STORMWATER CATCHMENT MANAGEMENT PLAN HYDRAULIC MODELLING

WHANGAMATA STORMWATER MODEL BUILD: *DATA ANOMALIES REPORT*

THAMES COROMANDEL DISTRICT COUNCIL

FINAL A
AUGUST 2006

WEC
water engineering consultants

WHANGAMATA STORMWATER MODEL BUILD:
DATA ANOMALIES REPORT

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Prepared For

FINAL A
AUGUST 2006

EXECUTIVE SUMMARY

OVERVIEW

Water Engineering Consultants (WEC) was appointed by Thames Coromandel District Council (TCDC) to undertake hydraulic modelling and flood hazard mapping of the Whangamata stormwater catchment.

The objectives of this report are as follows:

1) To summarise data anomalies and the significance of these anomalies on the proposed hydraulic modelling study.
2) Recommendations for the resolution of critical data anomalies.
3) Confirmation of our proposed modelling methodology as provided in our proposal document (WEC, 2005). We also provide further details regarding our proposed modelling methodology on items that we were unaware of at the time of writing the original methodology.
4) Confirmation of our understanding of the catchment and TCDC modelling requirements.
5) Confirmation that the data we have collected is up to date and we are not missing any critical catchment data.

FINDINGS AND RECOMMENDATIONS

Modelling Methodology

The following actions are recommended:

- A freeboard of 500mm.

Catchment Data

The following actions are recommended:

- Confirmation from TCDC of site impervious coverage
- Confirmation that there are no additional reported flooding issues other than those detailed in this report
- Confirmation that the Hydrologic Soil Groups are acceptable

Asset Data

The following actions are recommended:

- Greater effort than originally anticipated is required to develop the pipe network data to a level suitable for modelling. Much of this work can be done using engineering judgement to interpolate / estimate missing data as a desktop study with site visits to confirm connectivity. In addition if budget is available a targeted data capture program can be carried out to further improve confidence in the model network and GIS.
- The missing culvert data is recommended to be collected.
- Confirmation of LIDAR and GIS level datum.

Stream and Channel Data

The following actions are recommended:

- Greater effort than originally anticipated is required to develop the channelised stormwater system. Much of this work can be done through site walkovers and using the LIDAR data.
- Bridge and Culvert data along the river network should be captured.
- Extensive site walkover to confirm drainage network developed from LIDAR review.
- Critical points on the river network identified during the preliminary model runs may require site surveys to confirm flood hazard.

Overland Flowpaths and Ponding

The following actions are recommended:

- Critical points on the overland flowpaths and local ponding identified during the preliminary model runs may require site surveys to confirm flood hazard.

Rainfall Data

The following actions are recommended:

- Collection of HIRDS database

Tidal Data

The following actions are recommended:

- TCDC to provide tide level for the downstream water level boundary condition for the 4 design storm scenarios (5yr, 10yr, 50yr and 100yr)
- TCDC to provide the 100yr and 50yr tide levels for flood hazard mapping purposes.

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GLOSSARY

AEP: Annual Exceedence Probability
ARI: Average Recurrence Interval
ARC: Auckland Regional Council
CN: Curve Number
EW: Environment Waikato
NRCS: Natural Resource Conservation Service, USA
OFP: Overland Flow Path
SCS: Soil Conservation Service, USA
SW: Stormwater
TCDC: Thames Coromandel District Council
WEC: Water Engineering Consultants Ltd

1.0 INTRODUCTION

1.1 OBJECTIVE

The objectives of this report are as follows:

1. To summarise data anomalies and the significance of these anomalies on the proposed hydraulic modelling study.
2. Recommendations for the resolution of critical data anomalies
3. Confirmation of our proposed modelling methodology as provided in our proposal document (WEC, 2005). We also provide further details regarding our proposed modelling methodology on items that we were unaware of at the time of writing the original methodology.
4. Confirmation of our understanding of the catchment and TCDC modelling requirements.
5. Confirmation that the data we have collected is up to date and we are not missing any critical catchment data.

1.2 BACKGROUND

Water Engineering Consultants Ltd (WEC) were appointed by Thames Coromandel District Council (TCDC) to undertake hydraulic modelling and flood hazard mapping of the Whangamata stormwater catchment. This work will augment the Whangamata CMP developed by Opus International Consultants Ltd (Opus, 2005).

The OPUS CMP analyses the existing stormwater system and provides upgrading options, cost estimates and recommendations. This CMP is based on hydraulic calculations and no modelling was undertaken.

1.3 SCOPE

WEC have been engaged to develop the following:

1. Flood hazard information to be used in the Council's hazard register, for LIM's, and for regulating building floor levels
2. Emergency response data for extreme flood events
3. Definition of overland flow paths
4. Enhanced confidence in assessing and prioritising stormwater upgrading projects
5. A model that can be used in-house in TCDC to review sub divisional proposals and the stormwater management works proposed by developers
6. A modelling methodology that can be used by Developers to formulate sub divisional stormwater management proposals

1.4 PREVIOUS STUDIES

Several previous stormwater studies in the Whangamata area have been completed in the past 10 years, these include:

(a) Whangamata Stormwater Catchment Management Study – Stormwater Catchment Management Plan Issues and Options Report, Draft Version 2, Opus International Consultants Limited, September 2005

(b) Future Development Potential of Whangamata, TCDC policy and Planning Group, April 2005

(c) Whangamata and Onemana Stormwater Management, Woodward-Clyde Ltd, 1997

(d) Whangamata Harbour: Contaminant Loads and Water Quality, Environment Waikato Technical Report, June 2001

(e) Beach Road - Harbour View Road – Trailer Park Flooding,1997, Airey Consultants Ltd

Note: We have only received copies of reports (a) & (b) at the time of writing this report.

We have also not received a copy of TCDC's Code of Practise for Subdivision and Development (Engineering Standards).

1.5 DATA COLLECTED

The following information has been provided by TCDC:

- The current CMP information, excluding appendices
- Cadastral information
- LIDAR data and contour data
- TCDC District Plan Zoning Maps
- GIS manholes and nodes asset data
- GIS pipe and channel asset data.
- Reported flooding problems at Casement Road, Whangamata

We have not been provided the following information, at the time of writing this report:

- Additional flooding issues, to those identified above and in the CMP.
- Photo essay and stormwater questionnaires detailed in CMP.
- Field observation of flood levels during flood events and corresponding catchment rainfall records
- Ultimate development densities
- Culvert and bridge asset data

Selected stream / flow path cross-sections, long-sections and coordinates (locations to be specified by WEC) will need to be collected as the study progresses.

1.6 ASSUMPTIONS AND LIMITATIONS

- It is assumed that the existing drainage system (including pipes, overland flowpaths, culverts and channels) will be maintained without blockages. Our model and hence the floodplain levels are based on the assumption that the existing drainage system will continue to function without blockages, partial or complete. Particularly, overland flowpaths widths and levels as shown in the model are assumed to be available free of obstructions.
- We will assume a freeboard of 500mm.
- It is assumed that soakage in the Whangamata catchment is confined only to private soakholes.
- It is assumed that the soakage capacity equals the 1-in-5 year flow from the private soakhole catchment.
- The above are only the principle assumptions. There are a number of other important modelling assumptions described in other sections of this report.

The below level of service as taken from the Opus Whangamata CMP, 2005, will be assumed for the Whangamata Catchment:

"TCDC's Engineering Standards are set out in TCDC's Code of Practise for Subdivision and Development (Engineering Standards), which sets the following levels of service that are required in relation to stormwater in the Coromandel area:

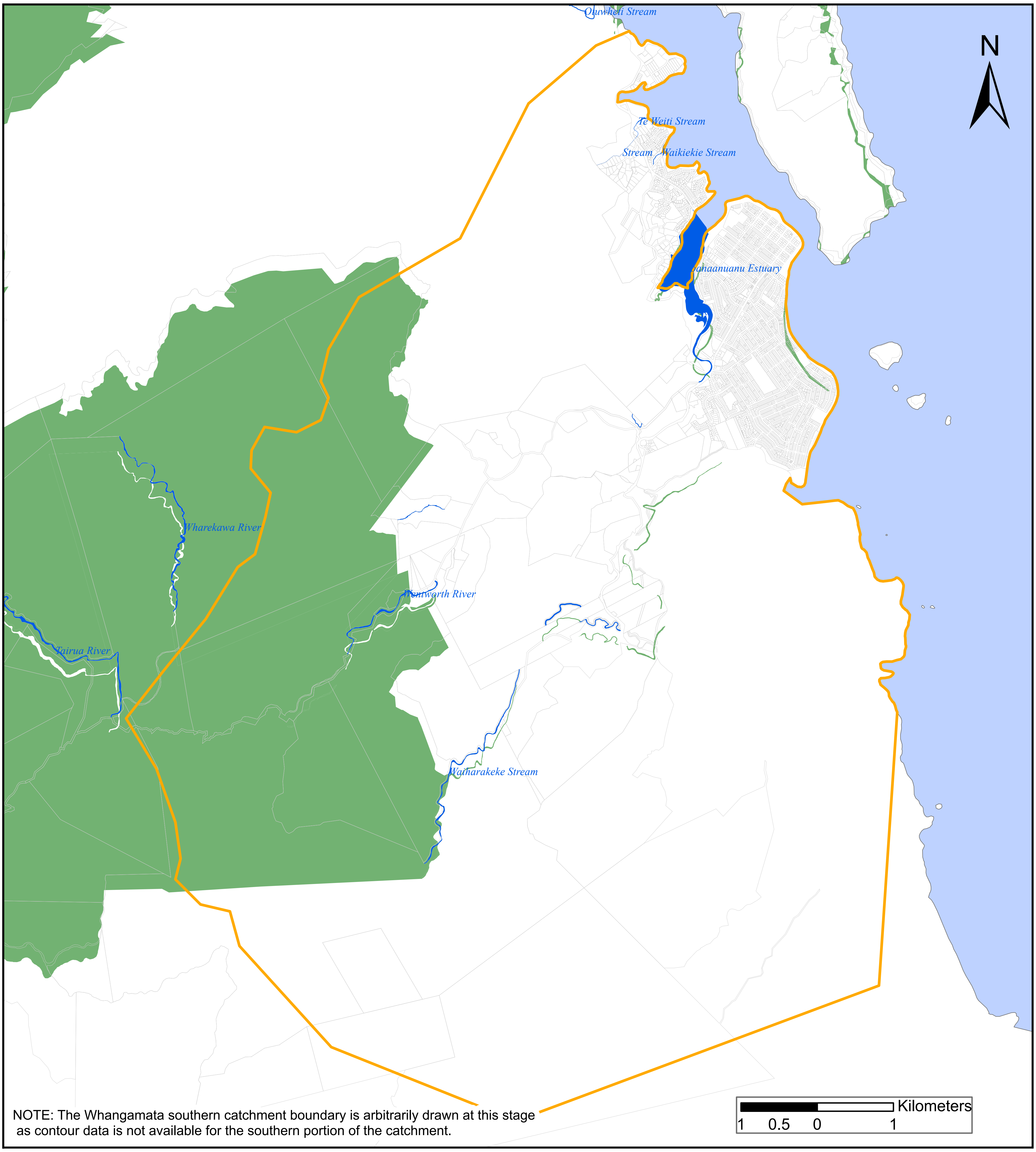
- *Primary piped systems must have adequate capacity to pass at least the 20% AEP (five year ARI) rain event (primary pipes in urban Whangamata are to be capable of carrying a 10% AEP 10 year ARI rain event);*

- *Culverts in all areas must be capable of carrying the 5% AEP (20 year) rain event;*

- *Open channels and overland flow paths should be capable of carrying the 2% AEP (50 year ARI) rain event to ensure that such surface water will not enter buildings; and*

- *Bridges must be capable of withstanding the 1% AEP (100 year) rain event."*

FIGURE 1-1: CATCHMENT LOCATION



NOTE: The Whangamata southern catchment boundary is arbitrarily drawn at this stage as contour data is not available for the southern portion of the catchment.

Legend

- RIVER
- SEA
- PARCEL
- CONSERVATION LAND
- WHANGAMATA CATCHMENT

STORMWATER CATCHMENT MANAGEMENT PLAN MODELLING

WHANGAMATA STORMWATER CATCHMENT

THAMES COROMANDEL DISTRICT COUNCIL

FEBRUARY 2006
FINAL A

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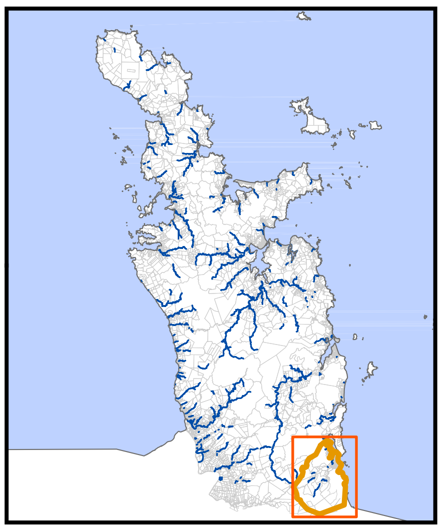


2.0 MODELLING METHODOLOGY

2.1 OVERVIEW

The purpose of this section is to amend, where necessary, and confirm our modelling methodology set out in our proposal documentation in September 2005 (WEC, September 2005) in the light of new information available from data evaluation to date. The following sections are adapted from the proposal documentation. The critical changes / additions made as result of our review of the provided catchment data are made in the following sections:

- Section 2.4.2 Soakage Stormwater System
- Section 2.5.3.2 Flood Hazard Mapping Limitations
- Table 2-1: Proposed Landuse / Coverage CN Values
- Table 2-2: Proposed Manning N Values
- Table 2-3: Proposed Model Simulations

2.2 MODELLING SOFTWARE

The hydraulic model will be developed in the SWMM version 5.0.006a modelling package, which is currently the latest available version. The SWMM model is a fully hydrodynamic hydraulic model and comprehensive hydrological model. SWMM software is capable of modelling catchment hydrology and hydraulics of sub-surface drainage systems and surface flow routes.

2.3 HYDROLOGICAL MODELLING

2.3.1 HYDROLOGICAL MODEL DESCRIPTION

SWMM hydrological model uses the kinematic wave equation for routing of runoff across impervious and pervious areas and we propose to use the US Soil Conservation Service (SCS) method for infiltration through pervious areas. This run-off model is deemed appropriate, as the main purpose of the model will be to simulate stormwater run-off. ARC recommends the SCS method in their stormwater runoff modelling guidelines for the Auckland Region. Based on published data in stormwater modelling of urban catchments in New Zealand and studies carried out elsewhere, suitable curve numbers applicable to the existing soil types & land use of TCDC catchments will be adopted. Other infiltration options available within the model are the Horton’s equation or Green-Ampt methodologies.

Table 2-1 outlines the proposed landuse / coverage Curve Numbers (CN), for use in runoff estimation in the SCS method.

Table 2-1: Proposed Landuse / Coverage CN Values

Landuse / Coverage	CN Value	
	Whangamata Flood Plain (Hydrologic Soil Group B)*	Whangamata Surrounding Hills (Hydrologic Soil Group C)*
Impervious Surfaces	98	98
Pervious Surfaces (e.g. Lawns and Parks)	69	79
Industrial (assumed 70% Impervious Coverage)**	89	92
Commercial and Business (assumed 80% Impervious Coverage)**	73	82
Housing (assumed 35% Impervious Coverage)**	79	85
Housing Extra Density (assumed 45% Impervious Coverage)**	76	84

Pasture	79	86
Forested	66	77

Source: SCS Urban Hydrology for Small Watersheds (NRCS, 1986)
*See Table 3-3 for Hydrologic Soil Group
**Maximum impervious coverage as specified in *Future Development Potential of Whangamata*, TCDC policy and Planning Group, April 2005, see Table 3-2 for more details on catchment impervious coverage.

2.3.2 SUB CATCHMENTS

Urban areas will be divided into sub catchments of 2-5 hectares and will be assigned to model nodes. Impervious areas will be estimated for existing and ultimate future development level (according to the current District Plan).

Upstream areas will be modelled as lumped "model subcatchments". See Figure 4-1: Proposed Model Network for the location of the proposed lumped sub catchments.

2.3.3 RAINFALL SCENARIOS

The model will be run for 4 design storm rainfall profiles for the 1 in 5yr, 1 in 10yr, 1 in 50yr and 1 in 100yr ARI events. These rainfall profiles will be taken from NIWA's HIRDS Depth – Duration – Frequency tables (see Section 7.0 RAINFALL DATA for more details). The modelling will be undertaken for both the existing development and future development scenarios.

2.4 HYDRAULIC MODELLING

2.4.1 PIPED STORMWATER SYSTEM

The pipe network will be represented in the model by nodes (i.e. manholes) and connecting pipes. The nodes will be defined by X & Y co-ordinates, cover levels, invert levels and manhole diameters.

The pipe data input to the model will comprise diameter, upstream and downstream inverts and connecting nodes. Pipes greater than 225mm will be modelled, where asset information is available.

See Section 4.0 for a review of the quality of asset data provided.

2.4.2 SOAKAGE STORMWATER SYSTEM

2.4.2.1 Soakage Modelling Assumptions

It is assumed that soakage in the Whangamata catchment is confined only to private properties and that every building within the catchment will have a soakhole with capacity to take the 1 in 5 year roof runoff, while runoff from other impervious and pervious areas will discharge directly to the stormwater system.

As there are many small private soakholes within a subcatchment, they will be lumped for modelling purposes into a single soakage node for the whole subcatchment. It is assumed that the soakage capacity equals the 1-in-5 year flow from the private soakhole catchment.

2.4.2.2 Soakage Modelling Limitations

Flooding problems due to inadequate private soakage capacity cannot be modelled accurately particularly at smaller ARI storms, as soakhole performance depends on many unknown variables.

2.4.2.3 Soakage Modelling Methodology

Each subcatchment will be split into two further subcatchments, one containing lumped roof areas and the other containing rest of the subcatchment area (lawns, parks and paved areas etc.).

For each lumped roof area subcatchment a lumped soakage node will be sized to take the 1 in 5yr runoff from this catchment area and the subcatchment will be attached to this node.

Each soakhole will be modelled as a storage unit, the storage unit will have two outlets one at the invert of the storage unit with a maximum outlet flow set equal to the peak 1 in 5yr flow (as sized based on the attached catchment area), the second outlet, set 1m above the invert will act as a overflow and discharge to the stormwater reticulation system.

The storage volume for each soakhole will be based on the 1 in 5yr ARI runoff of the attached catchment area. The invert outlet will be specified with a linear Q vs. H relationship to simulate actual soakhole performance, were H = 0, Q = 0 and where H = 1 (water level at overflow level) Q = max 1 in 5yr runoff. The objective of this methodology is that the soakhole can just dispose of the 1 in 5yr runoff, and that events in excess of this flow will overtop the soakhole.

2.4.3 OVERLAND FLOWPATHS (OFP)

Overland Flow Path (OFP) shape and location, for the preliminary model, will be identified from LIDAR data. These overland flow paths will be represented in the model as open channels, connected by weirs from the piped stormwater system nodes, so that any surcharged pipe systems will discharge excess water into the OFP. After carrying out site walkover and topographical surveys the modelled OFP's will be updated. See Section 6.1 for more details.

2.4.4 STREAMS

Stream cross sectional information (gained from the LIDAR data or survey) will be incorporated into the SWMM model in order to assess the maximum water level through the reach. This information will be utilised for the preparation of flood hazard maps of the area. See Section 5.1 for more details.

2.4.5 INLET CAPACITY

Where asset data is available, the system inlet (catchpits etc.) capacity within each sub-catchment will be checked. Where data is not available we will assume that the system has sufficient inlet capacity.

2.4.6 INLET CONTROL

Inlet control conditions at culverts will be modelled as a node at the upstream culvert end, which has an orifice intake and a weir overflow (for overtopping of road etc.).

2.4.7 TIDAL LEVELS

There are two sea levels relevant to the plotting of 100-year flood hazard areas. The first is the boundary condition for the flood modelling and the second is the 100-year highest tide level. For the modelling boundary condition, we propose to discuss and agree with TCDC the use of the Engineering High Water adopted by TCDC for their marine designs or Mean High Water Springs (MHWS). We expect TCDC will provide the 100-year highest tide level. If this information is not available, we are able to provide additional services to carry out a study based on available published literature to assist TCDC in determining the 100-year highest tide level. See Section 8.0 for more details.

Note: The 100yr and 50yr Flood hazard area will be plotted by merging the 100yr / 50yr floodplain with the 100yr / 50yr tide plain.

2.4.8 PONDING (DETENTION STORAGE)

The effect of ponding areas will be analysed based on available topographic information (LIDAR) from TCDC and modelled as a 'Storage Unit' in SWMM. See Section 6.2 for more details.

2.4.9 MODELLED ROUGHNESS VALUES

Industry standard values of Manning's "n" from the literature will be used to describe the roughness for various conduits and flow paths, based on our assessment of the roughness condition of each component.

See Table 2-2 for proposed Manning N values.

Table 2-2: Proposed Manning N Values

Type of Conduit	Description	Roughness Coefficient (n)
Pipe	Concrete	0.015
Channel	Maintained Earth Grassed Channel	0.030
	Not Maintained Earth Grassed Channel	0.050
Stream	Winding, Sluggish Reaches	0.080
Overland Flow Path	Roadway Overland Flow	0.035
	Pasture / Lawn Overland Flow	0.050 to 0.10

Adapted from Chow, V. T. *Open-Channel Hydraulics*, McGraw Hill, 1959. Table 5-5.

2.5 MODELLING SCENARIOS

2.5.1 OVERVIEW

This section outlines the proposed modelling scenarios, and the purposes of each scenario.

Table 2-3 outlines the proposed runs.

Table 2-3: Proposed Model Simulations

Scenario	Design Storm Rainfall ARI	Purpose
Existing Development (Baseline)	1 in 5yr	System Constraints
	1 in 10yr	System Constraints
	1 in 50yr	Flood Hazard Mapping
	1 in 100yr	Flood Hazard Mapping
Fully Developed (Future)	1 in 5yr	System Constraints
	1 in 10yr	System Constraints
	1 in 50yr	Flood Hazard Mapping
	1 in 100yr	Flood Hazard Mapping

2.5.2 SYSTEM CONSTRAINTS

The SWMM computer model will be used to determine the existing capacities of the public drainage system and its secondary flow paths. Any drainage deficiencies associated with the existing and future development scenarios during the 1 in 5yr (20% AEP) & 1 in 10yr (10% AEP) storm event will be identified.

2.5.3 FLOOD HAZARD MAPPING

2.5.3.1 Flood Hazard Mapping Scenarios

Peak flood flows, levels & flood hazard extents in the stormwater system will be determined for the 1 in 50yr (2% AEP) and 1 in 100yr (1% AEP) storm events in both the existing and future development scenarios.

2.5.3.2 Flood Hazard Mapping Limitations

The study is based on both information available from published documents and maps and information provided by TCDC. Job specific primary data collection will be limited to some topographical survey and walkover surveys.

Some of the key information, on which the reliability of the study outputs depends, is as follows:

- The flood flow estimation and flood plain mapping are based on statistical information for infrequent events such as the 2% AEP and 1% AEP storm events. These are

extrapolated data and it is likely that the estimates of flood flows and predicted extent of the flood plains will change over time as new information becomes available.
- The flood flow information and flood plain mapping are based on assumptions of land use in each subcatchment. There will be localised or catchment wide changes to estimates of flood flows and predicted extent of flood plains when land use changes from the assumed pattern, either locally or on a catchment –wide basis.
- Generally a catchment wide runoff model needs to be calibrated against measured events to improve its reliability. There is very limited anecdotal data available to calibrate the model developed for this study.
- Level of uncertainty due to the error terms associated with other parameters such as flood flow estimation and ground level interpolation.

It is proposed to insert the following note in the published Flood Hazard Maps:

"This drawing shall be read in conjunction with the Whangamata Flood Modelling Report (WEC, 2006), particularly the section on Limitations and Assumptions"

2.5.3.3 Flood Hazard Mapping Methodology

Flood hazard areas will be drawn by interpolation between topographical data provided by TCDC. These flood hazard areas will be refined, with any flood prone buildings identified for survey. Flood prone building floor levels and their corresponding flood levels will be detailed.

A site visit of any flood hazard areas identified through the previous stakeholder consultation process of the CMP, as lying outside the modelled flood hazard areas will be undertaken, with the flood hazard plans modified as necessary.

A sensitivity analysis will be undertaken in flood hazard areas where flooding may have significant effects.

Flood levels (to LINZ Datum) at all culvert inlets; surveyed cross-sections and existing detention facilities will be provided for the 2% AEP and 1% AEP storm events. Flood plain cross-sections will be provided at all surveyed cross sections.

2.5.3.4 Freeboard

We recommend that TCDC impose a suitable freeboard depth (typically 500mm) to take into account any modelling errors, wave action, survey error, design storm error, global warming etc. WEC recommend that this freeboard be incorporated into the extent of flooding area represented on the flood hazard plan produced.

2.5.3.5 Flood Hazard Map Production

A flood hazard plan will be prepared using Arcview on A3 sheets. The plan will show layers for both the 2% AEP and 1% AEP flood levels as well as flood prone areas (being other identifiable areas that might be at risk of flooding in circumstances such as culvert blockage).

The flood hazard plan will be provided to TCDC in a digital form.

2.6 MODELLING METHODOLOGY – RECOMMENDATIONS

The following actions are recommended:

- Confirmation from TCDC that the proposed freeboard is acceptable.
- Confirmation from TCDC that the soakage modelling methodology is acceptable.
- At the time of writing the proposal we were unaware of soakage modelling requirements in the Whangamata catchment, hence there is greater effort required than originally estimated to complete the model build.

3.0 CATCHMENT DATA

3.1 OVERVIEW

The Whangamata catchment is located on the east coast of the Coromandel Peninsula (as shown in Figure 1-1). The main Whangamata Township is fairly well developed, and is currently experiencing infill development. The Whangamata Township is bordered by the Otahu River to the south and the Whangamata Harbour to the north where the Wairoa Stream and Wentworth River meet the sea. The town is divided by the Moanaanuanu Estuary, which runs along the northern side of the main part of Whangamata (Opus, 2005).

Outside the main township the Whangamata catchment is predominately of rural land use with some residential development in the Wentworth Valley to the south and on the northern side of the Moanaanuanu Estuary (Opus, 2005). The Whangamata catchment is expected to undergo relatively intensive development over the next 15 years.

3.2 EXTENTS

The Whangamata catchment covers approximately 9,200 hectares, and is bounded by the Whangamata Harbour to the south and Mercury Bay to the east. Figure 1-1 shows the catchment extents. TCDC contour information, does not cover the south of the catchment and hence the southern boundary has not been defined at this stage. We are awaiting contour information that covers the southern boundary from TCDC.

3.3 LANDUSE

The Whangamata catchment consists of a range of land uses, as summarised in Table 3-1. It can be seen from this table that the Whangamata catchment consists mainly of undeveloped rural and coastal land uses with a significant portion of medium density development. Within residential landuse, small pockets of relatively dense developments such as the town centre are included.

Table 3-1: Whangamata Landuse

Landuse	Area (Ha)	Area (%)
Rural	4,116	45%
Coastal	48	1%
Housing	473	5%
Industrial	8	0%
Town Centre	6	0%
Unknown*	4,571	50%
Total	**9,223**	**50%**

Source: TCDC GIS
*Unknown: Unknown landuse is outside of the TCDC region, but within the estimated Whangamata catchment area.

3.4 TOPOGRAPHY

The Whangamata catchment topography varies from very steep hills to a flat low-lying area that contains the Whangamata Township. Catchment elevations range from 680m RL at the top of the catchment down to sea level.

The majority of Whangamata Township has been built on the flat sandy dune areas bordered by Moanaanuanu Estuary, Whangamata Harbour, the Pacific Ocean and the Otahu River. The other two areas of the town are to the southwest (Wentworth) and the northwest, which are both on steeper land (Opus, 2005).

3.5 GROUND COVER

Existing ground cover for the Whangamata catchment will be developed from aerial photographs and landuse data provided by TCDC.

Existing Ground Cover
The undeveloped land coverage in the Whangamata catchment is generally forested with patches of pasture, this undeveloped land is assumed to have insignificant impervious coverage (e.g. Occasional country roads).

The developed areas in and around the Whangamata Township and along the cost consist of residential, commercial and industrial landuses.

Future Ground Cover
For the future scenario model run the ground cover within the town centre areas will be assumed to be fully developed, with 100% impervious site coverage.

The ground cover for the housing landuse will also be assumed to be fully developed with 70% impervious coverage. It is assumed that land use outside these areas which are mainly zoned as coastal or rural will remain undeveloped.

Table 3-2: Proposed District Plan Decisions (1999) – Current Assumed Site Coverage by Landuse Type

Landuse / Zone	Max Site Impervious Coverage
Housing	35%
Housing Extra Density	45%
Housing Recreation	0%*
Housing Open Space	0%*
Coastal – Open Space	0%*
Town Centre	100%
Town Centre Recreational	0%*
Industrial	35%*
Rural	10%*

Adapted from *Future Development Potential of Whangamata*, TCDC policy and Planning Group, April 2005
*Assumed maximum site impervious coverage, as currently do not have a copy of the Proposed District Plan.

3.6 GEOLOGY AND SOILS

The Institute of Geological and Nuclear Sciences geological maps show the underlying geological unit immediately around the Whangamata Township as coastal sediments, such as silts and sands (Quaternary sediments) (Opus, 2005 & GNS, 1972). The hills surrounding the Whangamata catchment consist of volcanic rock. Table 3-3 summarise catchment geological and adopted hydrologic soil type for use in the SCS hydrological runoff modelling.

The Opus 2005 Whangamata CMP identifies the Whangamata area as comprised mainly of estuarine accumulations of alluvial material and sand deposits. To the southwest and northwest the primary geological material is minden rhyolite from the volcanic eruption of the Coromandel Ranges.

Table 3-3: Assumed Hydrologic Soil Type

Whangamata Catchment Location	Geological Unit Description*	Soil Description	Hydrologic Soil Group**	Hydrologic Soil Group Description**
Flood Plain Surrounding Whangamata Township	Coastal Sediments	Sandy Loam	B	Soils having moderate infiltration rates when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.
Hills	Volcanic	Clay	C	Soils having slow

Surrounding Whangamata Township Flood Plain	Rock			infiltration rates when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine textures.

*Taken from New Zealand Geological Map (GNS, 1972).
**Based on soil descriptions in Urban Hydrology for Small Watersheds (NRCS, 1986).

3.7 REPORTED FLOODING ISSUES

The Opus CMP identified a number of flooding issues. In addition TCDC have provided brief details on flooding at 115 Casement Rd, in April 2005

3.8 BUILDING FOOTPRINTS

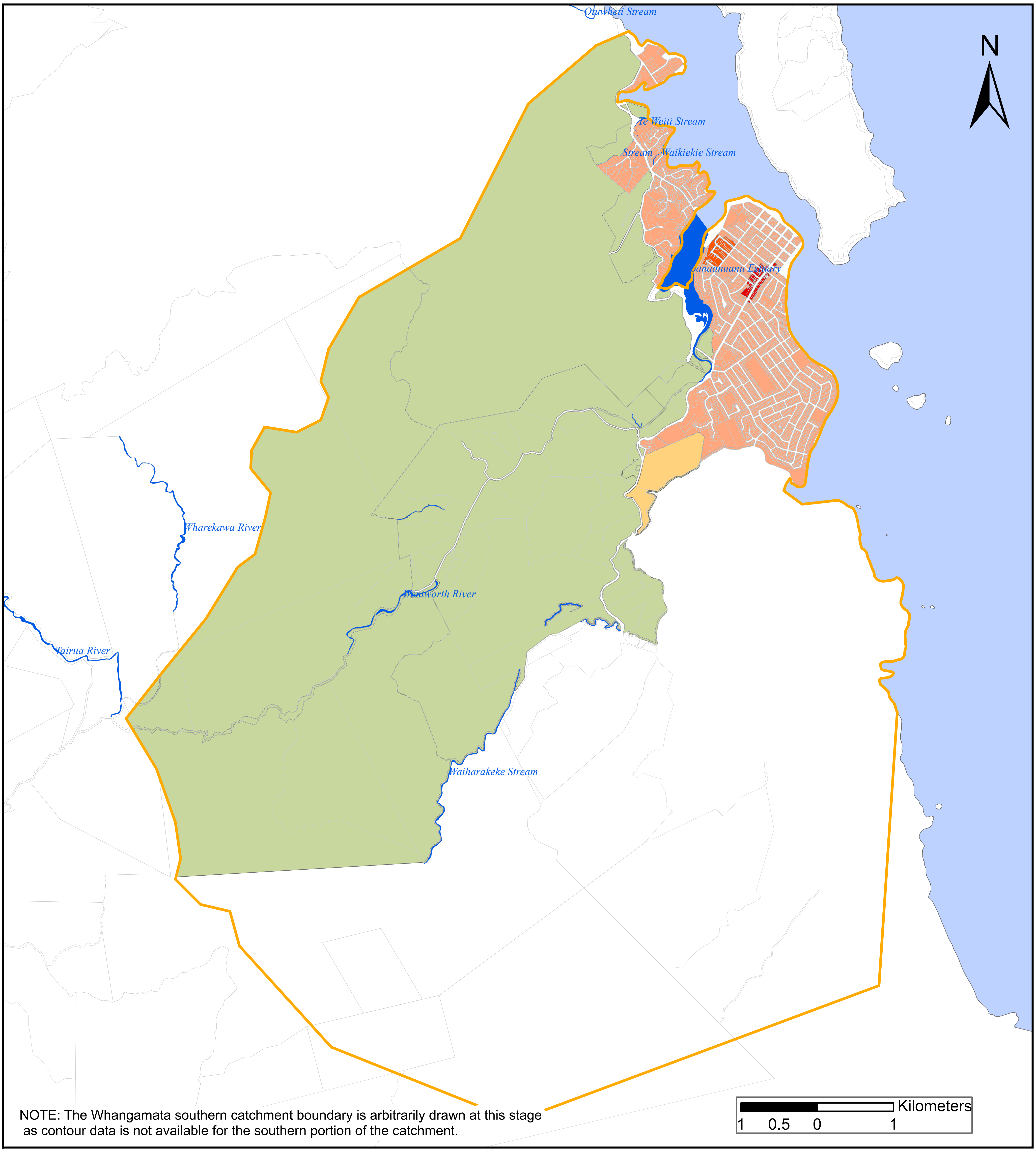
No building footprint data has been provided. Once the preliminary model runs have been completed, it may be necessary to survey building floor levels (habitable and non-habitable) identified to be within the modelled floodplain to confirm flood risk.

3.9 CATCHMENT DATA – FINDINGS AND RECOMMENDATIONS

The following actions are recommended:

- Confirmation from TCDC of site impervious coverage
- Confirmation that there are no additional reported flooding issues
- Confirmation that the Hydrologic Soil Groups are acceptable

FIGURE 3-1: CATCHMENT LANDUSE



Legend

- SEA
- PARCEL
- RIVER
- WHANGAMATA CATCHMENT

ZONE

- Coastal
- Housing
- Industrial
- Rural
- Town Centre

STORMWATER CATCHMENT MANAGEMENT PLAN MODELLING

WHANGAMATA STORMWATER CATCHMENT

THAMES COROMANDEL DISTRICT COUNCIL

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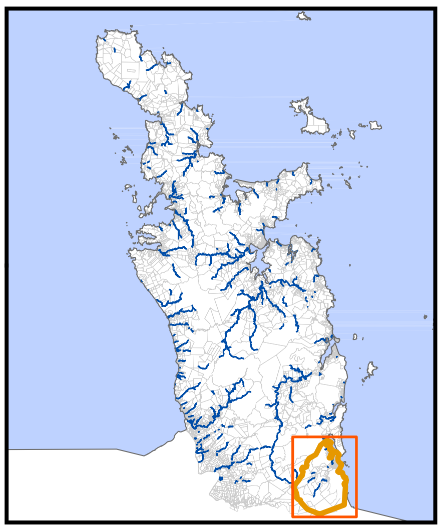


FIGURE 3-2: CATCHMENT TOPOGRAPHY

Legend

- SEA
- PARCEL
- RIVER
- WHANGAMATA CATCHMENT

Contour

Elevation (m RL)

- 0 - 80
- 81 - 200
- 201 - 320
- 321 - 440
- 441 - 560
- 561 - 680
- 681 - 880

STORMWATER CATCHMENT MANAGEMENT PLAN MODELLING

WHANGAMATA STORMWATER CATCHMENT

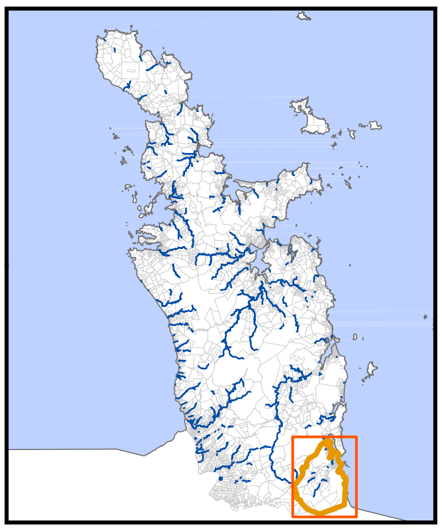
THAMES COROMANDEL DISTRICT COUNCIL

FEBRUARY 2006
FINAL A

DRAWN: TAL
CHECKED: TAD

SCALE (A3):1:50,000

WEC
water engineering consultants



4.0 ASSET DATA

4.1 MANHOLES / NODES

TCDC's GIS data coverage on the manholes / nodes in the Whangamata catchment is poor with about 40% of nodes missing invert levels. Node ground levels missing in the GIS have been identified from the LIDAR data. Table 4-1 summarises manhole / data source and quality. See Appendix A for a details on all reviewed manholes / nodes.

A check of the LIDAR Ground Level vs. GIS Manhole Lid Level, shows that ~70% of the proposed model manhole GIS lid levels are with 0.5m of the LIDAR data, which within the expected range from the LIDAR data. However 30% of the GIS lid levels are outside of this range, therefore the datum of the LIDAR and GIS lid levels should be confirmed.

Table 4-1 Manholes / Nodes Data Source*

<table>
<tr><th rowspan="2">Field</th><th colspan="6">Data Source</th></tr>
<tr><th>No Data</th><th>GIS</th><th>Overridden GIS LL Data with LIDAR</th><th>Blank LL Updated From LIDAR</th><th>Inferred IL from Depth & LIDAR Data</th><th>Total</th></tr>
<tr><td>DEPTH</td><td></td><td>296</td><td></td><td></td><td></td><td rowspan="4">296</td></tr>
<tr><td>DIAMETER</td><td>296</td><td></td><td></td><td></td><td></td></tr>
<tr><td>INVERT LEVEL</td><td></td><td>270</td><td></td><td></td><td>26</td></tr>
<tr><td>LID LEVEL</td><td></td><td>270</td><td></td><td>26</td><td></td></tr>
</table>

*Table includes only manholes / nodes within the model extents.

4.2 PIPES / CONDUITS

TCDC's GIS data on the existing pipe network is again poor, with a number of errors including incorrect connectivity and invert levels. While the GIS indicates that most fields are complete much of the actual data provided appears to be incorrect. In addition many of the nodes / manholes identified in the GIS are not connected by conduits in the GIS data. Due to the poor link data a greater amount of effort is required to resolve the connectivity problems and to develop the stormwater network. As and outcome of this exercise, it will be possible to update the GIS, post this work, to reflect a more accurate state of the network. See Appendix A for a details on all reviewed pipes / conduits.

Table 4-2 Pipe / Conduit Data Source*

<table>
<tr><th rowspan="2">Field</th><th colspan="3">Data Source</th></tr>
<tr><th>No Data</th><th>GIS</th><th>Total</th></tr>
<tr><td>MATERIAL</td><td></td><td>249</td><td rowspan="3">249</td></tr>
<tr><td>DIAMETER</td><td></td><td>249</td></tr>
<tr><td>USLEVEL</td><td></td><td>249</td></tr>
</table>

*Table includes only pipes / conduits within the model extents.

4.3 CULVERTS

TCDC's GIS data contains very limited information on culvert structures in the Whangamata catchment. As these structures are potentially critical points in a drainage system it is recommended that a data capture initiative is undertaken to collect at a minimum the location, diameter / area, shape, upstream and downstream inverts and inlet and outlet conditions.

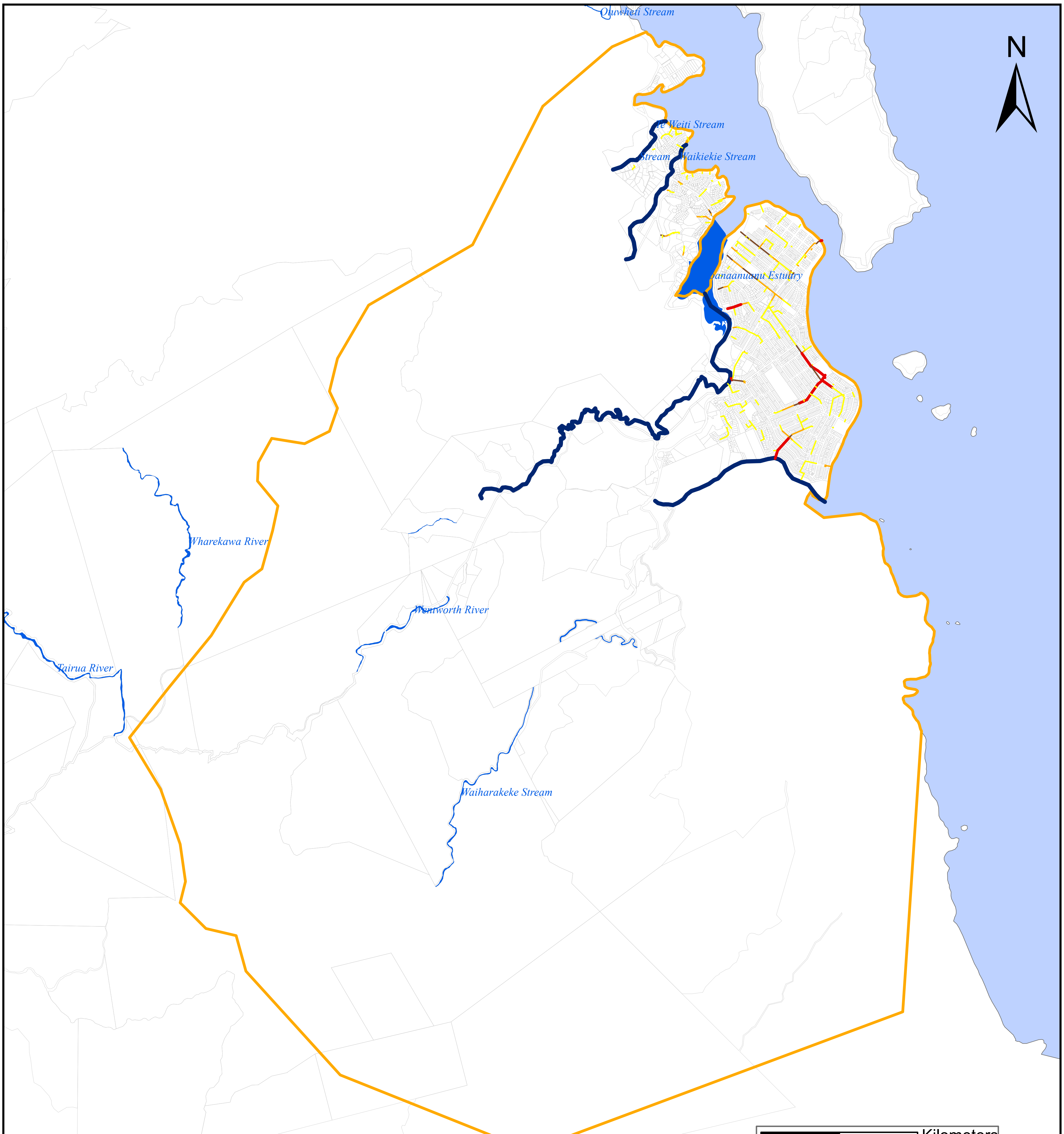
4.4 ASSET DATA – FINDINGS AND RECOMMENDATIONS

Overall the provided GIS data on pipes, manholes and culverts is of a poor standard, with a reasonable amount of effort required to develop piped model network based on the provided GIS data.

The following actions are recommended:

- Greater effort than originally anticipated is required to develop the pipe network data to level a suitable for modelling. Much of this work can be done using engineering judgement to interpolate / estimate missing data as a desktop study with site visits to confirm connectivity. In addition if budget is available a targeted data capture program can be carried out to further improve confidence in the model network and GIS.
- The missing culvert data is recommended to be collected.

FIGURE 4-1: PROPOSED MODEL NETWORK



NOTE: The Whangamata southern catchment boundary is arbitrarily drawn at this stage as contour data is not available for the southern portion of the catchment.

Legend

SEA
PARCEL
RIVER
WHANGAMATA CATCHMENT
Modelled Streams
Modelled Channels
Modelled Overland Flowpath

Modelled Pipes

Diameter (mm)

100 - 250
251 - 400
401 - 525
526 - 675
676 - 1050

STORMWATER CATCHMENT MANAGEMENT PLAN MODELLING

WHANGAMATA STORMWATER CATCHMENT

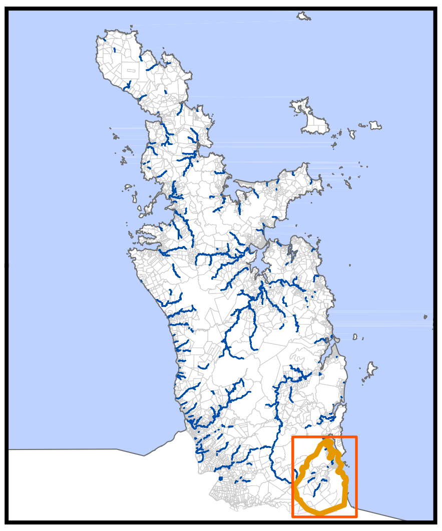
THAMES COROMANDEL DISTRICT COUNCIL

FEBRUARY 2006
FINAL A

DRAWN: TAL
CHECKED: TAD

SCALE (A3):1:50,000

WEC water engineering consultants



5.0 STREAM AND CHANNEL DATA

5.1 STREAMS

Modelled Streams

The following streams / rivers are included in the model extents (see Figure 4-1 for location):

- Te Weiti
- Waikiekie Stream
- Waiharakeke Stream

The above streams will be integrated into the SWMM stormwater model, while this integration obviously has benefits in time and reduces the number of required models it should be noted that SWMM is not a river modelling package and hence does not simulate many of the features of a river network that a river-modelling package such as HEC-RAS simulates. For the purpose of floodplain mapping, the integration of the river network into SWMM is acceptable. However, if specific structures on these rivers need to be designed or investigated then a more specific modelling approach / package may be required.

The crossections and locations of these streams have been developed using the LIDAR data see Figure 4-1. NOTE: there are limitations in using LIDAR data to represent the river crossections, as the LIDAR data is unlikely to provide accurate invert levels for the rivers. However as the model will be used mainly to simulate extreme events, this assumption will be acceptable for most locations. Critical locations identified during preliminary model runs, these crossections should be refined with a site survey.

5.2 CHANNELS

The provided GIS asset data does not include any data on the channelised stormwater system in the Whangamata catchment. A site walk prior to model build should be undertaken to identify the location and connectivity of any significant channels. Once significant channels have been identified, a representative channel crossection will be developed from the LIDAR data, NOTE: there are obvious limitations in using LIDAR data to represent the channel crossections as the LIDAR data is unlikely to provide accurate invert levels for the channels. However as the model will be used mainly to simulate extreme events, this assumption will be acceptable for most locations. At critical locations, identified during preliminary model runs, these crossections should be refined with a site survey.

Again due to the lack of information in the GIS on the channelised stormwater system to an extent greater than previously envisaged, a greater amount of effort is required to construct this stormwater system. The upshot of this will obviously be that the GIS can be updated, post this work, to reflect a more accurate state of the network.

5.3 STREAM AND CHANNEL – FINDINGS AND RECOMMENDATIONS

While the GIS identifies the location of streams within the catchment, it provides no data on locations of bridges and culverts along the streams. The GIS provides little data on the location and connectivity of channelised drainage system, with much of the data it does provide appears incorrect.

The following actions are recommended:

- Greater effort than originally anticipated is required to develop the channelised stormwater model. This can be achieved through a site walkover and use of the LIDAR data.
- Bridge and Culvert data along the river network should be captured.
- Extensive site walkover to confirm drainage network developed from LIDAR review.
- Critical points on the river and channel network identified during the preliminary model runs may require site surveys to confirm flood hazard.

6.0 OVERLAND FLOWPATHS AND LOCAL PONDING

6.1 OVERLAND FLOWPATHS

Preliminary potential overland flowpaths will be identified during the site walkover and with the LIDAR data. Again at a later date, once the preliminary model runs have been completed, critical overland flow paths may be identified for surveying to refine the LIDAR data.

6.2 LOCAL PONDING

Potential ponding areas have been identified from the LIDAR data, see Figure 4-1 for details. At a later date, post preliminary model runs, a site walkover will be completed to confirm the location and extent of the potential ponding. In addition, at critical ponding points identified during the preliminary model runs, surveying of these points maybe required to further refine the model.

6.3 OVERLAND FLOWPATHS AND LOCAL PONDING – FINDINGS AND RECOMMENDATIONS

Preliminary potential OFP's and Ponding areas have been identified from the LIDAR data.

The following actions are recommended:

- Critical points on the overland flowpaths and local ponding identified during the preliminary model runs may require site surveys to confirm flood hazard.

7.0 RAINFALL DATA

7.1 DESIGN RAINFALL SCENARIOS

Design rainfall scenarios will be developed from the HIRDS rainfall database, where storms from 10mins up to 72hr duration will be nested into a single storm for each ARI. The following design storms will be developed:

- 1 in 5yr ARI
- 1 in 10yr ARI
- 1 in 50yr ARI
- 1 in 100yr ARI

At the time of writing this report the HIRDS rainfall database has not been provided by TCDC.

7.2 RAINFALL – FINDINGS AND RECOMMENDATIONS

The following actions are recommended:

- HIRDS database to be provided by TCDC.

8.0 TIDAL DATA

8.1 TIDAL LEVELS

Tidal Levels are required for downstream water level boundary condition for the 4 design storms (5yr, 10yr, 50yr and 100yr).

In addition the 50yr and 100yr highest flood level is required, for hazard mapping purposes (see section 2.4.7 for more details).

8.2 TIDAL DATA ANOMALY SUMMARY – FINDINGS AND RECOMMENDATIONS

The following actions are recommended:

- TCDC to provide tide level for the downstream water level boundary condition for the 4 design storms (5yr, 10yr, 50yr and 100yr)
- TCDC to provide the 100yr and 50yr tide levels for flood hazard mapping purposes.

9.0 FINDINGS AND RECOMMENDATIONS

Modelling Methodology
The following actions are recommended:
- A freeboard of 500mm.

Catchment Data
The following actions are recommended:
- Confirmation from TCDC of site impervious coverage
- Confirmation that there are no additional reported flooding issues other than those detailed in this report
- Confirmation that the Hydrologic Soil Groups are acceptable

Asset Data
The following actions are recommended:
- Greater effort than originally anticipated is required to develop the pipe network data to a level suitable for modelling. Much of this work can be done using engineering judgement to interpolate / estimate missing data as a desktop study with site visits to confirm connectivity. In addition if budget is available a targeted data capture program can be carried out to further improve confidence in the model network and GIS.
- The missing culvert data is recommended to be collected.
- Confirmation of LIDAR and GIS level datum.

Stream and Channel Data
The following actions are recommended:
- Greater effort than originally anticipated is required to develop the channelised stormwater system. Much of this work can be done through site walkovers and using the LIDAR data.
- Bridge and Culvert data along the river network should be captured.
- Extensive site walkover to confirm drainage network developed from LIDAR review.
- Critical points on the river network identified during the preliminary model runs may require site surveys to confirm flood hazard.

Overland Flowpaths and Ponding
The following actions are recommended:
- Critical points on the overland flowpaths and local ponding identified during the preliminary model runs may require site surveys to confirm flood hazard.

Rainfall Data
The following actions are recommended:
- Collection of HIRDS database

Tidal Data
The following actions are recommended:
- TCDC to provide tide level for the downstream water level boundary condition for the 4 design storm scenarios (5yr, 10yr, 50yr and 100yr)
- TCDC to provide the 100yr and 50yr tide levels for flood hazard mapping purposes.

REFERENCES

Future Development Potential of Whangamata, TCDC policy and Planning Group, April 2005.

*Geological Map Of New Zealand***,** Institute of Geological & Nuclear Sciences (GNS). 1972.

SCS Urban Hydrology for Small Watersheds, 2nd Ed., (TR-55), Natural Resource Conservation Service (NRCS), June 1986

Stormwater Catchment Management Plan Modelling, Proposal Documentation, Water Engineering Consultants, September 2005.

Whangamata Stormwater Catchment Management Study – Stormwater Catchment Management Plan Issues and Options Report, Draft – Version 2, Opus International Consultants Limited, September 2005.

BIBLIOGRAPHY

APPENDIX A – GIS ASSET DATA QUALITY SUMMARY

	Flag Number	Hierarchy
	-1	No Data
	1a	Existing GIS Data Over-ridden by Modeller
	1b	Blank Data Estimated by Modeller
	1d	From As-built Drawings
	2	Survey
	3	GIS
	4	Overidden GIS Data with LIDAR Data
	5	From LIDAR updated blank
	6	Inferred Level from Depth & LIDAR Data
	7	IL=GL-1

NEW ASSET ID	OLD ASSET ID	ASSET TYPE	DEPTH	DIAM	INVERT	LID LEVEL	X COORDINATE	Y COORDINATE
201218	26468	CP	1.5		1.01	2.514	1854331.243	5878198.911
201225	26672	CP	0.8		10.94	11.74	1853664.632	5879766.402
201258	27149	CP	0.8		4.53	5.325	1853287.302	5880206.152
201292	27778	CP	0.8		0.75	1.545	1854267.148	5877176.599
201299	27803	CP	0.8		1.26	2.063	1854306.744	5877274.829
201302	27809	CP	0.8		4.04	4.837	1854466.301	5877226.889
201303	27810	CP	0.8		3.98	4.777	1854466.598	5877243.955
201304	27811	CP	0.8		3.98	4.775	1854453.685	5877250.574
201635	50151	CP	0.8		3.91	4.705	1854453.933	5877620.308
201636	50152	CP	0.8		3.88	4.679	1854459.985	5877630.796
201637	50153	CP	0.8		3.89	4.693	1854490.355	5877601.492
201638	50154	CP	0.8		3.86	4.659	1854494.37	5877607.881
201645	50193	CP	0.8		3.33	4.126	1854513.187	5878254.129
201649	50199	CP	0.9		3.91	4.814	1854658.718	5878001.041
201653	50212	CP	0.8		1.77	2.566	1854660.268	5878966.205
201654	50213	CP	0.8		1.73	2.531	1854644.313	5878941.11
201661	50257	CP	0.8		2.70	3.503	1854785.622	5878857.207
201662	50258	CP	0.8		2.73	3.528	1854779	5878849.268
201664	50261	CP	0.8		2.81	3.614	1854801.058	5878831.812
201667	50266	CP	0.8		2.79	3.59	1854870.249	5878790.46
201668	50267	CP	0.8		2.75	3.546	1854863.636	5878782.502
201670	50271	CP	0.9		2.36	3.259	1854894.022	5878758.447
201672	50275	CP	0.6		3.42	4.018	1854837.463	5878673.654
201673	50276	CP	0.5		3.26	3.764	1854831.897	5878666.865
201677	50282	CP	0.8		3.15	3.947	1854988.841	5878683.642
201678	50284	CP	0.8		3.16	3.958	1855054.313	5878658.997
201679	50285	CP	0.8		3.26	4.063	1855039.726	5878642.85
201680	50287	CP	0.8		3.11	3.907	1855089.044	5878631.773
201681	50288	CP	0.8		3.21	4.005	1855075.529	5878614.586
201682	50290	CP	0.8		3.39	4.187	1855023.836	5878555.958
201684	50343	CP	0.8		2.64	3.442	1854791.633	5878938.74
201685	50344	CP	0.9		2.59	3.491	1854783.94	5878936.85
201686	50347	CP	0.9		2.47	3.366	1854977.907	5878964.675
201687	50348	CP	0.8		2.73	3.531	1854971.772	5878957.286
201692	50362	CP	0.8		2.90	3.7	1855148.703	5878722.344
201695	50365	CP	0.8		2.47	3.27	1855310.643	5878927.872
201696	50366	CP	0.9		2.30	3.197	1855319.969	5878939.24
201702	50393	CP	0.8		4.38	5.176	1854905.483	5877797.752
201705	50400	CP	0.8		3.86	4.663	1854761.742	5878180.364
201706	50403	CP	0.9		3.41	4.311	1854937.865	5878111.419
201710	50410	CP	0.8		3.61	4.407	1854838.931	5878359.648
201713	50414	CP	0.8		3.40	4.199	1854756.3	5878453.989
201716	50418	CP	0.8		3.08	3.879	1854720.207	5878385.203
201717	50421	CP	1.2		2.80	4.002	1854955.973	5878281.694
201727	50481	CP	0.9		3.58	4.483	1855027.901	5877894.073
201745	50536	CP	1.35		-0.25	1.097	1854983.44	5879367.533
201749	50543	CP	0.9		1.12	2.019	1854885.1	5879258.275
201752	50548	CP	0.8		1.04	1.838	1855155.201	5879217.313
201755	50557	CP	0.8		2.36	3.164	1855378.894	5879006.036
201758	50562	CP	1.7		1.11	2.805	1854826.01	5879158.385
201762	50569	CP	0.9		2.82	3.716	1854824.658	5878999.298
201769	50621	CP	0.8		3.16	3.959	1855295.504	5877435.216
201779	50663	CP	0.8		2.34	3.141	1855368.298	5877178.538
201784	50670	CP	0.9		2.45	3.351	1855296.996	5877088.027
201795	50688	CP	0.8		2.70	3.497	1855226.296	5877015.002
201803	50701	CP	0.8		3.42	4.219	1854847.466	5876848.066
201804	50702	CP	0.8		3.37	4.166	1854838.395	5876842.607
201881	50963	CP	0.8		3.18	3.979	1855221.711	5876071.904
201887	50971	CP	0.8		2.27	3.069	1855487.698	5876175.892
201888	50972	CP	0.9		2.17	3.069	1855498.409	5876173.663
201889	50974	CP	0.9		2.12	3.021	1855496.207	5876158.446
201890	50975	CP	0.8		2.28	3.076	1855484.638	5876160.786
202873	95184	CP	1.49		0.49	1.978	1854269.844	5878400.5
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300629	25548	UN	1.6		1.35	2.95	1853398.473	5880351.143
300631	25554	UN	3.45		-0.87	2.58	1853407.18	5880377.297
300632	25556	UN	1.3		0.62	1.92	1853451.156	5880404.792
300634	25560	UN	1.05		0.95	2.001	1853491.049	5880404.602
300635	25564	UN	1.85		1.54	3.389	1853537.712	5880370.149
300641	25583	UN	3.05		-1.99	1.06	1853583.007	5880432.836
300642	25589	UN	2		1.31	3.314	1853602.252	5880408.591
300643	25591	UN	1.25		2.01	3.255	1853584.095	5880394.244
300644	25593	UN	1		0.29	1.29	1853656.56	5880417.419
300646	25601	UN	2		-0.13	1.874	1853728.966	5880365.3
300648	25612	UN	1.95		2.93	4.878	1853597.445	5880269.969
300649	25618	UN	3.7		1.10	4.802	1853663.305	5880230.727
300672	26667	UN	1.4		-0.22	1.182	1853657.054	5879898.755
300673	26702	UN	2.5		4.47	6.97	1853721.693	5879859.513
300674	26703	UN	3		7.66	10.657	1853726.723	5879826.349
300677	26710	UN	2.6		6.21	8.809	1853800.944	5879860.762
300678	26711	UN	0.86		4.67	5.529	1853794.125	5879886.247

	Flag Number	Hierarchy
	-1	No Data
	1a	Existing GIS Data Over-ridden by Modeller
	1b	Blank Data Estimated by Modeller
	1d	From As-built Drawings
	2	Survey
	3	GIS
	4	Overidden GIS Data with LIDAR Data
	5	From LIDAR updated blank
	6	Inferred Level from Depth & LIDAR Data
	7	IL=GL-1

NEW ASSET ID	OLD ASSET ID	ASSET TYPE	DEPTH	DIAM	INVERT	LID LEVEL	X COORDINATE	Y COORDINATE
300680	26719	UN	2		4.00	6.00	1854016.045	5879892.906
300681	26723	UN	1.38		3.83	5.21	1854040.115	5879811.612
300689	26975	UN	2.8		8.25	11.049	1853643.597	5879762.502
300691	26977	UN	2.1		10.37	12.467	1853558.508	5879657.784
300692	26980	UN	2.7		13.56	16.264	1853512.142	5879668.602
300693	26981	UN	3.3		13.84	17.135	1853502.535	5879685.428
300694	26989	UN	3.3		13.80	17.10	1853684.686	5878905.637
300711	27705	UN	1		2.84	3.836	1854479.882	5876696.377
300712	27708	UN	1.1		2.33	3.434	1854511.126	5876656.625
300713	27711	UN	1.3		1.85	3.154	1854560.172	5876693.997
300717	27741	MH	1.4		7.62	9.023	1854334.261	5876946.886
300718	27743	MH	1.5		4.26	5.763	1854361.307	5876954.194
300719	27745	MH	1.6		1.90	3.501	1854405.777	5876958.283
300720	27747	MH	1.2		2.34	3.539	1854487.774	5876956.764
300721	27748	MH	1		2.19	3.189	1854469.352	5876995.146
300722	27752	UN	1		2.64	3.637	1854402.742	5876843.817
300723	27776	UN	1.4		0.22	1.617	1854272.829	5877185.817
300724	27779	UN	1.2		1.29	2.486	1854306.538	5877101.144
300725	27783	UN	1		1.82	2.816	1854389.343	5877126.829
300726	27798	UN	1.4		3.63	5.032	1854340.709	5877448.343
300727	27799	UN	2.06		2.13	4.189	1854330.031	5877417.13
300728	27800	UN	1.32		1.36	2.682	1854318.388	5877323.859
300729	27801	UN	1.96		0.55	2.512	1854301.31	5877264.801
300730	27807	UN	1		3.81	4.811	1854438.274	5877247.694
301043	50005	UN	1.5		7.62	9.119	1853899.911	5879625.71
301044	50006	MH	2.1		2.18	4.275	1853926.38	5879651.975
301051	50023	UN	2.2		0.80	3.00	1854137.251	5879771.631
301052	50024	UN	1.8		0.80	2.601	1854153.199	5879744.886
301055	50059	UN	1.5		0.96	2.46	1854121.633	5879552.425
301056	50060	UN	1.5		-0.21	1.291	1854173.054	5879572.851
301057	50061	UN	1.24		-0.37	0.866	1854198.963	5879583.529
301058	50066	UN	1.5		0.36	1.864	1854168.775	5879551.855
301059	50070	UN	1.6		1.47	3.067	1854050.315	5879500.986
301060	50073	UN	1.9		1.51	3.41	1854034.681	5879496.477
301062	50097	UN	1.36		3.31	4.671	1854011.271	5879424.711
301063	50100	UN	2.1		4.24	6.339	1854033.823	5879388.809
301064	50111	UN	2.06		5.10	7.155	1854011.576	5879317.923
301065	50112	UN	2.38		5.35	7.73	1853966.793	5879352.116
301066	50113	UN	2.4		8.22	10.618	1853908.091	5879347.967
301067	50116	UN	2		8.21	10.211	1853919.849	5879356.415
301068	50121	UN	1.4		8.04	9.437	1853964.27	5879272.672
301069	50149	UN	1.2		3.84	5.041	1854394.629	5877541.624
301070	50150	UN	1.04		3.87	4.908	1854437.787	5877617.599
301071	50161	UN	1.66		2.25	3.906	1854365.521	5877938.934
301072	50162	MH	1.27		2.87	4.135	1854460.505	5877913.589
301073	50164	UN	1.76		3.53	5.29	1854575.815	5877854.811
301074	50165	MH	1.02		4.07	5.094	1854619.295	5877826.736
301075	50166	MH	0.9		4.25	5.146	1854630.798	5877833.445
301076	50176	UN	1.1		3.93	5.034	1854677.667	5877773.437
301077	50177	UN	1.05		4.16	5.207	1854687.843	5877760
301078	50188	UN	1.94		1.76	3.699	1854414.806	5878228.975
301079	50191	UN	1.1		3.09	4.19	1854507.341	5878251.8
301080	50194	UN	1		3.06	4.062	1854582.04	5878143.292
301081	50198	UN	1.2		3.67	4.866	1854644.997	5878009.879
301082	50211	UN	2.1		0.73	2.83	1854653.82	5878959.786
301083	50221	UN	1.56		2.47	4.026	1854633.445	5878536.682
301085	50225	UN	1.63		1.96	3.585	1854441.729	5878687.891
301087	50228	MH	1.21		0.63	1.835	1854334.121	5878773.174
301088	50230	MH	1.5		-0.26	1.245	1854301.302	5878799.249
301089	50241	UN	1.03		0.24	1.268	1854354.884	5878905.067
301090	50242	UN	1.11		0.64	1.748	1854412.143	5878855.457
301091	50243	UN	0.9		2.56	3.458	1854534.297	5878757.257
301092	50256	UN	2.31		1.35	3.658	1854785.012	5878856.317
301093	50265	UN	1.515		2.08	3.59	1854869.614	5878789.64
301094	50268	UN	1.71		1.69	3.398	1854900.313	5878765.675
301095	50273	UN	1.09		2.42	3.505	1854895.679	5878748.059
301096	50274	UN	0.71		3.31	4.018	1854838.445	5878675.244
301098	50280	UN	1.3		2.76	4.055	1854995.289	5878690.681
301099	50283	UN	1.35		2.93	4.275	1855046.438	5878650.679
301100	50286	UN	1.58		2.59	4.166	1855082.299	5878623.054
301101	50289	MH	1.06		3.25	4.314	1855017.083	5878546.62
301102	50291	MH	0.9		3.41	4.314	1855033.137	5878533.833
301105	50345	UN	1		2.64	3.635	1854782.711	5878946.708
301106	50346	UN	1		2.66	3.664	1854984.248	5878968.914
301107	50353	UN	1.56		2.48	4.04	1855305.951	5878963.055
301108	50355	UN	1.28		2.65	3.932	1855227.187	5878864.275
301109	50358	UN	1.1		2.73	3.825	1855179.699	5878803.278
301110	50360	UN	1		3.07	4.067	1855124.312	5878739.071
301111	50382	MH	1.35		3.77	5.117	1854673.503	5878059.519
301112	50383	MH	1.3		3.81	5.109	1854697.507	5878045.522
301113	50385	MH	1.2		4.05	5.253	1854769.584	5878006.34
301114	50386	MH	1		4.79	5.785	1854859.183	5877879.896
301117	50394	UN	1.4		3.65	5.046	1854684.965	5878078.965

	Flag Number	Hierarchy
	-1	No Data
	1a	Existing GIS Data Over-ridden by Modeller
	1b	Blank Data Estimated by Modeller
	1d	From As-built Drawings
	2	Survey
	3	GIS
	4	Overidden GIS Data with LIDAR Data
	5	From LIDAR updated blank
	6	Inferred Level from Depth & LIDAR Data
	7	IL=GL-1

NEW ASSET ID	OLD ASSET ID	ASSET TYPE	DEPTH	DIAM	INVERT	LID LEVEL	X COORDINATE	Y COORDINATE
301118	50395	UN	1.45		3.76	5.212	1854702.487	5878100.801
301119	50396	UN	1.55		3.63	5.182	1854735.85	5878158.629
301120	50398	UN	2.34		3.25	5.593	1854763.597	5878205.929
301121	50401	UN	1.2		4.01	5.211	1854821.508	5878124.686
301122	50402	MH	1.1		3.68	4.778	1854887.351	5878149.441
301123	50405	MH	1		3.53	4.531	1854893.007	5878024.166
301124	50407	UN	1.7		3.13	4.83	1854808.215	5878283.673
301125	50409	MH	2.3		2.60	4.895	1854853.163	5878363.077
301126	50413	UN	1.83		2.52	4.348	1854747.625	5878446.81
301127	50417	UN	1		3.02	4.023	1854711.863	5878392.781
301128	50419	MH	1.27		3.11	4.381	1854897.114	5878328.424
301129	50420	MH	1.25		2.82	4.074	1854945.937	5878289.402
301130	50422	UN	1		3.00	4.002	1855047.254	5878211.748
301131	50480	UN	1.1		3.94	5.039	1855004.186	5877867.248
301132	50484	UN	1.3		3.23	4.527	1855087.436	5877749.982
301133	50486	UN	1.4		3.35	4.751	1855122.753	5877701.232
301134	50491	MH	2.17		2.68	4.85	1855191.334	5877603.982
301135	50492	MH	1.45		3.68	5.132	1855206.086	5877621.978
301136	50494	MH	1.65		3.76	5.407	1855237.37	5877644.783
301137	50497	UN	1		4.31	5.308	1855202.095	5877695.323
301138	50500	MH	1		3.74	4.743	1855311.533	5877696.463
301139	50537	UN	1.3		-0.05	1.249	1854978.558	5879358.995
301140	50541	UN	1.2		0.10	1.297	1854957.572	5879348.167
301141	50542	MH	1		0.97	1.967	1854906.333	5879285.2
301142	50550	UN	3.81		-0.99	2.824	1855431.197	5879042.779
301143	50554	UN	1.12		2.32	3.435	1855380.691	5879008.196
301144	50555	UN	1.79		2.34	4.13	1855352.136	5879011.625
301146	50559	UN	1.3		2.24	3.537	1855007.971	5879014.505
301147	50566	MH	1.6		1.09	2.693	1854735.743	5879064.305
301148	50568	UN	1.3		2.47	3.774	1854821.368	5878995.199
301149	50571	MH	1.8		0.97	2.771	1854700.038	5879018.404
301151	50617	UN	1.2		3.23	4.429	1855325.741	5877456.802
301152	50620	UN	1.92		2.39	4.305	1855308.788	5877438.625
301153	50623	UN	1.68		2.05	3.728	1855424.815	5877275.939
301154	50624	UN	1.87		1.76	3.629	1855447.202	5877261.981
301155	50625	UN	2.4		0.79	3.19	1855481.167	5877313.381
301156	50628	UN	1.71		1.88	3.591	1855438.066	5877246.335
301157	50631	UN	1.97		2.06	4.033	1855512.188	5877216.101
301158	50632	UN	1.82		2.21	4.028	1855576.918	5877169.43
301159	50634	UN	1.32		2.12	3.436	1855658.923	5877111.162
301160	50659	UN	1.54		1.97	3.509	1855398.337	5877213.221
301161	50661	UN	1.37		2.02	3.387	1855372.709	5877177.329
301162	50664	UN	1		2.50	3.495	1855379.545	5877167.271
301163	50668	UN	1.43		2.20	3.634	1855305.192	5877082.388
301164	50674	UN	1.4		2.30	3.698	1855348.409	5877057.653
301165	50675	UN	1.2		2.80	3.995	1855421.096	5877005.774
301166	50676	UN	1.1		2.97	4.073	1855439.674	5876962.882
301168	50682	UN	1.28		2.33	3.609	1855256.278	5877011.862
301169	50685	UN	1.26		2.38	3.642	1855219.147	5876995.926
301171	50689	UN	1.425		2.44	3.862	1855177.258	5876975.2
301172	50692	UN	1.3		2.62	3.917	1855094.082	5876942.207
301173	50696	UN	1.1		3.18	4.28	1854944.156	5876878.15
301175	50700	UN	0.9		3.42	4.324	1854853.757	5876839.947
301176	50747	UN	1.4		2.27	3.673	1855592.065	5877026.889
301177	50750	UN	1.2		2.58	3.779	1855565.975	5876902.135
301178	50753	UN	1.1		2.73	3.831	1855554.893	5876853.035
301179	50756	UN	1		2.69	3.69	1855544.561	5876811.293
301181	50765	UN	1		2.30	3.302	1855662.584	5876799.126
301182	50787	UN	1.1		1.49	2.589	1854675.276	5876618.742
301183	50792	UN	1.3		0.60	1.898	1854710.214	5876509.085
301187	50824	MH	1.2		2.25	3.449	1855177.819	5876717.562
301188	50827	MH	1		2.76	3.761	1855263.163	5876769.942
301189	50834	UN	1.27		2.05	3.317	1855208.296	5876641.558
301190	50836	UN	1.1		2.77	3.871	1855316.159	5876673.651
301191	50837	UN	1		2.88	3.883	1855330.276	5876668.272
301192	50841	UN	1.73		1.54	3.268	1855067.25	5876566.613
301193	50842	UN	1.19		1.37	2.563	1855034.844	5876532.53
301196	50857	UN	1.2		1.50	2.695	1854942.713	5876611.294
301197	50863	UN	1		2.51	3.511	1854910.926	5876685.469
301198	50866	UN	1.9		1.86	3.764	1854959.081	5876448.247
301200	50874	MH	2.505		0.63	3.135	1854882.106	5876362.814
301201	50879	MH	1		1.82	2.816	1854831.477	5876360.975
301202	50951	UN	1		3.44	4.443	1855371.481	5876484.53
301203	50952	UN	1.3		3.00	4.301	1855308.12	5876316.204
301204	50955	UN	1.22		2.77	3.993	1855285.872	5876216.784
301205	50960	UN	1.6		2.57	4.169	1855236.373	5876227.452
301206	50961	UN	2.08		2.55	4.628	1855166.349	5876091.36
301207	50962	UN	2.17		2.83	5.00	1855220.219	5876068.274
301208	50966	UN	0.9		2.69	3.59	1855377.756	5876197.228
301209	51006	UN	1		2.80	3.796	1855839.408	5877103.324
301210	51007	UN	1.2		2.33	3.53	1855861.902	5877048.175
301211	51012	UN	1.2		2.51	3.706	1855697.266	5876862.393
301212	51014	UN	1.4		1.90	3.298	1855716.165	5876954.844

	Flag Number	Hierarchy
	-1	No Data
	1a	Existing GIS Data Over-ridden by Modeller
	1b	Blank Data Estimated by Modeller
	1d	From As-built Drawings
	2	Survey
	3	GIS
	4	Overidden GIS Data with LIDAR Data
	5	From LIDAR updated blank
	6	Inferred Level from Depth & LIDAR Data
	7	IL=GL-1

NEW ASSET ID	OLD ASSET ID	ASSET TYPE	DEPTH	DIAM	INVERT	LID LEVEL	X COORDINATE	Y COORDINATE
301213	51017	UN	1.6		2.30	3.902	1855733.358	5877040.127
301214	51020	UN	1.56		1.89	3.449	1855705.404	5877077.899
301215	51023	UN	1.6		1.81	3.412	1855689.902	5877068.631
301650	95207	UN	2.15		1.89	4.042	1855396.474	5877382.447
301926	99337	UN	1.4		1.82	3.223	1854592.059	5878854.867
301927	99338	UN	0.9		0.87	1.765	1854482.702	5878939.48
301928	99339	UN	0.9		0.21	1.107	1854347.899	5878983.681
301929	99340	UN	1.18		0.59	1.771	1854384.503	5879019.264
301933	99368	UN	2.73		7.37	10.1	1853639.144	5879781.938
302006	102936	UN	1.61		2.73	4.343	1854413.116	5877250.984
302011	102986	UN	0.94		3.10	4.044	1855345.729	5877387.066
550021	50259	NO	1.5		2.09	3.592	1854807.3	5878838.62
551081	25562	OU	0.8		0.05	0.85	1853528.93	5880469.998
551082	25587	OU	0.8		-0.30	0.50	1853584.689	5880454.302
551083	25607	OU	1		-1.00	0.00	1853747.899	5880316.24
551084	25620	OU	1.5		3.28	4.781	1853669.11	5880228.418
551086	26666	OU	1		4.95	5.948	1853709.135	5879915.451
551087	26670	OU	1		6.58	7.576	1853614.522	5879798.245
551088	26701	OU	1		5.18	6.183	1853737.723	5879868.611
551089	26712	OU	0.7		3.70	4.398	1853789.763	5879898.475
551091	26720	OU	1		0.28	1.28	1854018.107	5879921.36
551092	26724	OU	1		1.98	2.98	1854052.624	5879803.504
551094	26988	OU	1.5		12.71	14.21	1853674.47	5878860.416
551095	27148	OU	0.9		2.59	3.49	1853312.947	5880215.84
551101	27714	OU	1		2.51	3.508	1854521.334	5876743.937
551103	27746	OU	1.5		2.26	3.761	1854429.88	5876911.433
551104	27754	OU	1		2.52	3.523	1854460.002	5876877.47
551105	27775	OU	1		11.33	12.334	1854245.469	5877216.261
551106	27802	OU	1		1.06	2.056	1854288.81	5877284.387
551145	50009	OU	0.8		4.01	4.805	1853972.095	5879702.285
551147	50022	OU	0.8		1.21	2.01	1854126.705	5879796.426
551148	50062	OU	1		-0.26	0.74	1854217.326	5879590.847
551150	50103	OU	1.4		4.19	5.586	1854033.939	5879368.583
551151	50110	OU	1.5		5.12	6.624	1854027.276	5879316.463
551152	50120	OU	1		6.51	7.507	1854018.404	5879275.392
551154	50160	OU	0.7		2.39	3.092	1854313.374	5877931.915
551155	50240	OU	0.9		0.89	1.786	1854296.932	5878955.957
551157	50535	OU	0.8		-0.37	0.43	1854993.021	5879384.919
551158	50547	OU	1		0.64	1.64	1855175.089	5879248.787
551159	50549	OU	1		-1.00	0.00	1855448.357	5879045.348
551160	50564	OU	1		0.40	1.4	1854730.589	5879233.25
551161	50793	OU	1		0.02	1.02	1854667.113	5876488.169
551163	50883	OU	1.5		-1.50	0.00	1854849.61	5876256.046
551165	50965	OU	0.34		0.66	1.00	1855183.088	5875992.53
551166	50976	OU	1		3.00	4.00	1855553.227	5876160.776
551639	99364	OU	1		2.06	3.06	1854268.797	5878715.825
551763	50973	PS	2		1.15	3.154	1855499.3	5876169.424

	Flag Number	Hierarchy
	-1	No Data
	1	Over-ridden by Modeller
	1a	GIS Dia increased to match US Dia
	1b	Material Changed to Match US and DS Materials
	1c	GIS Dia changed to a nominal pipe size
	1d	As Built Data
	2	Survey
	3	GIS
	4	LIDAR

ASSETID	ID	ASSETTYPE	MATERIAL	DIA(m)	USNODE_ID	DSNODE_ID	USLEVEL	DSLEVEL
404140	301172_301171	GM	RC	0.6	301172	301171	2.617	2.362
404139	301173_301172	GM	RC	0.45	301173	301172	3.180	2.617
404138	301125_301126	GM	RC	0.525	301125	301126	3.095	2.348
404137	301119_301120	GM	RC	0.375	301119	301120	3.632	3.993
404136	301122_301121	GM	RC	0.3	301122	301121	3.678	4.011
404135	301181_301211	GM	RC	0.3	301181	301211	2.302	2.506
404133	300730_302006	GM	CC	0.6	300730	302006	3.311	4.343
404132	301073_301072	GM	AC	0.375	301073	301072	3.530	2.735
403902	301152_302011	GM	RC	0.6	301152	302011	4.305	4.044
403851	301125_301126	GM	RC	0.525	301125	301126	3.095	2.348
403850	301083_301085	GM	RC	0.675	301083	301085	1.826	1.085
403677	301933_551087	GM	RC	0.525	301933	551087	7.370	6.576
403676	203255_551639	GM	RC	0.3	203255	551639	3.977	2.060
403675	301928_301929	GM	AL	0.375	301928	301929	0.207	0.471
403674	301927_301929	GM	AL	0.375	301927	301929	0.965	0.471
403673	301926_301927	GM	AL	0.375	301926	301927	1.823	0.965
403252	300643_300641	GM	RC	0.3	300643	300641	3.255	1.060
403251	300643_300644	GM	RC	0.3	300643	300644	3.255	1.290
403249	301152_301650	GM	RC	0.75	301152	301650	4.305	4.042
403248	301650_301155	GM	RC	0.825	301650	301155	4.042	3.190
403245	301110_301109	GM	RC	0.3	301110	301109	4.067	3.825
403240	300625_202873	GM	AC	0.375	300625	202873	2.383	1.978
403230	301111_301119	GM	RC	0.375	301111	301119	5.117	5.182
403227	201702_301114	GM	RC	0.3	201702	301114	5.176	5.785
401512	301134_301152	GM	RC	0.75	301134	301152	3.350	2.505
401511	301212_301213	GM	RC	0.3	301212	301213	1.898	2.302
401510	301211_301212	GM	RC	0.3	301211	301212	2.506	1.898
401509	301181_301211	GM	RC	0.3	301181	301211	2.302	2.506
401508	301213_301214	GM	RC	0.375	301213	301214	2.302	1.749
401507	301176_301215	GM	RC	0.375	301176	301215	2.273	1.812
401506	301215_301214	GM	RC	0.45	301215	301214	1.812	1.749
401505	301214_301159	GM	RC	0.375	301214	301159	1.749	1.636
401504	551763_551166	GM	RC	0.45	551763	551166	1.154	3.000
401503	201889_551763	GM	CC	0.45	201889	551763	2.101	1.154
401502	201890_201889	GM	RC	0.45	201890	201889	2.276	2.121
401501	201887_201888	GM	CC	0.45	201887	201888	2.159	2.219
401500	201888_551763	GM	RC	0.45	201888	551763	2.169	1.154
401499	301208_301204	GM	AC	0.3	301208	301204	3.090	2.773
401498	201881_301207	GM	AC	0.375	201881	301207	3.179	3.700
401497	301205_301204	GM	AC	0.3	301205	301204	2.969	2.393
401496	301206_301205	GM	AC	0.3	301206	301205	3.128	1.829
401495	301207_301206	GM	AC	0.375	301207	301206	2.640	2.458
401494	551165_301207	GM	AC	0.375	551165	301207	-1.300	4.660
401492	301202_301203	GM	AC	0.3	301202	301203	3.443	2.841
401490	301188_301187	GM	CC	0.3	301188	301187	2.561	2.449
401489	301191_301190	GM	CC	0.375	301191	301190	2.783	2.871
401487	301187_301189	GM	CC	0.375	301187	301189	2.149	2.117
401484	301192_301193	GM	RC	0.6	301192	301193	1.668	0.863
401482	301196_301193	GM	RC	0.45	301196	301193	1.495	0.863
401481	301197_301196	GM	RC	0.3	301197	301196	2.511	1.495
401480	301193_301198	GM	RC	0.75	301193	301198	0.863	2.564
401479	301198_301200	GM	RC	0.9	301198	301200	1.864	1.035
401478	301201_301200	GM	RC	0.3	301201	301200	1.816	1.035
401477	301200_551163	GM	RC	0.9	301200	551163	1.035	-1.500
401476	551161_301183	GM	RC	0.3	551161	301183	-0.280	0.898
401475	301182_301183	GM	RC	0.3	301182	301183	1.489	0.598
401474	301177_301176	GM	RC	0.375	301177	301176	2.579	2.273
401473	301178_301177	GM	RC	0.3	301178	301177	2.731	2.579
401472	301179_301178	GM	RC	0.3	301179	301178	2.690	2.731
401471	301162_301161	GM	RC	0.375	301162	301161	2.495	1.387
401470	301166_301165	GM	RC	0.3	301166	301165	2.973	2.795
401469	301165_301164	GM	RC	0.3	301165	301164	2.795	2.298
401468	301164_301163	GM	RC	0.3	301164	301163	2.298	1.834
401466	301163_301161	GM	RC	0.825	301163	301161	1.834	1.387
401465	301161_301160	GM	RC	0.825	301161	301160	1.387	1.409
401464	301160_301156	GM	RC	0.825	301160	301156	1.409	1.391
401463	301169_301168	GM	RC	0.75	301169	301168	2.042	1.909
401462	301171_301169	GM	RC	0.75	301171	301169	2.362	2.042
401461	301172_301171	GM	RC	0.75	301172	301171	2.617	2.362
401460	301173_301172	GM	RC	0.45	301173	301172	3.180	2.617
401459	301175_301173	GM	RC	0.375	301175	301173	3.424	3.180
401458	201803_301175	GM	RC	0.3	201803	301175	3.419	3.424
401457	201804_201803	GM	RC	0.3	201804	201803	3.366	3.419
401456	301159_301158	GM	RC	0.375	301159	301158	1.636	2.028
401455	301158_301157	GM	RC	0.825	301158	301157	2.028	1.933
401454	301157_301154	GM	RC	0.825	301157	301154	1.933	1.429
401453	301156_301154	GM	RC	0.825	301156	301154	1.391	1.429
401452	301154_301155	GM	RC	0.975	301154	301155	1.329	0.790
401451	301153_301154	GM	RC	0.675	301153	301154	1.728	1.329
401450	301152_301153	GM	RC	0.6	301152	301153	2.505	1.728
401449	201769_301152	GM	RC	0.3	201769	301152	3.159	2.505

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	-1	No Data
	1	Over-ridden by Modeller
	1a	GIS Dia increased to match US Dia
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	4	LIDAR

ASSETID	ID	ASSETTYPE	MATERIAL	DIA(m)	USNODE_ID	DSNODE_ID	USLEVEL	DSLEVEL
401448	301151_301152	GM	RC	0.3	301151	301152	3.229	2.505
401447	301148_301147	GM	CC	0.375	301148	301147	2.224	1.093
401446	301147_301149	GM	CC	0.375	301147	301149	1.693	1.571
401445	301149_301082	GM	CC	0.45	301149	301082	0.971	0.930
401444	201762_301148	GM	CC	0.3	201762	301148	2.816	2.774
401443	301105_301148	GM	CC	0.3	301105	301148	2.535	2.244
401442	301146_201758	GM	RC	0.375	301146	201758	2.237	1.105
401441	201758_551160	GM	RC	0.45	201758	551160	1.105	0.400
401440	301106_301146	GM	AC	0.375	301106	301146	2.664	2.337
401439	301142_551159	GM	RC	1.05	301142	551159	0.924	-1.000
401436	201755_301143	GM	RC	0.6	201755	301143	2.364	1.735
401435	301144_301143	GM	RC	0.525	301144	301143	2.530	1.735
401434	301107_301144	GM	AC	0.525	301107	301144	2.640	2.530
401433	201752_551158	GM	RC	0.375	201752	551158	1.038	0.640
401432	201745_551157	GM	RC	0.3	201745	551157	-0.253	-0.370
401431	301139_201745	GM	RC	0.3	301139	201745	-0.051	-0.253
401430	301140_301139	GM	RC	0.3	301140	301139	0.097	-0.051
401429	301141_301140	GM	RC	0.3	301141	301140	0.967	0.097
401428	201749_301141	GM	RC	0.3	201749	301141	1.119	0.967
401426	301137_301136	GM	RC	0.3	301137	301136	4.308	4.207
401425	301138_301136	GM	RC	0.375	301138	301136	3.743	4.207
401424	301136_301135	GM	RC	0.45	301136	301135	4.207	3.832
401423	301135_301134	GM	RC	0.45	301135	301134	3.832	3.350
401422	301133_301134	GM	RC	0.6	301133	301134	3.351	3.350
401421	301132_301133	GM	RC	0.375	301132	301133	3.227	3.351
401418	201727_301131	GM	RC	0.3	201727	301131	3.583	3.939
401416	301125_301126	GM	RC	0.525	301125	301126	3.095	2.348
401415	301127_301126	GM	RC	0.3	301127	301126	3.023	2.348
401414	201713_301126	GM	RC	0.3	201713	301126	3.399	2.348
401413	301126_301083	GM	RC	0.525	301126	301083	2.348	1.826
401412	301130_201717	GM	RC	0.375	301130	201717	3.002	2.802
401410	301129_301128	GM	RC	0.45	301129	301128	2.824	3.031
401408	201710_301125	GM	CC	0.3	201710	301125	3.607	3.255
401406	301120_301124	GM	CC	0.375	301120	301124	4.133	3.330
401405	201706_301122	GM	RC	0.3	201706	301122	3.411	3.678
401404	301122_301121	GM	RC	0.3	301122	301121	3.678	4.011
401403	301123_301121	GM	RC	0.3	301123	301121	3.531	4.011
401402	301121_301120	GM	RC	0.3	301121	301120	4.011	3.993
401401	301119_301120	GM	RC	0.375	301119	301120	3.632	3.993
401400	201705_301120	GM	CC	0.3	201705	301120	3.863	4.093
401399	301118_301119	GM	RC	0.375	301118	301119	3.762	3.632
401398	301117_301118	GM	RC	0.375	301117	301118	3.646	3.762
401397	301111_301117	GM	RC	0.375	301111	301117	3.767	3.646
401396	301114_301113	GM	RC	0.3	301114	301113	4.785	4.053
401395	301113_301112	GM	RC	0.3	301113	301112	4.053	3.809
401394	301112_301111	GM	RC	0.3	301112	301111	3.809	3.767
401393	301080_301079	GM	RC	0.375	301080	301079	3.062	3.090
401392	201692_301110	GM	RC	0.525	201692	301110	2.900	3.167
401390	301109_301108	GM	AC	0.3	301109	301108	2.725	2.732
401387	301108_301107	GM	AC	0.45	301108	301107	2.732	2.640
401386	201695_201696	GM	RC	0.525	201695	201696	2.470	2.297
401385	201687_201686	GM	RC	0.3	201687	201686	2.731	2.466
401383	201684_301105	GM	CC	0.3	201684	301105	2.792	2.835
401382	201685_301105	GM	CC	0.3	201685	301105	2.691	2.535
401381	301102_301101	GM	AC	0.3	301102	301101	3.314	3.074
401380	201682_301101	GM	CC	0.45	201682	301101	3.387	3.564
401379	301101_301099	GM	AC	0.45	301101	301099	3.074	3.135
401378	201667_301093	GM	CC	0.3	201667	301093	2.790	2.290
401377	201668_301093	GM	CC	0.375	201668	301093	2.746	2.190
401374	201664_550021	GM	CC	0.3	201664	550021	3.014	2.092
401373	201662_301092	GM	CC	0.3	201662	301092	2.728	2.658
401372	201673_201672	GM	AC	0.3	201673	201672	3.264	3.228
401371	201672_301096	GM	AC	0.3	201672	301096	3.418	3.208
401370	301096_301095	GM	AC	0.3	301096	301095	3.158	2.415
401369	301095_301094	GM	AC	0.3	301095	301094	2.415	2.298
401368	201670_301094	GM	AC	0.3	201670	301094	2.359	2.298
401367	201677_301098	GM	CC	0.3	201677	301098	3.147	3.555
401366	201678_301099	GM	CC	0.6	201678	301099	3.158	3.135
401365	201679_301099	GM	CC	0.6	201679	301099	3.263	3.075
401364	201681_301100	GM	CC	0.6	201681	301100	3.205	3.066
401363	201680_301100	GM	CC	0.6	201680	301100	3.107	3.266
401362	301100_301099	GM	CC	0.375	301100	301099	3.066	3.115
401361	301099_301098	GM	CC	0.375	301099	301098	3.105	2.845
401360	301098_301094	GM	CC	0.375	301098	301094	2.905	2.218
401359	301094_301093	GM	AC	0.45	301094	301093	2.168	2.290
401357	550021_301092	GM	CC	0.525	550021	301092	2.092	1.888
401356	301092_301082	GM	CC	0.6	301092	301082	1.828	2.830
401355	301091_301090	GM	RC	0.375	301091	301090	2.558	0.638
401353	301090_301089	GM	CC	0.375	301090	301089	0.638	-0.032
401351	301089_551155	GM	CC	0.525	301089	551155	-0.032	0.886
401349	301083_301085	GM	RC	0.675	301083	301085	1.826	1.085

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	-1	No Data
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ASSETID	ID	ASSETTYPE	MATERIAL	DIA(m)	USNODE_ID	DSNODE_ID	USLEVEL	DSLEVEL
401346	301087_301088	GM	AC	0.45	301087	301088	-0.765	-0.255
401345	201654_301082	GM	CC	0.3	201654	301082	1.731	1.630
401344	201653_301082	GM	CC	0.3	201653	301082	1.766	1.530
401340	301078_201218	GM	RC	0.75	301078	201218	2.399	1.114
401339	301079_301078	GM	RC	0.525	301079	301078	3.090	2.399
401338	201645_301079	GM	RC	0.3	201645	301079	3.326	3.090
401336	301077_301076	GM	AC	0.375	301077	301076	4.157	3.934
401335	301076_301075	GM	AC	0.375	301076	301075	3.934	4.246
401334	301075_301074	GM	AC	0.375	301075	301074	4.246	4.074
401333	301074_301073	GM	AC	0.375	301074	301073	4.074	3.530
401332	301073_301072	GM	AC	0.375	301073	301072	3.530	2.735
401331	301072_301071	GM	AC	0.375	301072	301071	2.865	2.246
401330	301071_551154	GM	AC	0.45	301071	551154	2.246	2.392
401329	201638_201637	GM	CC	0.3	201638	201637	3.859	4.013
401328	201637_201635	GM	AC	0.3	201637	201635	3.893	3.905
401327	201636_201635	GM	RC	0.45	201636	201635	3.879	3.905
401326	201635_301070	GM	CC	0.375	201635	301070	3.755	3.908
401325	301070_301069	GM	CC	0.375	301070	301069	3.908	3.491
401322	301067_301066	GM	RC	0.3	301067	301066	8.211	8.218
401320	301066_301065	GM	RC	0.45	301066	301065	8.218	5.530
401319	301065_301064	GM	RC	0.45	301065	301064	5.530	5.055
401318	301064_551151	GM	RC	0.525	301064	551151	5.055	5.124
401317	301068_551152	GM	RC	0.3	301068	551152	8.037	6.507
401316	301063_551150	GM	RC	0.525	301063	551150	4.239	4.186
401315	301062_301063	GM	RC	0.6	301062	301063	3.471	4.239
401313	301060_301059	GM	RC	0.3	301060	301059	1.510	1.467
401310	301058_301056	GM	RC	0.3	301058	301056	0.364	-0.209
401309	301057_551148	GM	RC	0.525	301057	551148	-0.434	-0.260
401308	301056_301057	GM	RC	0.45	301056	301057	-0.209	-0.434
401307	301044_551145	GM	RC	0.375	301044	551145	2.175	4.005
401306	301043_301044	GM	RC	0.375	301043	301044	7.619	2.175
401304	301052_301051	GM	RC	0.3	301052	301051	0.801	0.800
401303	301051_551147	GM	RC	0.3	301051	551147	0.800	1.210
401024	201302_300730	GM	CC	0.45	201302	300730	4.037	3.711
401023	201304_300730	GM	CC	0.375	201304	300730	3.975	3.711
401022	201303_201304	GM	CC	0.45	201303	201304	3.977	4.075
401018	201299_300729	GM	CC	0.3	201299	300729	1.263	1.712
401017	300729_551106	GM	CC	0.825	300729	551106	0.912	2.056
401016	300728_300729	GM	CC	0.375	300728	300729	1.522	0.712
401015	300727_300728	GM	CC	0.375	300727	300728	2.539	1.522
401014	300726_300727	GM	CC	0.375	300726	300727	3.232	2.689
401013	301069_300726	GM	CC	0.375	301069	300726	3.491	3.232
401012	300725_300724	GM	RC	0.3	300725	300724	1.816	1.286
401011	300724_300723	GM	RC	0.375	300724	300723	1.286	0.217
401010	300723_551105	GM	RC	0.375	300723	551105	0.217	11.334
401009	300722_551104	GM	RC	0.3	300722	551104	2.637	2.523
401008	300720_300721	GM	RC	0.3	300720	300721	2.539	1.989
401007	551103_300720	GM	RC	0.3	551103	300720	2.561	2.039
401006	300719_551103	GM	RC	0.375	300719	551103	1.901	2.261
401005	300718_300719	GM	RC	0.375	300718	300719	4.263	1.901
401004	300717_300718	GM	RC	0.375	300717	300718	7.623	4.263
401001	300713_551101	GM	RC	0.3	300713	551101	1.854	2.508
400999	300712_300713	GM	RC	0.3	300712	300713	2.634	1.854
400998	300711_300712	GM	RC	0.3	300711	300712	2.836	2.334
400992	201258_551095	GM	RC	0.3	201258	551095	4.525	2.590
400989	300694_551094	GM	RC	0.525	300694	551094	13.800	12.710
400988	300689_301933	GM	RC	0.3	300689	301933	8.249	8.560
400987	300691_300692	GM	RC	0.3	300691	300692	10.367	13.564
400986	300692_300693	GM	RC	0.3	300692	300693	13.564	13.835
400984	300677_300678	GM	RC	0.3	300677	300678	6.209	4.669
400983	300678_551089	GM	RC	0.3	300678	551089	4.669	3.698
400981	300680_551091	GM	RC	0.3	300680	551091	4.000	0.280
400980	300681_551092	GM	RC	0.3	300681	551092	3.830	1.980
400979	300674_300673	GM	RC	0.3	300674	300673	7.657	4.470
400978	300673_551088	GM	RC	0.3	300673	551088	4.470	5.183
400977	201225_301933	GM	RC	0.45	201225	301933	10.940	8.560
400976	300672_551086	GM	RC	0.3	300672	551086	-0.218	4.948
400963	300649_551084	GM	RC	0.3	300649	551084	1.102	3.281
400962	300648_300649	GM	RC	0.3	300648	300649	2.928	1.102
400961	300646_551083	GM	RC	0.3	300646	551083	-0.126	-1.000
400960	300642_300641	GM	RC	0.3	300642	300641	1.314	-1.990
400959	300641_551082	GM	RC	0.375	300641	551082	-1.990	-0.300
400958	300635_300634	GM	RC	0.3	300635	300634	1.539	0.951
400957	300634_551081	GM	RC	0.375	300634	551081	0.951	0.050
400956	300632_300634	GM	RC	0.3	300632	300634	0.620	0.951
400955	300631_300632	GM	RC	0.3	300631	300632	-0.870	0.620
400954	300629_300631	GM	RC	0.3	300629	300631	1.350	-0.870
400952	300624_300625	GM	CC	0.525	300624	300625	0.308	1.083
101400	301209_301210	GM	RC	0.3	301209	301210	2.796	2.330
101302	201779_301161	GM	RC	0.3	201779	301161	2.341	1.387
101291	201784_301163	GM	RC	0.3	201784	301163	2.451	1.834

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	-1	No Data
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ASSETID	ID	ASSETTYPE	MATERIAL	DIA(m)	USNODE_ID	DSNODE_ID	USLEVEL	DSLEVEL
101286	201795_301169	GM	RC	0.45	201795	301169	2.697	2.742
101228	201716_301127	GM	AC	0.3	201716	301127	3.079	3.023
101193	201661_301092	GM	RC	0.3	201661	301092	2.703	2.108
101177	201649_301081	GM	CI	0.3	201649	301081	3.914	3.666
101153	301055_301056	GM	RC	0.3	301055	301056	0.960	-0.209
100805	201292_300723	GM	AC	0.3	201292	300723	0.745	0.217