
- 0.0000
- 1.0000

400 0 400 800 1200

Metres

Scale: 1:40,000

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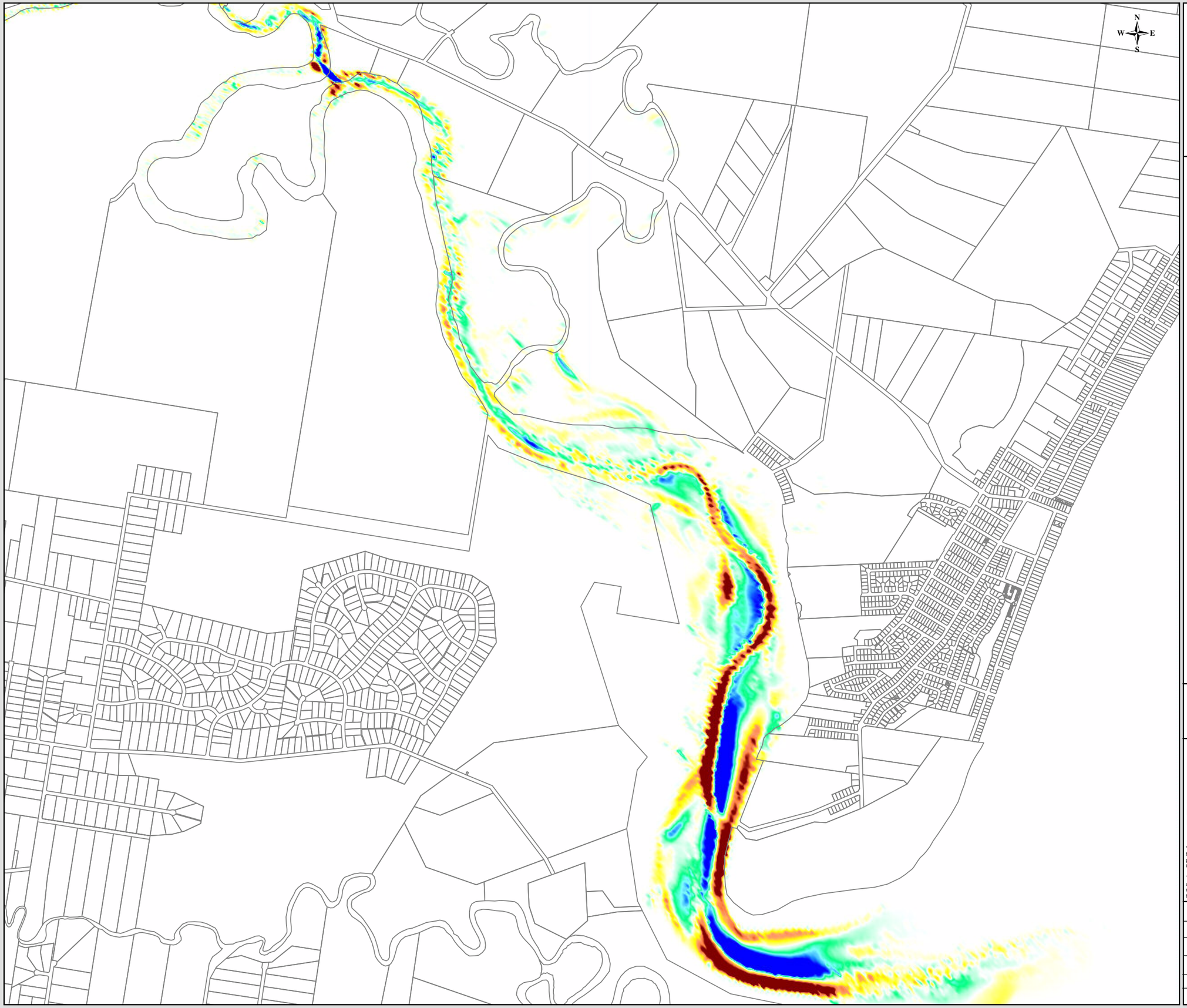

Figure 6

Bed Level Difference - Tidal Conditions

North East Business Park

LEGEND

Bed Levels Difference (m)

-1.2500
-1.0000
-0.7500
-0.5000
-0.2500
0.0000
0.2500
0.5000
0.7500
1.0000
1.2500
-1.5000
-1.2500
-1.0000
-0.7500
-0.5000
-0.2500
0.0000

200 0 200 400 600

Metres

Scale: 1:20,000

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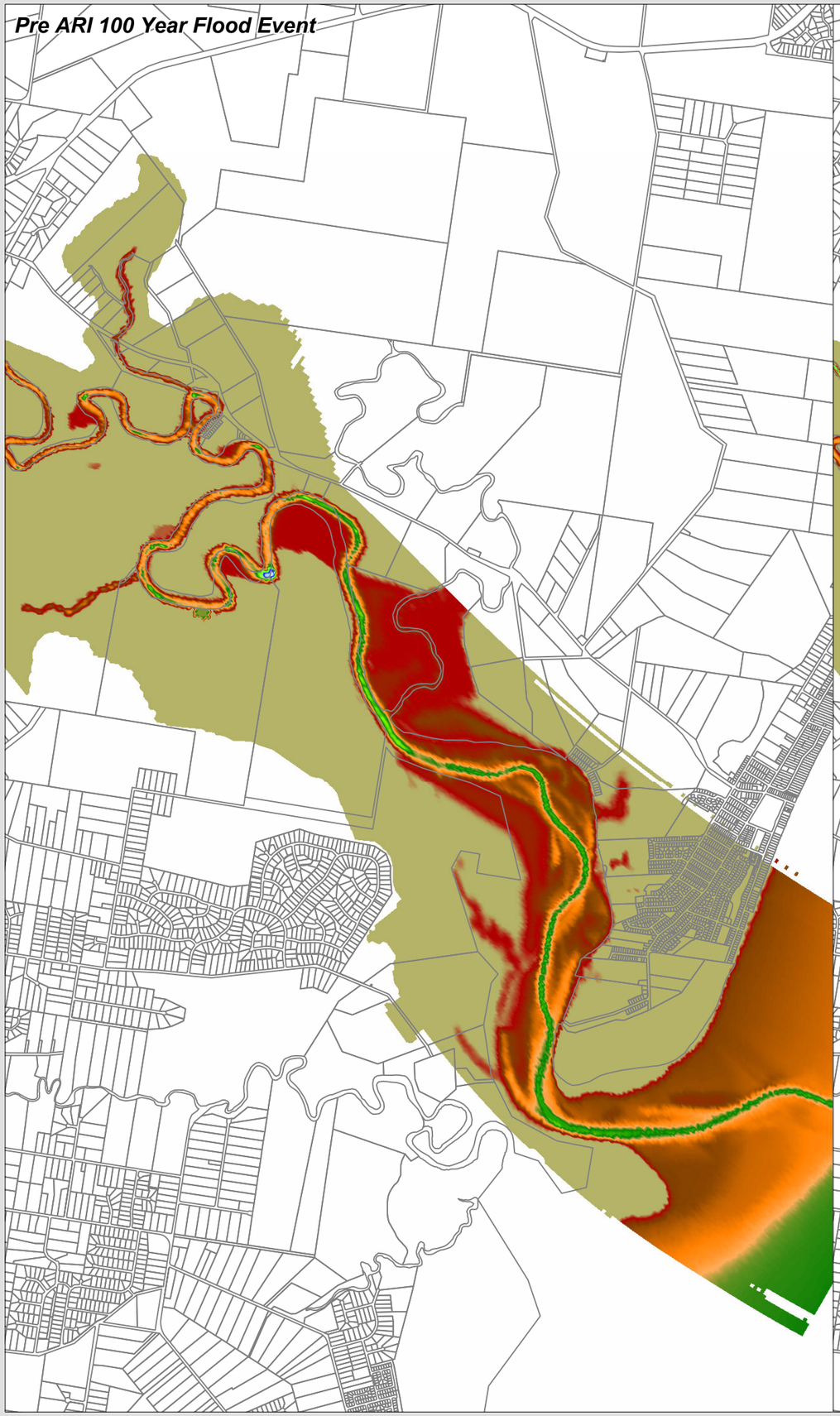

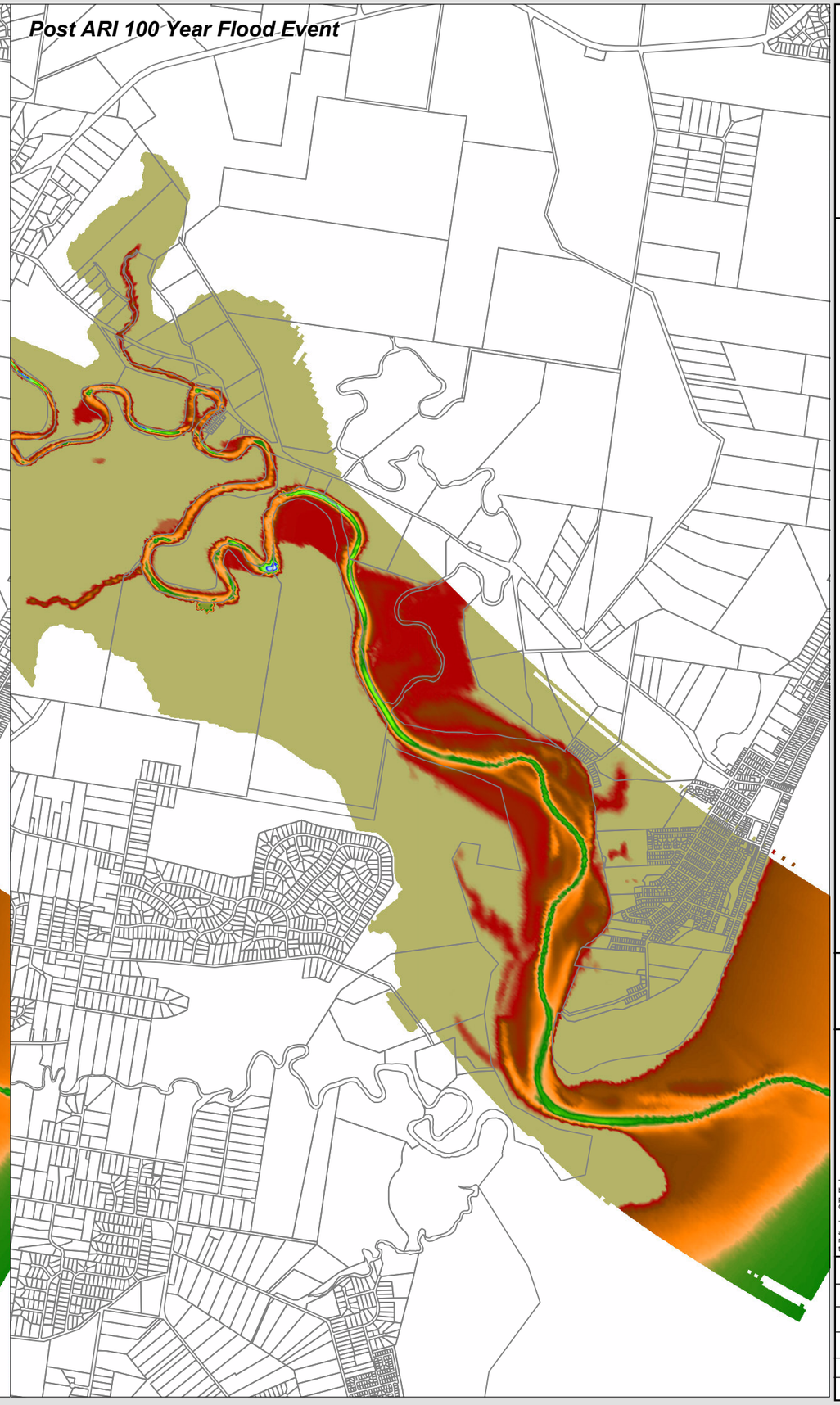

Figure 7

Post - Dredging Bed Levels - 100 year ARI Flood Event

North East Business Park

LEGEND

Bed Levels (mAHD)

	-9.0000
	-8.0000
	-7.0000
	-6.0000
	-5.0000
	-4.0000
	-3.0000
	-2.0000
	-1.0000
	0.0000
	1.0000

400 0 400 800 1200

Metres

Scale: 1:40,000

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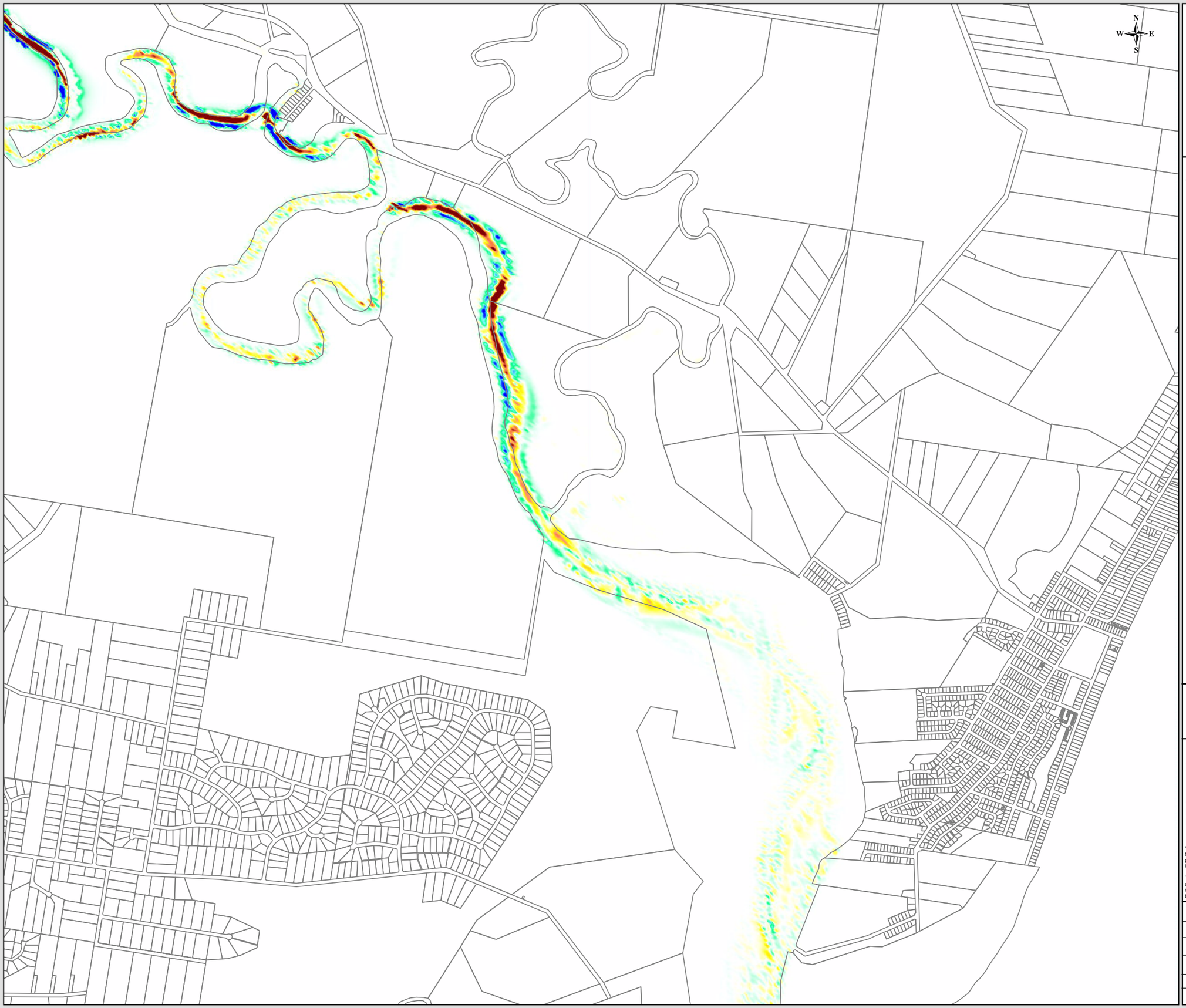

Figure 8

Bed Level Difference - 100 year ARI Flood Event

North East Business Park

LEGEND

Bed Level Difference (m)

	-1.2500
	-1.0000
	-0.7500
	-0.5000
	-0.2500
	0.0000
	0.2500
	0.5000
	0.7500
	1.0000
	1.2500

200 0 200 400 600

Metres

Scale: 1:20,000

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SHEET	**A3**
Project No:	**7900-33**
Date:	**05-11-2007**
Revision Number:	
Designed by:	
Client Name:	**North East Business Park**

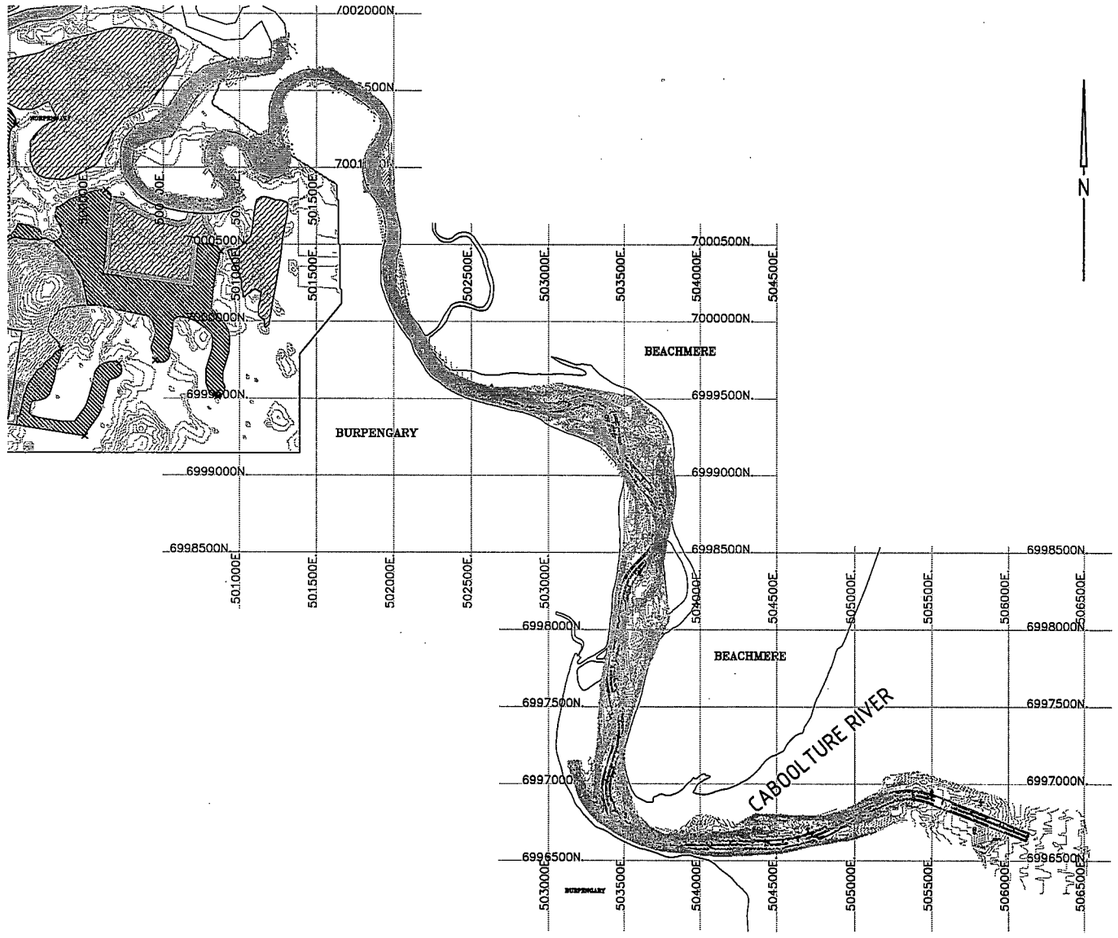
File Path: M:\2814-80\MapinfoVFigures

REFERENCE DRAWINGS

Cardno
Engineering the Future

NORTH EAST BUSINESS PARK

CABOOLTURE RIVER DREDGING



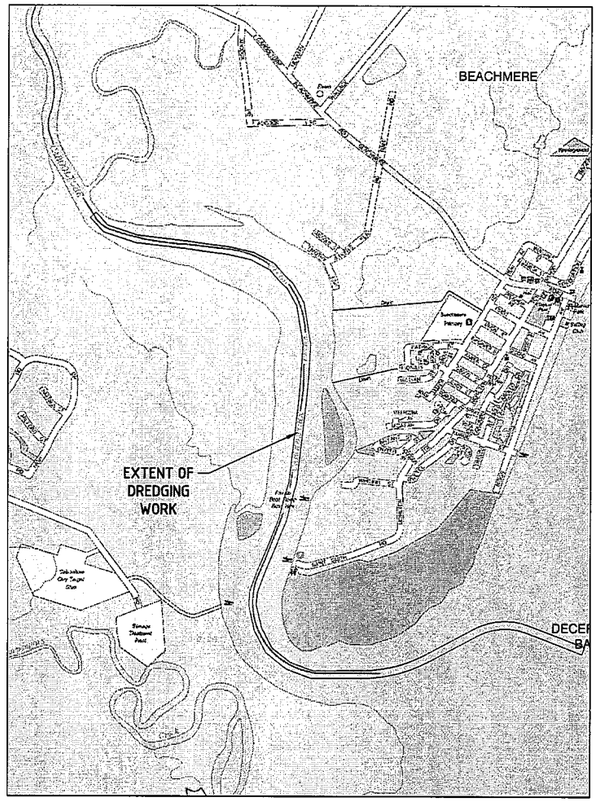
SITE PLAN
1:20000

Cardno (Qld) Pty Ltd
ABN 57 051 074 992

Level 1, 5 Gardner Close, Milton QLD 4064
PO Box 388, Toowong QLD 4066 Australia

Telephone: 07 3369 9822
Facsimile: 07 3369 9722

Dwg No.: 7900/33/01-100 Date: 23.02.2007 Rev.:



LOCALITY PLAN
NTS

SCHEDULE OF DRAWINGS	
DRAWING No.	DESCRIPTION
7900/33/01-100	Cover Sheet
CABOOLTURE RIVER DREDGING	
7900/33/01-101	Locality Plan, Notes and Schedule of Drawings
7900/33/01-102	Layout Plan
7900/33/01-103	Centre Line Set Out
7900/33/01-104	Layout Plan - Sheet 1 of 10 - Chainage 0.000 - 800.000
7900/33/01-105	Layout Plan - Sheet 2 of 10 - Chainage 800.000 - 1600.000
7900/33/01-106	Layout Plan - Sheet 3 of 10 - Chainage 1600.000 - 2300.000
7900/33/01-107	Layout Plan - Sheet 4 of 10 - Chainage 2300.000 - 3100.000
7900/33/01-108	Layout Plan - Sheet 5 of 10 - Chainage 3100.000 - 3600.000
7900/33/01-109	Layout Plan - Sheet 6 of 10 - Chainage 3600.000 - 4100.000
7900/33/01-110	Layout Plan - Sheet 7 of 10 - Chainage 4100.000 - 4700.000
7900/33/01-111	Layout Plan - Sheet 8 of 10 - Chainage 4700.000 - 5200.000
7900/33/01-112	Layout Plan - Sheet 9 of 10 - Chainage 5200.000 - 5700.000
7900/33/01-113	Layout Plan - Sheet 10 of 10 - Chainage 5700.000 - 6522.954
7900/33/01-114	Cross Sections - Sheet 1 of 4 - Chainage 0.000 - 1900.000
7900/33/01-115	Cross Sections - Sheet 2 of 4 - Chainage 2000.000 - 3900.000
7900/33/01-116	Cross Sections - Sheet 3 of 4 - Chainage 4000.000 - 5700.000
7900/33/01-117	Cross Sections - Sheet 4 of 4 - Chainage 5800.000 - 6522.954

NAVIGATION AIDS-GDA94 MGA Zone 56		
NAV AID	EASTING	NORTHING
SPECIAL BCN	506473	6996538
STBD BCN	505818	6996864
PORT BCN	505776	6996683
STBD BCN	505499	6996929
PORT BCN	505385	6996895
STBD BCN	504703	6996690
PORT BCN	505098	6996766
STBD BCN	503879	6996660
PORT BCN	504756	6996622
SPECIAL BCN	503641	6996686
PORT BCN	503357	6996820
STBD BCN	503509	6996785
PORT BCN	503412	6997417
STBD BCN	503448	6997007
PORT BCN	503610	6998323
STBD BCN	503460	6997679
PORT BCN	503691	6998585
STBD BCN	503518	6998078
PORT BCN	503731	6998661
STBD BCN	503716	6998353
PORT BCN	503424	6999239
STBD BCN	503705	6998715
PORT BCN	503381	6999361
STBD BCN	503464	6999231
PORT BCN	503323	6999447
STBD BCN	503102	6999453
PORT BCN	503239	6999468
STBD BCN	502633	6999551
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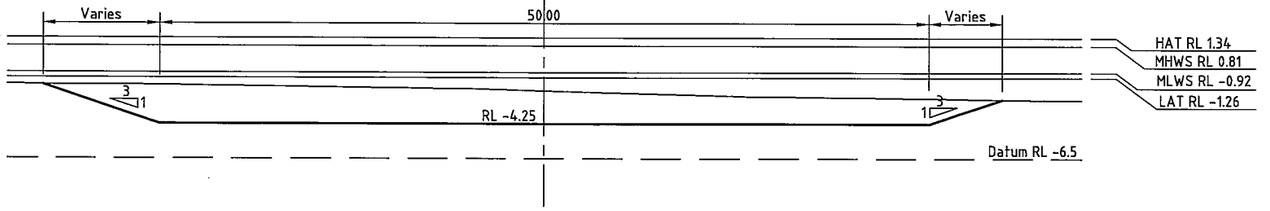

TYPICAL DREDGING SECTION
CH 0.000 - CH 6522.954
Scale1:200

2.0 0 2.0 4.0 6.0 8.0 10.0m
SCALE BEFORE REDUCTION 1:200

DATE PLOTTED: 07 March, 2007 - 11:49am

Rv.	DATE	REVISIONS	REC.	APPR.

DESIGNED:
DRAWN:
CHECKED:
RECOMMENDED: PROJ. MGR
APPROVED: PROJ. DIR

A1 DATUM: A.H.D.

CAD FILE: L:\7900-33\SUB 01\Acad\7900-33-01-101.dwg
XREF's: X-A1-BD-SHT A

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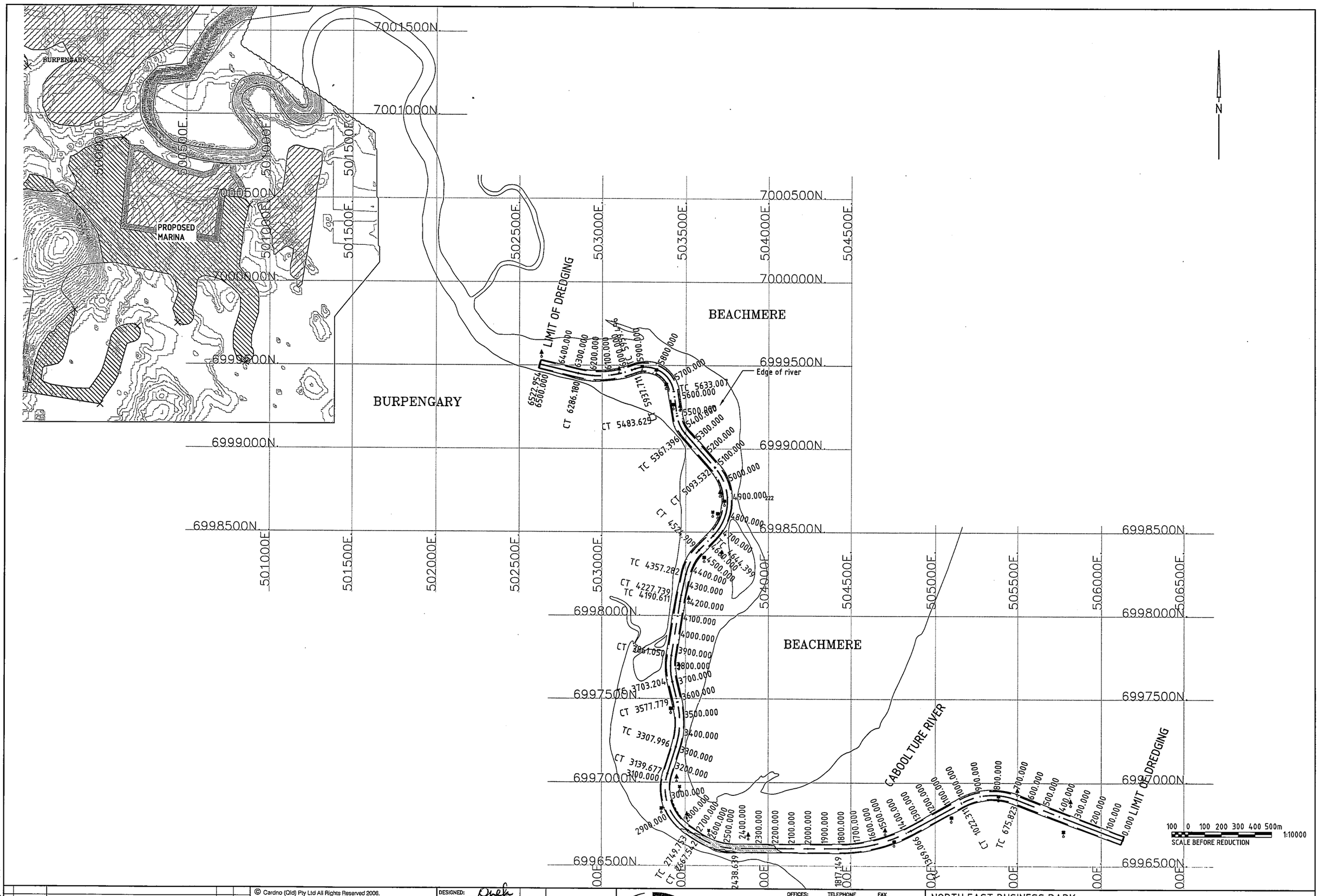
Rockhampton	(07) 4924 7500	(07) 4926 4375
Toowoomba	(07) 4637 6122	(07) 4637 8155

NORTH EAST BUSINESS PARK

CABOOLTURE RIVER DREDGING
LOCALITY PLAN, NOTES
& SCHEDULE OF DRAWINGS

DATE: 09-02-2007 Rv.
DRAWING No:
7900/33/01-101



Rv.	DATE	REVISIONS	REC.	APPR.

DESIGNED: DWH
DRAWN: DWH
CHECKED: JSF
RECOMMENDED: PROJ. MGR
APPROVED: PROJ. DIR
A1 DATUM: A.H.D.

CAD FILE: L:\7900-33\SUB 01\Acad\7900-01-102.dwg
XREFs: X-A1-BD-SHT A; X-Base

DATE PLOTTED: 07 March, 2007 - 11:49am

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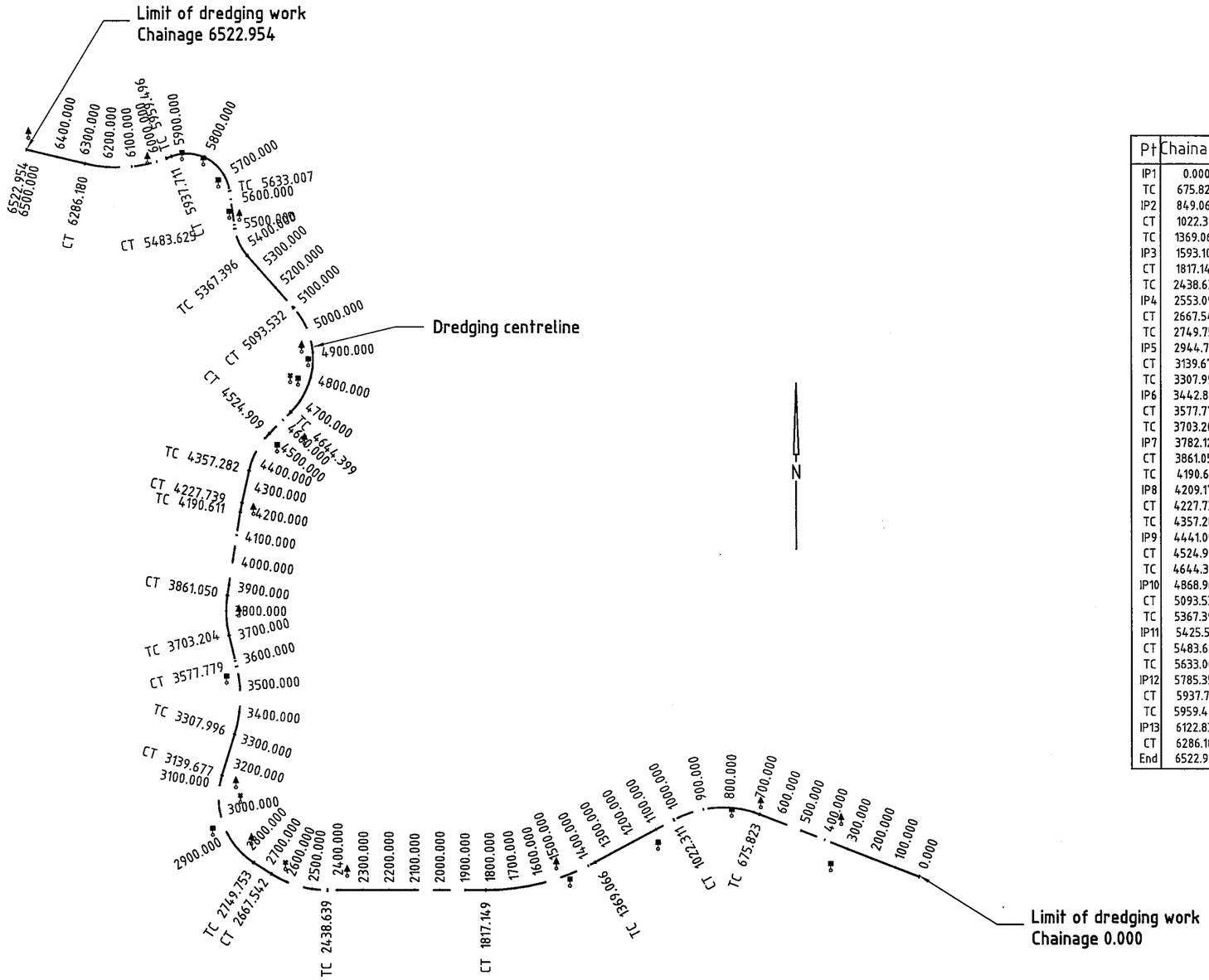
Rockhampton	(07)	4924 7500	(07)	4926 4375
Toowoomba	(07)	4637 8122	(07)	4637 8155

NORTH EAST BUSINESS PARK

CABOOLTURE RIVER DREDGING
LAYOUT PLAN

DATE: 09-02-2007
DRAWING No: 7900/33/01-102
Rv.



HORIZONTAL CENTRELINE CONTROL DETAILS

Pt	Chainage	Easting	Northing	Level	Bearing	Radius	Length	Angle
IP1	0.000	506125.109	6996658.439	-4.250				
TC	675.823	505494.473	6996901.411	-4.250	291°04'15"			
IP2	849.067	505321.884	6996967.907			-400.000	-346.488	49°37'51"
CT	1022.311	505159.433	6996879.483	-4.250	241°26'24"			
TC	1369.066	504854.873	6996713.708	-4.250	241°26'24"			
IP3	1593.107	504653.925	6996604.330			900.000	448.083	28°31'33"
CT	1817.149	504425.138	6996604.193	-4.250	269°57'57"			
TC	2438.639	503803.648	6996603.824	-4.250	269°57'57"			
IP4	2553.090	503685.968	6996603.754			400.000	228.903	32°47'16"
CT	2667.542	503586.998	6996667.422	-4.250	302°45'14"			
TC	2749.753	503517.858	6996711.901	-4.250	302°45'14"			
IP5	2944.715	503326.108	6996835.257			300.000	389.923	74°28'12"
CT	3139.677	503393.620	6997053.033	-4.250	17°13'25"			
TC	3307.996	503443.460	6997213.805	-4.250	17°13'25"			
IP6	3442.888	503484.400	6997345.867			-500.000	-269.783	30°54'53"
CT	3577.779	503451.675	6997480.200	-4.250	346°18'32"			
TC	3703.204	503421.988	6997602.061	-4.250	346°18'32"			
IP7	3782.127	503403.062	6997679.752			400.000	157.846	22°36'35"
CT	3861.050	503415.459	6997758.749	-4.250	8°55'07"			
TC	4190.611	503466.551	6998084.326	-4.250	8°55'07"			
IP8	4209.175	503469.430	6998102.671			600.000	37.127	3°32'43"
CT	4227.739	503473.438	6998120.803	-4.250	12°27'50"			
TC	4357.282	503501.397	6998247.293	-4.250	12°27'50"			
IP9	4441.095	503519.972	6998331.329			300.000	167.627	32°00'52"
CT	4524.909	503580.272	6998392.737	-4.250	44°28'42"			
TC	4644.399	503663.992	6998477.995	-4.250	44°28'42"			
IP10	4868.965	503859.240	6998676.830			-300.000	-449.134	85°46'42"
CT	5093.532	503675.317	6998886.187	-4.250	318°42'01"			
TC	5367.396	503494.567	6999091.931	-4.250	318°42'01"			
IP11	5425.511	503455.094	6999136.862			200.000	116.230	33°17'50"
CT	5483.625	503446.768	6999196.088	-4.250	351°59'51"			
TC	5633.007	503425.972	6999344.014	-4.250	351°59'51"			
IP12	5785.359	503396.380	6999554.503			-170.000	-304.705	102°41'45"
CT	5937.711	503197.541	6999479.375	-4.250	249°18'06"			
TC	5959.496	503177.163	6999471.675	-4.250	249°18'06"			
IP13	6122.838	503019.707	6999412.183			550.000	326.684	34°01'55"
CT	6286.180	502855.924	6999451.001	-4.250	283°20'02"			
End	6522.954	502625.533	6999505.607	-4.250				

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SCALE BEFORE REDUCTION 1:10000

DATE PLOTTED: 07 March, 2007 - 11:55am

Rv.	DATE	REVISIONS	REC.	APPR.

DESIGNED:
DRAWN:
CHECKED:
RECOMMENDED: PROJ. MAN.
APPROVED: PROJ. DIR.

A1 DATUM: A.H.D.

CAD FILE: I:\7900-33\SUB 01\Acad\7900330101-103.dwg
XREF's: X-Base; X-A1-B0-SHT A

Cardno
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NORTH EAST BUSINESS PARK

CABOOLTURE RIVER DREDGING
CENTRE LINE SET OUT

DATE: 09-02-2007 Rv.
DRAWING No:
7900/33/01-103

N

Green Navigation Beacon

Red Navigation Beacon

Yellow Navigation Beacon

Existing minor contours

Existing minor contours

Area notbe dredged

Area to be dredged

800.000

700.000

TC 675.823

600.000

500.000

400.000

300.000

200.000

100.000

0.000

Channel starts from CH. 0.000 at RL -4.250. Slope at 1 in 5 to natural surface.

10 0 10 20 30 40 50m

SCALE BEFORE REDUCTION 1:1000

Rv.	DATE	REVISIONS	REC.	APPR.

DESIGNED:
DRAWN:
CHECKED:
RECOMMENDED: PROJ. MAN.
APPROVED: PROJ. DIR.

A1 DATUM: A.H.D.

CAD FILE: L:\7900-33_JSUB 01_JA\DWG\7900033-01-104.dwg
XREF's: X-Base; EXISTING UNCLIPPED CONTOURS; X-A1-BO-SHT A

Cardno

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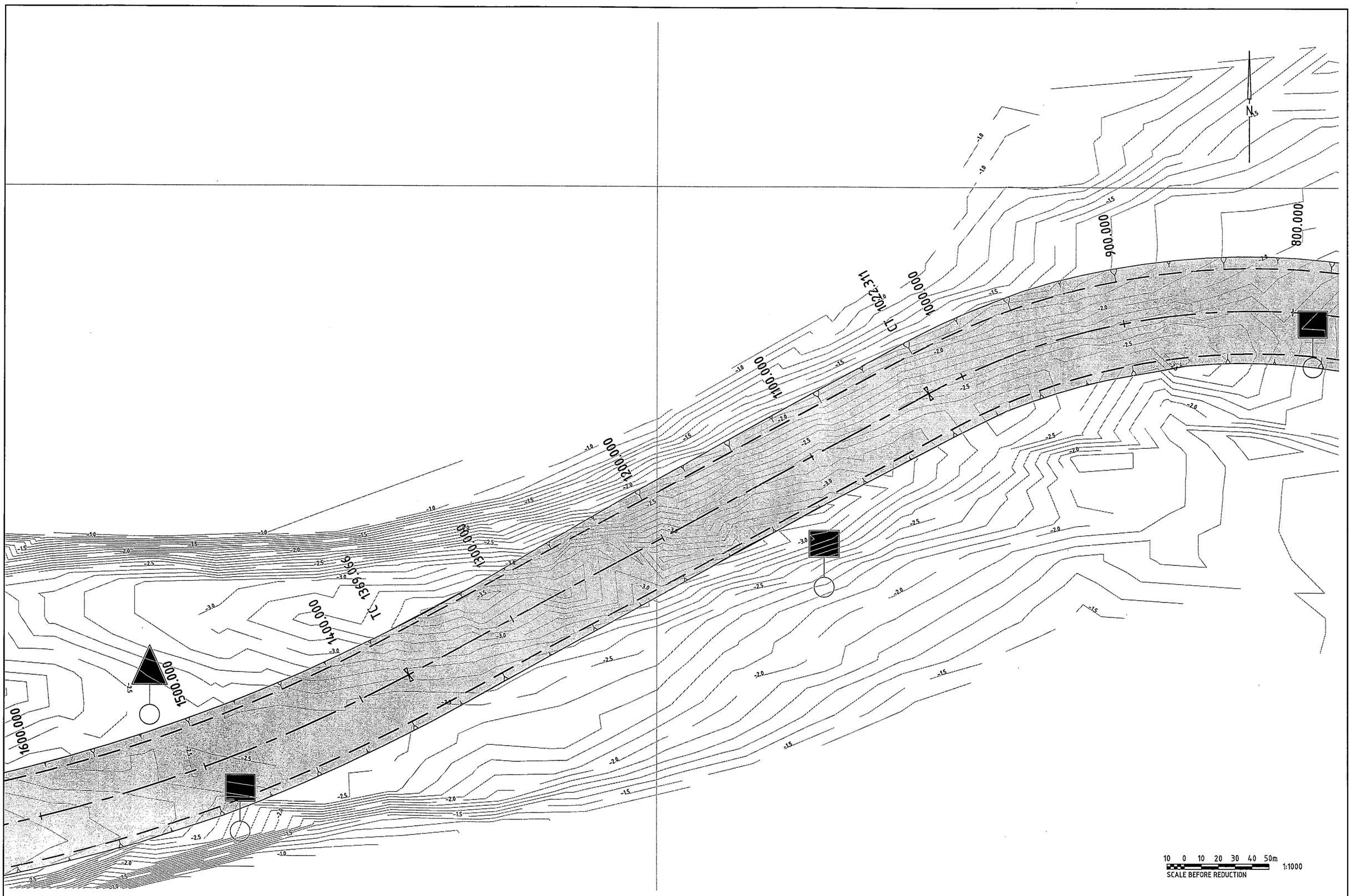
NORTH EAST BUSINESS PARK

CABOOLTURE RIVER DREDGING
LAYOUT PLAN - CH 0.000 - CH 800.000
SHEET 1 OF 10

DATE: 09-02-2007
DRAWING No:
7900/33/01-104

Rv.



Rv.	DATE	REVISIONS	REC.	APPR.

DESIGNED:
DRAWN:
CHECKED:
RECOMMENDED: PROJ. MGR
APPROVED: PROJ. DIR.

A1 DATUM: A.H.D.

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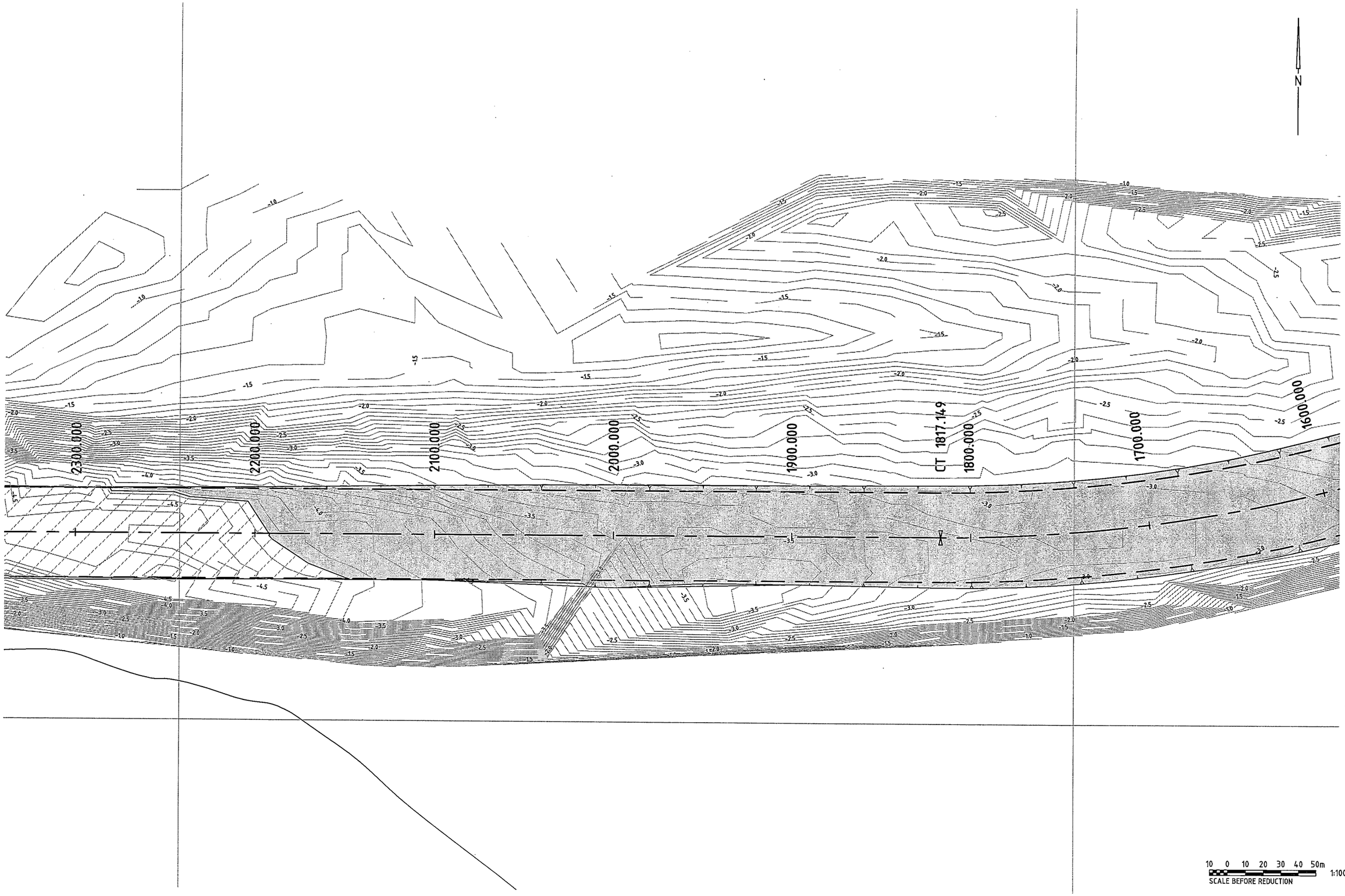
NORTH EAST BUSINESS PARK

CABOOLTURE RIVER DREDGING
LAYOUT PLAN - CH 800.000 - CH 1600.000
SHEET 2 OF 10

DATE: 09-02-2007
DRAWING No:
7900/33/01-105
Rv.



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Rv.	DATE	REVISIONS	REC.	APPR.

DESIGNED:
DRAWN:
CHECKED:
RECOMMENDED: PROJ. MGR
APPROVED: PROJ. DIR

A1 DATUM: A.H.D.

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XREFs: X-Base; EXISTING UNCLIPPED CONTOURS; X-A1-BD-SHT A

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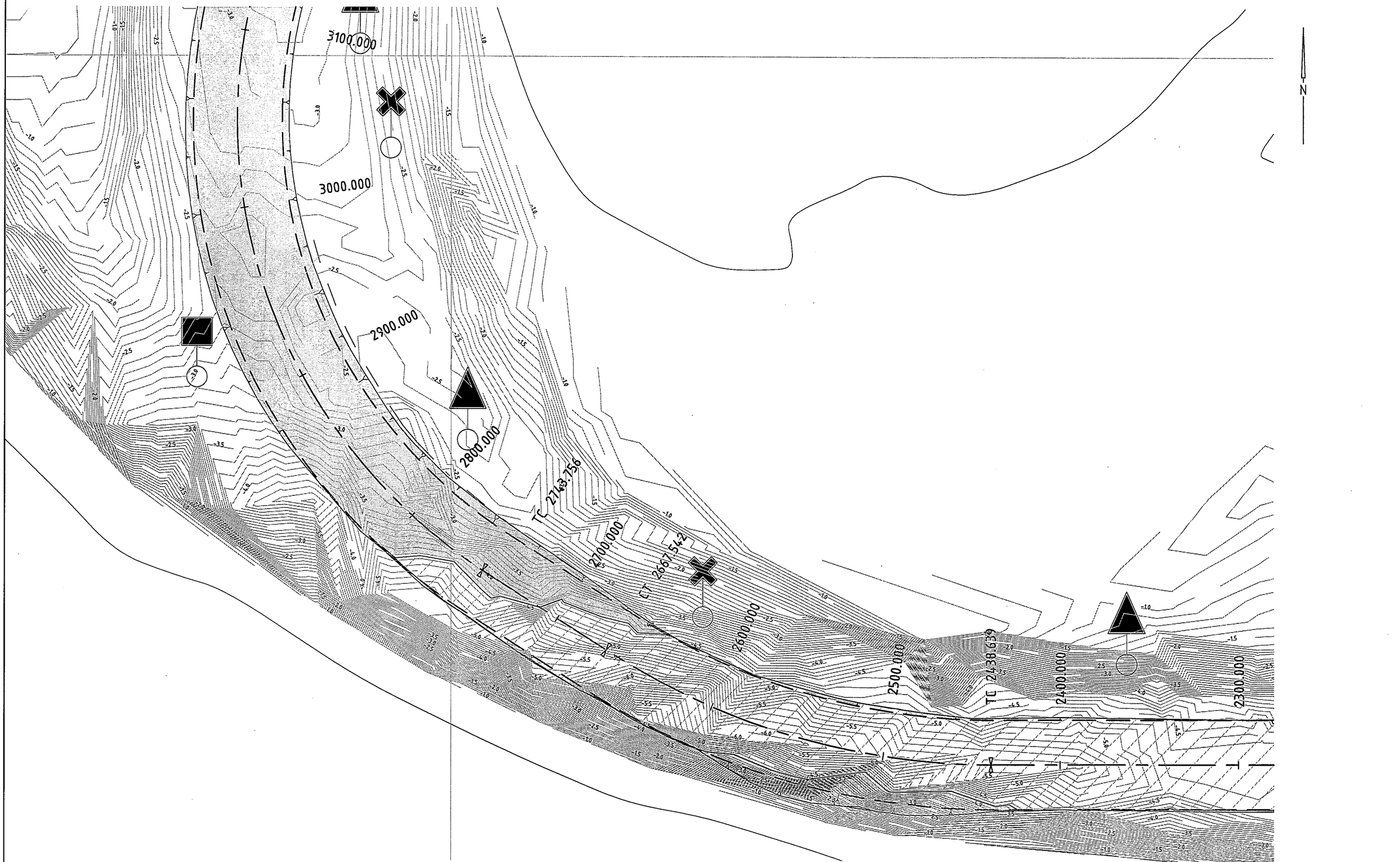
NORTH EAST BUSINESS PARK

CABOOLTURE RIVER DREDGING
LAYOUT PLAN - CH 1600.000 - CH 2300.000
SHEET 3 OF 10

DATE: 09-02-2007
DRAWING No:
7900/33/01-106
Rv.



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Rv.	DATE	REVISIONS	REC.	APPR.

DESIGNED:
DRAWN:
CHECKED:
RECOMMENDED: PROJ. MGR
APPROVED: PROJ. DIR

A1 DATUM: A.H.D.

CAD FILE: L:\7900-33_SUB 01_JACOBS\7900033-01-107.dwg
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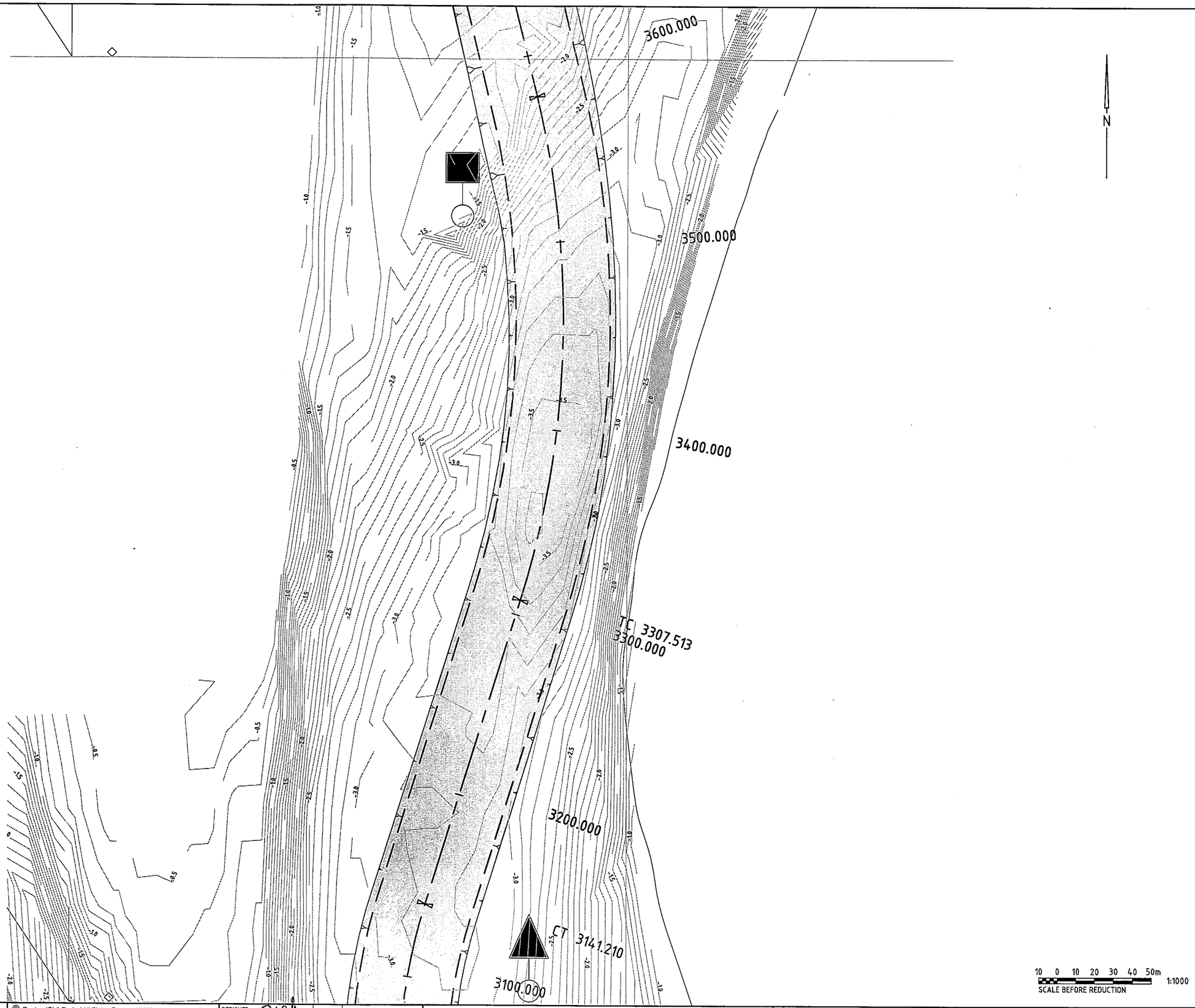
NORTH EAST BUSINESS PARK

CABOOLTURE RIVER DREDGING
LAYOUT PLAN - CH2300.000 - CH 3100.000
SHEET 4 OF 10

DATE: 09-02-2007
DRAWING No: 7900/33/01-107
Rv.



Rv.	DATE	REVISIONS	REC.	APPR.

DESIGNED:
DRAWN:
CHECKED:
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APPROVED: PROJ. DIR.

A1 DATUM: A.H.D.

CAD FILE: L:\7900-33_SUB 01-ACAD\7900033-01-108.dwg
XREF's: X-Base; EXISTING UNCLIPPED CONTOURS; X-A1-BD-SHT A

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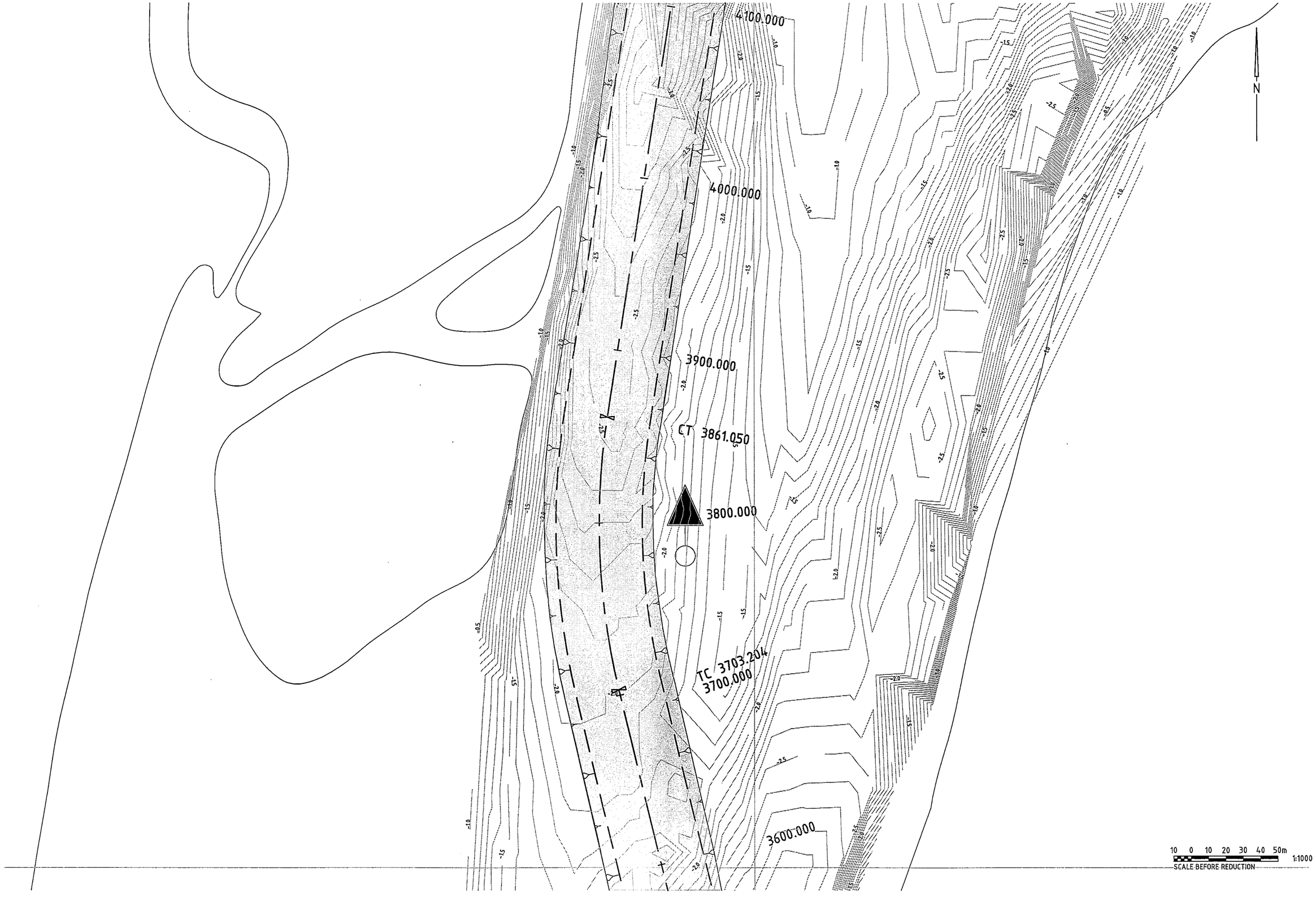
NORTH EAST BUSINESS PARK

CABOOLTURE RIVER DREDGING
LAYOUT PLAN - CH 3100.000 - CH 3600.000
SHEET 5 OF 10

DATE: 09-02-2007
DRAWING No: 7900/33/01-108
Rv.



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DRAWN:
CHECKED:
RECOMMENDED: PROJ. MGR.
APPROVED: PROJ. DIR.

A1 DATUM: A.H.D.

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XREF's: X-A1-BO-SHT A; X-Base-EXISTING UNCLIPPED CONTOURS

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ACN: 051 074 992

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Sunshine Coast	(07) 5443 2555	(07) 5443 5642
Townsville	(07) 4772 1166	(07) 4721 2508
Hervey Bay	(07) 4124 5455	(07) 4124 5155
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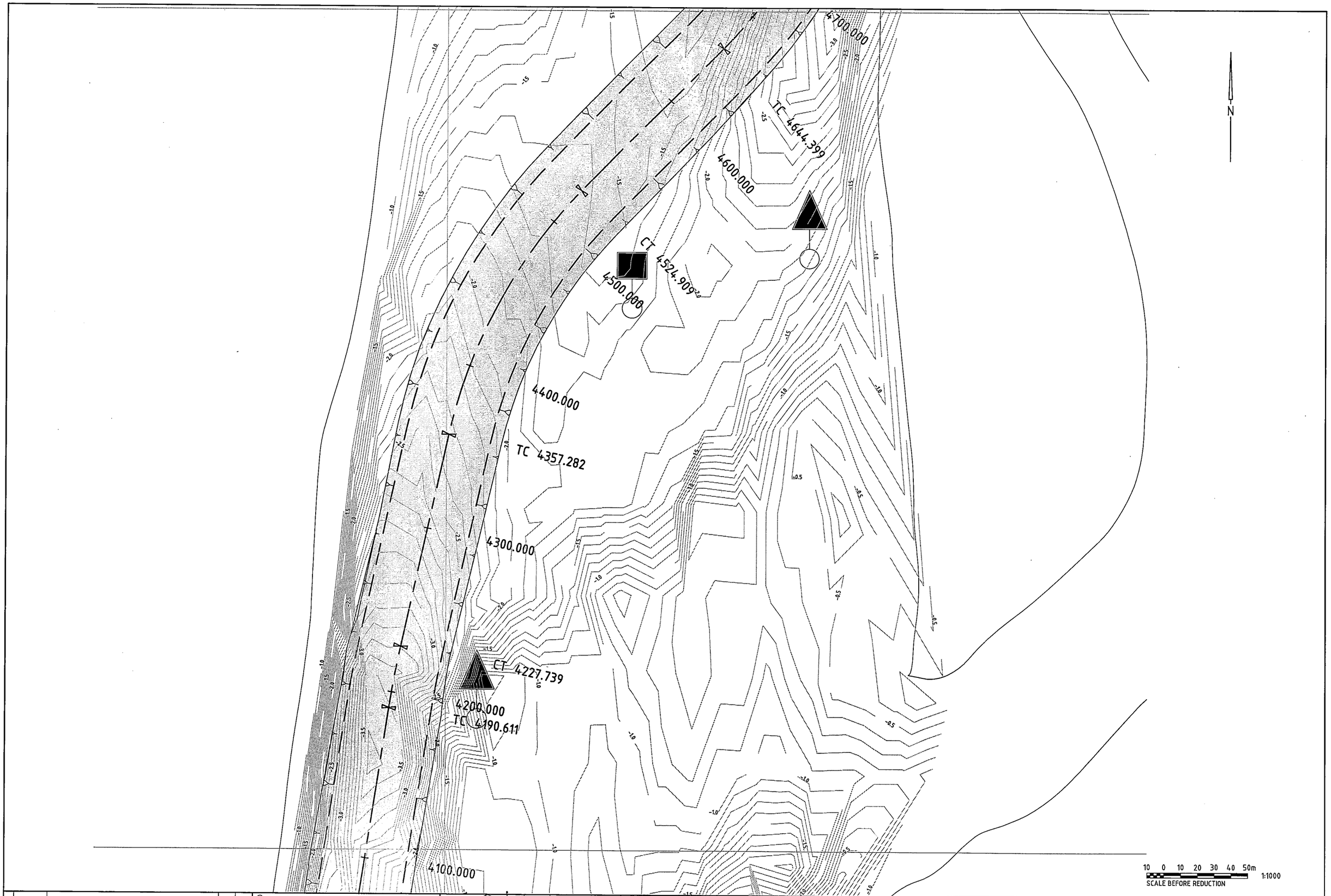
NORTH EAST BUSINESS PARK

CABOOLTURE RIVER DREDGING
LAYOUT PLAN - CH 3600.000 - CH 4100.000
SHEET 6 OF 10

DATE: 09-02-2007 Rv.

DRAWING No:
7900/33/01-109



Rv.	DATE	REVISIONS	REC.	APPR.

DESIGNED:
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CHECKED:
RECOMMENDED: PROJ. MAN.
APPROVED: PROJ. DIR.

A1 DATUM: A.H.D.

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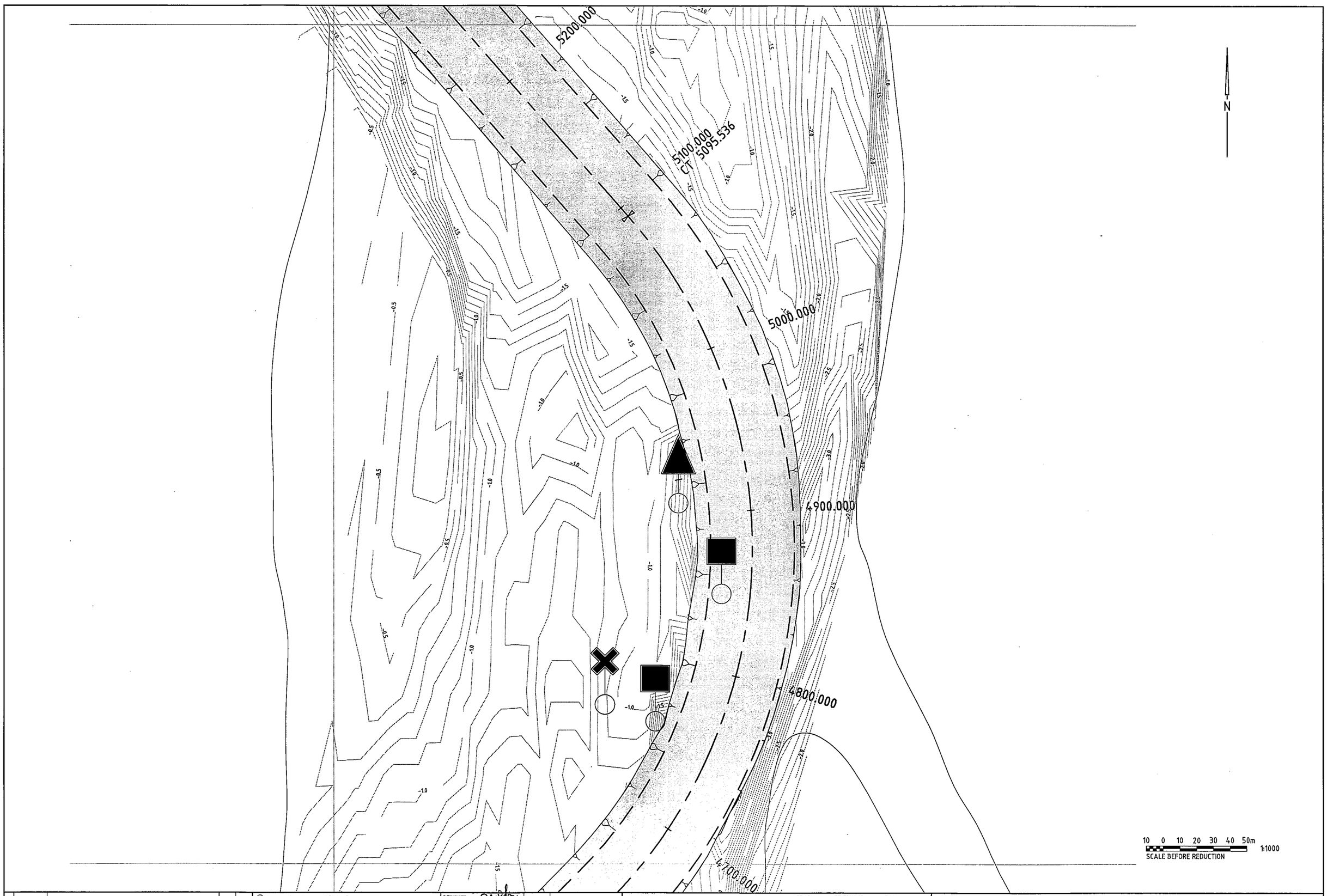
Toowoomba	(07) 4637 8122	(07) 4637 8155

NORTH EAST BUSINESS PARK
CABOOLTURE RIVER DREDGING
LAYOUT PLAN - CH 4100.000 - CH 4700.000
SHEET 7 OF 10

DATE: 09-02-2007 Rv.
DRAWING No:
7900/33/01-110



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DRAWN:
CHECKED:
RECOMMENDED PROJ. MGR.
APPROVED PROJ. DIR.

A1 DATUM: A.H.D.

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Central Coast	(02) 4323 2558	(02) 4324 3251
Melbourne	(03) 9818 7755	(03) 9818 7033
Rockhampton	(07) 4924 7500	(07) 4926 4375
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NORTH EAST BUSINESS PARK

CABOOLTURE RIVER DREDGING
LAYOUT PLAN - CH 4700.000 - CH 5200.000
SHEET 8 OF 10

DATE: 09-02-2007
DRAWING No:
7900/33/01-111
Rv.

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1:1000
SCALE BEFORE REDUCTION

Rv.	DATE	REVISIONS	REC.	APPR.

DESIGNED:
DRAWN:
CHECKED:
RECOMMENDED: PROJ. MAN.
APPROVED: PROJ. DIR.

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Rockhampton	(07) 4924 7500	(07) 4926 4375
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NORTH EAST BUSINESS PARK

CABOOLTURE RIVER DREDGING
LAYOUT PLAN – CH 5200.000 – CH 5700.000
SHEET 9 OF 10

DATE: 09-02-2007
DRAWING No:
7900/33/01-112
Rv.

N

6522.954

6500.000

6400.000

6300.000

CT 6286.180

6200.000

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5900.000

5800.000

5700.000

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Rv.	DATE	REVISIONS	REC.	APPR.

DESIGNED:
DRAWN:
CHECKED:
RECOMMENDED: PROJ. MGR.
APPROVED: PROJ. DIR.

A1 DATUM: A.H.D.

CAD FILE: L:\7900-33_JSUB 01_Acad_7900333-01-113.dwg
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Sunshine Coast	(07) 5443 2555	(07) 5443 5842
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NORTH EAST BUSINESS PARK

CABOOLTURE RIVER DREDGING
LAYOUT PLAN - CH 5700.000 - CH 6522.954
SHEET 10 OF 10

DATE: 09-02-2007 Rv.
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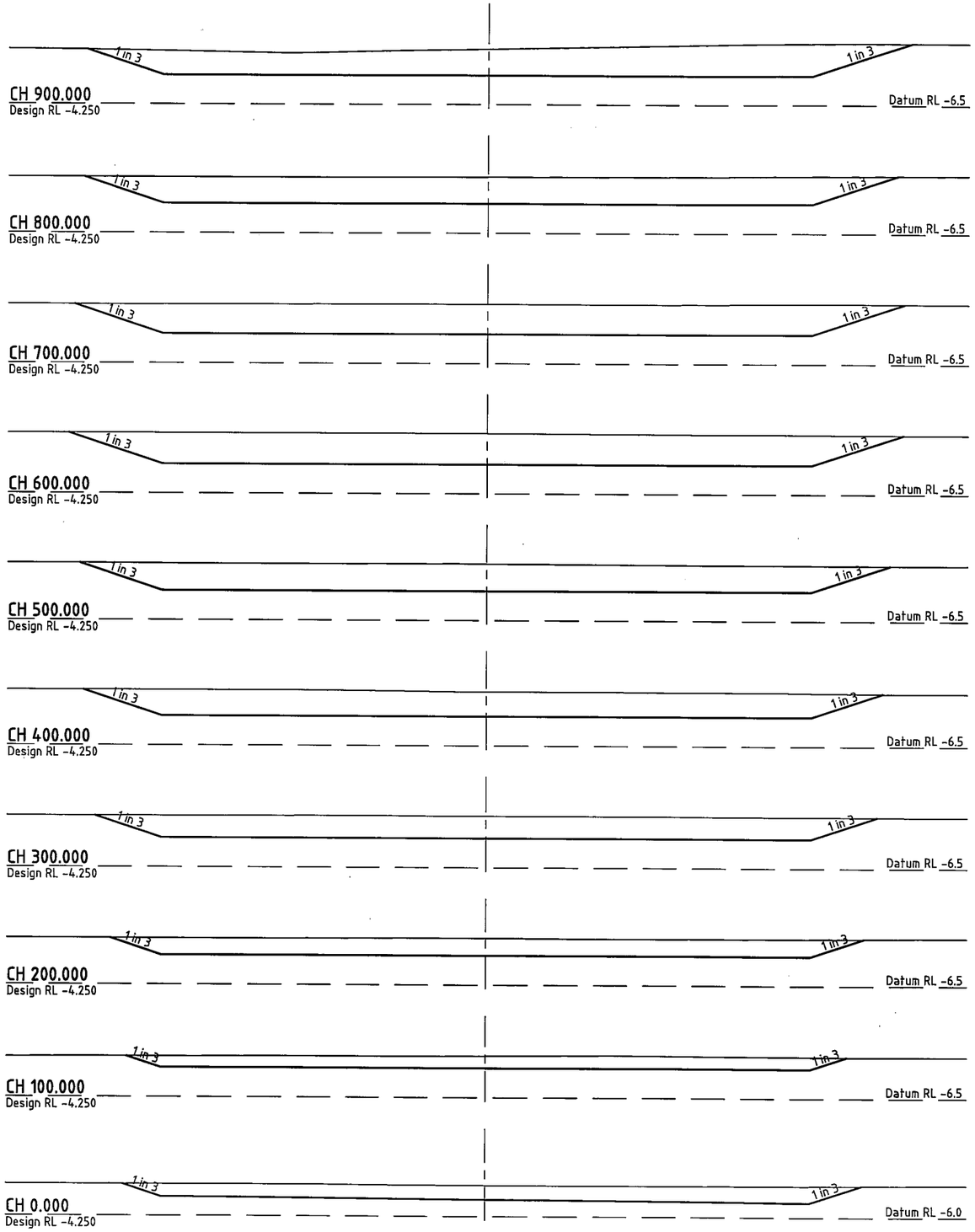
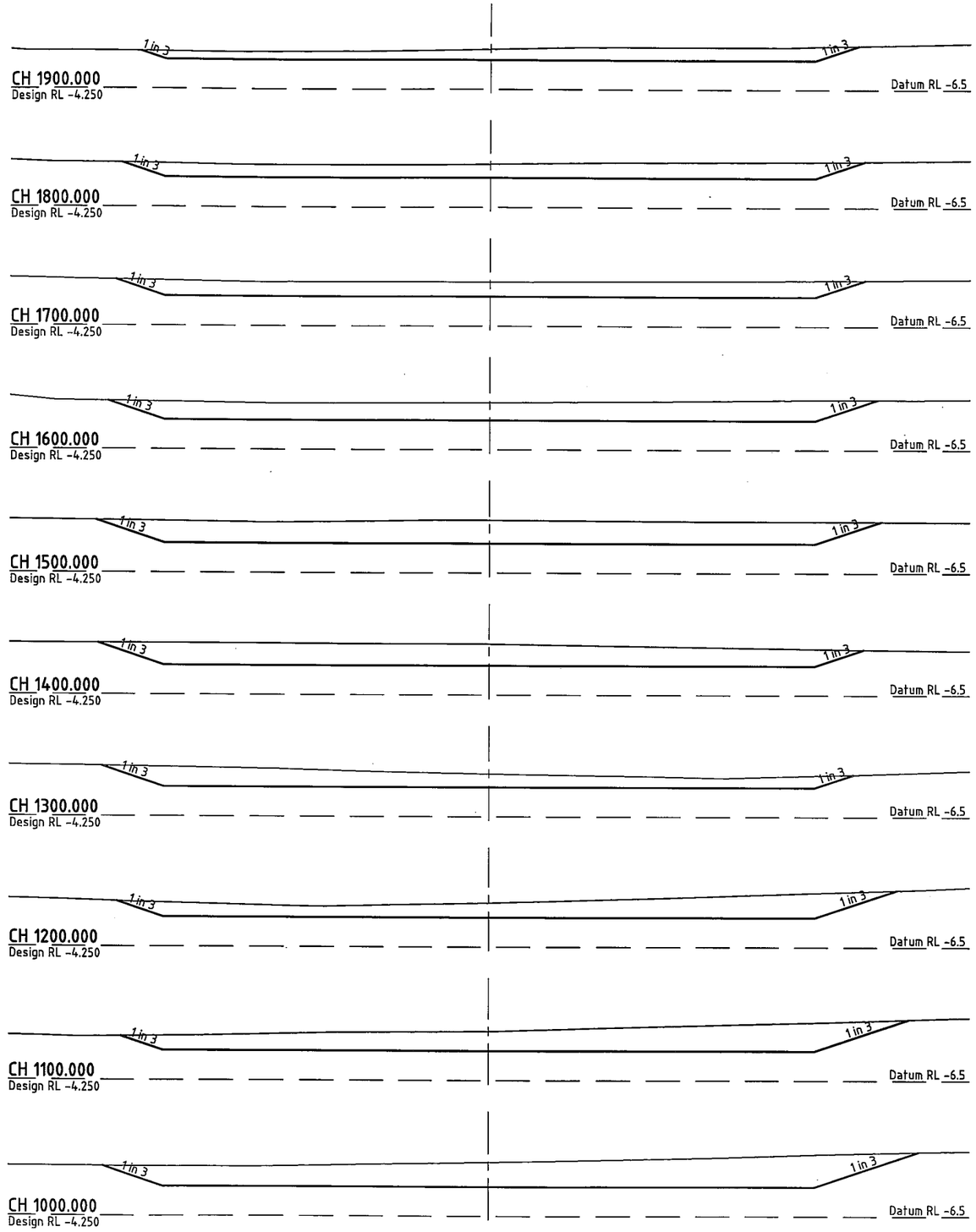
7900/33/01-113





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Rv.	DATE	REVISIONS	REC.	APPR.

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DRAWN:
CHECKED:
RECOMMENDED: PROJ. MGR
APPROVED: PROJ. DIR.
A1 DATUM: A.H.D.
CAD FILE: L:\7900-33_JSUB 01\Acad_\790033-01-114.dwg
XREFs: X-A1-BD-SHT A

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NORTH EAST BUSINESS PARK
CABOOLTURE RIVER DREDGING
CROSS SECTIONS - CH 0.000 - CH 1900.000
SHEET 1 OF 4

DATE: 09-02-2007
DRAWING No: 7900/33/01-114
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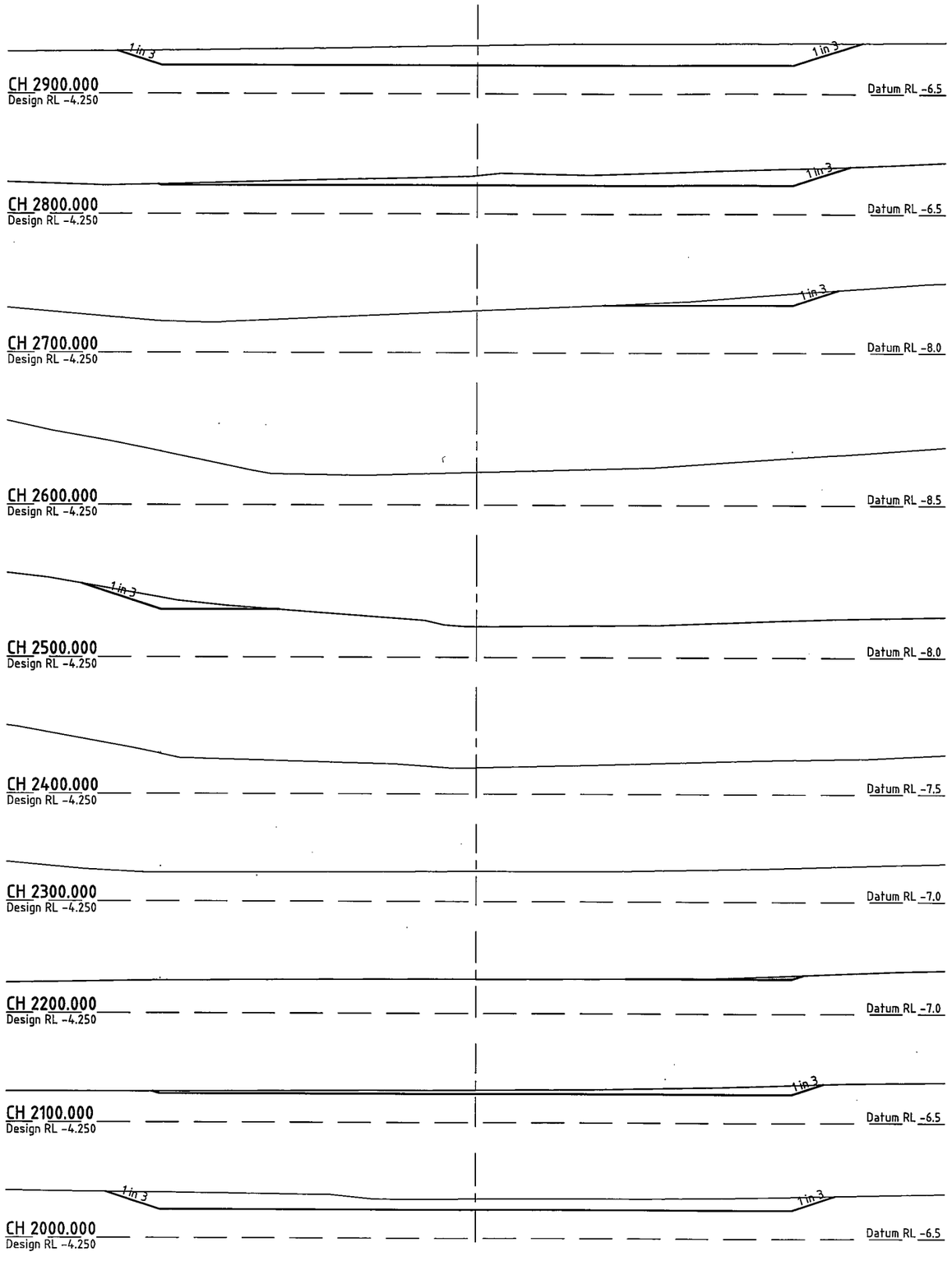

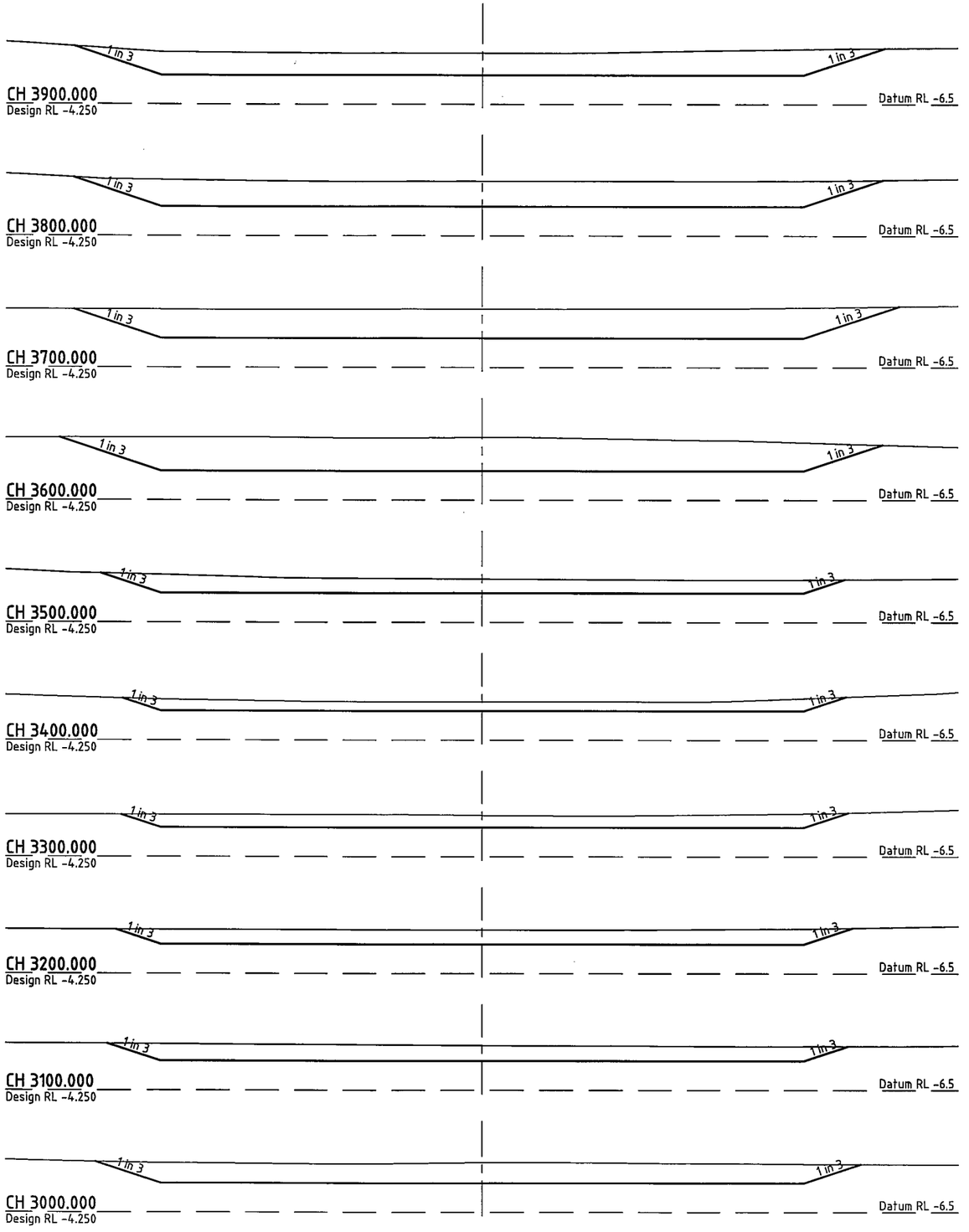

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Rv.	DATE	REVISIONS	REC.	APPR.

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DRAWN:
CHECKED:
RECOMMENDED: PROJ. MAN.
APPROVED: PROJ. DIR.
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A1 DATUM: A.H.D.

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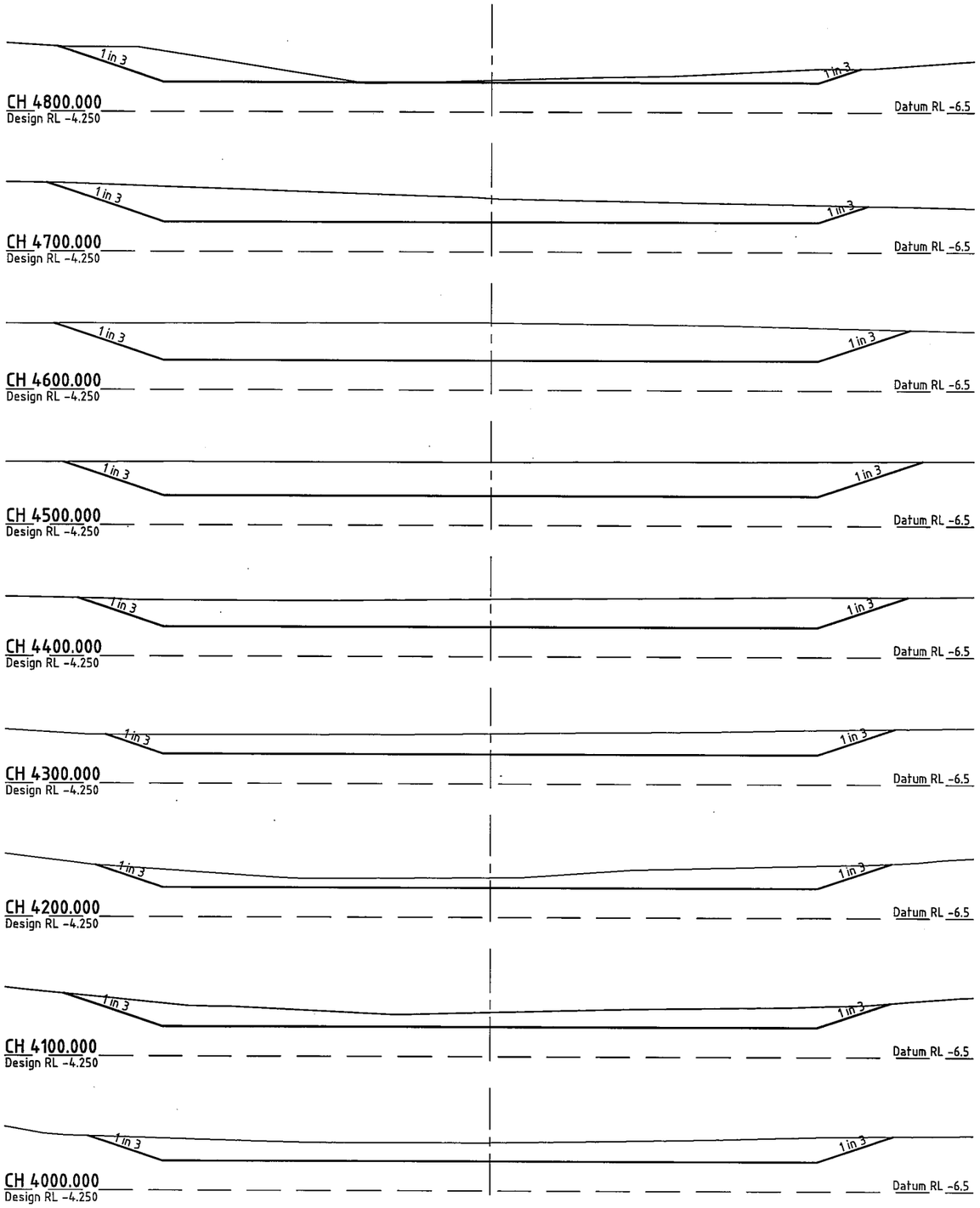
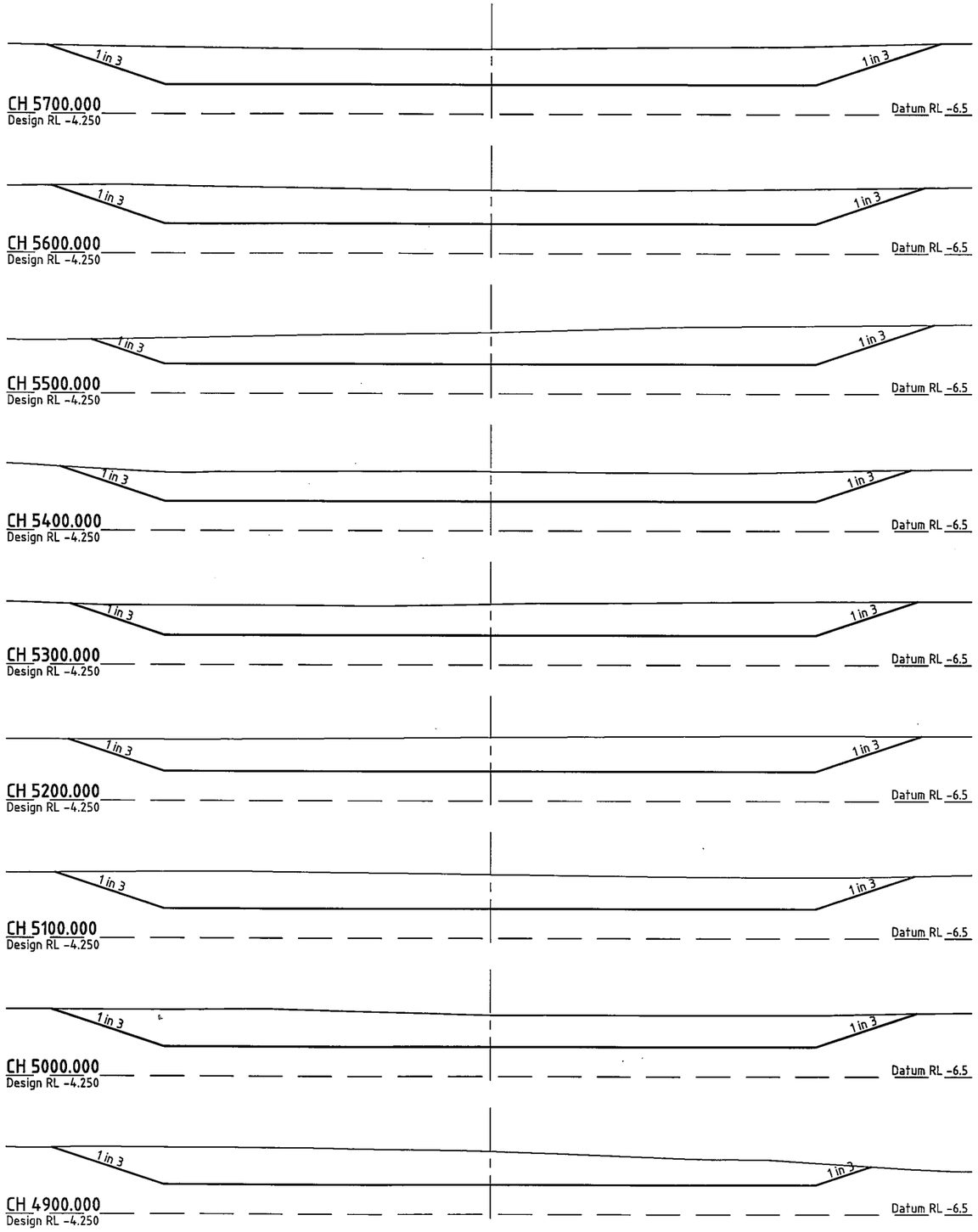
NORTH EAST BUSINESS PARK
CABOOLTURE RIVER DREDGING
CROSS SECTIONS - CH 2000.000 - CH 3900.000
SHEET 2 OF 4

DATE: 09-02-2007 Rv.
DRAWING No:
7900/33/01-115





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DRAWN: owb
CHECKED: A.M.
RECOMMENDED: PROJ. MAN.
APPROVED: PROJ. DIR.
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XREF's: X-A1-80-SHT A

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Sunshine Coast	(07) 5443 2555	(07) 5443 5542
Townsville	(07) 4772 1166	(07) 4721 2508
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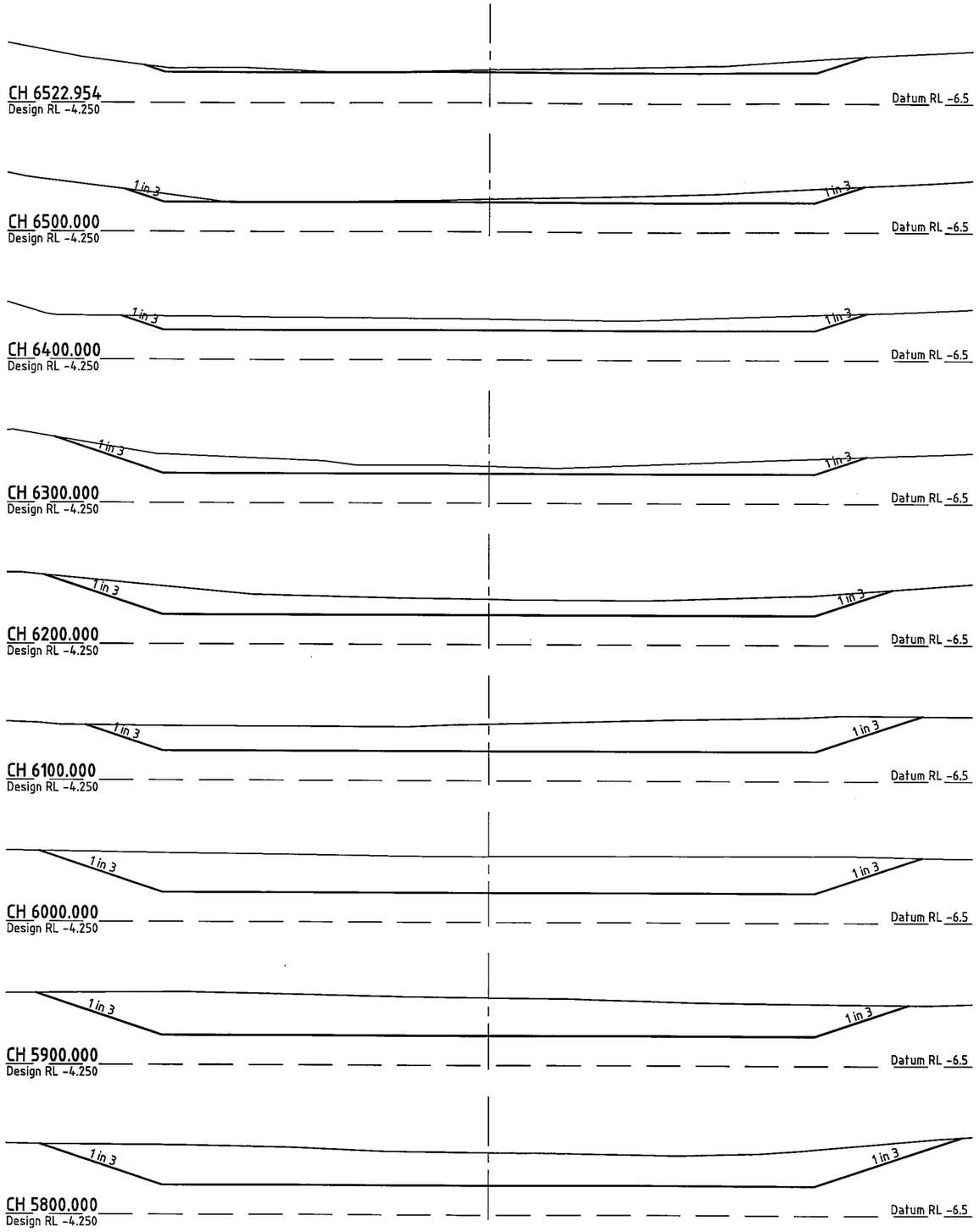
NORTH EAST BUSINESS PARK

CABOOLTURE RIVER DREDGING
CROSS SECTIONS - CH 4000.000 - CH 5700.000
SHEET 3 OF 4

DATE: 09-02-2007 Rv.
DRAWING No:
7900/33/01-116



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Rv.	DATE	REVISIONS	REC.	APPR.

DESIGNED:
DRAWN:
CHECKED:
RECOMMENDED: PROJ. MAN.
APPROVED: PROJ. DIR.

A1 DATUM: A.H.D.

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NORTH EAST BUSINESS PARK

CABOOLTURE RIVER DREDGING
CROSS SECTIONS - CH 5800.000 - CH 6522.954
SHEET 4 OF 4

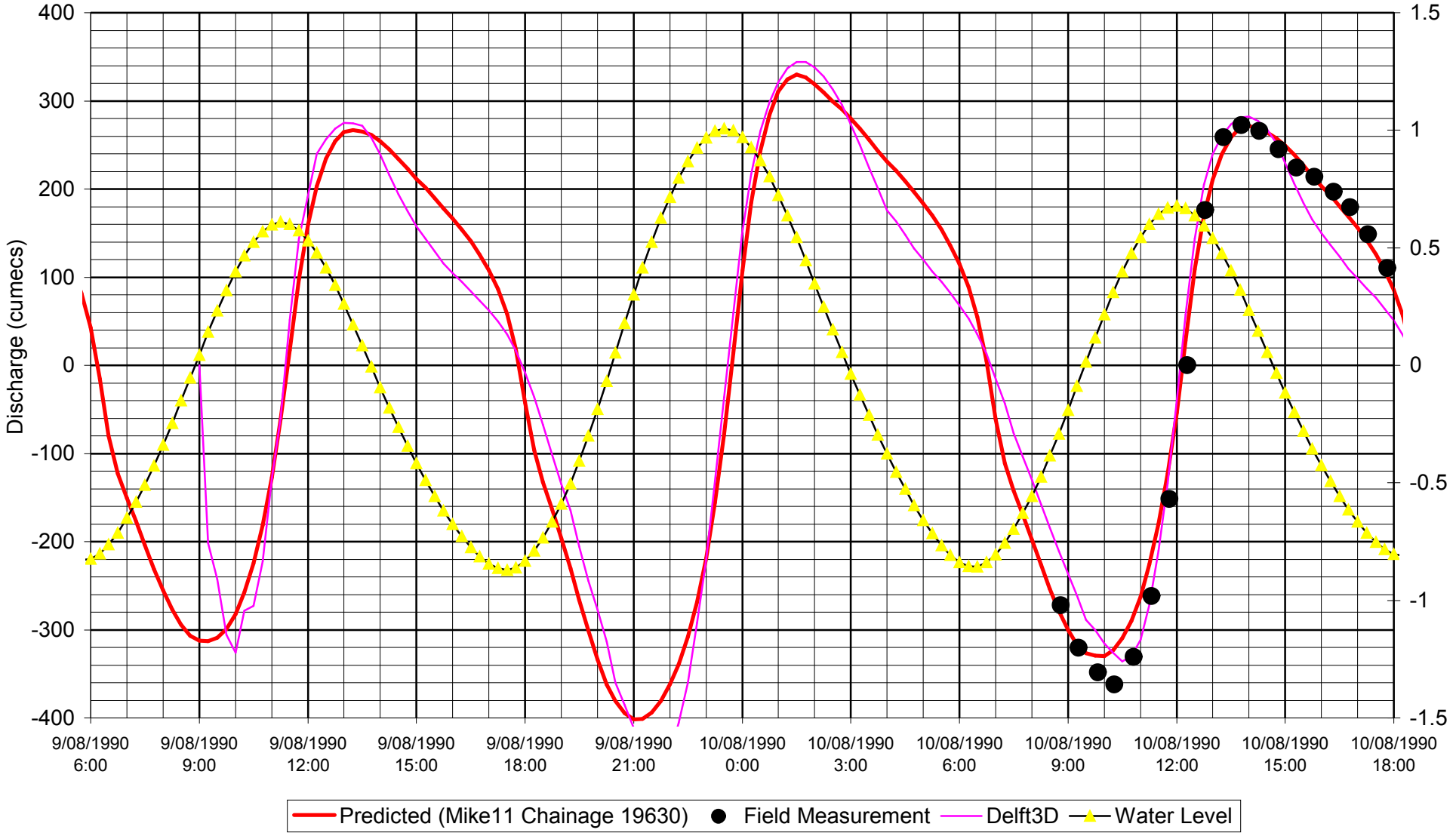
DATE: 09-02-2007
DRAWING No:
7900/33/01-117
Rv.

APPENDIX A

Hydrodynamic Model Calibration Results

Cardno Lawson Treloar

Caboolture River Tide Model Calibration
Discharge - "August 90 D/S Flow"



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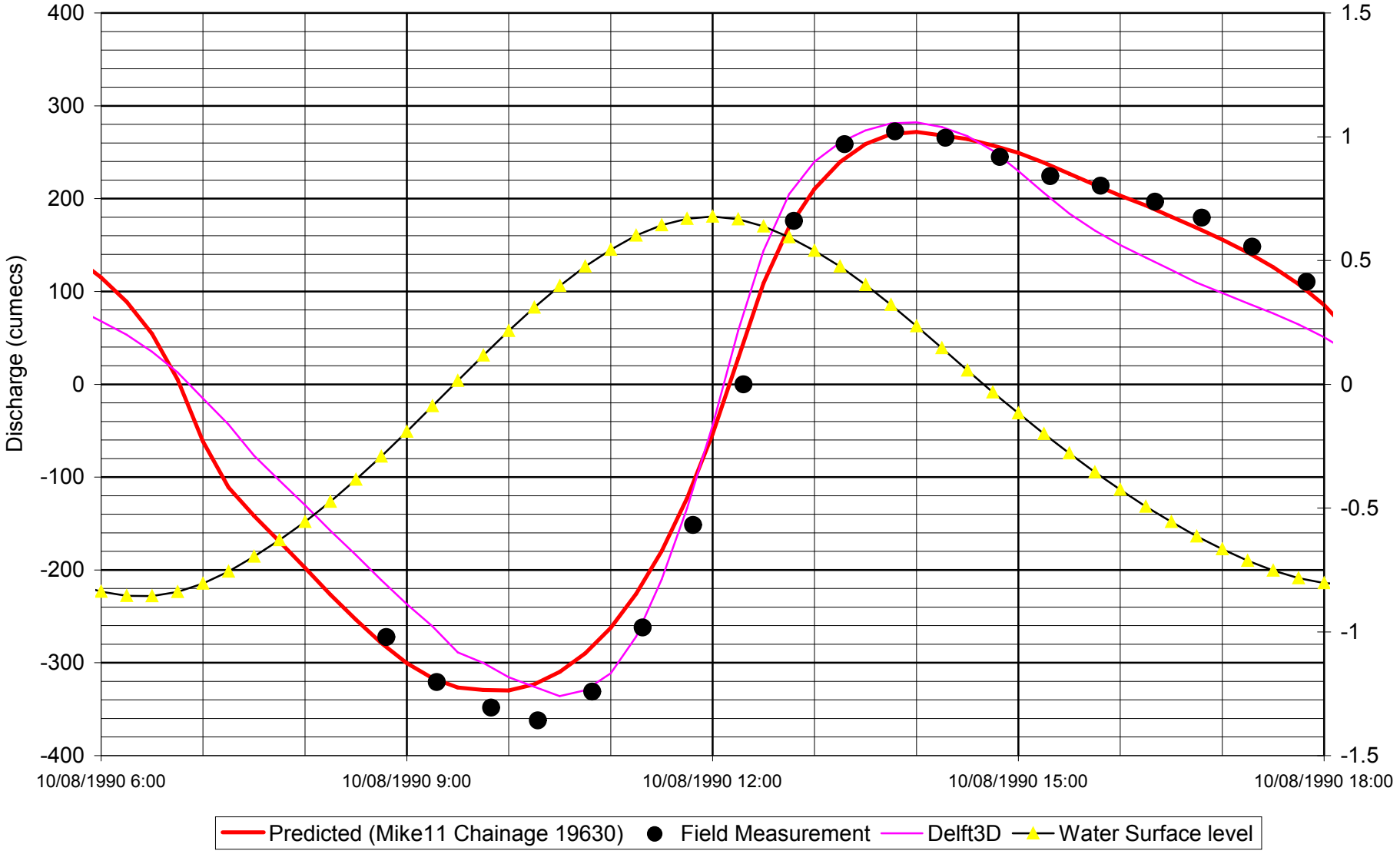
Cardno Lawson Treloar

Caboolture River Tide Model Calibration
Discharge - "August 90 D/S Flow"



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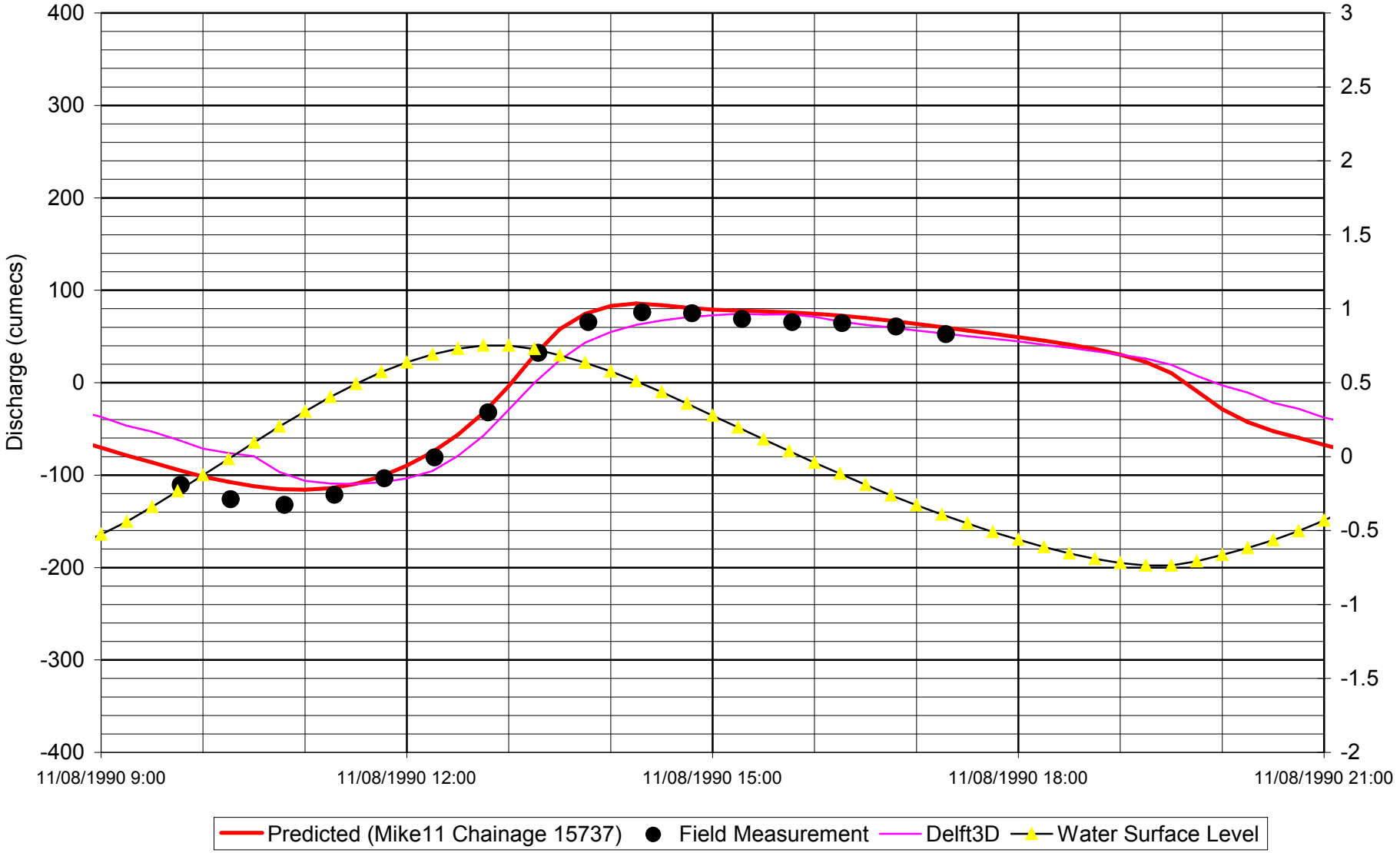
Cardno Lawson Treloar

Caboolture River Tide Model Calibration
Discharge - "August 90 U/S Flow"



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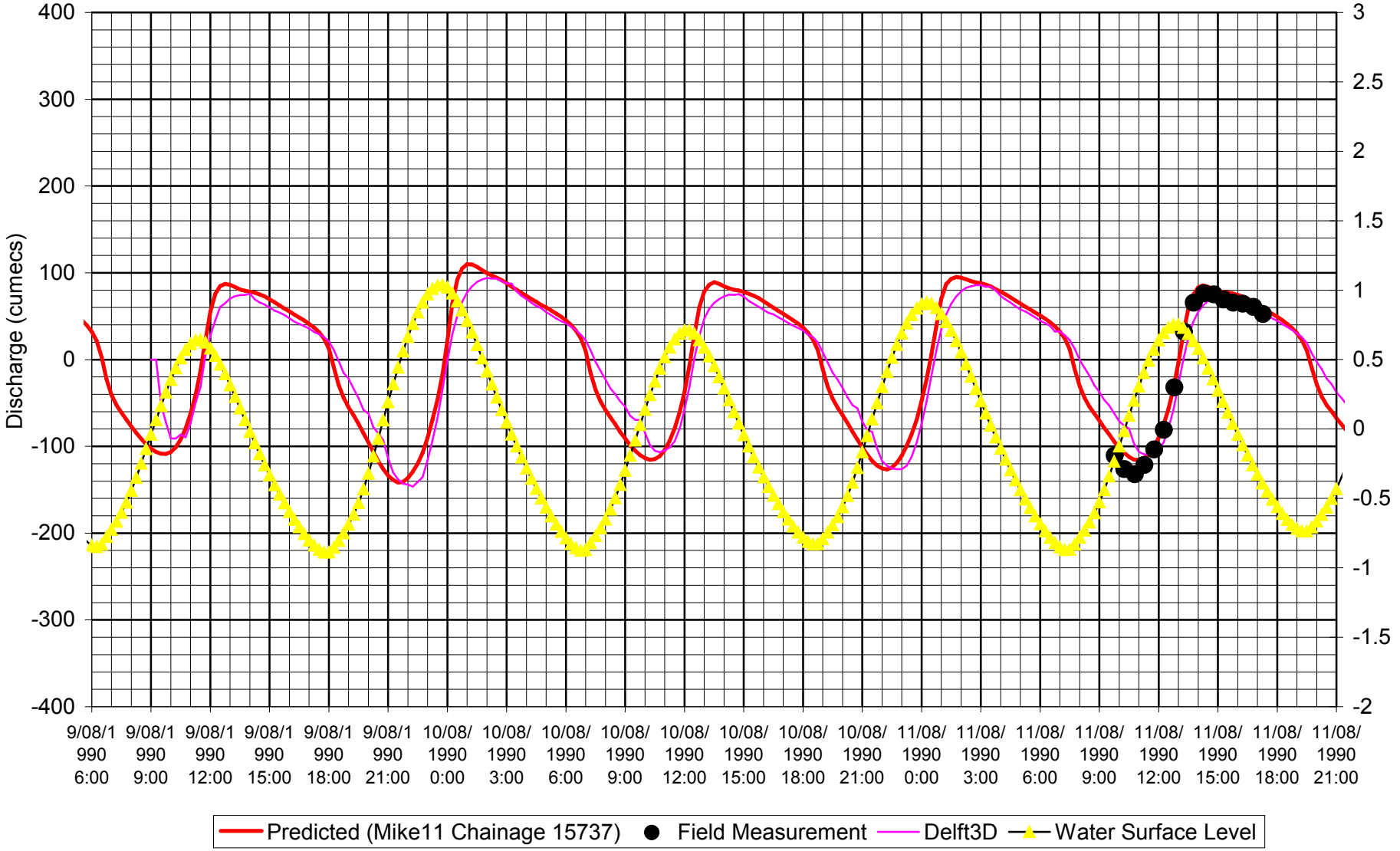
Cardno Lawson Treloar

Caboolture River Tide Model Calibration
Discharge - "August 90 U/S Flow"



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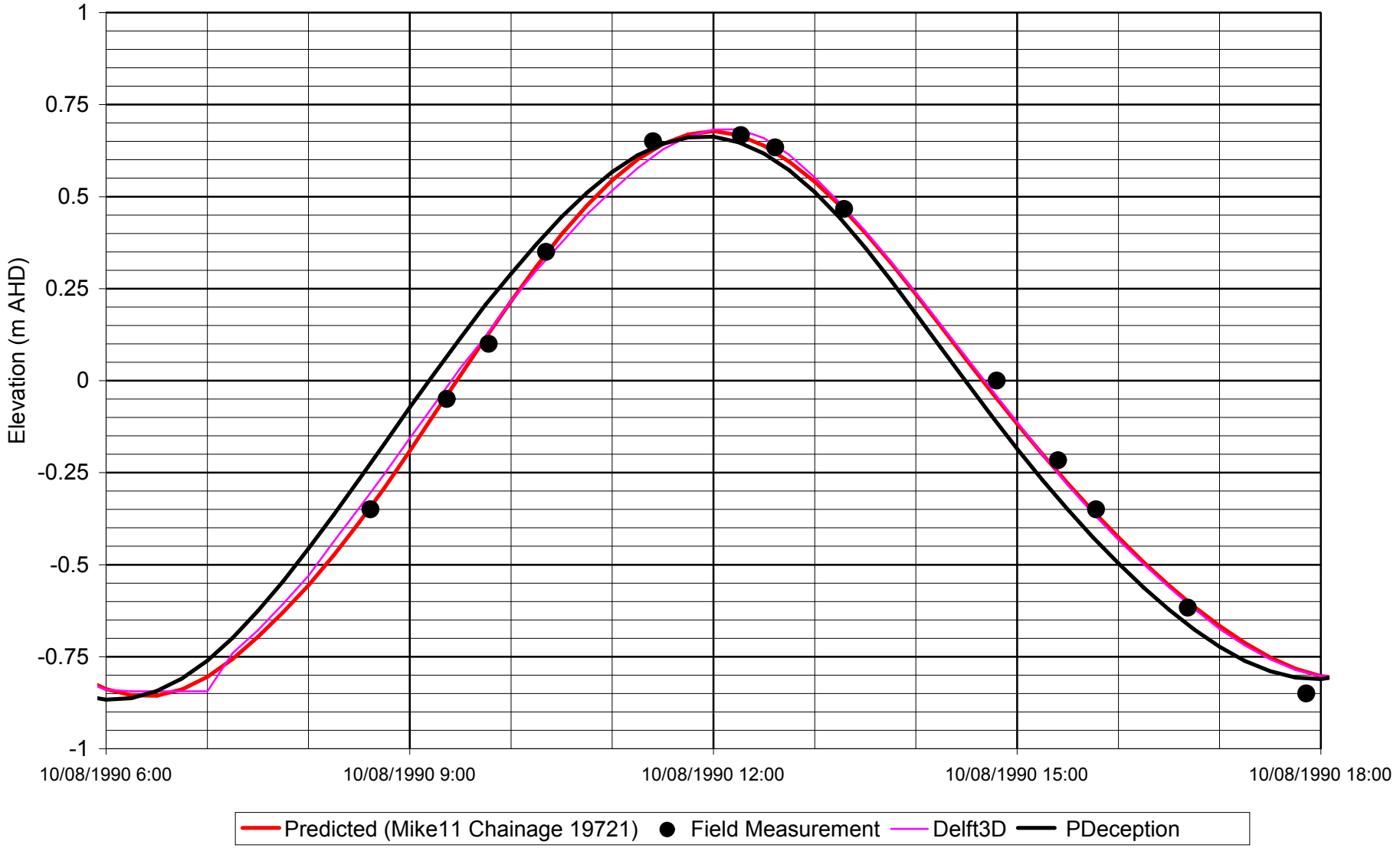
Cardno Lawson Treloar

Caboolture River Tide Model Calibration
Water Surface Level - "August 90 D/S Level"



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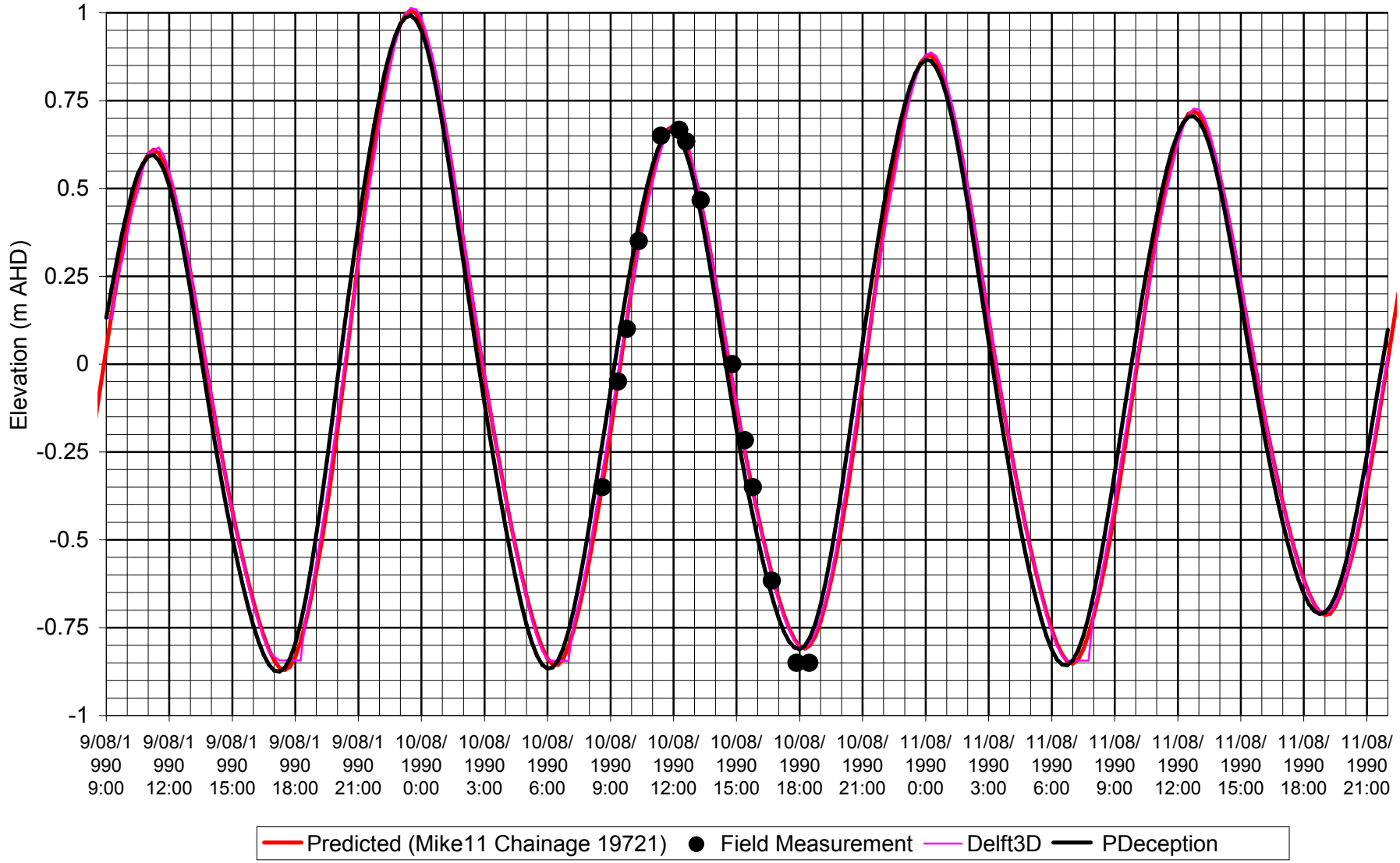
Cardno Lawson Treloar

Caboolture River Tide Model Calibration
Water Surface Level - "August 90 D/S Level"



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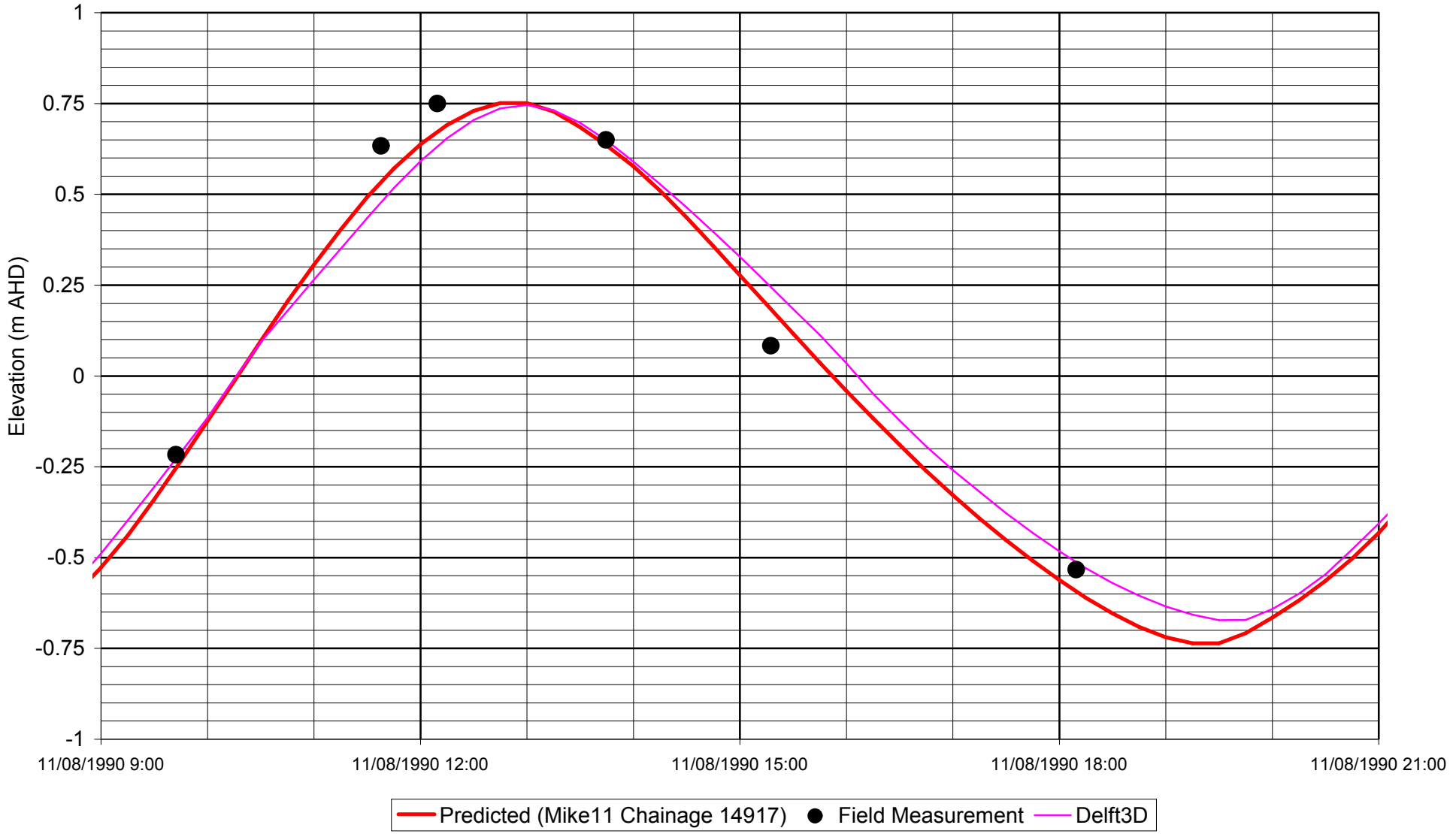
Cardno Lawson Treloar

Caboolture River Tide Model Calibration
Water Surface Level - "August 90 U/S Level"



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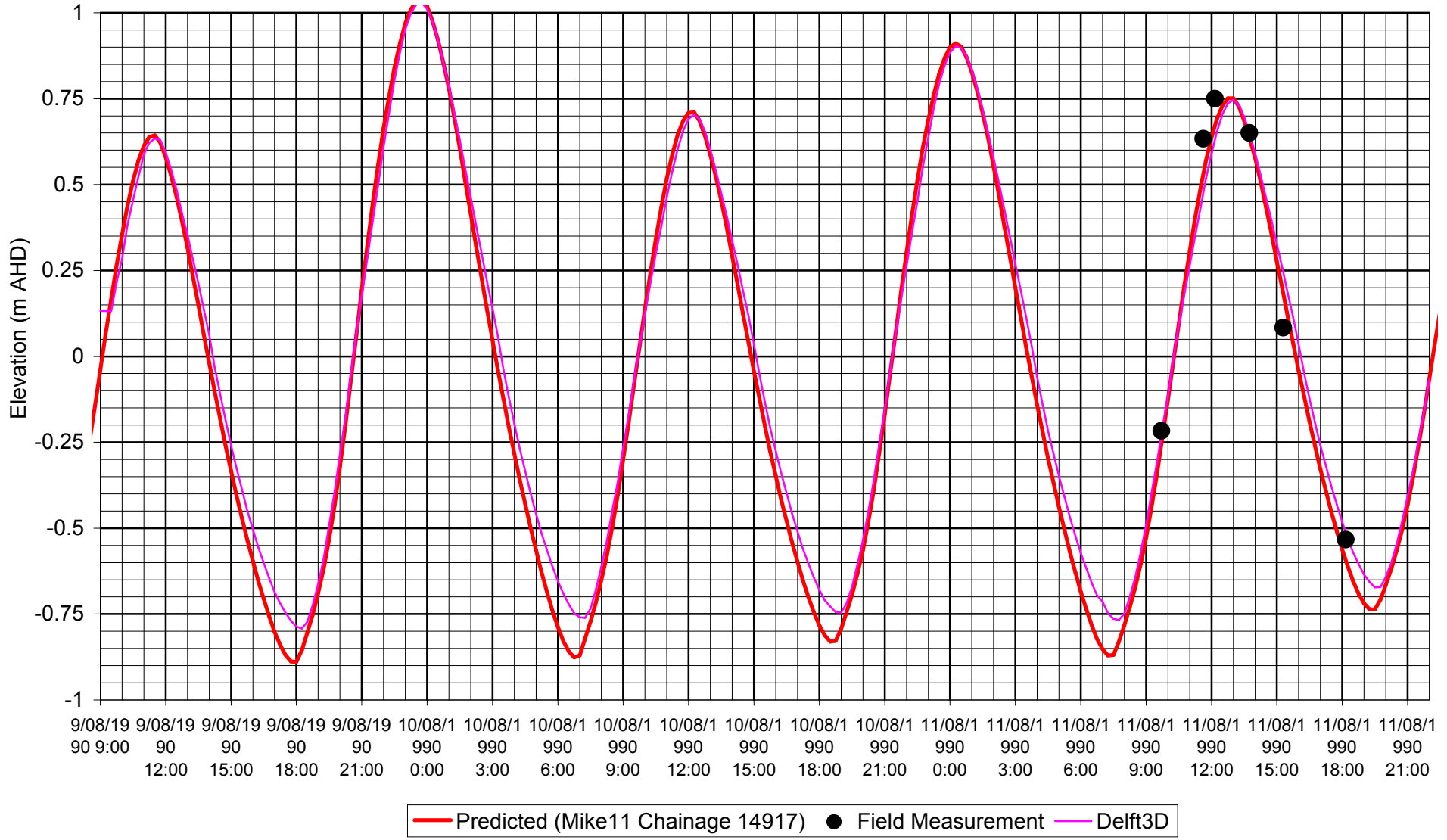
Cardno Lawson Treloar

Caboolture River Tide Model Calibration
Water Surface Level - "August 90 U/S Level"



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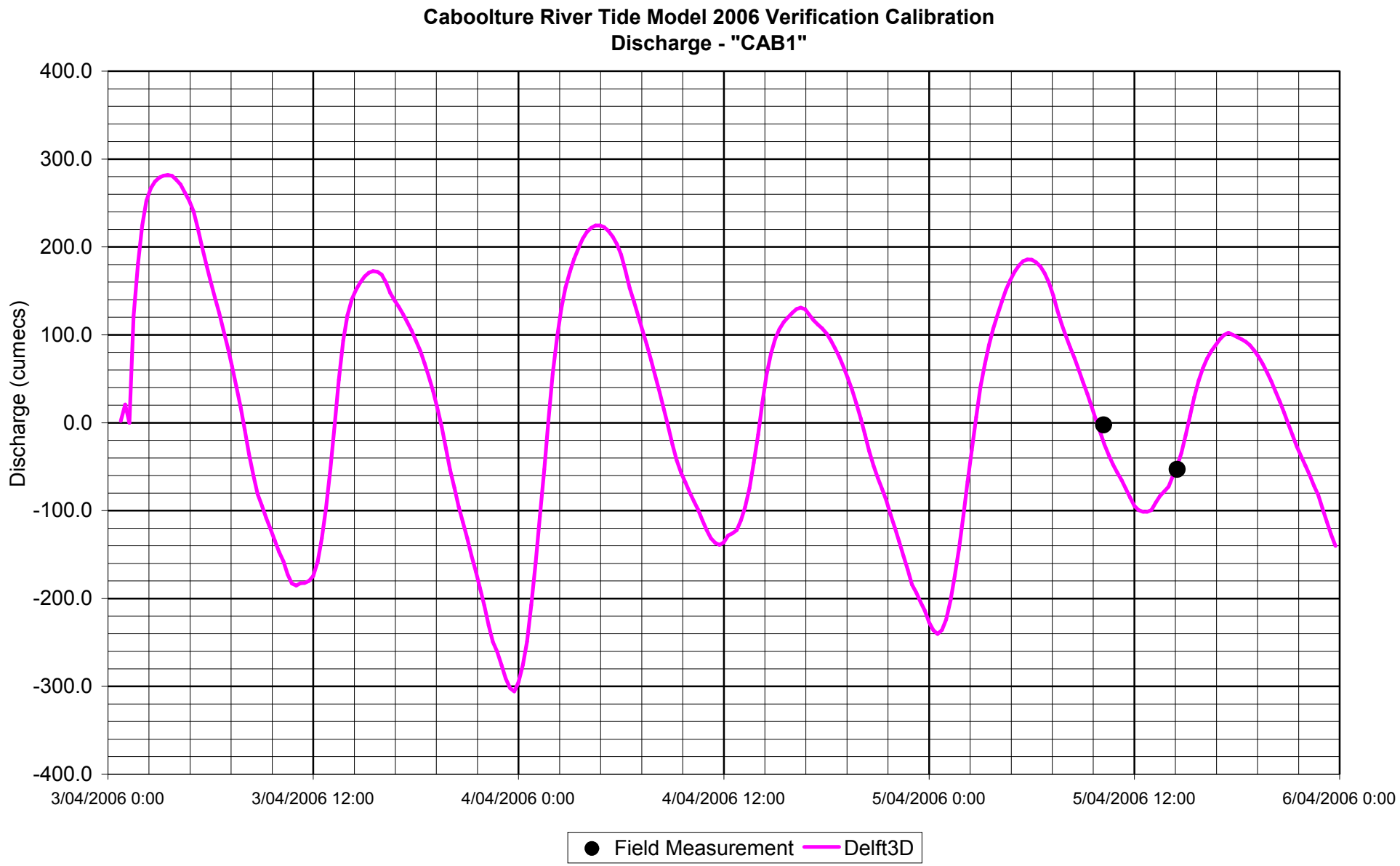
APPENDIX B

Hydrodynamic Model Validation Results



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Cardno Lawson Treloar

Caboolture River Tide Model 2006 Verification Calibration
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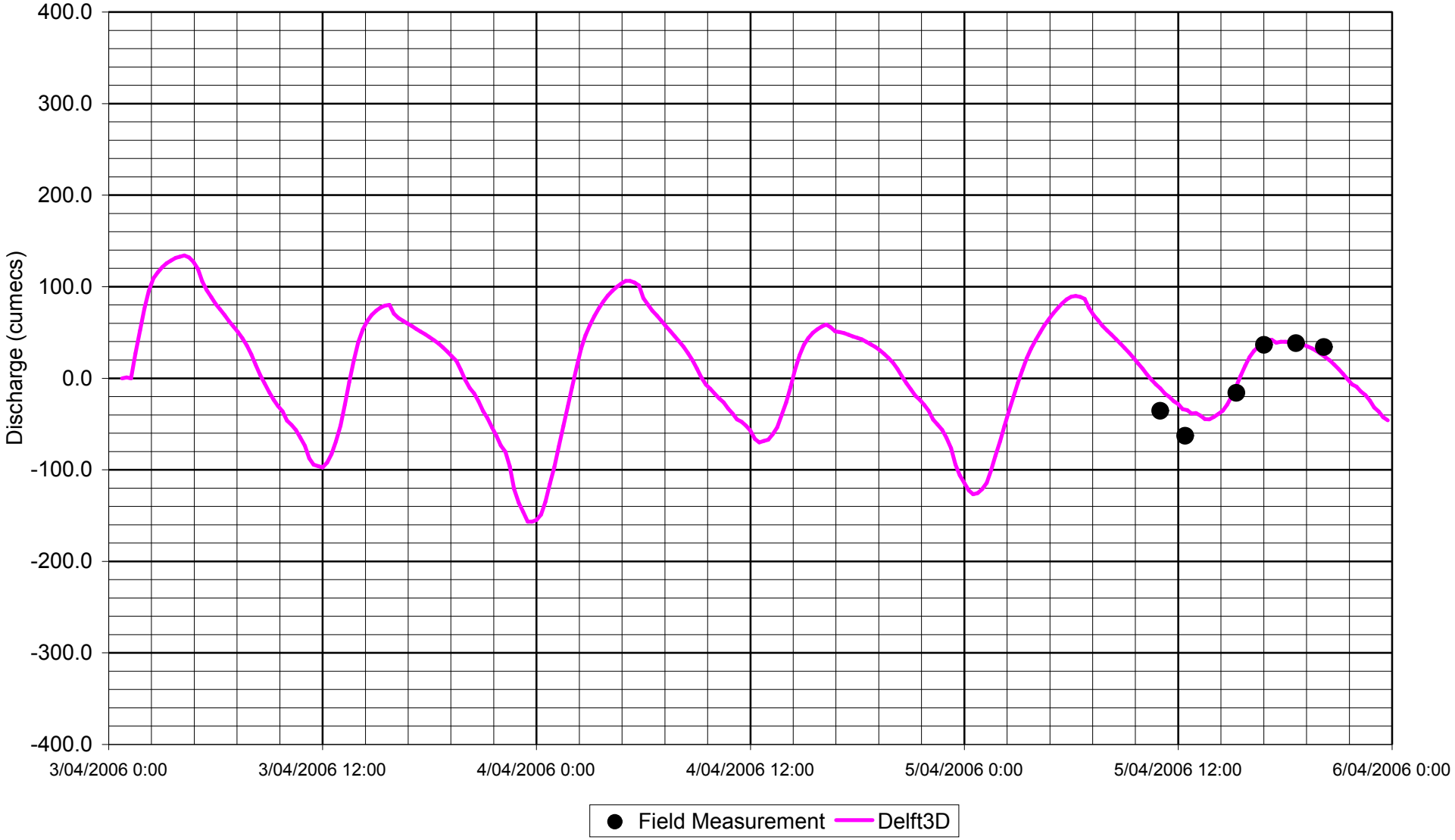

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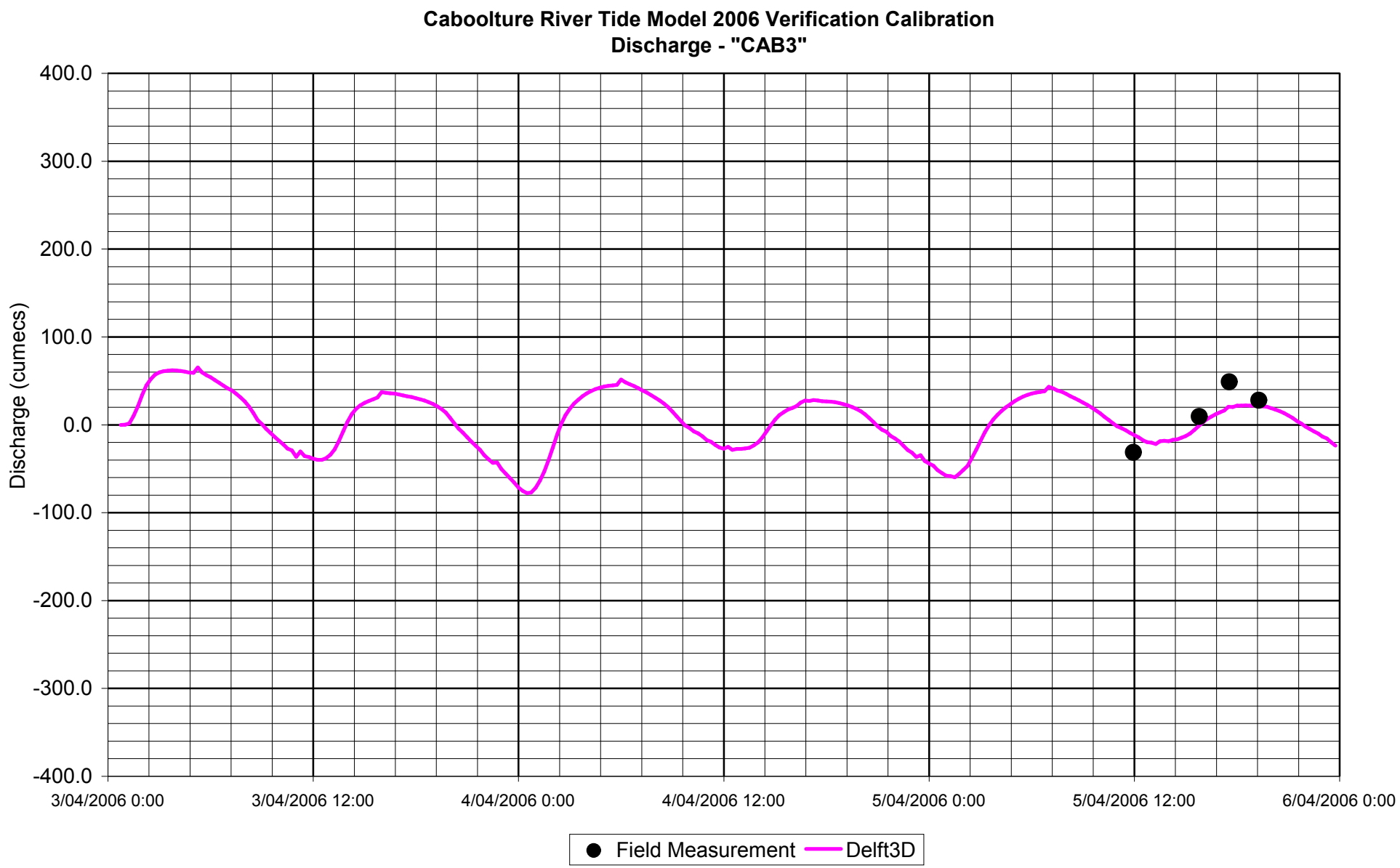
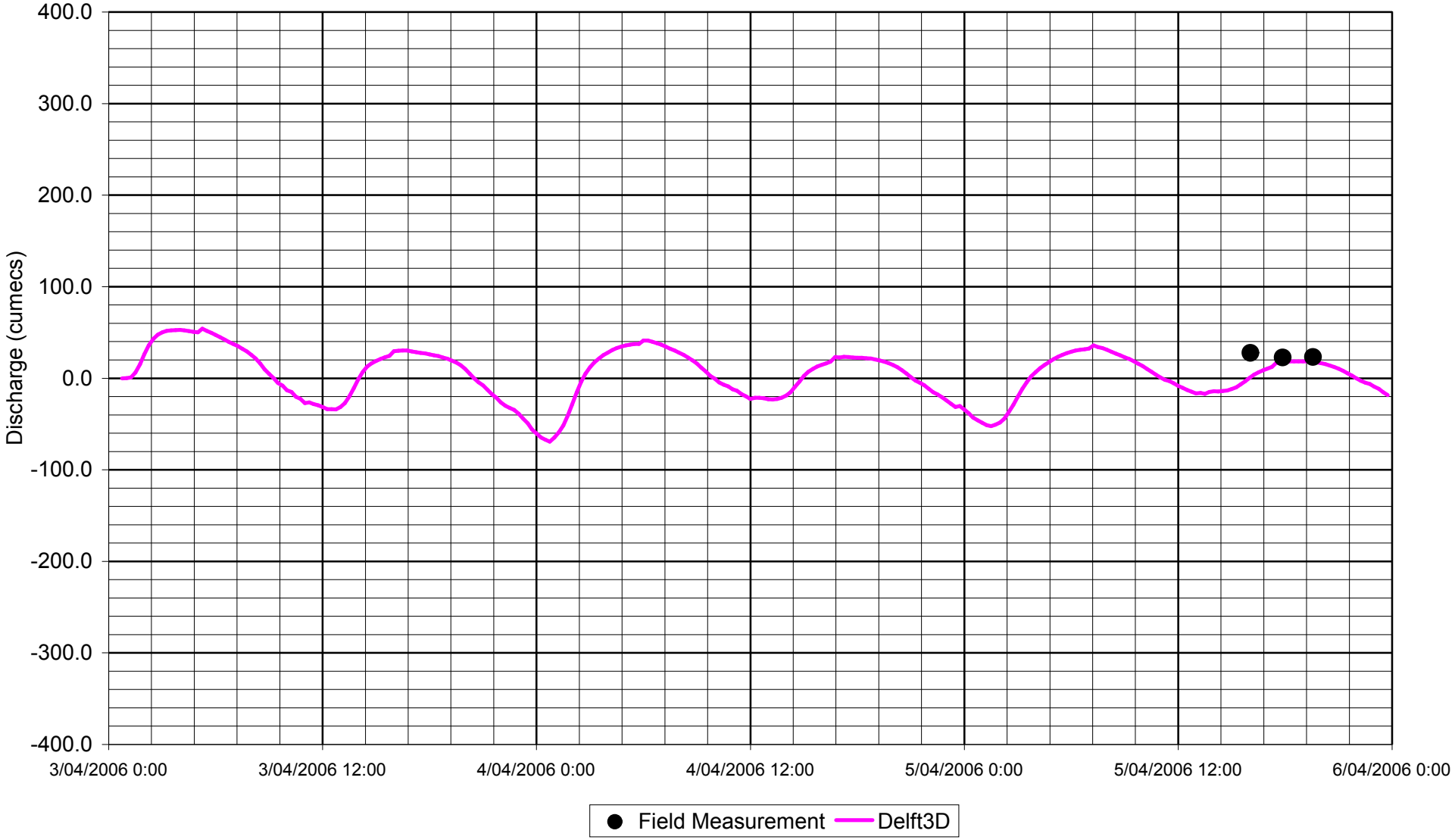

Caboolture River Tide Model 2006 Verification Calibration
Discharge - "CAB3"
Discharge (cumecs)
400.0
300.0
200.0
100.0
0.0
-100.0
-200.0
-300.0
-400.0
3/04/2006 0:00
3/04/2006 12:00
4/04/2006 0:00
4/04/2006 12:00
5/04/2006 0:00
5/04/2006 12:00
6/04/2006 0:00
Field Measurement
Delft3D

Cardno Lawson Treloar

Caboolture River Tide Model 2006 Verification Calibration
Discharge - "CAB4"



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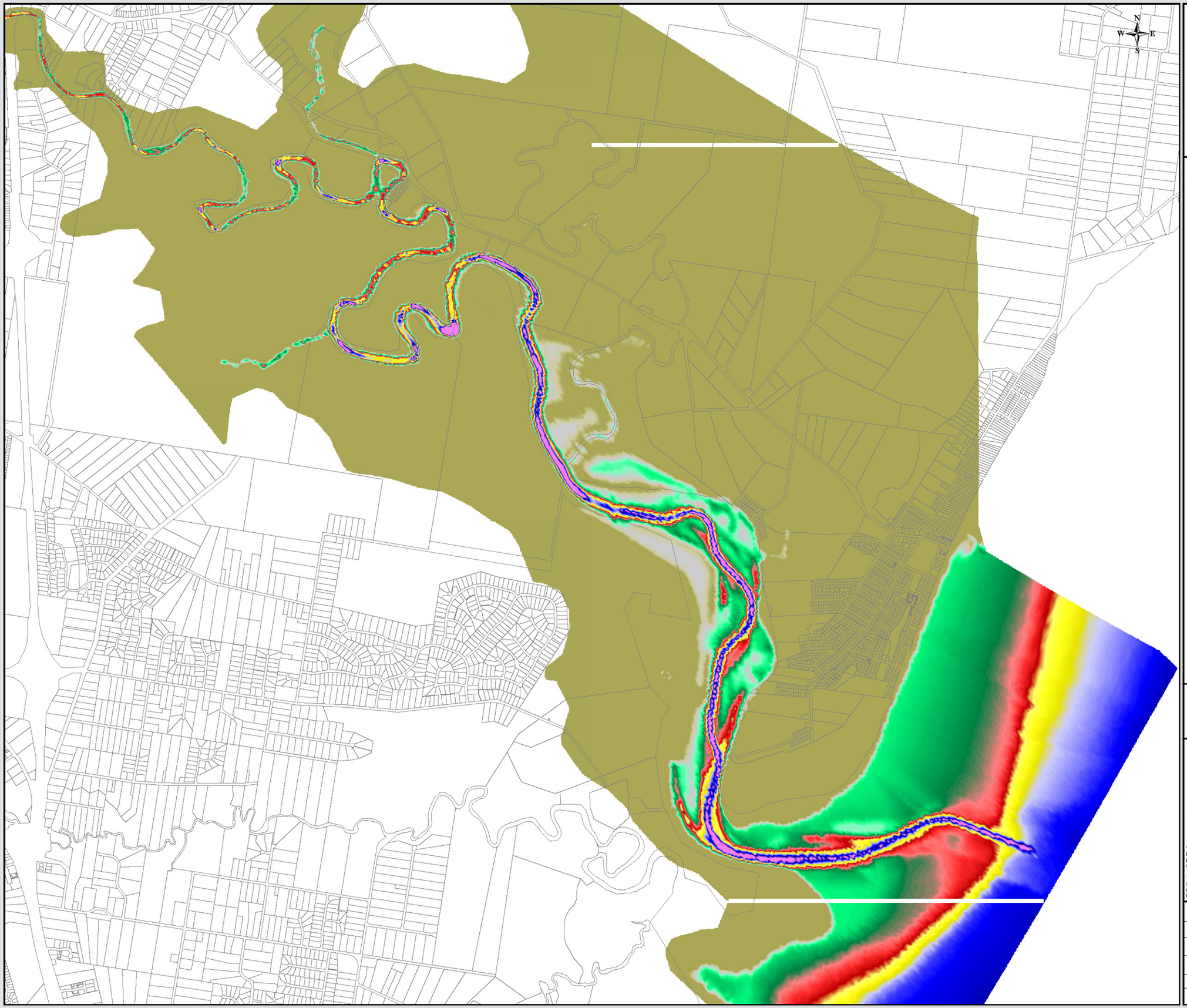
APPENDIX C

Tidal Flow Bed Changes



Predicted Bed Levels After 0 Years

LEGEND

Bed Levels (mAHD)

	-4.2500
	-4.0000
	-3.7500
	-3.5000
	-3.2500
	-3.0000
	-2.7500
	-2.5000
	-2.2500
	-2.0000
	-1.7500
	-1.5000
	-1.2500
	-1.0000
	-0.7500
	-0.5000
	-0.2500
	0.0000

300 0 300 600 900

Metres

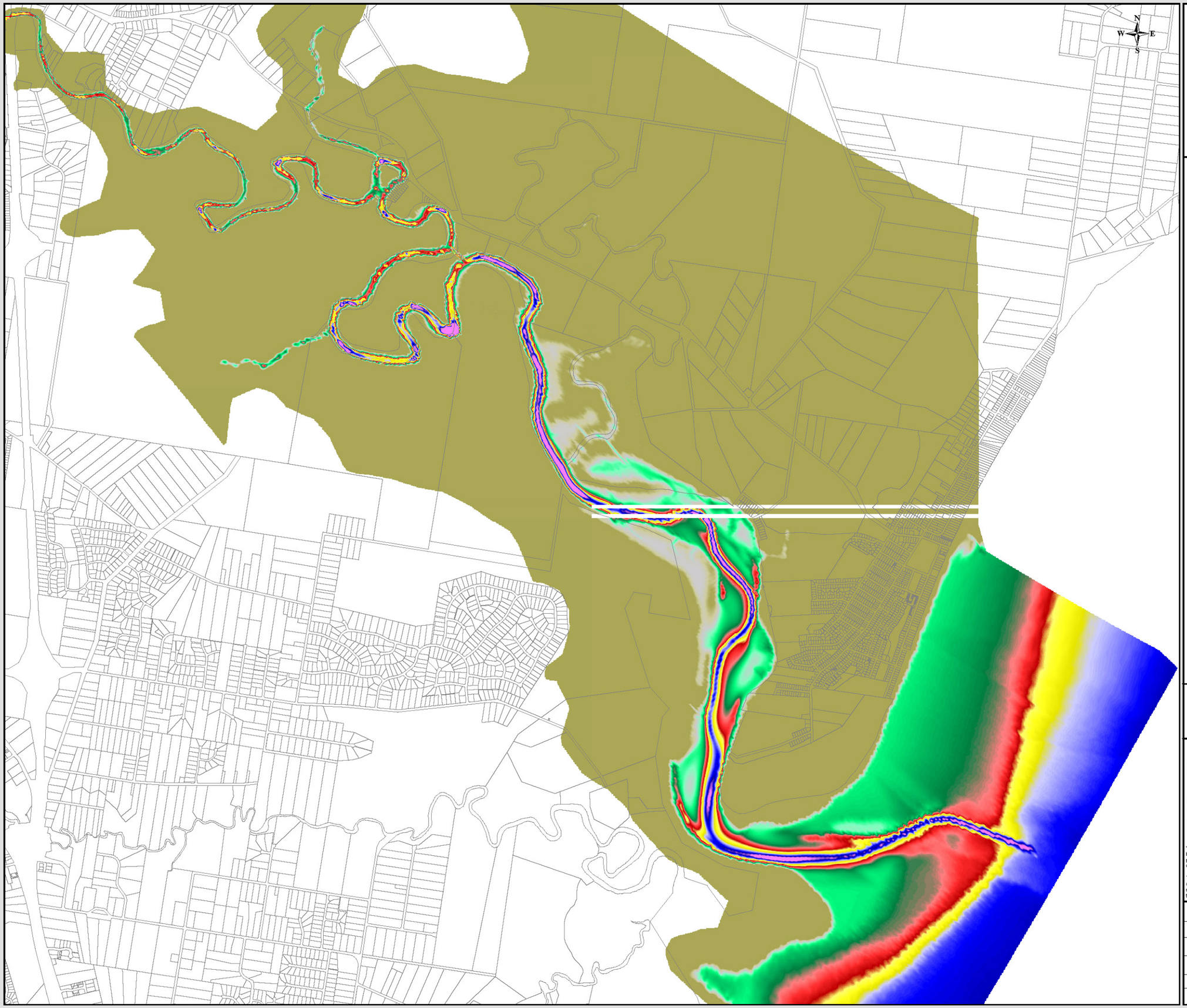
Scale: 1:30,000

Cardno
Shaping the Future

Cardno (QLD) Pty Ltd | ABN 57 051 074 992
Level 1, 5 Gardner Close Milton QLD 4064
PO Box 388, Toowong QLD 4066
Tel: 07 3369 9822 Fax: 07 3369 9722

SHEET	A3
Project No:	7900-33
Date:	05/11/07
Revision Number:	1
Designed by:	MG
Client Name:	North East Business Park

File Path: M:\2814-80\MapinfoFigures



Predicted Bed Levels After 1 Year

LEGEND

Bed Levels (mAHD)

- -4.2500
- -4.0000
- -3.7500
- -3.5000
- -3.2500
- -3.0000
- -2.7500
- -2.5000
- -2.2500
- -2.0000
- -1.7500
- -1.5000
- -1.2500
- -1.0000
- -0.7500
- -0.5000
- -0.2500
- 0.0000

300 0 300 600 900

Metres

Scale: 1:30,000

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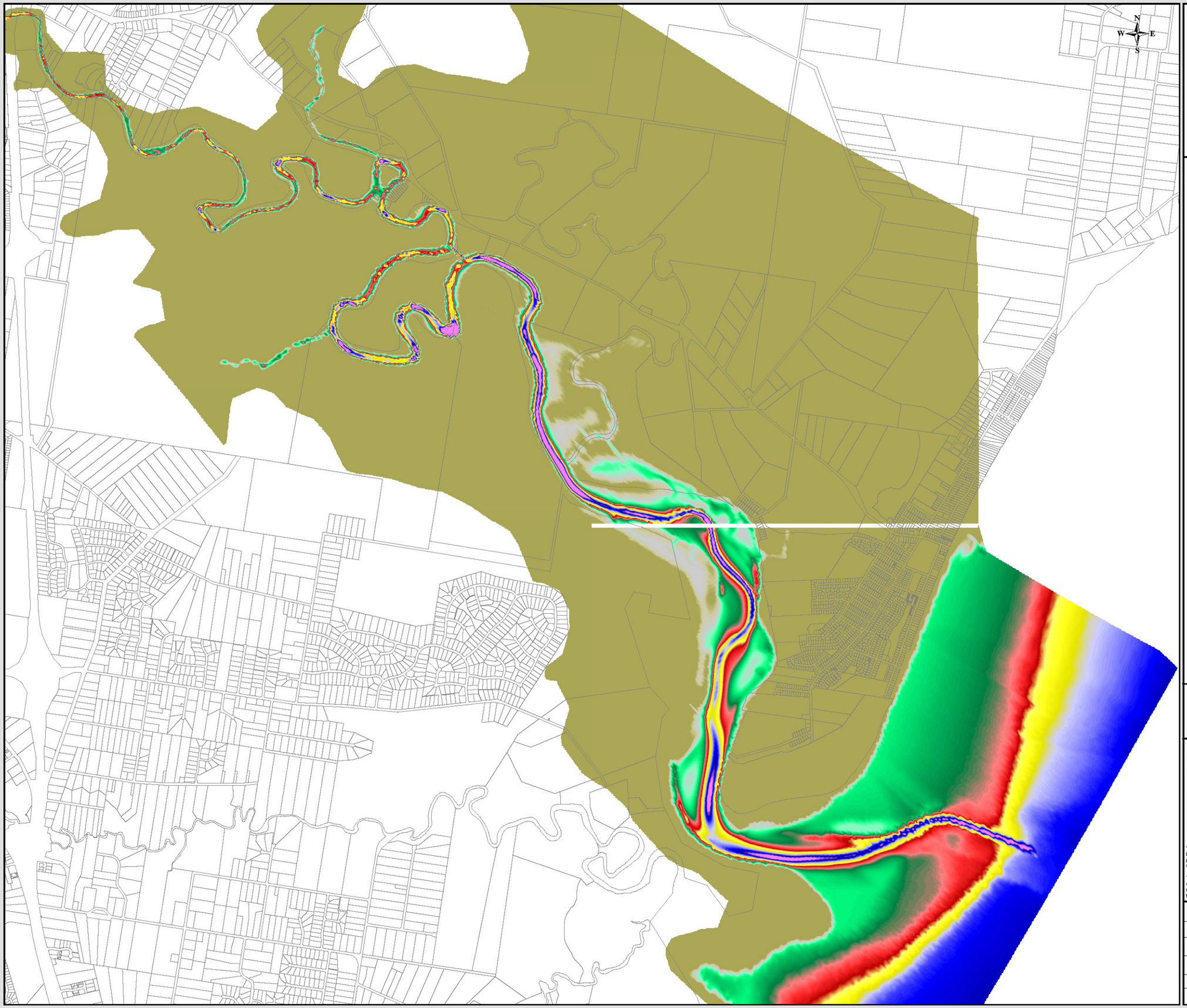
SHEET	A3
Project No:	7900-33
Date:	05/11/07
Revision Number:	1
Designed by:	MG
Client Name:	North East Business Park

File Path: M:\2814-80\MapinfoFigures



Predicted Bed Levels After 2 Years

LEGEND

Bed Levels (mAHD)

- -4.2500
- -4.0000
- -3.7500
- -3.5000
- -3.2500
- -3.0000
- -2.7500
- -2.5000
- -2.2500
- -2.0000
- -1.7500
- -1.5000
- -1.2500
- -1.0000
- -0.7500
- -0.5000
- -0.2500
- 0.0000

300 0 300 600 900

Metres

Scale: 1:30,000

Cardno
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Revision Number:	1
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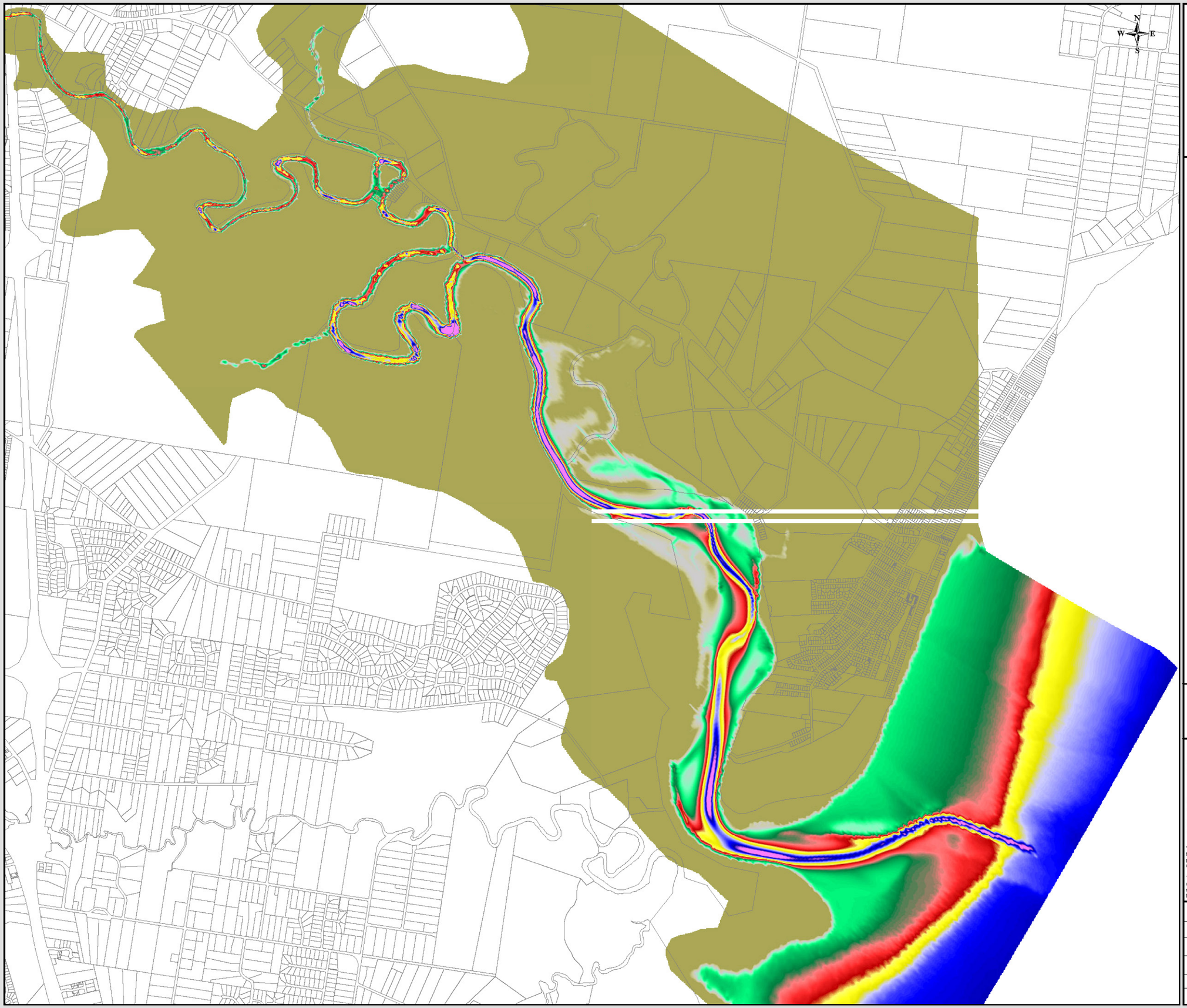
Client Name:	North East Business Park

File Path: M:\2814-80\MapinfoFigures



Predicted Bed Levels After 3 Years

LEGEND

Bed Levels (mAHD)

- -4.2500
- -4.0000
- -3.7500
- -3.5000
- -3.2500
- -3.0000
- -2.7500
- -2.5000
- -2.2500
- -2.0000
- -1.7500
- -1.5000
- -1.2500
- -1.0000
- -0.7500
- -0.5000
- -0.2500
- 0.0000

300 0 300 600 900

Metres

Scale: 1:30,000

Cardno
Shaping the Future

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Level 1, 5 Gardner Close Milton QLD 4064
PO Box 388, Toowong QLD 4066
Tel: 07 3369 9822 Fax: 07 3369 9722

SHEET	**A3**
Project No:	**7900-33**
Date:	**05/11/07**
Revision Number:	**1**
Designed by:	**MG**
Client Name:	**North East Business Park**

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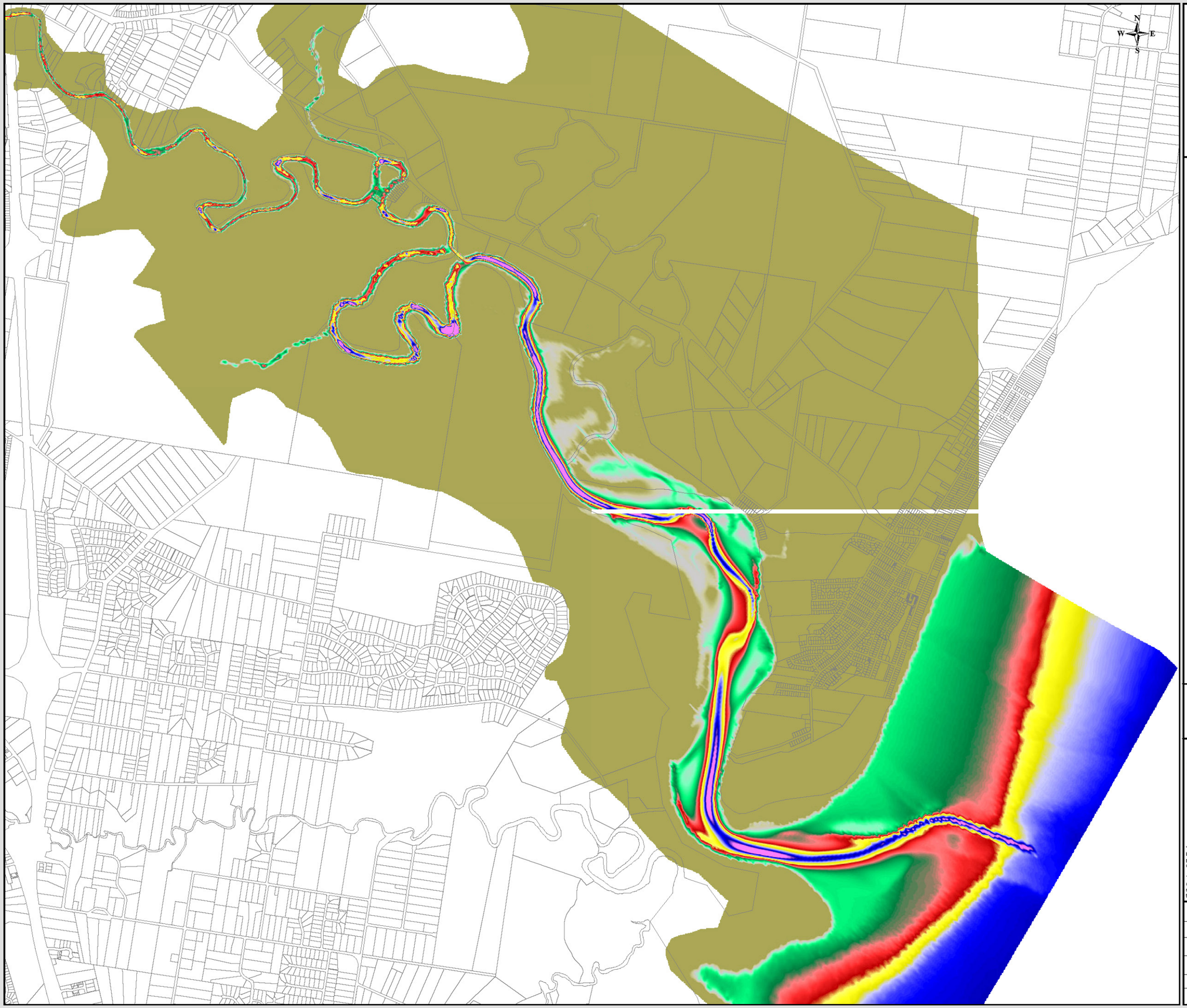

Predicted Bed Levels After 4 Year

LEGEND

Bed Levels (mAHD)

- -4.2500
- -4.0000
- -3.7500
- -3.5000
- -3.2500
- -3.0000
- -2.7500
- -2.5000
- -2.2500
- -2.0000
- -1.7500
- -1.5000
- -1.2500
- -1.0000
- -0.7500
- -0.5000
- -0.2500
- 0.0000

300 0 300 600 900

Metres

Scale: 1:30,000

Cardno
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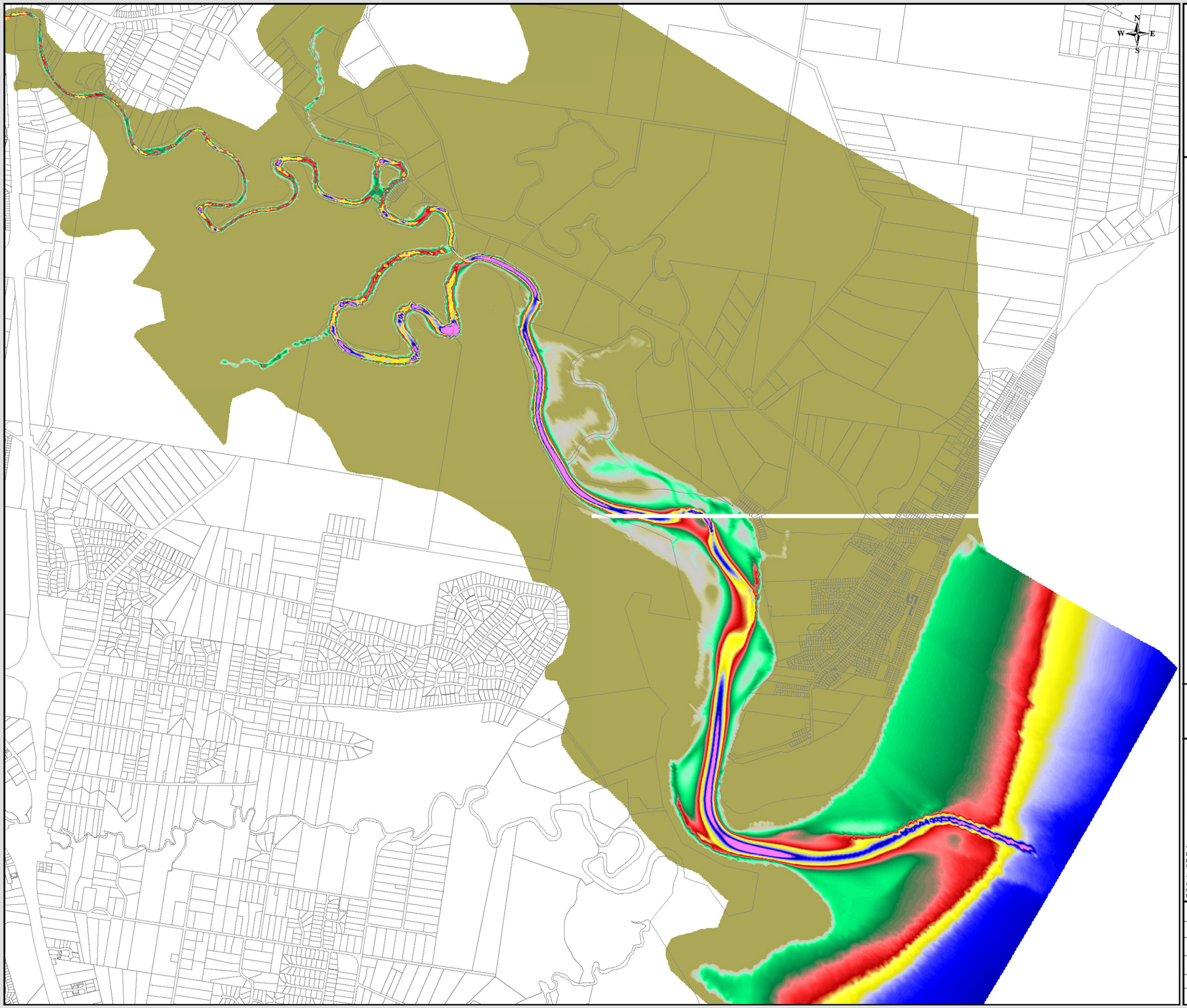
Tel: 07 3369 9822 Fax: 07 3369 9722

SHEET	A3
Project No:	7900-33
Date:	05/11/07
Revision Number:	1
Designed by:	MG
Client Name:	North East Business Park

File Path: M:\2814-80\MapinfoFigures



Predicted Bed Levels After 5 Year

LEGEND

Bed Levels (mAHD)

- -4.2500
- -4.0000
- -3.7500
- -3.5000
- -3.2500
- -3.0000
- -2.7500
- -2.5000
- -2.2500
- -2.0000
- -1.7500
- -1.5000
- -1.2500
- -1.0000
- -0.7500
- -0.5000
- -0.2500
- 0.0000

300 0 300 600 900

Metres

Scale: 1:30,000

Cardno
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SHEET	A3
Project No:	7900-33
Date:	05/11/07
Revision Number:	1
Designed by:	MG
Client Name:	North East Business Park

File Path: M:\2814-80\MapinfoFigures