Townsville

TOWNSVILLE CITY COUNCIL

NORTH WARD FLOOD STUDY
BASE-LINE FLOODING ASSESSMENT

OCTOBER 2011

Flood Report

103 WALKER STREET, TOWNSVILLE QLD 4810 ▪ PO BOX 1268, TOWNSVILLE QLD 4817

The flood modelling contained in this report does not in itself indicate whether any particular property has or has not been affected by floods.

The council considers that the information presented in the report is the best available at the time of the report's preparation. However the modelling contained in this report is based upon projections, assumptions and analysis about circumstances that may not eventuate, or may eventuate in different combinations and with different outcomes.

Because of that, the information in the report is not provided with the intention that persons will rely upon its accuracy or completeness for the purpose of making decisions with financial or legal implications. Neither the council nor its officers will be liable in contract, negligence or otherwise for the consequences of any deficiency, inaccuracy or error in the report or for the consequences of any person relying upon the report.

Quality Information

Prepared for:

Information

Prepared by:

Jared Johnston

Document	TOWNSVILLE CITY COUNCIL
DW ID	s:\infrastructure planning\stormwater-flooding\projects\townsville flood constraints map\reports\northward\north ward baseline report final.doc
Date	20/09/2011

Revision History

Revision	Revision Date	Details	Reviewer	
			Name/Position	Signature
A	May 2011	Draft for internal comment	Wesley Bailey	
B	October 2011	Final for release	Wesley Bailey	

Townsville City Council
ABN 44 741 992 072
103 Walker Street
Townsville QLD 4810
PO BOX 1268
Townsville QLD 4810

Telephone: 4727 9000
Facsimile: 4727 9050
Email: enquiries@townsville.qld.gov.au

Table of Contents

Executive Summary

The *North Ward Flood Study – Baseline Flooding Assessment* has been undertaken as part of Townsville City Council's City Wide Flood Constraints Project. The project seeks to develop up to date flood models for the city of Townsville at scales suitable for:

- defining flood levels for most urban properties;
- identifying the flood hazard overlay for the planning scheme;
- evaluating recent and future flood mitigation projects; and
- assisting the disaster management process.

The newly developed flood model for North Ward was undertaken using XP-RAFTS, a hydrologic runoff routing model, and MIKE FLOOD, a combined 1D and 2D hydraulic model. The model incorporates North Ward's catchments, underground stormwater system, natural open channels, open drains, road kerb and channel, and flood plains. The critical storm duration for the study area was determined to be either 1 or 1.5 hours for most locations.

This study identifies water levels, depths, and flooding extent for storm Average Recurrence Intervals from 2 year to the Probable Maximum Flood. The flooding has been assessed on the basis of the confirmed land uses within the study area.

The results of the model confirmed problematic areas that were already known to Council. The area around Howitt and Rose Streets was demonstrated to be significantly affected by flooding and is unlikely to have a low cost solution.

The model was used to demonstrate significant improvements in the Mitchell Street area due to recent mitigation works. The model shows water depth improvements of over 200mm and time of inundation improvements in the order of several hours. The area is still a flooding problem though and providing full flood immunity will be quite costly.

Flood hazard maps have been developed to assist with floodplain planning. They show hazardous zones that develop in the 50, 100, and 500 Year ARI storms, and in the Probable Maximum Flood. A road closure analysis has also been completed. It shows that Heatleys Parade is an area of concern for evacuation as a 10 year ARI event will close the road, cutting access to Rowes Bay and Pallarenda.

An assessment of the impact of climate change on flooding has been completed. The analysis assumed a sea level rise of 0.88m by 2100, as specified by *Queensland Coastal Plan*. The effect of an increased sea level due to climate change is most evident in more frequent, less intense storms. The rise in flood levels is only significant around the Rose Street area. The effect of an increase in existing Average Recurrence Interval storm intensities has not been assessed.

Glossary

AEP	Annual Exceedance Probability
ARI	Average Recurrence Interval
ARR	Australian Rainfall and Runoff (1998)
AusIFD	A program to calculate average rainfall intensities and temporal patterns within Australia
DEM	Digital Elevation Model
DFE	Defined Flood Event
GSDM	General Short Duration Method – A method of calculating Probable Maximum Precipitation
GSS	Geospatial Solutions Unit
HAT	Highest Astronomical Tide - The highest level of water which can be predicted to occur under any combination of astronomical conditions.
HEC-RAS	Steady State One Dimensional Hydraulic Model
IFD	Intensity Frequency Distribution
LiDAR	Light Detection and Ranging (Aerial Laser Survey)
MHWS	Mean High Water Springs - The average height of the high waters of spring tides
MIKE11	Fully Dynamic One Dimensional Hydraulic Model
MIKE21	Fully Dynamic Two Dimensional Hydraulic Model
MIKE FLOOD	Fully Dynamic Coupled One & Two Dimensional Hydraulic Model
MLWS	Mean Low Water Springs
NWFS	North Ward Flood Study
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
QUDM	Queensland Urban Drainage Manual
Spring Tides	The tide that rises highest and falls lowest from the mean sea level within a lunar cycle.
TFHAS	Townsville Flood Hazard Assessment Study
XP-RAFTS	An urban and rural runoff routing application

1.0 Introduction

1.1 Overview

The *North Ward Flood Study – Baseline Flooding Assessment* has been undertaken as part of Townsville City Council's City Wide Flood Constraints Project. The project seeks to develop up to date flood models for the city of Townsville at scales suitable for:

- defining flood levels for most urban properties;
- identifying the flood hazard overlay for the planning scheme;
- evaluating recent and future flood mitigation projects; and
- assisting the disaster management process.

This study incorporates, recent works at Mitchell Street, the latest Light Detection and Ranging (LiDAR) topographic data, as well as recent infrastructure survey to develop up to date hydrologic and hydraulic flood models for North Ward.

1.2 Study Area

The North Ward study covers some of the oldest and most valuable areas of Townsville including the iconic landmarks of The Strand, and Castel Hill. The catchment also contains over 1500 residential properties, the older of which are particularly flood prone.

North Ward is a series of standalone catchments; it has no significant inflows from other catchments with all outflows directly into Cleveland Bay. The outlets of the North Ward subcatchments are in the following areas:

- Soroptimist Park
- Marshall Street
- Ryan Street
- Howitt Street
- Stuart Street
- Kennedy Street
- Gregory Street
- Fryer Street

The size of the catchment is quite small relative to other catchments in Townsville, having a total area of only 414 Ha. The North Ward catchment is almost fully developed to its potential. The only undeveloped areas left are located in the higher parts of Castle Hill, which are the headwaters of the catchment. Along with the fact that Castle Hill is designated Green Space by council, the undeveloped areas are very steep making further development unlikely. An increase in fraction impervious within the North Ward study area in the short to medium term is unlikely.

Figure 1.2.1 show the North Ward Study Area

TOWNSVILLE CITY COUNCIL
NORTH WARD
STUDY AREA

LEGEND

2009 Contours

Elevation [m]

- -0.5 - 0
- 0 - 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.5
- 2.5 - 3
- 3 - 3.5
- 3.5 - 4
- 4 - 4.5
- 4.5 - 5

390 195 0
Meters

SCALE: 1:12,000 @ A3

Strategic Planning Department
PLANNING AND DEVELOPMENT

DATE: 14/03/2011
DRAWN BY: JAJ
DIGITAL FILE: mxd

Figure 1.2.1:
Study Area

1.3 Scope of Works

The scope of works for this *Baseline Flooding Assessment* includes:

- review of previous engineering reports and data;
- collation of relevant data including rainfall, construction drawings, and topographic survey;
- identification of a suitable approach for hydrologic and hydraulic modelling;
- development and calibration of hydrologic and hydraulic models; and
- identification of the base-line flooding issues for North Ward.

1.4 Study Approach

The flood model is the key tool used in completing a flood study. It is used to numerically simulate flooding to create flood maps, determine velocities, determine road closures, assess mitigation options, and classify the flood immunity of properties and structures. No interaction with other study areas of the City Wide Flood Constrains Project has been considered.

XP-RAFTS is the hydrologic model used to determine inflows into the hydraulic models.

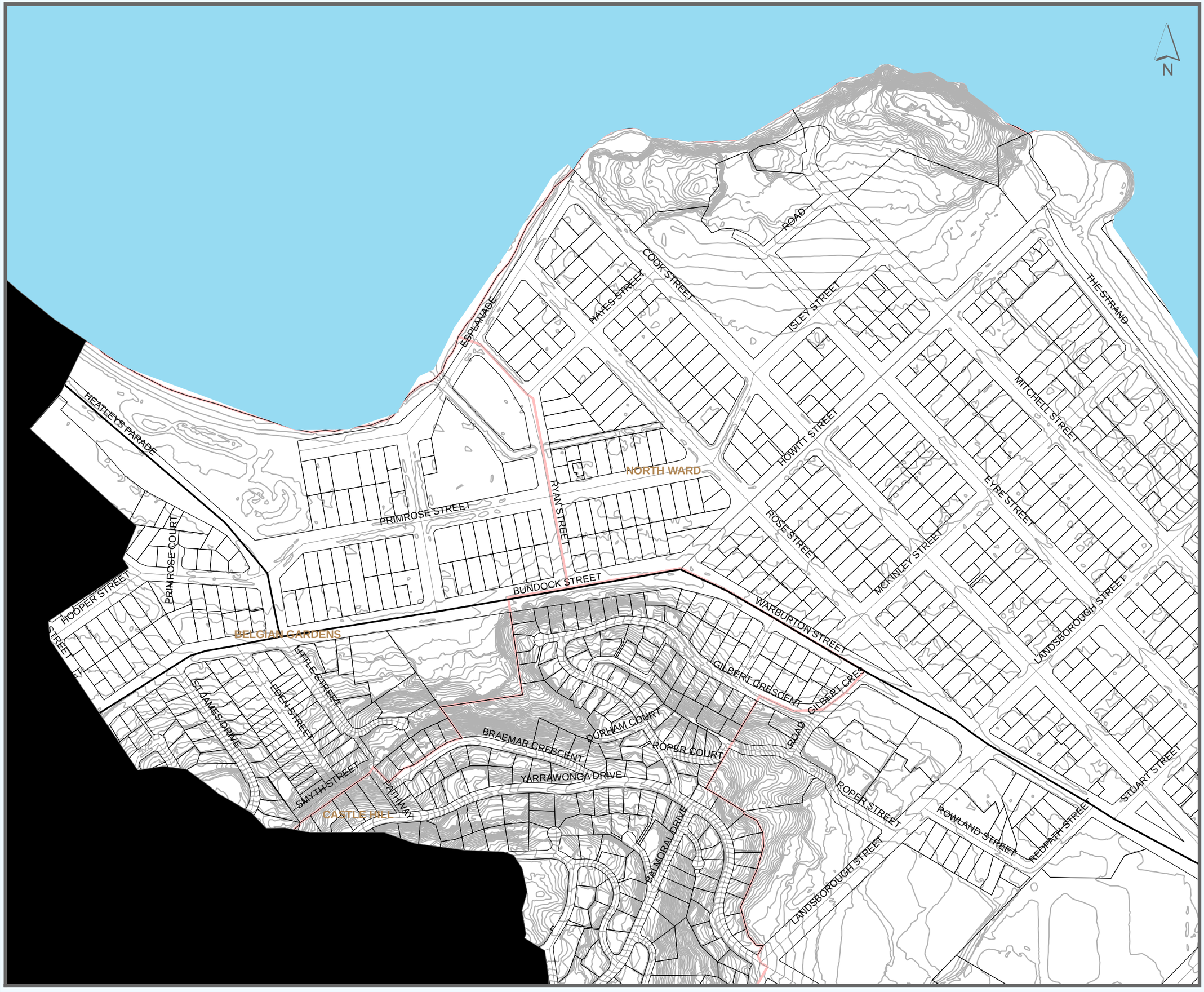
The MIKE FLOOD hydraulic model uses input from the hydrologic model and the available data listed in chapter 2. It provides results as areas of inundation, water depth, surface elevation, and velocity. These results are then used to make the conclusions listed above. To ensure the accuracy of the model, historic events are run through the model and the levels are compared to those surveyed after the event. Events from January 1998 and December 2007 were used to calibrate this model.

2.0 Available Data

2.1 Topographic Data

The main topographic data used in modelling North Ward was Townsville City Council LiDAR. LiDAR was used for determining catchment delineation, sub-catchment slope, sub-catchment routing, and for basic topography of the model. The other source of topographic data for the study was the Mitchell Street Drainage Report. This report details the changes in topography due to the constructed flood mitigation works at Mitchell Street.

Figure 2.1.1 A1 to B2 shows the LiDAR data in the form of contours over the North Ward study area.

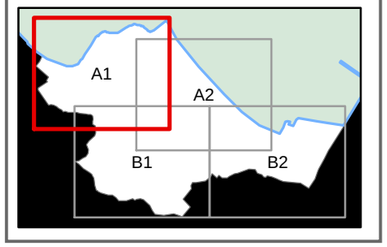


TOWNSVILLE CITY COUNCIL
NORTH WARD CATCHMENT

LEGEND

2009 Contours

1m intervals



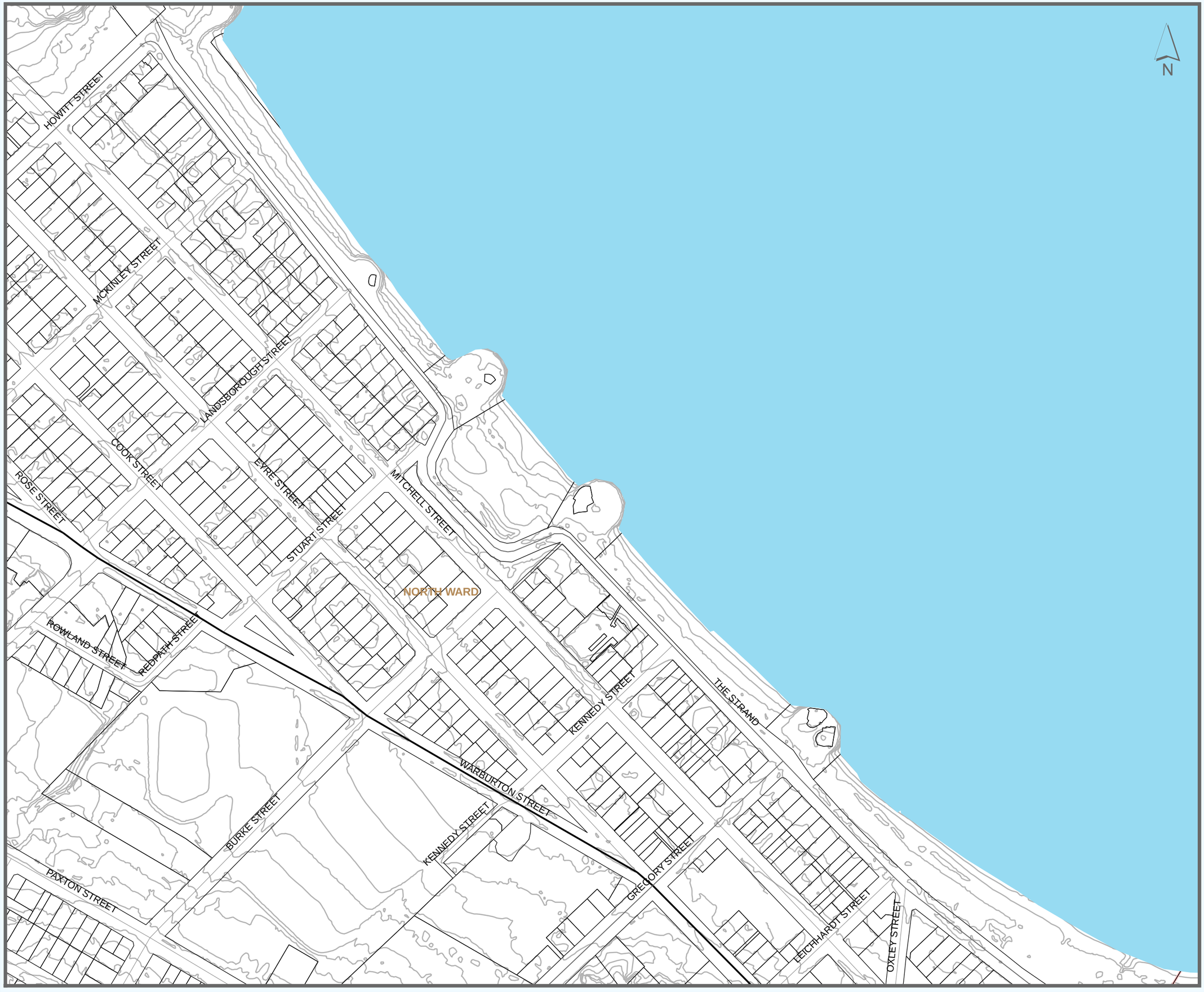
160 80 0
Meters

SCALE: 1:5,000 @ A3

Strategic Planning Department
PLANNING AND DEVELOPMENT

DATE: 14/03/2011
DRAWN BY: JAJ
DIGITAL FILE: mxd

Figure 2.1.1:
Topographic Data

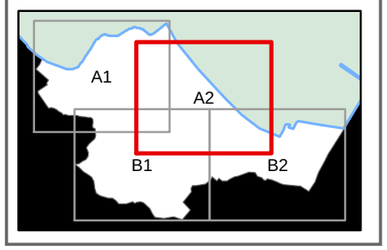


TOWNSVILLE CITY COUNCIL
NORTH WARD CATCHMENT

LEGEND

2009 Contours

1m intervals



160 80 0
Meters

SCALE: 1:5,000 @ A3

Strategic Planning Department
PLANNING AND DEVELOPMENT

DATE: 14/03/2011
DRAWN BY: JAJ
DIGITAL FILE: mxd

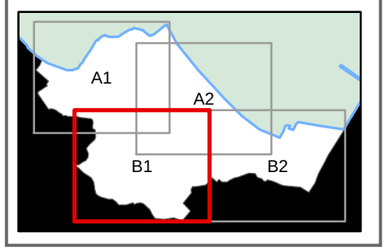
Figure 2.1.1: Topographic Data

TOWNSVILLE CITY COUNCIL
NORTH WARD
CATCHMENT

LEGEND

2009 Contours

1m intervals



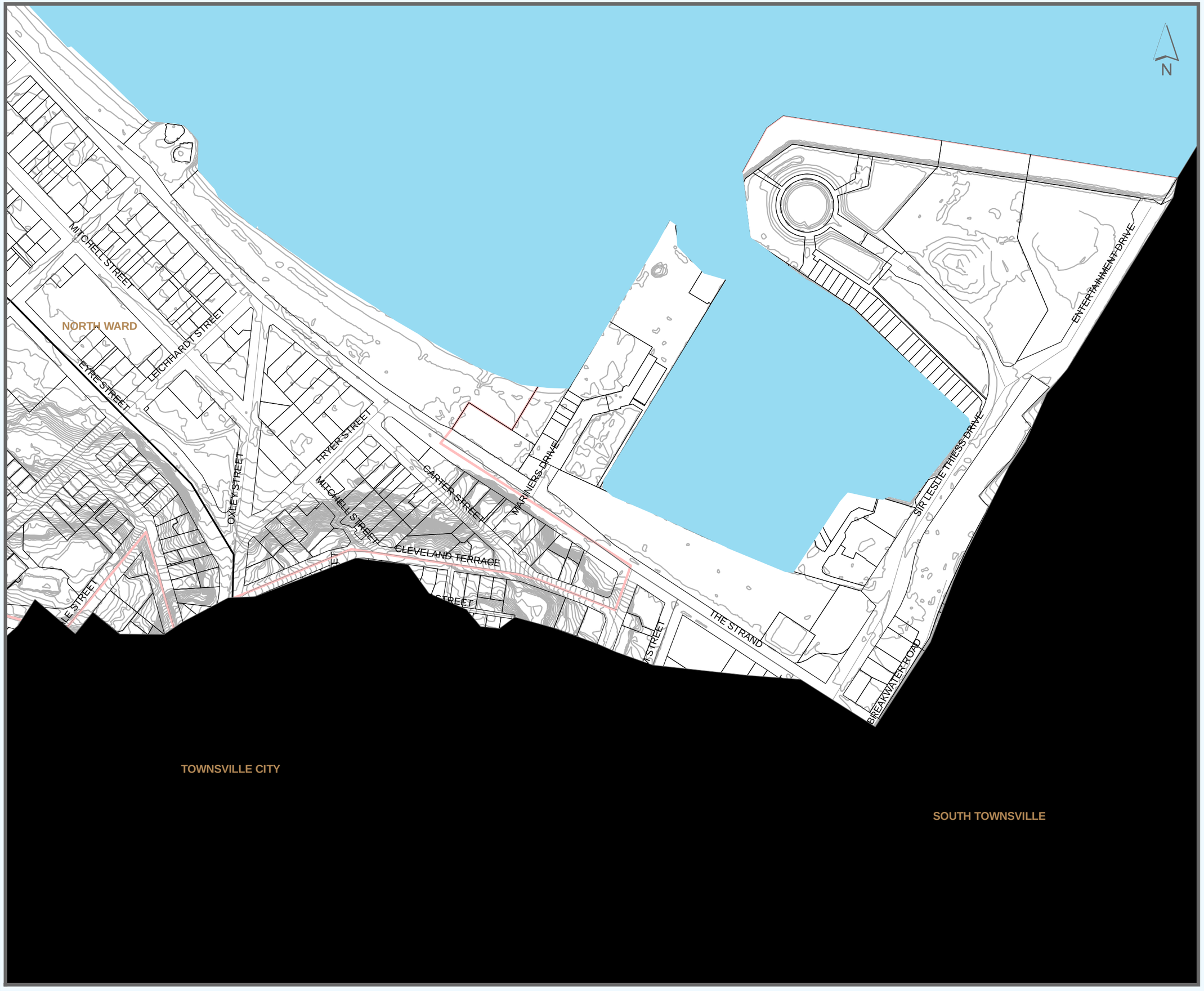
160 80 0
Meters

SCALE: 1:5,000 @ A3

Strategic Planning Department
PLANNING AND DEVELOPMENT

DATE: 14/03/2011
DRAWN BY: JAJ
DIGITAL FILE: mxd

Figure 2.1.1:
Topographic Data

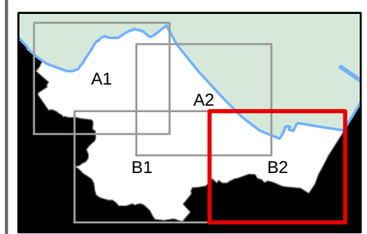


TOWNSVILLE CITY COUNCIL
NORTH WARD
CATCHMENT

LEGEND

2009 Contours

1m intervals



160 80 0
Meters

SCALE: 1:5,000 @ A3

Strategic Planning Department
PLANNING AND DEVELOPMENT

DATE: 14/03/2011
DRAWN BY: JAJ
DIGITAL FILE: mxd

Figure 2.1.1:
Topographic Data

2.2 Stormwater Network

All council Stormwater Network data was available to use for the flood study. It was available on both GIS software and Mosaic. Surveyed invert levels were also obtained from survey completed by Brazier Motti for the project. **Figure 2.2.1** shows the available stormwater network and the surveyed points.

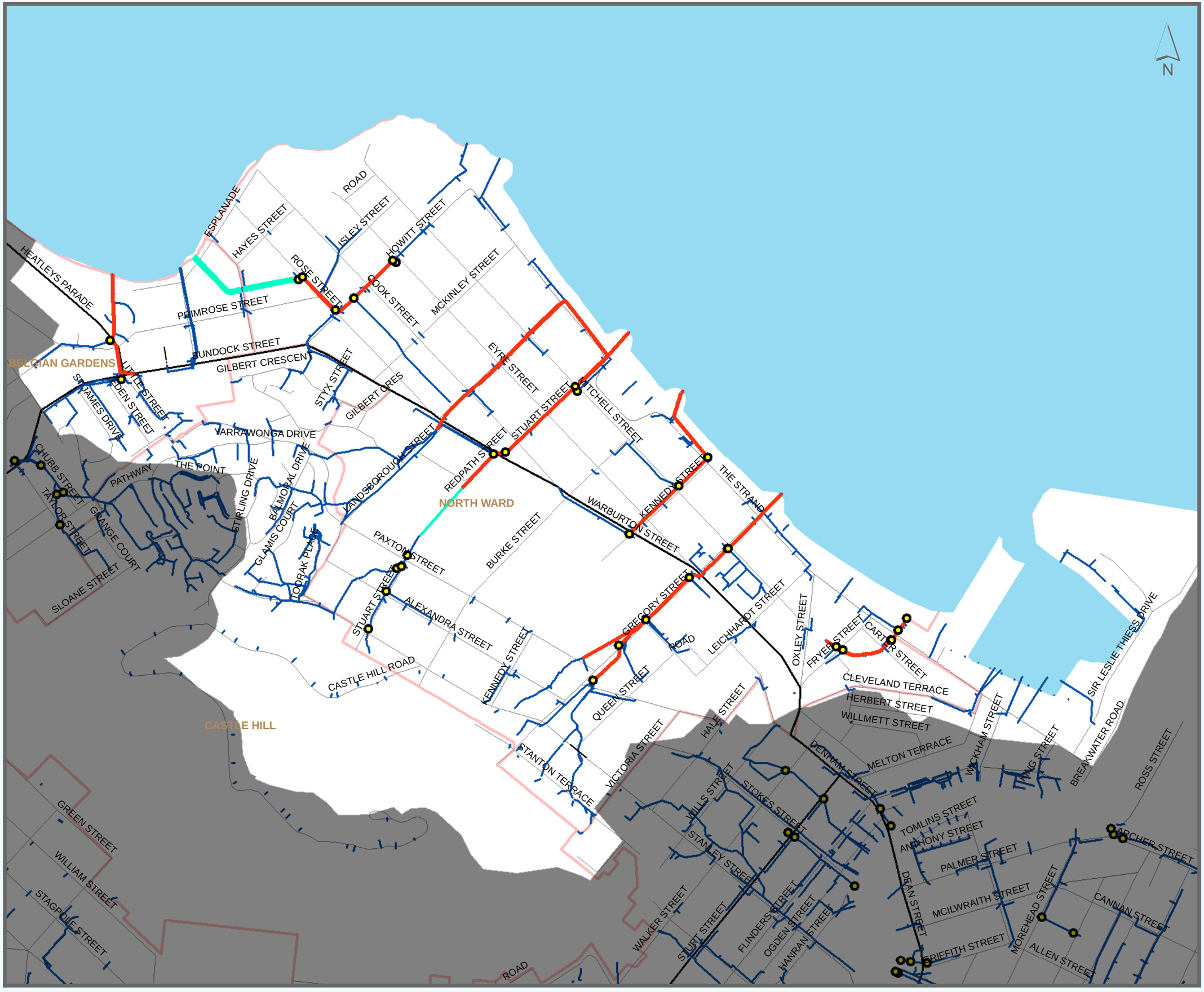
2.3 Historical Flood Level

North Ward is a stand alone catchment with several small outlets and no stream gauges. The only historical flood data available are a few surveyed spot levels from the January 1998 event, and a few from the December 2007 event which were extracted from the Mitchell Street Drainage Report October 2008. These flood levels were used in a joint calibration of the hydraulic and hydrologic models. **Figure 2.3.1** show the locations of surveyed flood levels used for calibration and **Table 2.3.1** shows the values at these points.

Table 2.3.1: Historical Flood Levels

Jan-98	
Street	**Surveyed Results**
56 Alexandra St	19.75
300 Stanley St	31.89
13 Gregory St	14.38
12 Redpath St	10.8
Dec-07	
Street	**Surveyed Results**
76 Mitchell St	6.8
88 Mitchell St	6.8

TOWNSVILLE CITY COUNCIL
NORTH WARD CATCHMENT



LEGEND

- Pipes of diameter >900mm
- Pipes of diameter <900mm
- Open Drain
- Surveyed Invert Levels

400 200 0

Meters

SCALE: 1:11,000 @ A3

Strategic Planning Department
PLANNING AND DEVELOPMENT

DATE: 14/03/2011
DRAWN BY: JAJ
DIGITAL FILE: mxd

Fig 2.2.1
Stormwater Network