ATTACHMENT BOOKLET

ENVIRONMENT & SUSTAINABILITY

ORDINARY COUNCIL MEETING

TUESDAY 26 JULY 2022

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Cowan Creek Estuarine Planning Levels Study

Stage 1 and 2 Report

Northern Beaches Council | Stage 1 and 2 Report | July 2022

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Executive Summary

Cowan Creek is a tributary of the Hawkesbury River, located in its downstream reaches, where the river flows to the sea. Foreshore areas of Cowan Creek are subject to periodic inundation by coastal and estuarine processes (coastal/estuarine inundation is one aspect of coastal hazard).

Cowan Creek is located within Ku-ring-gai Chase National Park and includes Cottage Point as the main populated settlement. The local government boundary between the Northern Beaches local government area (LGA) and the Hornsby Shire local government area sets an administrative border along the length of Cowan Creek.

This estuarine planning levels study seeks to define the estuarine inundation risk on foreshore properties (primarily residential properties) within the Northern Beaches LGA both under existing and future sea level conditions.

Coastal Inundation and Development

Coastal inundation (and subsequent impacts on property and infrastructure within this zone) can be caused by large waves and elevated water levels associated with a range of coastal and oceanographic responses to severe storms. Within this report this is referred to as 'Estuarine Inundation Risk' (estuaries form part of the overall coastal zone). The nature and extent of the inundation is dependent on the interactions between the ocean and the land. Thus, an understanding of the interactions of the ocean and the land is essential to identify the likely extent of coastal inundation.

In order to ensure development is compatible with the effects of coastal inundation, it is necessary to apply appropriate development controls to proposed developments and considered in infrastructure planning. Appropriate planning levels for the purposes of design and construction of buildings and other features are estimated from the best available information on water levels associated with either or both catchment flooding and coastal inundation (both types of flooding/inundation can occur on some properties).

The planning levels are generally set to seek to minimise the potential for inundation and damage during rare and extreme inundation events. In this report the levels associated with Estuarine Inundation Risk are referred to as Estuarine Planning Levels (EPLs). Flood Planning Levels (FPLs) are those associated with catchment flooding, which may be associated with flooding from the Hawkesbury-Nepean River system or from local overland flows. These FPLs are beyond the scope of this assessment. In the study area estuarine inundation is considered the predominant form of flooding. There will be interaction with catchment flooding and there may be local circumstances where a property has both an EPL and an FPL notification on its Section 10.7 planning certificate.

This EPL Study has been prepared in the following stages, which are both presented within this report:

- Stage 1 Coastal Modelling: coastal and estuarine modelling to define the foreshore inundation risk; and
- Stage 2 Property Data: application of the modelling outcomes at a property scale (i.e. defining the EPLs for each at risk property).

Coastal Inundation Processes Overview

To calculate appropriate EPLs it is necessary to understand the oceanographic and coastal processes impacting the foreshore. The following coastal processes have been considered in the determination of EPLs for Cowan Creek:

- Regional Processes (ocean scale of hundreds of kilometres);
- Local Processes (within Hawkesbury River and Cowan Creek – scale of a few kilometres); and
- Site Specific Processes (scales of tens of metres).

The following data and model inputs have been utilised in this study to complete numerical modelling required to define coastal inundation extent and levels in the study area:

- Cowan Creek Water Levels; and
- Coastal Storm Winds.

Note that Cowan Creek is sufficiently protected from ocean swells and only local wind waves generated over Cowan Creek have been considered in this study.

Coastal Inundation Numerical Modelling

The estuarine modelling has been undertaken with two separate model systems to account for the varying processes that contribute to the calculation of EPLs. The two model systems are:

1. Delft3D hydrodynamic model to model local wind setup that occurs within Cowan Creek; and
2. SWAN wave model, which adopts the same grid as the Delft3D model, to model local sea waves generated within Cowan Creek from wind forcing.

Estuarine Planning Levels

Results for over 1900 output locations at 30m spacing were derived, however only 74 locations from Cottage Point and the d'Albora Marina at Akuna Bay, are presented in this report as these generally relate directly to the location of private property. EPLs have been calculated for each of these output locations along the foreshore at Cottage Point and Akuna Bay based on the outcomes of the estuarine modelling. Specifically, this includes:

- Identifying the 100 Year ARI ocean tidal level and incorporating sea level rise;
- Calculating the wind setup and wave heights (sea and swell) based on the model results;
- Calculating wave run-up and overtopping, which requires:
  - Defining the typical foreshore types around the Cowan Creek study area;
  - Calculation of the reduction in overtopping wave heights as a result of distance from the foreshore; and
- Applying a freeboard to allow for any uncertainties primarily associated with the water level and wave calculations.

The components of the EPLs are shown diagrammatically in **Figure E1-1**.

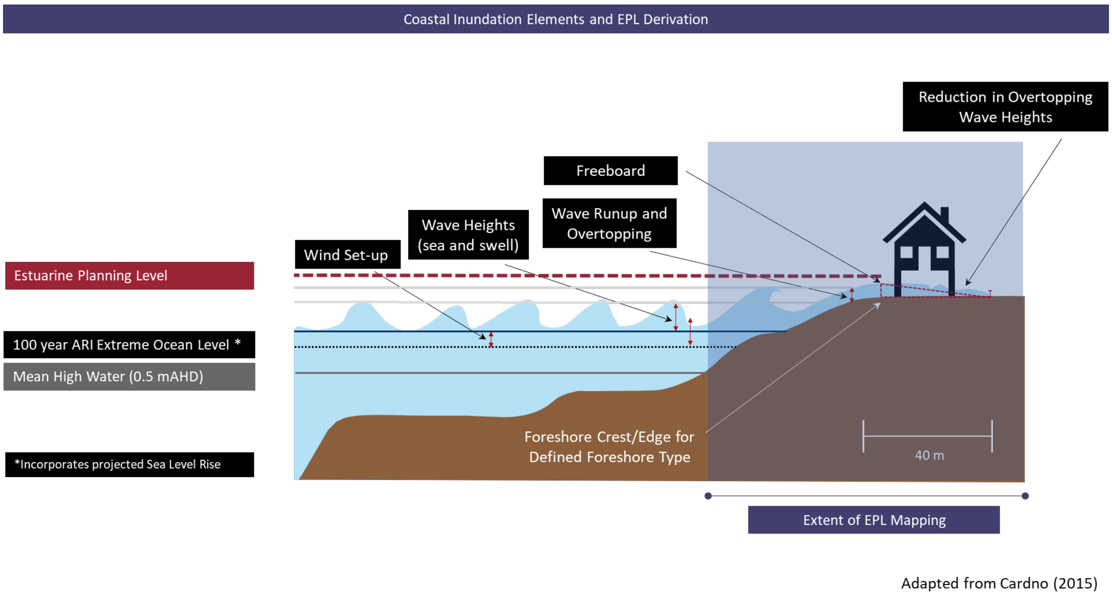

Figure E1-1 Estuarine Planning Level Components

This report provides the identification of 61 allotments in Cowan Creek, specifically at Cottage Point and Akuna Bay, that would potentially have estuarine inundation risk planning controls applied to development proposed on these allotments. Further, this report identifies EPLs for each of these allotments.

Council is currently reviewing its planning process with regards to the application of EPLs within the study area and notification of estuarine inundation risk on property planning certificates. The results of this study should be used to update planning certificates for properties that have an estuarine inundation risk within Cowan Creek.

It is anticipated that community engagement will be an important aspect of future stages of this project.

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Glossary*

Australian Height Datum (AHD)	A common national surface level datum approximately corresponding to mean sea level.
Average recurrence interval (ARI)	The average time between which a threshold is reached or exceeded (e.g. large wave height or high water level) of a given value. Also known as Return Period.
Benchmarks	A standard by which something can be measured or judged. For example, predicted amounts of sea level rise to incorporate into planning considerations.
Cadastre, cadastral base	Information in map or digital form showing the extent and usage of land, including streets, lot boundaries, water courses etc.
Catchment	The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
Climate change	A process that occurs naturally in response to long-term variables, but often used to describe a change of climate that is directly attributable to human activity that alters the global atmosphere, increasing change beyond natural variability and trends.
Crest level	The level in metres Australian Height Datum (mAHD) of the top of a particular foreshore type.
Coast	A strip of land of variable width that extends from the shoreline inland to the first significant landform that is not influenced by coastal processes (such as waves, tides and associated currents).
Coastal inundation	Coastal inundation occurs when a combination of marine and atmospheric processes raises the water level at the coast above normal elevations, causing land that is usually 'dry' to become inundated by sea water. Alternatively, the elevated water level may result in wave run-up and overtopping of natural or built shoreline structures (e.g. dunes, seawalls). In the case of an estuary, coastal inundation may be caused by a combination of processes including high tides, storm surge and wave run-up onto the foreshore.
Coastal processes	Coastal processes are the set of mechanisms that operate at the land-water interface. These processes incorporate sediment transport and are governed by factors such as tide, wave and wind energy.
Coastal Zone	The coastal zone, as defined by the Coastal Management Act 2016, means the area of land comprised of the following coastal management areas: (a) the coastal wetlands and littoral rainforests area, (b) the coastal vulnerability area, (c) the coastal environment area, (d) the coastal use area.

Design storm event	A significant event to be considered in the planning process.
Development	As defined in the Environmental Planning and Assessment Act 1979 (EP&A Act). New development refers to development of a completely different nature to that associated with the former land use, e.g. the urban subdivision of an area previously used for rural purposes. New developments involve re-zoning and typically require major extensions of existing urban services, such as roads, water supply, sewerage and electric power. Infill development refers to the development of vacant blocks of land that are generally surrounded by already developed properties and is permissible under the current zoning of the land. Conditions such as minimum floor levels may be imposed on infill development Redevelopment refers to rebuilding in an area, e.g., as urban areas age, it may become necessary to demolish and reconstruct buildings on a relatively large scale. Redevelopment generally does not require either re-zoning or major extensions to urban services.
Estuarine Planning Level	The combinations of elevated estuarine water levels (derived from significant historical sea or ocean events or sea/ocean levels of specific ARIs) and freeboards selected for estuarine inundation risk management purposes.
Estuary	The CM Act defines an estuary as any part of a river, lake, lagoon, or coastal creek whose level is periodically or intermittently affected by coastal tides, up to the highest astronomical tide.
Extreme Ocean Water Level	The highest elevation reached by the sea/ocean as recorded by a tide gauge during a given period (after MHL, 2018).
Extreme Storm Event	Storm for which characteristics (wave height, period, water level etc.) were derived by statistical 'extreme value' analysis. Typically, these are storms with average recurrence intervals (ARI) ranging from one to 100 years.
Foreshore	The part of the shore, lying between the crest of the seaward berm (or upper limit of wave wash at high tide) and the ordinary low water mark, that is ordinarily traversed by the uprush and backrush of the waves as the tides rise and fall; or the beach face, the portion of the shore extending from the low water line up to the limit of wave uprush at high tide. The CM Act defines the foreshore as 'the area of land between highest astronomical tide and the lowest astronomical tide'.
Foreshore Crest/Edge	Generally, the landward limit of the foreshore. In some cases, it may be located higher than the upper limit of wave wash at high tide.
Foreshore type	The nature of the foreshore at any given location, e.g. retaining wall, sandy beach, rocky foreshore.

Flood	A general and temporary condition of partial or complete inundation of normally dry land areas, including inundation as a result of sea/ocean storms and other coastal processes or catchment flows.
Flood risk	Potential danger to personal safety and potential damage to property resulting from flooding. The degree of risk varies with circumstances across the full range of floods. Flood risk is divided into three types, existing, future and continuing risks as described below: ▪ Existing flood risk is the risk a community is exposed to as a result of its location on the floodplain. ▪ Future flood risk is the risk a community may be exposed to as a result of new development on the floodplain. ▪ Residual flood risk is the risk a community is exposed to after floodplain risk management measures have been implemented.
Freeboard	Provides reasonable certainty that the risk exposure selected in deciding on a particular flood chosen as the basis for the EPL is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest levels, etc. Freeboard is included in the flood planning level. As a component of the EPL, a freeboard is added to the local (still) water level.
Geographical information system (GIS)	A system of software and procedures designed to support the management, manipulation, analysis and display of spatially referenced data.
High Tide	The maximum height reached by a rising tide. The high water is due to the periodic tidal forces and the effects of meteorological, hydrologic, and/or oceanographic conditions.
Highest astronomical tide (HAT)	The highest level which can be predicted to occur under average meteorological conditions and any combination of astronomical conditions. In Australia HAT is calculated as the highest level from tide predictions over the tidal datum epoch (TDE), this is currently set to 1992 to 2011. The HAT and the Lowest Astronomical Tide (LAT) levels will not be reached every year. LAT and HAT are not the extreme water levels which can be reached, as storm surges may cause considerably higher and lower levels to occur.
Mean high water mark	The line of the medium high tide between the highest tide each lunar month (the springs) and the lowest tide each lunar month (the neap) averaged over out over the year. In NSW, the methods for determining the position of the MHWM are outlined in the *Crown Directions to Surveyors - No. 6 Water as a Boundary.*
Mean High Water Springs (MHWS)	The MHWS is the highest level which spring tides reach on the average over a period of time (usually several years).
Mean Low Water Springs (MLWS)	The MLWS is the lowest level which spring tides reach on the average over a time period (usually several years).

Mean Sea Level (MSL)	MSL is a measure of the average height of the sea or ocean's surface such as the halfway point between the mean high tide and the mean low tide. At present, mean sea level is approximately equivalent to 0mAHD (reported as 0.03 mAHD in MHL, 2019).
Probability	A statistical measure of the expected frequency or occurrence of flooding.
Risk	The chance of something happening that will have an impact on objectives, usually measured in terms of a combination of the consequences of an event and their likelihood.
Sea	Tasman Sea (interchangeably also referred to as Ocean in this report).
Sea level rise (SLR)	A rise in the level of the sea surface that has occurred or is projected to occur in the future, as measured from a point in time. The rise can be reported as a global mean or as measured at a specific point or estimated for a specific part of the sea or ocean.
Storm surge	The increase in coastal water level caused by the effects of storms. Storm surge consists of two components – the increase in water level caused by the reduction in barometric pressure and the increase in water level caused by the action of wind blowing over the sea surface (wind set-up).
Storm tide	An abnormally high water level that occurs when a storm surge combines with a high astronomical tide. The storm tide must be accurately predicted to determine the extent of coastal inundation.
Tidal inundation	The inundation of land by tidal action under average meteorological conditions and the incursion of sea water onto low lying land that is not normally inundated, during a high sea level event such as a king tide or due to longer-term sea level rise. For these planning controls, it is defined as the land that is inundated up to the level of Highest Astronomical Tide (HAT).
Wave run-up	The vertical distance above mean water level reached by the uprush of water from waves across a beach or up a structure.
Wave set-up	The rise in the water level above the still water level when a wave reaches the coast. It can be very important during storm events as it results in further increases in water level above the tide and surge levels.
Wind waves	Waves resulting from the action of the wind on the surface of the water.

*Many of the glossary terms here are derived or adapted from the *Coastal Management Glossary* (OEH, 2018).

Acronyms and Abbreviations

1D	One-Dimensional
2D	Two- Dimensional
3D	Three-Dimensional
AHD	Australian Height Datum
AEP	Annual Exceedance Probability
AIDR	Australian Institute for Disaster Resilience
ARI	Average Recurrence Interval
AR	Assessment Report (IPCC)
ARR	Australian Rainfall and Runoff
BoM	Bureau of Meteorology
CD	Chart Datum
CM Act	Coastal Management Act, 2016
CM SEPP	State Environmental Planning Policy (Coastal Management) 2018
DCP	Development Control Plan
DECC	Department of Environment and Climate Change (now largely DPIE)
DECCW	Department of Environment, Climate Change & Water (now largely DPIE)
DEM	Digital Elevation Model
DLWC	Department of Land and Water Conservation (now largely DPIE)
DoI (Water)	Department of Industry (Water) (formerly DPI Water) (now DPIE)
DPE	Department of Planning and Environment (now DPIE)
DPIE	Department of Planning, Industry and Environment
DPI Water	Department of Primary Industries – Water (Now DPIE)
ECL	East Coast Low
ENSO	El Niño-Southern Oscillation
EPL	Estuarine Planning Level
FFL	Finished Floor Level
FPL	Flood Planning Level
FRMP	Floodplain Risk Management Plan
FRMS	Floodplain Risk Management Study
GIS	Geographic Information System
Ha	Hectares

Hs	Significant Wave Height
Hm0	Significant Wave Height
IFD	Intensity-Frequency-Duration
IPCC	Intergovernmental Panel on Climate Change
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
km^2	Square kilometres
LAT	Lowest Astronomical Tide
LEP	Local Environment Plan
LGA	Local Government Area
LiDAR	Light Detention and Ranging
m^2	Square metres
m^3	Cubic metres
m/s	Metres per second
m^3/s	Cubic metres per second
mAHD	metres to Australian Height Datum
mm	Millimetres
m/s	Metres per second
NSW	New South Wales
OEH	Office of Environment and Heritage (now DPIE)
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
$R_{2\%}$	Two percent wave run up level. This is the run-up level, vertically measured with respect to the still water level, which is exceeded by two per cent of the incoming waves.
RCP	Representative Concentration Pathway
SES	State Emergency Service
SWL	Still Water Level
TN	True North
Tp	Wave period

1 Introduction

Cowan Creek is a tributary of the Hawkesbury River, located in its downstream reaches, where the river flows to the sea (see **Figure 1-1**). Foreshore areas of Cowan Creek are subject to periodic inundation by coastal and estuarine processes. Coastal/estuarine inundation is one aspect of coastal hazard (*Coastal Management Act 2016*).

In order to ensure development is compatible with the effects of coastal inundation, it is necessary to ensure appropriate development controls are applied to proposed developments where consent is required under Part 4 of the *Environmental Planning and Assessment Act 1979* or where information is relevant to infrastructure planning (such as under the provisions of *State Environmental Planning Policy (Infrastructure) 2007*). Appropriate planning levels for the purposes of design and construction of buildings and other features are estimated from the best available information on water levels associated with either or both catchment flooding and coastal inundation (both types of flooding/inundation can occur on some properties). The planning levels are generally set to seek to minimise the potential for inundation and damage during rare and extreme inundation events.

Rhelm, with the assistance of Baird Australia, was engaged by Northern Beaches Council (Council) to determine appropriate planning levels for the foreshore areas of Cowan Creek based on a range of oceanic and estuarine processes (including ocean tide, wind set up and wave height, wave runup, a freeboard and allowance for sea level rise).

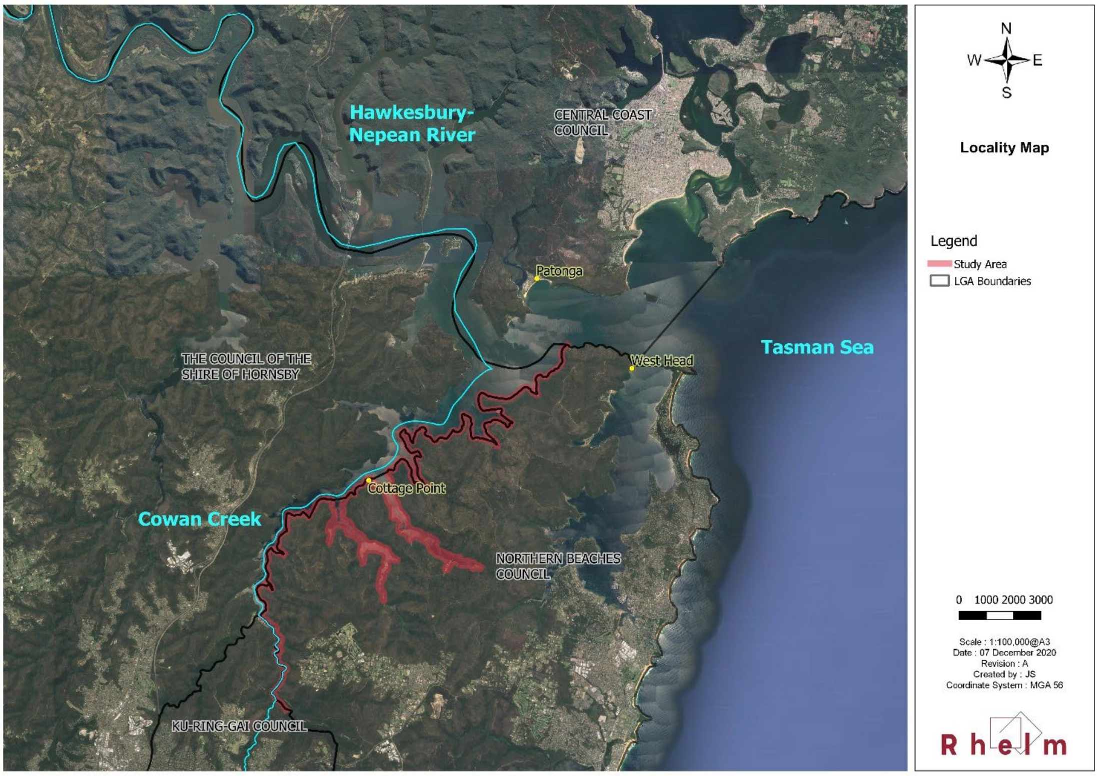

Figure 1-1 Locality Map

1.1 Study Context

Inundation of the coastal zone (and subsequent impacts on the urban development within this zone) can be caused by large waves and elevated water levels associated with a range of coastal and oceanographic process responses to severe storms. Within this report this is referred to as 'Estuarine Inundation Risk'. The nature and extent of the inundation is dependent on the interactions between the ocean and the land. Thus, an understanding of the interactions of the ocean and the land is essential to identify the extent of coastal inundation.

Estuarine Planning Levels (EPLs) are currently applied as a method for managing risk to property along the foreshore of Pittwater (in the north of the Northern Beaches LGA). EPLs are applied under the provisions of the *Pittwater Local Environmental Plan 2014*. More specifically, Council's approach to managing this risk is set out in the *Estuarine Risk Management Policy for Development in Pittwater*, within the *Pittwater 21 Development Control Plan*.

At the time of preparation of this study Northern Beaches Council still had separate Local Environmental Plans (LEPs) and Development Control Plans (DCPs) operating for the three former LGA regions (Manly, Warringah and Pittwater). The study area includes part of both the former Pittwater and Warringah LGAs, with the boundary between the former LGAs generally being Coal and Candle Creek in this area.

Coastal hazard is managed at the highest level through the *State Environmental Planning Policy (Coastal Management) 2018*. However, the coastal vulnerability provisions for the Northern Beaches LGA are not yet operational as vulnerability mapping was not in place for Cowan Creek at the time of the completion of this study.

Cowan Creek was not included in the previous EPL study for the Pittwater LGA, *Pittwater Estuary Mapping of Sea Level Rise* (Cardno, 2015), as it was located outside the former Pittwater LGA boundary at the time. Cottage Point is the main population settlement associated with Cowan Creek and this suburb is located in the former Warringah LGA.

Coastal hazard is managed through Clause 6.5 of the *Warringah LEP 2011*, however, this clause only applies to the Coastal Hazard Map (Sheet CHZ_009) and Cowan Creek is not included on this map. Specific development controls relating to coastal hazard are contained within the *Warringah DCP 2011* (Section E9).

The EPLs derived from this study will inform the new planning controls currently being developed by Council for the amalgamated Northern Beaches LGA. This may be done in a similar manner to the existing *Pittwater LEP 2014* and *Pittwater 21 DCP*.

1.2 Study Approach

This EPL Study has been prepared in the following stages, which are both presented within this report:

- Stage 1 Coastal Modelling: coastal and estuarine modelling to define the foreshore risk; and
- Stage 2 Property Data: application of the modelling outcomes at a property scale (i.e. defining the EPLs for each at risk property).

The coastal modelling for Stage 1 has adopted methods to generate coastal flood parameters that are consistent with the *Pittwater Estuary Mapping of Sea Level Rise* (Cardno, 2015) which provided the flood data to inform coastal planning. This included the analysis of the impact of sea level rise values of 0.4m and 0.9m on estuarine inundation.

2 Study Area

The study area includes the foreshore areas of Cowan Creek that lie within the Northern Beaches LGA. Cowan Creek is located within Ku-ring-gai Chase National Park and includes Cottage Point as the main populated settlement. Land uses are predominantly national park, public recreation, and residential and commercial within the suburb of Cottage Point. The study area is shown in **Figure 2-1**.

The local government boundary between the Northern Beaches local government area and the Hornsby Shire local government area sets an administrative border along the length of Cowan Creek. The whole of Cowan Creek has been considered for this study, however reporting only relates to the Northern Beaches portion of the foreshore.

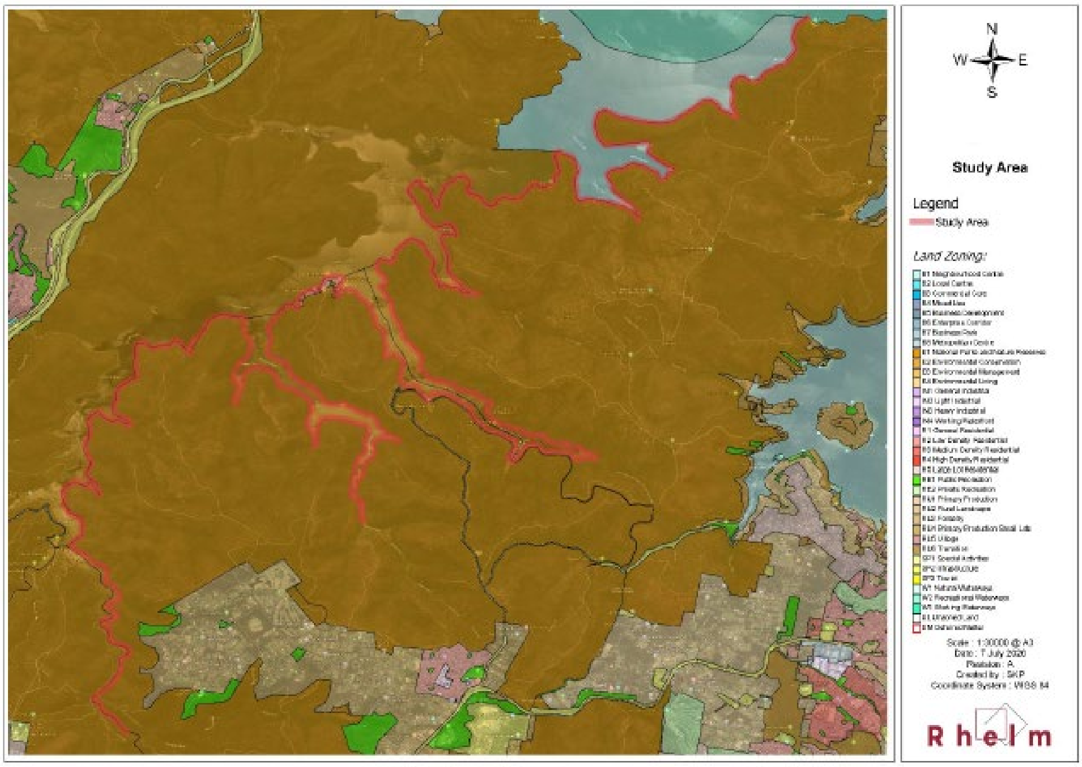

Figure 2-1 Study Area

2.1 Coastal Processes Summary

Cowan Creek is a tributary of the Hawkesbury River, which is a drowned river valley estuary. The Hawkesbury River is tidally dominated in its lower reaches, where Cowan Creek is located (see **Figure 2-1**). Diurnal tides with a range of 0.3-1.6 mLAT (-0.6 - +0.7 mAHD) flow through Cowan Creek with minimal friction loss or transformation of the tide characteristics compared to the open ocean due to the relatively deep channels and uninhibited waters.

The most significant weather systems which can lead to coastal inundation of the Northern Beaches Council areas of Cowan Creek are associated with East Coastal Low (ECL) storms that generate strong winds offshore and along the coastal fringe. These events result in elevated coastal water levels, and strong winds within Cowan Creek to produce wind waves.

Elevated coastal water levels during the passage of a severe storm are the result of barometric effects and wind setup. The combined effect of barometric setup and wind setup is referred to as storm surge. Barometric setup occurs due to the intense low-pressure systems that generate large storms. This reduction in air pressure over the water surface results in a local rise of the water level. Wind setup is a result of the wind inducing wind shear stresses on the water, which in turn generate currents. When these currents are impeded by the coast, a resulting increase in the water level occurs.

As Cowan Creek is very protected from the prevailing southerly and south-easterly swell waves that occur in the Sydney Region, limited swell waves propagate into the creek. Locally generated wind waves are the predominant wave type in Cowan Creek and can be particularly significant for coastal inundation when wave or wave runup impact on coastal structures, for example seawalls. Waves can overtop these structures which can result in significant inundation of adjoining properties. However, the configuration of Cowan Creek and small distances over water the wind can act on, the “fetch”, result in relatively small waves produced by even the strongest winds.

The coastal modelling completed in this study to define coastal flood levels within Cowan Creek have focused on spatially quantifying the following processes that result in coastal inundation of foreshore areas:

- Wind and water level setup from winds acting over Cowan Creek from all possible directions; and
- Local wind waves generated over Cowan Creek from all possible directions.

3 Discussion of Coastal Processes

To calculate appropriate EPLs it is necessary to understand the oceanographic and coastal processes impacting the foreshore. The following coastal processes have been considered in the determination of EPLs for Cowan Creek:

- Regional Processes (ocean scale of hundreds of kilometres);
- Local Processes (within Hawkesbury River and Cowan Creek – scale of a few kilometres); and
- Site Specific Processes (scales of tens of metres).

These processes are consistent with those adopted for the Pittwater EPL Study (Cardno, 2015) and North and Middle Harbour EPL Study (Rhelm, 2022), and are outlined schematically in **Figure 3-1** and described in more detail in the following sections.

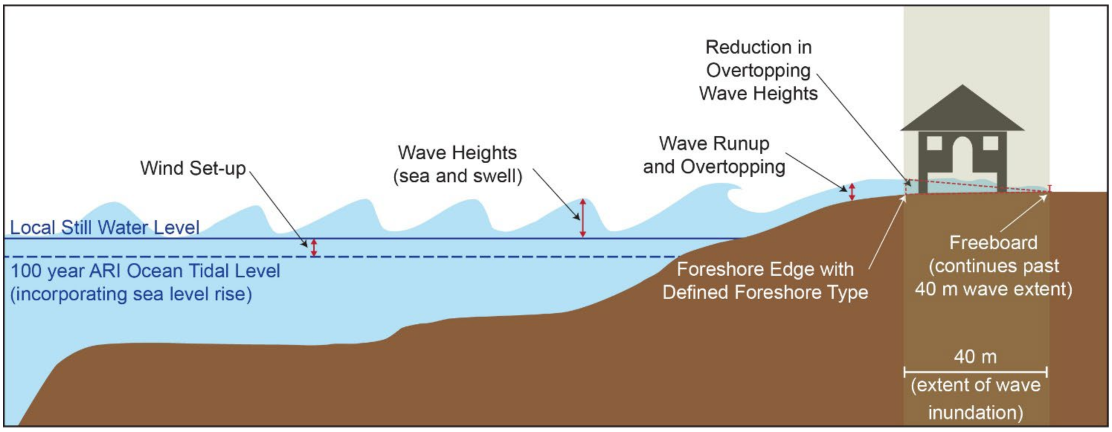

Figure 3-1 Coastal Processes Affecting Estuarine Planning Levels

3.1 Regional Processes

Regional oceanographic processes relate to those ocean processes that are influenced by energy inputs causing sea level fluctuations over the larger scales of the NSW coastal waters and essentially affect coastal waters between Wollongong and Newcastle simultaneously (i.e. hundreds of kilometres of coastline). Coastal water levels in the study area region can be influenced by the following oceanographic processes:

- Astronomic Tides;
- Meteorological / Oceanographic Processes:
    - Storm Surge from wind setup and barometric setup;
    - Ocean Waves;
    - Coastal Trapped Waves;
    - El Niño-Southern Oscillation (ENSO);
    - Meteorological Oscillations;
- Climate Change and Sea Level Rise; and
- Tectonic Processes.

Tectonic processes are not considered in this assessment as they play a very minor role (and hence low risk) in the study area.

At times, these individual factors interact in complex ways to elevate water levels significantly above normal tidal levels. Storms, principally East Coast Lows, with low central atmospheric pressure (barometric setup), strong onshore winds (resulting in wind setup) and large waves superimposed on spring (or king) tides, are the most common cause of elevated water levels (NSW Government, 1990). This is shown diagrammatically in **Figure 3-2**.

Taylor *et al* (2017) and Aldridge *et al* (2018) were able to replicate the extreme wave and water level probability distributions along the NSW coastline with a stochastic East Coast Low model. Those studies concluded along the NSW coast hazard models for the erosion and coastal inundation needed to include astronomical tide, storm surge and ocean waves.

For the Sydney Region, those processes can all be defined from analysis of measured data. The combined probability of water levels from Astronomic Tides and Meteorological / Oceanographic Processes can be well defined from the long-term Fort Denison tide gauge data set (Watson and Lord, 2008). The deep water probability of ocean wave conditions can be defined from the long-term measured wave data along the NSW coast (Shand *et al*, 2011). **Sections 4.1** and **4.2** present the regional scale water level and wave conditions adopted for this study.

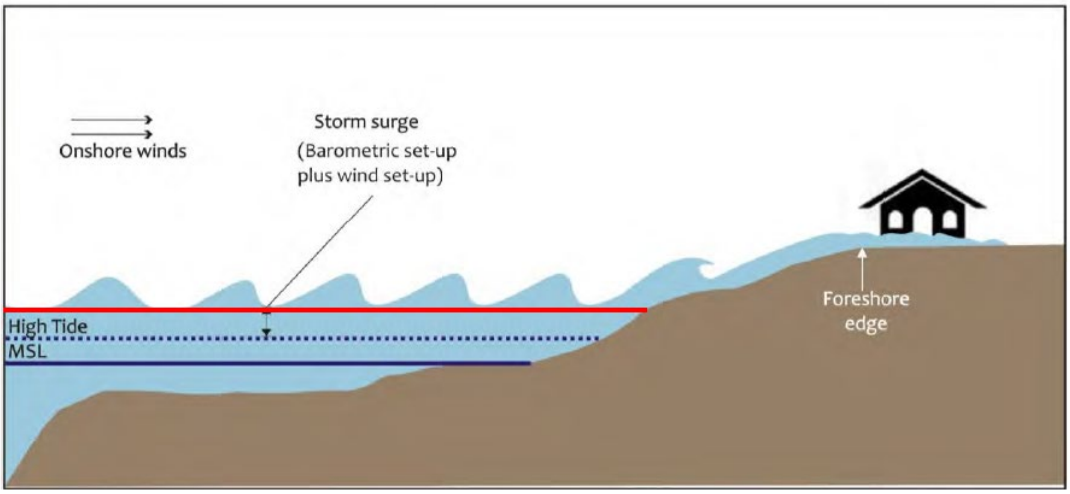

Figure 3-2 Regional Coastal Processes (Source: Cardno, 2015)

Determining a regional elevated water level for planning purposes depends on the probability of that level occurring and the risk associated with it. Planning benchmarks are generally determined on the basis of an annual exceedance probability (AEP) or average recurrence interval (ARI), which relates to the probability of a particular water level occurring or being exceeded. Department of Planning (2007) advises that for flood prone land unless there are exceptional circumstances, councils should adopt the 100 Year Average Recurrence Interval (ARI) flood levels for planning of residential development. This relates to the water level associated with a storm event that has the probability of occurring approximately once every hundred years.

It is important to note that at the time of preparation of this study, the planning circular of 2007 (Department of Planning, 2007) was under review and the Draft Flood Prone Land Package was exhibited for this purpose in mid-2020 (Department of Planning, Industry and Environment, 2020).

3.1.1 Sea Level Rise

Sea level rise will have an impact on coastal inundation levels in the future. It is noted that estuarine inundation is an existing risk as well as a future risk. Sea level rise analysis was therefore undertaken to understand how that risk may increase in the future.

The impact of two sea level rise scenarios has been assessed in this study. In the absence of a Council policy defining specific sea level rise values for this purpose, sea level rise of 0.4m and 0.9m have been selected for analysis to ensure consistency with many of Council's previous flood studies, the Pittwater EPL Study (Cardno, 2015) and the North and Middle Harbour EPL Study (Rhelm, 2022).

The selection of these values is supported by current science. In its fifth assessment report (2013), the IPCC (reported in Church et al, 2013) developed a range of future sea level rise projections associated with different greenhouse gas emission scenarios (representative concentration pathways (RCPs)). These indicate that 0.4m sea level rise is almost certain by 2100 and 0.9m is likely (**Table 3-1**). The application of these levels in this study is discussed in **Section 6.2**. More recent analyses prepared in advance of the sixth assessment report for the IPCC affirm these projections (Oppenheimer et al, 2019).

Table 3-1 Likely Global Sea Level Rise by 2100 (Church et al, 2013)

Scenario	***Likely* global mean sea level rise range by 2100 (relative to 1986-2005)**
Significantly Reduced Emissions (RCP 2.6)	0.24–0.61 m
Highest Emissions (RCP 8.5)	0.54–1.06 m

3.2 Local Processes

Local processes within the context of this study relate to the processes that cause variations in 'elevated local water levels' within Cowan Creek (see **Figure 2-1**). Water levels within the study area will be influenced by local variations as a result of both wind strength and direction and waves.

3.2.1 Local Wind Setup

The same wind that adds to the regional storm surge in the form of wind setup will also cause further variation in the water level through wind setup developed over Cowan Creek. This wind setup, however, is much smaller than the regional storm surge discussed in **Section 3.1** and is limited by the distance of water (fetch) over which the wind blows. As Cowan Creek is relatively narrow, the fetch is small and therefore only a small local wind setup is generated i.e. the highest wind setup is 0.05m at Akuna Bay.

3.2.2 Wave Height

Ocean storms can contribute to elevated water levels along the coastline and inside Hawkesbury River. In the Sydney region the most severe ocean storm waves come from the southeast to south sector. The ocean storm waves propagate from the deeper ocean into the shallow water of Hawkesbury River and the waves undergo changes caused by diffraction, refraction, shoaling, bed friction and wave breaking. As Cowan Creek is located a significant distance from the open ocean (the confluence of Cowan Creek and the Hawkesbury River is approximately 8 km upstream of West Head and Cottage Point is approximately 13 km upstream of West Head), these processes lead to a substantial reduction in swell wave occurrence; hence as influence on local water level is minimal, swell waves have not been analysed in this study.

Local wind generated waves can contribute to the elevated water levels during coastal storms. The highest local wind generated waves will occur during storms that have south to easterly winds that 'push' water onto the coast. In this way the two processes (regional and local) are correlated and the likelihood the highest ocean water levels and highest local wind-generated waves occurring together (joint occurrence) will be very rare on the westward-facing shorelines of the study area. As the foreshore of Cowan Creek within the Northern Beaches LGA has large proportions of west-oriented coastline, this means that the co-incident occurrence of highest ocean water levels and the largest wind-generated waves have a very small likelihood.

Numerical wave modelling of the local wind waves is presented in **Section 5**. Wave heights will vary depending on the location along the Council foreshore areas, however wave heights are typically very small in the study area (0.26m to 0.56m).

3.3 Site Specific Processes

Site specific processes within the context of this study relate to the processes at the foreshore. The physical factors that will impact the elevated water level will be the nature of the foreshore (e.g. retaining wall or sandy beach, referred to in this report as "foreshore type") and the height of the foreshore.

As a wave reaches the foreshore an 'uprush' of water onto the foreshore will occur, this is called wave run-up. The height of wave run-up is affected by the nature of the foreshore. Should wave run-up be large, wave overtopping may occur, which results in the temporary inundation of the foreshore area. The inland extent of the wave inundation is assumed to be 40m from the foreshore crest. With the inclusion of a freeboard allowance (see **Section 6.4**) this is an appropriate distance to assess the impacts of waves on coastal inundation and has been verified from site observations by this study's coastal engineers following severe storms along the NSW coastline.

Wave run-up mechanisms in this study have been quantified in a manner consistent with the Pittwater EPL Study (Cardno, 2015) and North and Middle Harbour EPL Study (Rhelm, 2022), described in **Figure 3-3**. Wave run-up for shoreline types in the study area is presented in **Section 6.3**.

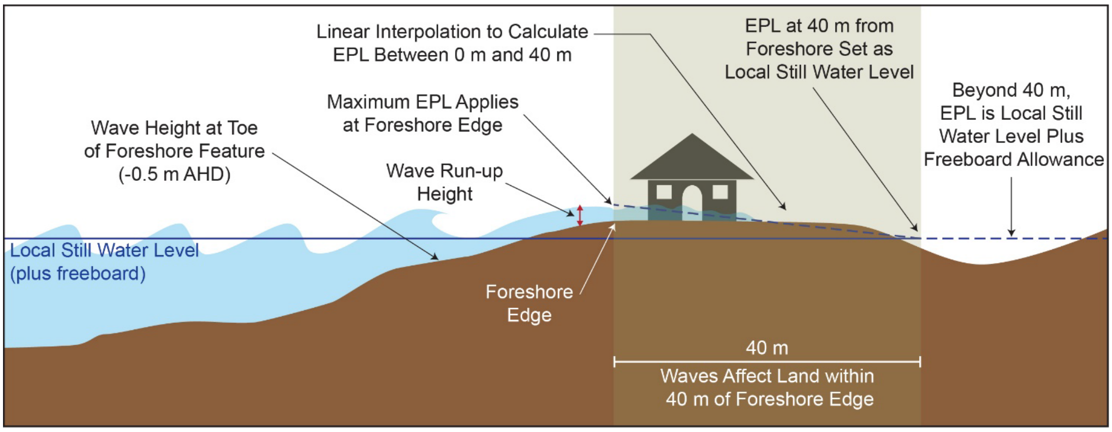

Figure 3-3 Site Specific Coastal Processes

4 Data Compilation and Review

The following sections summarise the data and model inputs that have been utilised in this study to complete modelling required to define estuarine planning levels in the study area.

4.1 Cowan Creek Water Levels

Water levels were obtained from Patonga tide gauge, which provided data in close proximity to Cowan Creek, and from Sydney Harbour (Fort Denison) tide gauge, which provides a long, reliable dataset. Present day extreme design still water levels at Fort Denison based on a statistical analysis of measured historical records are provided in **Table 4-1** which are aligned with the outputs from the Fort Denison Sea Level Rise Vulnerability Study (Watson and Lord, 2008). The extremes analysis is based on water level data measured continuously at Fort Denison for over 100 years. The data reflects the astronomical tide levels as well as anomalies or variations from the predicted tide from storm surge and freshwater flows (assumed very minimal). Similarly, the data inherently incorporates climate change and other seasonal-induced sea level rise over this timeframe. **Table 4-1** presents the extreme water levels for Fort Denison from Watson and Lord (2008).

Table 4-1 Extreme water levels at Fort Denison, Sydney (Watson and Lord, 2008)

Average Recurrence Interval (ARI) (years)	Present Day Extreme Still Water Level	
	m CD*	m AHD
1	2.2	1.2
10	2.3	1.3
50	2.3	1.4
100	2.4	1.4
200	2.4	1.5

* CD = Chart Datum which approximates to LAT and is about 0.93m below AHD.

To determine the difference in water level between Patonga (estuary entrance to Cowan Creek) and Fort Denison, Extreme Value Analysis was performed for concurrent data for both sites. Patonga was observed to have higher water levels than Fort Denison, as shown in **Table 4-2.** A report by Manly Hydraulics Laboratory analysed numerous tidal gauges along the NSW coastline using several methods; the 100 Year ARI water level determined is presented in **Table 6-1** showing a difference of 0.01m between the two gauges (MHL, 2018).

Previous Northern Beaches EPL studies (Cardno, 2015 and Rhelm, 2022) have applied a 100 Year ARI of 1.4 mAHD and 1.44 mAHD respectively. To provide consistency across the Council area, the Watson and Lord (2008) Fort Denison 100 Year ARI value of 1.44mAHD was selected; then a +0.01m correction was applied to account for the variability in water level identified by MHL (2018).

Table 4-2 Comparison of Patonga and Fort Denison tide gauge 100 Year ARI: Various sources

Data Reference	Present Day Extreme Still Water Level (m AHD)	
	Patonga	**Fort Denison**
Current Study (Concurrent Data)	1.45	1.42
Manly Hydraulics Laboratory (MHL, 2018)	1.43	1.42
Watson and Lord (2008)	-	1.44

4.2 Coastal Storm Winds

A range of wind data sets have been analysed to define extreme winds which can generate enhanced storm surge and local sea waves in the study area. The key data sets reviewed in this study were:

- Long-term measured wind speeds at Sydney Airport which spanning 68 years (1948-2016);
- 23 years of wind measurements from at Fort Denison (1990-2019); and
- A synthetic ECL wind dataset which is a 1,000 year independently derived Monte Carlo model (Taylor et al, 2017).

The directional extreme wind data from Sydney Airport has been adopted to define 100-year ARI sustained (10-minute average) winds for 8 directional sectors as defined in **Table 4-3**. The strongest storm winds occur from a southerly direction, which results in minimal exposure for the majority of the Cowan Creek coastline that is predominantly west to north-west facing. Due to the steep ridges that surround Cowan Creek, the wind speeds specified in **Table 4-3** are likely to be conservative for sustained winds acting over the surface of Cowan Creek.

Table 4-3 Extreme wind speeds (10min average, 10 m elevation) based on long-term Sydney Airport data (1948-2016)

Direction	100-year ARI wind speed (m/s)
Omni-Directional	28.2
North	15.4
Northeast	16.3
East	17.8
Southeast	20.4
South	27.5
Southwest	22.7
West	22.3
Northwest	20.8

4.3 Extreme Coastal Waves

Cowan Creek is sufficiently protected from ocean swells and only local wind waves generated over Cowan Creek have been considered in this study.

5 Estuarine Modelling

The estuarine modelling has been undertaken with two separate model systems to account for the following processes that contribute to the calculation of EPL's. The two model systems are:

- Delft3D hydrodynamic model to model local wind setup that occurs within Cowan Creek; and
- SWAN wave model, which adopts the same grid as the Delft3D model, to model local sea waves generated within Cowan Creek from wind forcing.

The extent of these models is shown in **Figure 5-1.**

The EPLs derived from the results from these two models are presented in **Appendix B**. Results for over 1900 output locations at 30m spacing were derived, however, only 48 locations from Cottage Point have been presented in this report, in addition to 26 locations at the d'Albora Marina in Akuna Bay, with locations shown in **Figure 5-2** and **Figure 5-3**.

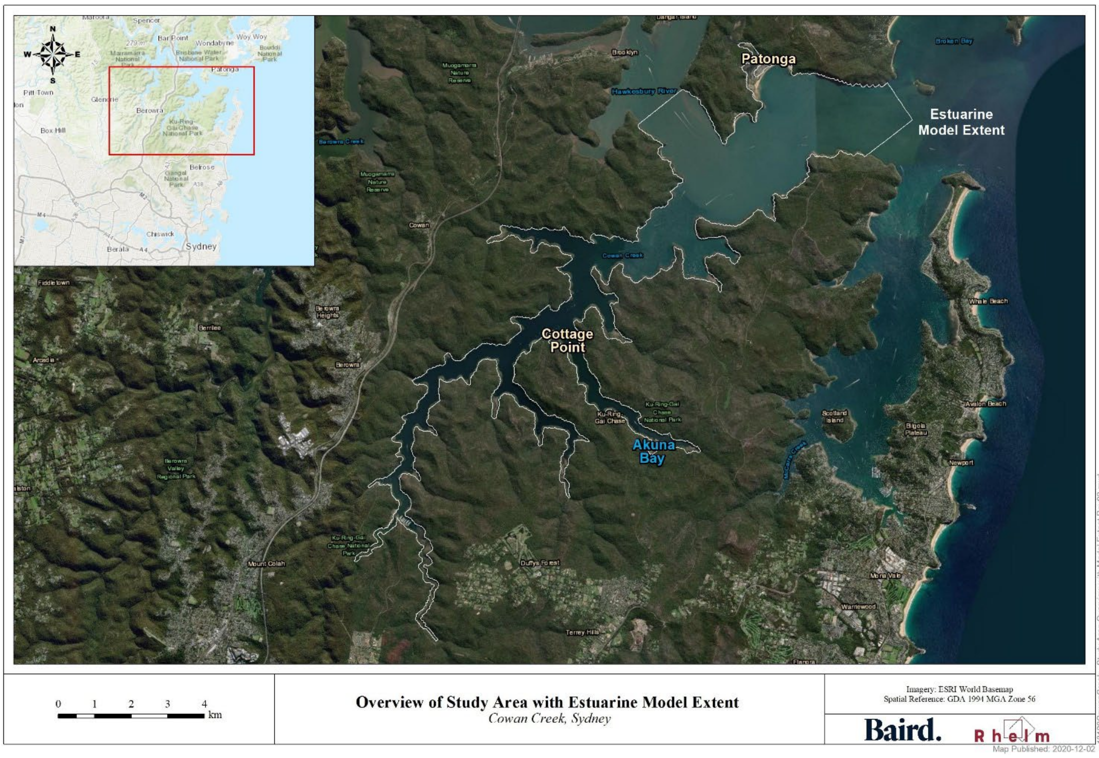

Figure 5-1 Plan view of Delft3D and SWAN model Extents

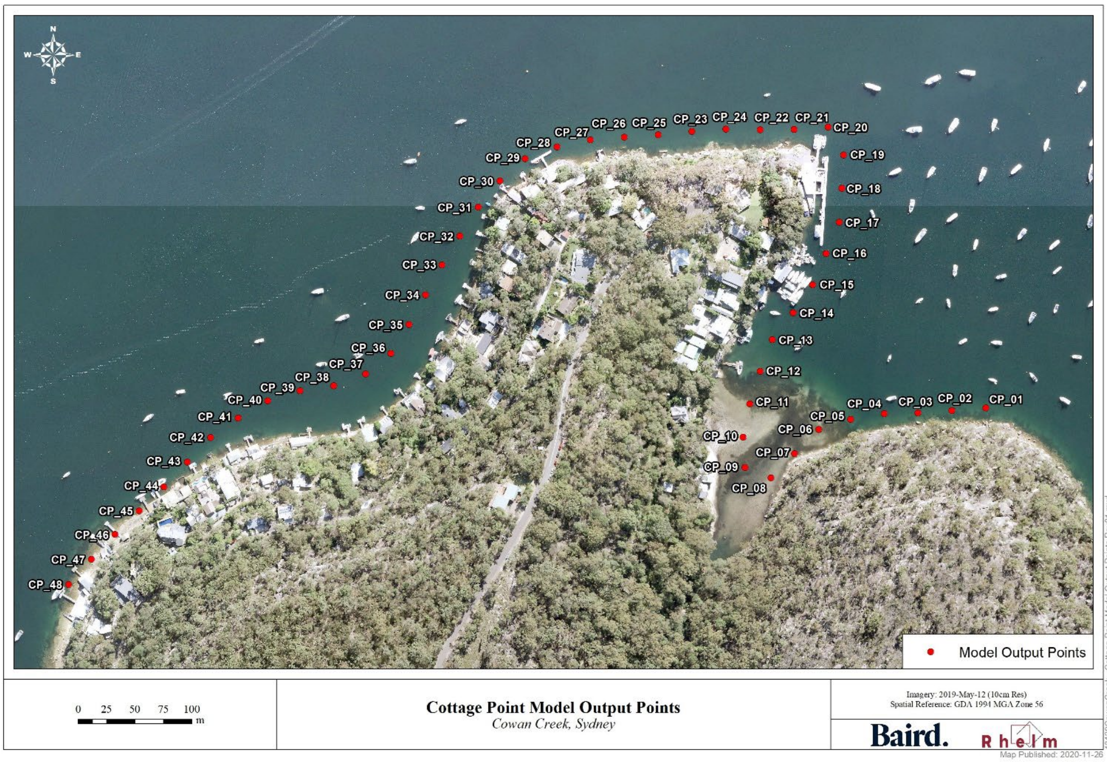

Figure 5-2 Plan view of EPL calculation points – Cottage Point

Figure 5-3 Plan view of EPL calculation points – Akuna Bay

5.1 Delft3D Model

The Patonga and Fort Denison water level datasets provide a good basis to define extreme ocean water levels for return periods of 200-years ARI and greater. However, additional wind setup can occur within embayments, which could potentially elevate water levels compared to the local Patonga dataset.

Modelling of wind setup along the foreshore has been undertaken using a Delft3D hydrodynamic model covering the whole of Cowan Creek, and part of the Hawkesbury River to Patonga to quantify the variation in extreme water levels between Patonga and the study area. High model resolution of 35m grid cells enable detailed results for properties along the Cowan Creek foreshore areas.

The Delft3D model was applied with the 100 Year ARI water level (1.45 mAHD) and wind forcing to model wind setup for the eight directional sector winds defined in **Table 4-3.** The wind setup was calculated as the maximum difference between the maximum modelled water level and the boundary tide level for each of the calculation points. The largest wind setup from all direction scenarios were adopted as the 100-year ARI wind setup at a particular output location.

5.2 SWAN Wave Model

Local sea waves were calculated in a consistent manner using a SWAN wave model which adopted the same model grids and wind conditions as the Delft3D model scenarios described in the previous section, with an additional nested grid of 10m resolution around Cottage Point. The SWAN wave model adopted a fixed 100-year ARI water level (1.45 mAHD) for each model simulation and local sea waves defined by significant wave height (Hm0), wave period (Tp) and wave direction were computed for each output location. The 100 Year ARI north-west wind wave modelling results are shown in **Appendix A**.

6 Calculation of Estuarine Planning Levels

6.1 Estuarine Planning Level Components

EPLs have been calculated for each of the 74 output locations (**Section 5**) based on the outcomes of the estuarine modelling. Specifically, this includes:

- Identifying the 100 Year ARI ocean tidal level and incorporating sea level rise;
- Calculating the wind setup and wave heights (sea and swell) based on the model results described in **Section 5.2**;
- Calculating wave run-up and overtopping, which requires:
  - Defining the typical foreshore types around the Cowan Creek study area;
  - Calculation of the reduction in overtopping wave heights as a result of distance from the foreshore; and
- Applying a freeboard to allow for any uncertainties primarily associated with the water level and wave calculations.

The components of the EPLs are shown diagrammatically in **Figure 6-1**.

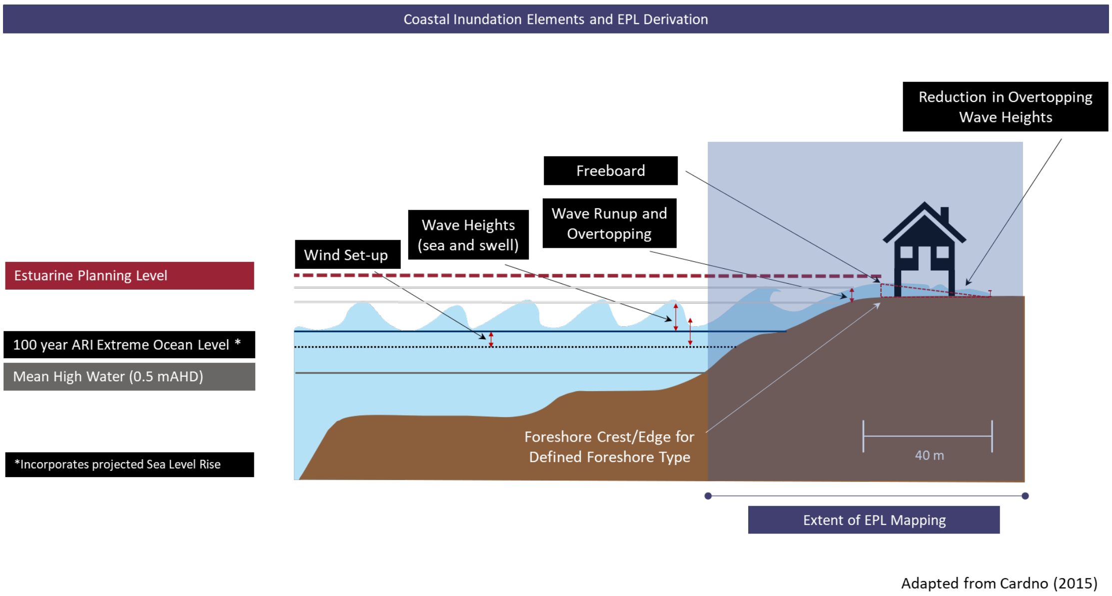

Figure 6-1 Estuarine Planning Level Components

6.2 Tidal Event Mapping and Sea Level Rise

It was considered appropriate to adopt the 100 Year ARI ocean water level event as the design event for planning purposes within the Cowan Creek coastal zone. As outlined in **Section 4.1**, extremal analysis of the Fort Denison tide gauge data reported in Watson and Lord (2008) has been applied. The extreme water levels provided from this gauge provide a historical record of the combined effects of the processes described above. The 100 Year ARI level at Fort Denison was determined to be 1.44 mAHD (to two decimal places).

To provide an estimation of the projected impact of sea level rise on these tidal events, predicted sea level rise of 0.4m and 0.9m have been applied (see **Section 3.1.1**, as per Cardno (2015) and Rhelm (2022)).

Table 6-1 provides the levels that were used with what is referred to here as the 'present-day levels', which are actually based on the analysis of recorded tidal levels for the period 1914 – 2006 (Watson and Lord, 2008). In reality, Watson and Lord (2008) note that sea level rise has been observed at a rate of 3.1 mm/year and so using this trend as a coarse guide then the actual present-day reference point (at 2020 when the calculations for this study were conducted) is potentially up to 0.04 m higher (i.e. 3.1 mm/yr times 13 years that have elapsed since the calculations based on actual data were completed). Given the small nature of the variance, the present-day values have been retained as those reported by Watson and Lord (2008), which is consistent with that adopted for Pittwater (Cardno, 2015). It is important to note that the ocean water level projections in **Table 6-1** for 2050 and 2100 are adjusted from the reference point of 1990 which has been the common basis for sea level rise projections by the Intergovernmental Panel for Climate Change (Gregory and Church, 2001; Church et al, 2013).

Table 6-1 Present Day, 2050 and 2100 Ocean Levels

	Present Day Level	**2050**	**2100**
Predicted Sea Level Rise	0 m	0.4 m	0.9 m
100 Year ARI Ocean Water Level*	1.45 mAHD	1.85 mAHD	2.35 mAHD

*Does not include wind set up or wave run up.

Sea level rise has been incorporated into the determination of EPLs by calculating EPLs for 0.4m and 0.9m of sea level rise (in addition to the existing sea level). The shoreline wave height has also been updated where appropriate for the sea level rise predictions.

6.3 Wave Height and Wind Set-up

When selecting a design event upon which to calculate local wave heights, the likelihood of those waves occurring at the same time as the 100 Year ARI ocean water level needs to be considered.

Since many of the shoreline areas in the study area experience the largest local sea waves and wind setup as a result of winds from a southeast to southwest direction, the maximum 100-year ARI ocean water level was adopted to be concurrent with the 100-year ARI wind setup, local sea and ocean swell waves modelled in the scenarios presented in **Section 5**.

The wind setup and local sea waves were calculated at 1934 output locations along the Council foreshore areas of Cowan Creek; presented in this report and provided to Council are results for Cottage Point, the only developed location in the study area, as well as the marina at Akuna Bay.

6.3.1 Wave Run-up and Overtopping

The height of wave run-up and the depth of overtopping are dependent on the foreshore type and the height of the foreshore edge (crest level). The inland extent of the wave inundation is assumed to be 40 m from the foreshore crest based on the study team's observations from severe storms in the Sydney region. Therefore, the EPL applied to a development depends on the distance of the development from the foreshore edge.

6.3.2 Foreshore Types

The nature of the foreshore (foreshore type) is critical in the calculation of wave run-up and overtopping. The Pittwater EPL Study (see Cardno, 2015) adopted the following foreshore types:

- Type 1 – 1 in 10 natural slope (representing grassed and sandy gently sloping foreshores);
- Type 2 – 1 in 5 rocky shoreline (representing natural rocky foreshore or sloped rip rap);

- Type 3 – Vertical sea wall (e.g. block work or other retaining walls); and
- Type 4 – Mangroves.

The shoreline types are also appropriate for Cowan Creek and each foreshore type has been applied to determine wave run-up to the maximum vertical level (or 'crest') of shoreline structures and the toe level of structures based on information for the study area. This study has adopted the following assumptions for structure levels that are consistent with Cardno (2015) and Rhelm (2022) for the wave overtopping calculations:

- Structure crest levels up to 3.5 m AHD have been adopted. In Cowan Creek at Cottage Point several seawalls have high crest elevations; and
- Toe level of the shoreline seaward of the structure of -0.5 mAHD. This level was adopted to calculate breaking wave heights (where applicable) but is not a sensitive parameter in the context of the wave conditions in Cowen Creek.

For these foreshore type categories, with the exception of mangroves, calculations were undertaken for five foreshore crest levels, being:

- 1.5 mAHD;
- 2.0 mAHD;
- 2.5 mAHD;
- 3.0 mAHD; and
- 3.5 mAHD.

The wave overtopping of the shore were calculated using methods described in USACE (2002) and CERC (1984). The methods and equations are briefly summarised below.

Firstly, wave run-up is computed for a scenario without overtopping to determine the maximum elevation of run-up for each shoreline type. This was calculated using the equations of De Waal and van der Meer (1992). The runup level equation is presented in equation 6.1:

$$\frac{R_{2\%}}{H_s} = 1.6\,\xi_{op}\ where\ 0.5 < \xi_{op} < 2, or\ 3.2\ where\ \xi_{op} > 2 \qquad (6.1)$$

$$Level = SWL + R_{2\%} \qquad (6.2)$$

ξ_{op} is the surf similarity parameter based on deepwater wave height and wavelength and includes the structure slopes that were specified at the start of this Section. The 2% wave run-up level is adjusted based on shoreline type using the following reduction factors:

- Smooth concrete or block waves: 1.0 (no reduction);
- Grassy or vegetated bank: 0.9; and
- Rocky shoreline: 0.6.

Following calculation of the unobstructed maximum run-up level, wave run-up and overtopping is calculated using van der Meer and Janssen (1995):

$$K_{TO} = C\left(1 - \frac{R_c}{R_{2\%}}\right)\ where\ C = 0.51 \qquad (6.3)$$

For vertical walls, Equation 6.3 is modified and the shoreline wave height replaces the $R_{2\%}$term. The wave height transmitted over the wall and flood level is then calculated as follows:

$$H_{TO} = K_{TO} \times H_s \qquad (6.4)$$

$$Level = Crest\ Level + H_{TO} \quad (6.5)$$

If the still water level is above the structure crest, the following equation from Public Works (1990) is adopted:

$$Level = SWL + \frac{H_s}{2} \quad (6.6)$$

6.3.3 Inland Extent of Wave Overtopping

Where a block slopes steeply back from the shoreline edge structure, the EPL may affect only a small part of the block. However, where a block is relatively flat, wave run-up may penetrate some distance inland, but is attenuated by percolation and friction. This landward reduction of wave inundation cannot be estimated with great confidence and has been based on observational experience. As Cowan Creek, in particular Cottage Point properties, has steep slopes rising from the shoreline, wave run-up is not expected to contribute to inundation a significant distance from the shoreline.

It is assumed that wave run-up diminishes to zero at a point 40m inland from the edge structure. This means that at the foreshore, the EPL is set to the "maximum EPL" and at 40m from the foreshore the EPL is set at the local (still) water level. A linear interpolation has been used to calculate the EPL for areas between 0m and 40m from the foreshore, as shown in **Figure 6-2**.

The freeboard allowance accommodates the potential that some shallow, low velocity wave inundation may extend further than 40 m from the foreshore edge.

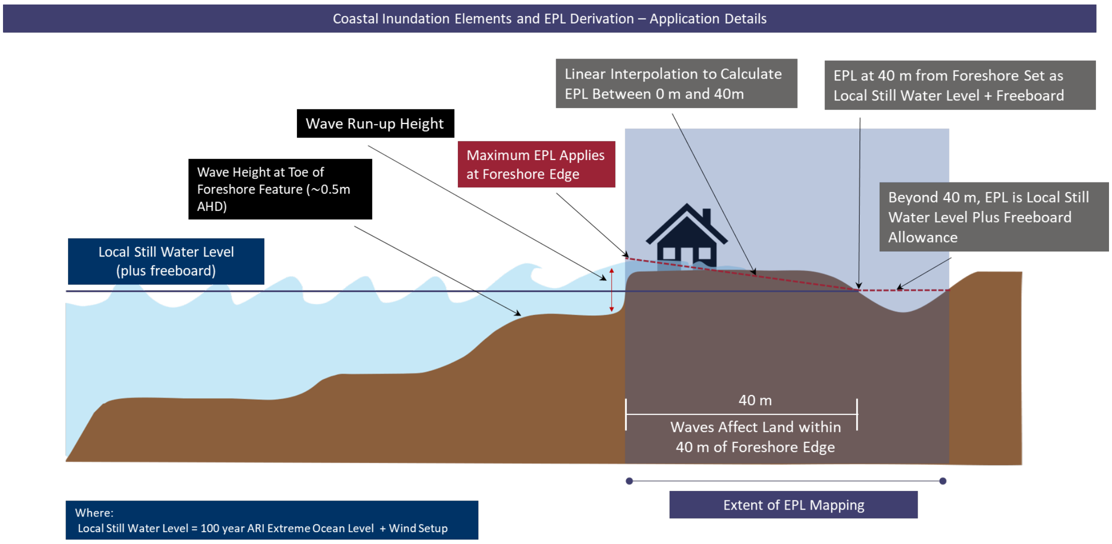

Figure 6-2 Calculation of Landward Reduction in Wave Inundation

Reduction factors have been calculated for each of the Foreshore Zones (**Section 6.3.2**). The reduction factors vary for each of the localities due to the fact that the Design Still Water Levels and Wave Height calculations vary between each locality.

Reduction factors have been calculated:

- At 5 metre increments with regards to distance from the foreshore edge (up to a maximum distance of 40 metres);
- For the foreshore type and height combination that produces the greatest amount of wave run-up (i.e. the highest EPL for that location); and

- For the 0.4m and 0.9m sea level rise scenarios (the existing or present day sea level rise scenario is not used for planning purposes and as such no reduction factors are required).

This results in a total of 16 reduction factors (8 for each sea level rise scenario) for each property within the 'existing' (or present day) sea level EPL database.

6.4 Freeboard

The estimation of all the components that make up the EPL at each selected location includes some uncertainty, and the degree of uncertainty varies with each water level component. It is greatest for wave run-up; and wave run-up is normally the largest water level component, other than astronomical tide.

It is common practice to take some precaution over this uncertainty. This is generally achieved through the application of a freeboard.

Prior to explicit incorporation of provision for sea level rise in planning levels, a freeboard of 0.5 m was commonly been adopted in NSW, incorporating a 0.3 m freeboard with an additional 0.2 m to account for potential sea level rise (much less than the current predicted sea level rise).

A freeboard of 0.3m is considered appropriate for the definition of the EPL. This accounts for 0.05m uncertainty in wind setup, 0.15m (i.e. 10% variance on 1.5m) uncertainty on maximum wave height, with the remaining 0.1m allowing for uncertainty in wave overtopping and runup.

It should be noted that the freeboard has not been included in the provisions of estuarine risk inundation extents to identify affected properties. However, those properties identified as being affected by estuarine risk inundation would have a freeboard included in their EPL.

The identification of "at risk" properties is discussed in more detail in **Section 7.1**.

6.5 Summary of Calculated EPLs

A summary of the significant EPL parameters from the 48 output points at Cottage Point are presented in **Table 6-2.** The full suite of EPLs from Cottage Point and Akuna Bay (48 and 26 output points respectively) are presented in **Appendix B** (also provided to Council in digital format).

Table 6-2 Summary of Significant EPL Parameters for Present Day, 2050 and 2100 Ocean Levels at Cottage Point, Cowan Creek

Parameter	Location Name	Easting (MGA z56)	Northing (MGA z56)	Current	2050	2100
Maximum local wind setup	91% of locations	-	-	0.03 m	0.03 m	0.03 m
Maximum Wave Height – Sea Dominated	CP-04	334165	6279203	0.61 m	0.61 m	0.61 m
Maximum EPL – Type 1 3.5 m AHD Crest (1 in 10 natural slope)	CP-03, CP-04	334165 334165	6279243 6279203	2.21 mAHD	2.61 mAHD	3.11 mAHD
Maximum EPL – Type 2 3.5 m AHD Crest (1 in 5 rocky slope)	CP-01 – CP-05	334184 – 334186	6279177 – 6279299	2.22 mAHD	2.62 mAHD	3.12 mAHD

Parameter	Location Name	Easting (MGA z56)	Northing (MGA z56)	Current	2050	2100
Maximum EPL – Type 3 3.5 m AHD Crest (Vertical sea wall)	CP-03 CP-04	334165 334165	6279243 6279203	2.38 mAHD	2.78 mAHD	3.28 mAHD
Maximum EPL – Type 4 (Mangrove)	91% of locations	-	-	1.78 mAHD	2.18 mAHD	2.68 mAHD

7 Properties Affected by Estuarine Planning Levels

7.1 Identifying Affected Properties

Those properties affected by EPLs have been identified spatially using an 'EPL extent' generated as an area using the EPL calculations described in this report and LiDAR survey for the study area.

Properties have been identified as being affected if they are:

- Entirely or partially within the still water level map extent; and / or
- Entirely or partially within 'Worst Case' 'Maximum' EPL Extent within 40m of the foreshore - this is the highest wave run-up and overtopping level possible at that location. The foreshore type that produces the highest level of wave run up and over topping has been used for this purpose, rather the existing foreshore type.

Sea level rise of 0.9m has been used to identify the at-risk properties (**Section 3.1.1** and **6.2**).

It should be noted that no reduction factor has been applied to the overtopping height. For the purposes of identifying the 40m setback, it has been assumed that the foreshore crest/edge is located at the 0.5mAHD contour (which is approximately the mean high water (MHW) tide level of 0.56 mAHD, as measured at Patonga tide gauge for the period 1992-2010 (MHL, 2012).

No freeboard has been applied for the purposes of mapping the EPL extent. However, a freeboard of 0.3m will be applied for all planning levels issued to properties (as discussed in **Section 6.4**).

The estuarine inundation risk properties for Cottage Point are shown on **Figure 7-1**, 60 land parcels in total. The estuarine inundation risk extent mapping for the affected Cottage Point residential properties are shown on **Figure 7-2**. The extent shown is for the 0.9m sea level rise scenario. **Figure 7-3** shows the estuarine inundation risk properties and inundation risk extent for Akuna Bay, 1 land parcel in total. To be conservative the EPL results for AB_26 have been applied to the single affected lot/DP at Akuna Bay in the EPL database.

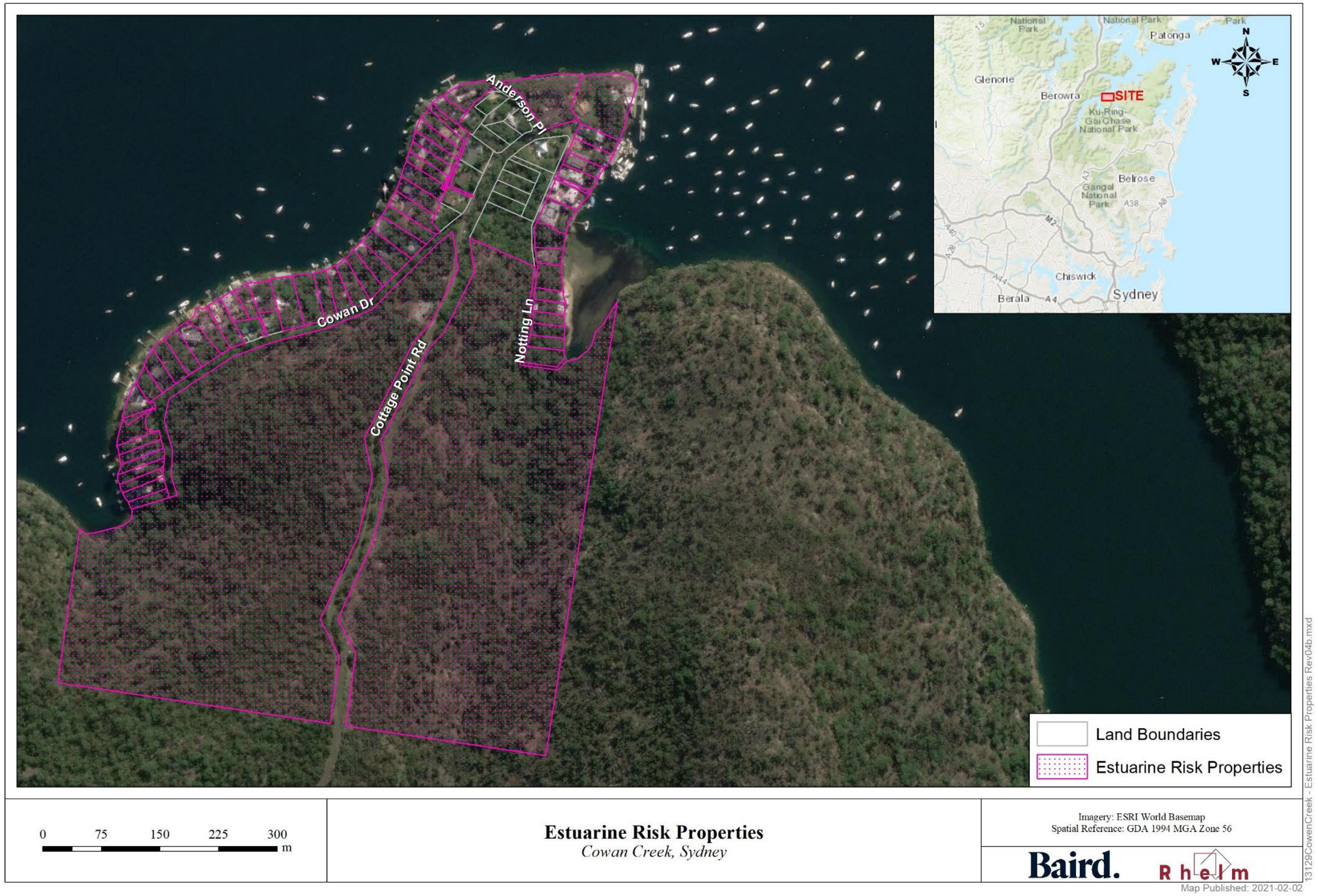

Figure 7-1 Estuarine Inundation Risk Properties at Cottage Point, Cowan Creek

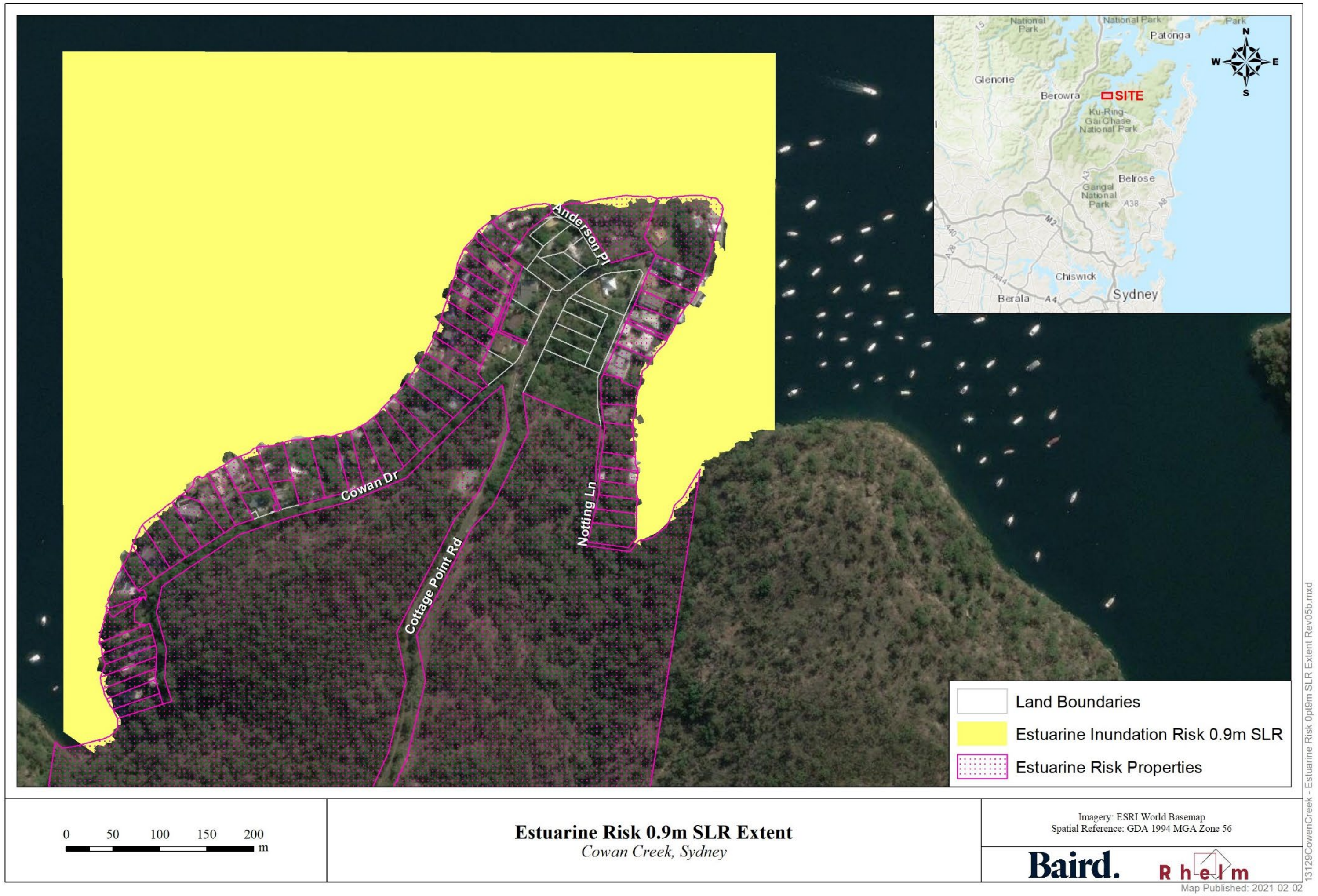

Figure 7-2 Estuarine Inundation Risk Extent at Cottage Point, Cowan Creek

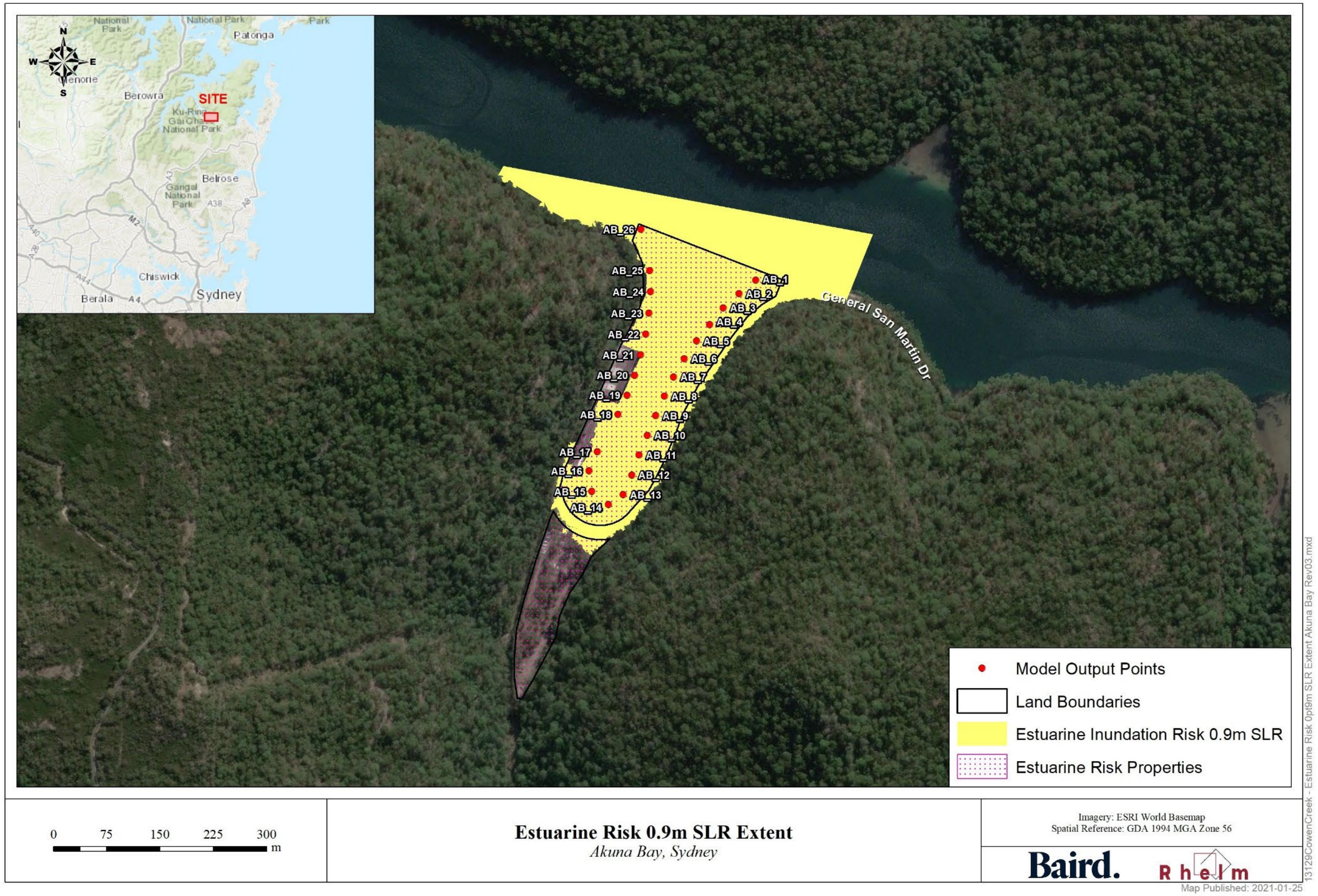

Figure 7-3 Estuarine Inundation Risk Properties and Inundation Risk Extent at Akuna Bay, Cowan Creek

7.2 Partially Affected Properties and Foreshore Reserves

Due to the relatively steep topography around the foreshore in the study area, there are a large number of land parcels (properties) where the estuarine inundation risk mapping only impacts the portion of the property at the water interface and the existing dwelling is located outside of the risk extent. Whilst there would be no estuarine inundation risk associated with the dwelling, the notification would still be present on the property's Section 10.7 planning certificate. This would ensure that any development or works proposed on the affected portion of the property (e.g. boatsheds, jetties or other structures) would consider the impacts of estuarine inundation risk.

Several private properties are fronted by foreshore reserves or have domestic waterfront tenancy arrangements over Crown Land parcels. Where the estuarine inundation risk mapping is contained within these foreshore land parcels, no notification will be present for the adjacent private property. Where the estuarine inundation risk mapping includes even a small area of the private property, the relevant planning certificate notation would be present.

7.3 Application of Estuarine Planning Levels

The EPL for any proposed development on properties within 40m of the foreshore edge is calculated for the proposed foreshore type (or existing if to remain the same after the development) and the distance of the development from the foreshore edge. The resulting EPL will account for the 'local water level', wave run-up and overtopping and the reduction in the wave height as a result of distance from the foreshore, plus a freeboard of 0.3m, as described in **Sections 6.3** and **6.4**.

The EPL for any proposed development on properties beyond 40m of the foreshore edge will be equal to the 'local water level' at the property location, plus a freeboard of 0.3m.

If the proposed development lies outside the EPL extent, then no EPL or estuarine hazard mitigation measures would be applied to the development.

7.4 Piered Properties over Water

No site inspection was undertaken for this study, however based on aerial imagery it appears several properties or ancillary structures in Cottage Point may be piered over water. This will impact the coastal processes at these locations and associated risk to estuarine inundation. In order to improve the estimation of the EPL it is recommended that floor survey of the properties identified in **Appendix C** be undertaken by Council. If any properties are confirmed to be piered over-water it may be reasonable to add an additional freeboard to these properties.

7.5 Estuarine Inundation Risk Related Development Controls

As discussed in **Section 1.1**, EPLs are currently applied as a method for managing risk along the foreshore of Pittwater (in the north of the Northern Beaches LGA) and similarly will be applied to all coastal and estuarine inundation risk areas within the Northern Beaches LGA, including within the Cowan Creek study area, in future planning controls.

The EPLs derived from this study will inform the new planning controls currently being developed by Council for the amalgamated Northern Beaches LGA. This may be done in a similar manner to the existing *Pittwater LEP 2014* and *Pittwater 21 DCP*. The application of planning controls is discussed further in Rhelm (2020).

8 Recommendations

This report provides the identification of land parcels in Cowan Creek, specifically at Cottage Point and Akuna Bay, that would potentially have estuarine inundation risk planning controls applied to development proposed within these land parcels. Further, this report identifies EPLs for each of these land parcels.

Council is currently reviewing its planning process with regards to the application of EPLs within the study area and notification of estuarine inundation risk on property planning certificates. The results of this study should be used to update planning certificates for properties that have an estuarine inundation risk within Cowan Creek (**Figure 7-1**, **Figure 7-3** and model results in **Appendix B**).

It is anticipated that community engagement will be an important aspect of future stages of this project.

9 Assumptions and Qualifications

The following assumptions and qualifications apply to this study:

- Storm climatology which processes storm surge and waves has been analysed as a stationary data record based on the available historical data sets for water levels and waves referenced in this report;
- A toe level of -0.5 m AHD was adopted for all shoreline and structure types. The toe level drives the wave run up and overtopping calculations. As such, where the toe level may be deeper than -0.5 m AHD, the EPL's may be non-conservative. Similarly, if a scoured toe level seaward of the edge treatment is higher than -0.5 m AHD, the EPLs may be more conservative;
- The EPLs have been calculated for a select number of edge treatments that comprise the majority of the shoreline area in Cowan Creek. If a particular property has an edge treatment that significantly differs from the edge treatments considered in this study, a site-specific assessment by a coastal engineer may be required;
- The hydrodynamic model has not been calibrated or validated with any site specific data, however, appropriate model coefficients are adopted based on similar models that have had site specific calibration; and
- No changes to future storm climatology (such as those potentially associated with climate change) have been considered.

10 References

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Appendix A

Local Wave Results

Northern Beaches Council | Stage 1 and 2 Report | Job No. J1389

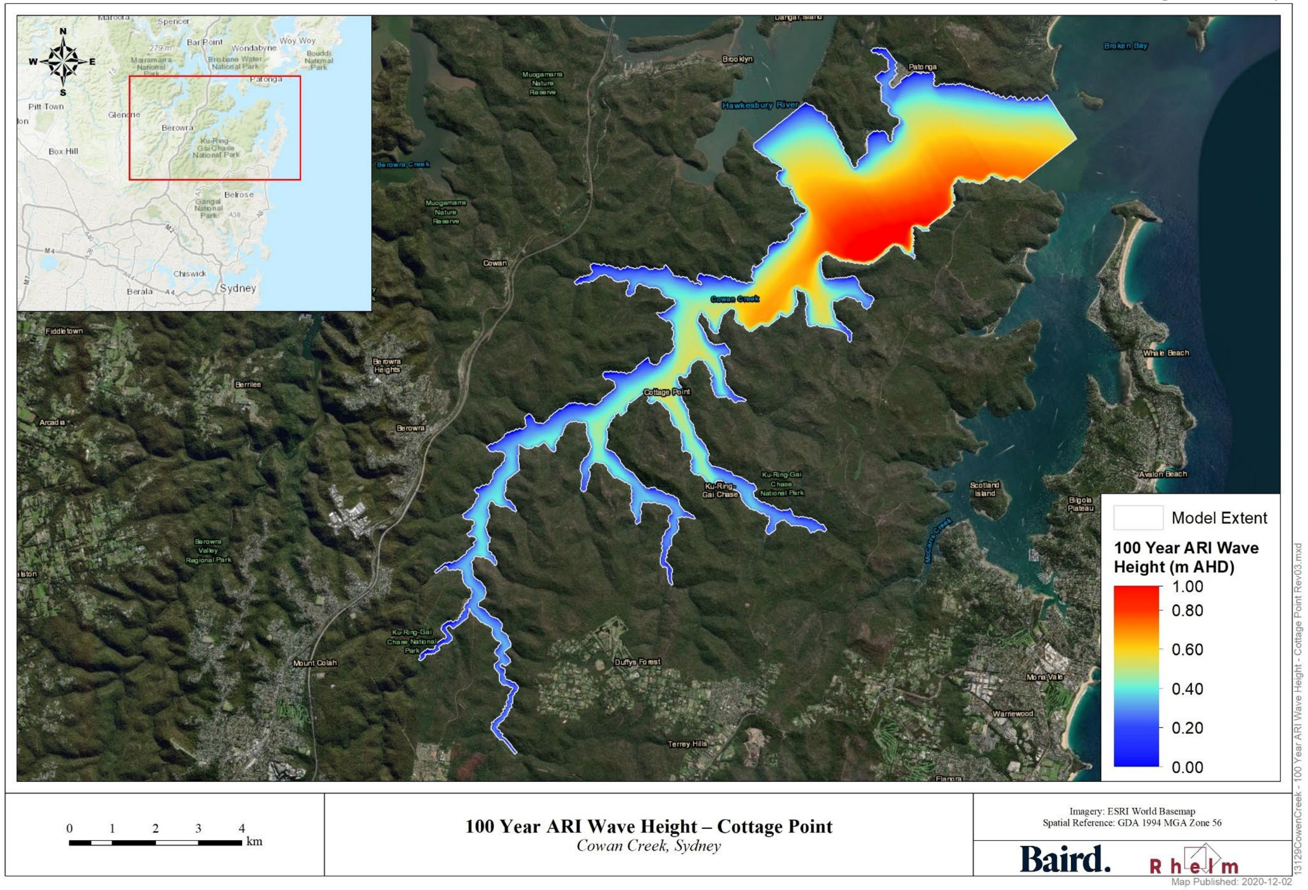

Figure A-1 North-West 100 Year ARI Wind Wave Height at Cottage Point and Cowan Creek

Appendix B

Model Results for Cottage Point and Akuna Bay

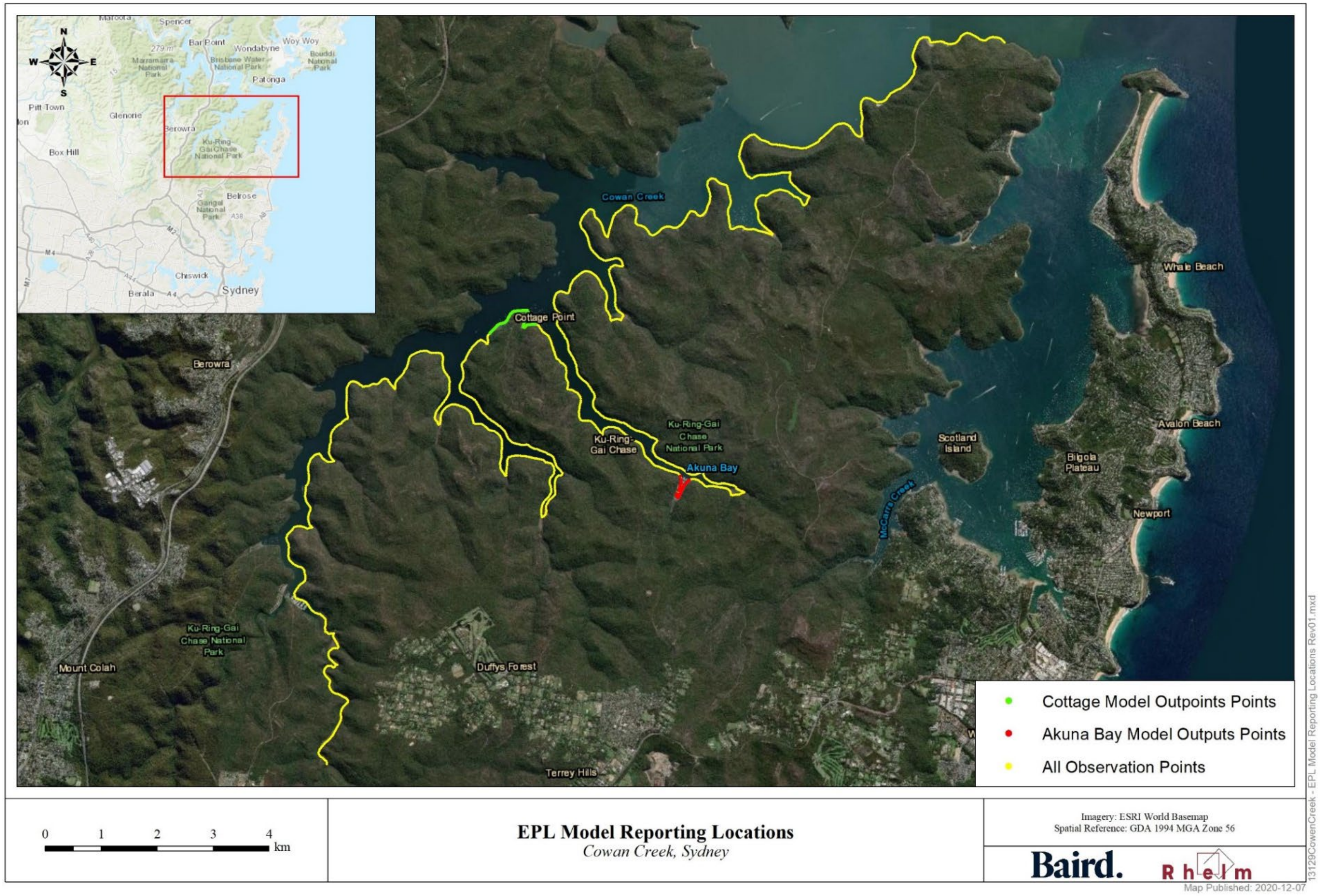

Figure B-1 Model Output Points

Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Patonga is **1.45** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5m will be the equivalent.

Mean Sea Level Rise Allowances taken from Council Policy **0.00** m to the year 2010
Freeboard of **0.3** m included in EPLs

Foreshore Location				100yrARI					Estuarine Planning Level (m)																	REDUCTION FACTORS NOT CALCULATED FOR 2010 LEVELS AS THE 0m SLR LEVELS ARE NOT BEING USED FOR PLANNING PURPOSES							
				Wave						Foreshore Type ##																							
										1					2					3					4								
										Crest Level (mAHD)																							
Location ID	Location	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	Local (Still) Water Level (mAHD) 2010	Local (Still) Water Level with 0.3m Freeboard (mAHD) 2010	Max EPL of all Foreshore Types and Crest Levels (mAHD)	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
CP_01	Cottage Point	333834	6278821	0.56	2.40	0.03	1.48	1.78	2.33	2.07	2.18	2.18	2.18	2.18	2.07	2.20	2.20	2.20	2.20	2.07	2.32	2.33	2.33	2.33	1.78								
CP_02	Cottage Point	333794	6278832	0.55	2.40	0.03	1.48	1.78	2.33	2.06	2.17	2.17	2.17	2.17	2.06	2.20	2.20	2.20	2.20	2.07	2.31	2.33	2.33	2.33	1.78								
CP_03	Cottage Point	333774	6278816	0.54	2.40	0.03	1.48	1.78	2.32	2.06	2.17	2.17	2.17	2.17	2.06	2.20	2.20	2.20	2.20	2.06	2.31	2.32	2.32	2.32	1.78								
CP_04	Cottage Point	333734	6278827	0.52	2.40	0.03	1.48	1.78	2.30	2.05	2.15	2.15	2.15	2.15	2.05	2.19	2.19	2.19	2.19	2.06	2.30	2.30	2.30	2.30	1.78								
CP_05	Cottage Point	333715	6278811	0.50	2.40	0.03	1.48	1.78	2.28	2.04	2.14	2.14	2.14	2.14	2.04	2.19	2.19	2.19	2.19	2.05	2.28	2.28	2.28	2.28	1.78								
CP_06	Cottage Point	333695	6278796	0.48	2.40	0.03	1.48	1.78	2.26	2.03	2.13	2.13	2.13	2.13	2.03	2.18	2.18	2.18	2.18	2.04	2.26	2.26	2.26	2.26	1.78								
CP_07	Cottage Point	333675	6278781	0.47	2.40	0.03	1.48	1.78	2.25	2.03	2.12	2.12	2.12	2.12	2.03	2.17	2.17	2.17	2.17	2.03	2.25	2.25	2.25	2.25	1.78								
CP_08	Cottage Point	333656	6278766	0.45	2.40	0.03	1.48	1.78	2.24	2.02	2.11	2.11	2.11	2.11	2.02	2.17	2.17	2.17	2.17	2.02	2.24	2.24	2.24	2.24	1.78								
CP_09	Cottage Point	333636	6278750	0.44	2.40	0.03	1.48	1.78	2.22	2.01	2.10	2.10	2.10	2.10	2.01	2.16	2.16	2.16	2.16	2.02	2.22	2.22	2.22	2.22	1.78								
CP_10	Cottage Point	333636	6278791	0.43	2.40	0.03	1.48	1.78	2.21	2.01	2.09	2.09	2.09	2.09	2.01	2.16	2.16	2.16	2.16	2.01	2.21	2.21	2.21	2.21	1.78								
CP_11	Cottage Point	333635	6278832	0.42	2.40	0.03	1.48	1.78	2.21	2.01	2.09	2.09	2.09	2.09	2.01	2.15	2.15	2.15	2.15	2.01	2.21	2.21	2.21	2.21	1.78								
CP_12	Cottage Point	333655	6278847	0.42	2.40	0.03	1.48	1.78	2.20	2.00	2.08	2.08	2.08	2.08	2.00	2.15	2.15	2.15	2.15	2.00	2.20	2.20	2.20	2.20	1.78								
CP_13	Cottage Point	333674	6278862	0.43	1.87	0.03	1.48	1.78	2.21	2.00	2.09	2.09	2.09	2.09	2.00	2.07	2.07	2.07	2.07	2.01	2.21	2.21	2.21	2.21	1.78								
CP_14	Cottage Point	333674	6278903	0.46	1.87	0.03	1.48	1.78	2.24	2.02	2.11	2.11	2.11	2.11	2.02	2.08	2.08	2.08	2.08	2.02	2.24	2.24	2.24	2.24	1.78								
CP_15	Cottage Point	333713	6278933	0.49	1.87	0.03	1.48	1.78	2.27	2.03	2.13	2.13	2.13	2.13	2.03	2.09	2.09	2.09	2.09	2.04	2.27	2.27	2.27	2.27	1.78								
CP_16	Cottage Point	333712	6278974	0.52	1.87	0.03	1.48	1.78	2.30	2.05	2.15	2.15	2.15	2.15	2.05	2.10	2.10	2.10	2.10	2.05	2.30	2.30	2.30	2.30	1.78								
CP_17	Cottage Point	333732	6278989	0.54	1.87	0.03	1.48	1.78	2.32	2.06	2.17	2.17	2.17	2.17	2.06	2.11	2.11	2.11	2.11	2.06	2.31	2.32	2.32	2.32	1.78								
CP_18	Cottage Point	333712	6279014	0.56	2.11	0.03	1.48	1.78	2.33	2.06	2.18	2.18	2.18	2.18	2.06	2.15	2.15	2.15	2.15	2.07	2.32	2.33	2.33	2.33	1.78								
CP_19	Cottage Point	333711	6279055	0.58	2.11	0.02	1.47	1.77	2.35	2.07	2.19	2.19	2.19	2.19	2.07	2.16	2.16	2.16	2.16	2.08	2.33	2.35	2.35	2.35	1.77								
CP_20	Cottage Point	333691	6279080	0.59	2.40	0.03	1.48	1.78	2.36	2.08	2.20	2.20	2.20	2.20	2.08	2.22	2.22	2.22	2.22	2.09	2.33	2.36	2.36	2.36	1.78								
CP_21	Cottage Point	333671	6279065	0.56	1.87	0.02	1.47	1.77	2.34	2.06	2.18	2.18	2.18	2.18	2.06	2.11	2.11	2.11	2.11	2.07	2.32	2.34	2.34	2.34	1.77								
CP_22	Cottage Point	333632	6279075	0.53	1.87	0.03	1.48	1.78	2.31	2.05	2.16	2.16	2.16	2.16	2.05	2.10	2.10	2.10	2.10	2.06	2.30	2.31	2.31	2.31	1.78								
CP_23	Cottage Point	333612	6279060	0.50	2.11	0.03	1.48	1.78	2.28	2.04	2.14	2.14	2.14	2.14	2.04	2.14	2.14	2.14	2.14	2.04	2.28	2.28	2.28	2.28	1.78								
CP_24	Cottage Point	333572	6279070	0.50	2.11	0.03	1.48	1.78	2.28	2.04	2.14	2.14	2.14	2.14	2.04	2.14	2.14	2.14	2.14	2.04	2.28	2.28	2.28	2.28	1.78								
CP_25	Cottage Point	333552	6279055	0.49	2.11	0.03	1.48	1.78	2.27	2.04	2.13	2.13	2.13	2.13	2.04	2.13	2.13	2.13	2.13	2.04	2.27	2.27	2.27	2.27	1.78								
CP_26	Cottage Point	333513	6279065	0.50	2.40	0.03	1.48	1.78	2.27	2.04	2.13	2.13	2.13	2.13	2.04	2.18	2.18	2.18	2.18	2.04	2.27	2.27	2.27	2.27	1.78								
CP_27	Cottage Point	333493	6279050	0.52	2.40	0.03	1.48	1.78	2.30	2.05	2.15	2.15	2.15	2.15	2.05	2.19	2.19	2.19	2.19	2.06	2.30	2.30	2.30	2.30	1.78								
CP_28	Cottage Point	333453	6279060	0.55	2.40	0.03	1.48	1.78	2.33	2.07	2.18	2.18	2.18	2.18	2.07	2.21	2.21	2.21	2.21	2.07	2.32	2.33	2.33	2.33	1.78								
CP_29	Cottage Point	333434	6279045	0.56	2.40	0.03	1.48	1.78	2.34	2.07	2.18	2.18	2.18	2.18	2.07	2.21	2.21	2.21	2.21	2.08	2.32	2.34	2.34	2.34	1.78								
CP_30	Cottage Point	333414	6279029	0.56	2.40	0.03	1.48	1.78	2.34	2.07	2.18	2.18	2.18	2.18	2.07	2.21	2.21	2.21	2.21	2.08	2.32	2.34	2.34	2.34	1.78								
CP_31	Cottage Point	333394	6279014	0.56	2.40	0.03	1.48	1.78	2.34	2.07	2.18	2.18	2.18	2.18	2.07	2.21	2.21	2.21	2.21	2.08	2.32	2.34	2.34	2.34	1.78								
CP_32	Cottage Point	333395	6278973	0.56	2.40	0.03	1.48	1.78	2.34	2.07	2.18	2.18	2.18	2.18	2.07	2.21	2.21	2.21	2.21	2.07	2.32	2.34	2.34	2.34	1.78								
CP_33	Cottage Point	333375	6278958	0.55	2.40	0.03	1.48	1.78	2.33	2.07	2.18	2.18	2.18	2.18	2.07	2.21	2.21	2.21	2.21	2.07	2.32	2.33	2.33	2.33	1.78								
CP_34	Cottage Point	333356	6278902	0.54	2.40	0.03	1.48	1.78	2.32	2.06	2.17	2.17	2.17	2.17	2.06	2.20	2.20	2.20	2.20	2.07	2.31	2.32	2.32	2.32	1.78								
CP_35	Cottage Point	333337	6278887	0.53	2.11	0.03	1.48	1.78	2.31	2.05	2.16	2.16	2.16	2.16	2.05	2.15	2.15	2.15	2.15	2.06	2.30	2.31	2.31	2.31	1.78								
CP_36	Cottage Point	333317	6278872	0.51	2.11	0.03	1.48	1.78	2.29	2.04	2.15	2.15	2.15	2.15	2.04	2.14	2.14	2.14	2.14	2.05	2.29	2.29	2.29	2.29	1.78								
CP_37	Cottage Point	333298	6278856	0.49	2.11	0.03	1.48	1.78	2.27	2.04	2.13	2.13	2.13	2.13	2.04	2.13	2.13	2.13	2.13	2.04	2.27	2.27	2.27	2.27	1.78								
CP_38	Cottage Point	333278	6278841	0.49	2.11	0.03	1.48	1.78	2.27	2.04	2.13	2.13	2.13	2.13	2.04	2.13	2.13	2.13	2.13	2.04	2.27	2.27	2.27	2.27	1.78								
CP_39	Cottage Point	333238	6278851	0.52	2.40	0.03	1.48	1.78	2.30	2.05	2.15	2.15	2.15	2.15	2.05	2.19	2.19	2.19	2.19	2.05	2.30	2.30	2.30	2.30	1.78								
CP_40	Cottage Point	333199	6278821	0.54	2.40	0.03	1.48	1.78	2.31	2.06	2.16	2.16	2.16	2.16	2.06	2.20	2.20	2.20	2.20	2.06	2.31	2.31	2.31	2.31	1.78								
CP_41	Cottage Point	333179	6278805	0.54	2.40	0.03	1.48	1.78	2.32	2.06	2.17	2.17	2.17	2.17	2.06	2.20	2.20	2.20	2.20	2.06	2.31	2.32	2.32	2.32	1.78								
CP_42	Cottage Point	333160	6278790	0.54	2.40	0.03	1.48	1.78	2.32	2.06	2.17	2.17	2.17	2.17	2.06	2.20	2.20	2.20	2.20	2.06	2.31	2.32	2.32	2.32	1.78								
CP_43	Cottage Point	333140	6278775	0.53	2.40	0.03	1.48	1.78	2.31	2.06	2.16	2.16	2.16	2.16	2.06	2.20	2.20	2.20	2.20	2.06	2.31	2.31	2.31	2.31	1.78								
CP_44	Cottage Point	333121	6278760	0.53	2.40	0.03	1.48	1.78	2.31	2.06	2.16	2.16	2.16	2.16	2.06	2.20	2.20	2.20	2.20	2.06	2.30	2.31	2.31	2.31	1.78								
CP_45	Cottage Point	333081	6278729	0.53	2.40	0.03	1.48	1.78	2.30	2.05	2.16	2.16	2.16	2.16	2.05	2.20	2.20	2.20	2.20	2.06	2.30	2.30	2.30	2.30	1.78								
CP_46	Cottage Point	333082	6278689	0.52	2.40	0.03	1.48	1.78	2.30	2.05	2.16	2.16	2.16	2.16	2.05	2.19	2.19	2.19	2.19	2.06	2.30	2.30	2.30	2.30	1.78								
CP_47	Cottage Point	333062	6278673	0.52	2.40	0.03	1.48	1.78	2.30	2.05	2.15	2.15	2.15	2.15	2.05	2.19	2.19	2.19	2.19	2.05	2.30	2.30	2.30	2.30	1.78								
CP_48	Cottage Point	333043	6278658	0.50	2.40	0.03	1.48	1.78	2.28	2.04	2.14	2.14	2.14	2.14	2.04	2.19	2.19	2.19	2.19	2.05	2.28	2.28	2.28	2.28	1.78								
AB_1	Akuna Bay	336595	6276023	0.36	1.65	0.04	1.49	1.79	2.15	1.98	2.05	2.05	2.05	2.05	1.98	2.03	2.03	2.03	2.03	1.98	2.15	2.15	2.15	2.15	1.79								
AB_2	Akuna Bay	336575	6276008	0.35	1.65	0.04	1.49	1.79	2.14	1.97	2.05	2.05	2.05	2.05	1.97	2.03	2.03	2.03	2.03	1.98	2.14	2.14	2.14	2.14	1.79								
AB_3	Akuna Bay	336555	6275994	0.35	1.65	0.04	1.49	1.79	2.14	1.97	2.04	2.04	2.04	2.04	1.97	2.02	2.02	2.02	2.02	1.97	2.14	2.14	2.14	2.14	1.79								
AB_4	Akuna Bay	336516	6275964	0.34	1.65	0.04	1.49	1.79	2.14	1.97	2.04	2.04	2.04	2.04	1.97	2.02	2.02	2.02	2.02	1.97	2.14	2.14	2.14	2.14	1.79								
AB_5	Akuna Bay	336496	6275949	0.34	1.65	0.04	1.49	1.79	2.13	1.97	2.04	2.04	2.04	2.04	1.97	2.02	2.02	2.02	2.02	1.97	2.13	2.13	2.13	2.13	1.79								
AB_6	Akuna Bay	336476	6275934	0.33	1.65	0.04	1.49	1.79	2.12	1.96	2.03	2.03	2.03	2.03	1.96	2.02	2.02	2.02	2.02	1.96	2.12	2.12	2.12	2.12	1.79								
AB_7	Akuna Bay	336476	6275893	0.33	1.65	0.04	1.49	1.79	2.12	1.96	2.03	2.03	2.03	2.03	1.96	2.02	2.02	2.02	2.02	1.97	2.12	2.12	2.12	2.12	1.79								
AB_8	Akuna Bay	336456	6275878	0.32	1.45	0.04	1.49	1.79	2.12	1.96	2.03	2.03	2.03	2.03	1.96	1.99	1.99	1.99	1.99	1.96	2.12	2.12	2.12	2.12	1.79								
AB_9	Akuna Bay	336456	6275838	0.31	1.45	0.05	1.50	1.80	2.11	1.96	2.02	2.02	2.02	2.02	1.96	1.99	1.99	1.99	1.99	1.96	2.11	2.11	2.11	2.11	1.80								
AB_10	Akuna Bay	336436	6275823	0.30	1.45	0.05	1.50	1.80	2.09	1.95	2.01	2.01	2.01	2.01	1.95	1.99	1.99	1.99	1.99	1.95	2.09	2.09	2.09	2.09	1.80								
AB_11	Akuna Bay	336436	6275782	0.28	1.65	0.05	1.50	1.80	2.07	1.94	2.00	2.00	2.00	2.00	1.94	2.00	2.00	2.00	2.00	1.94	2.07	2.07	2.07	2.07	1.80								

13129.201
10/02/2021

File Reference:
C:\Dropbox (Rhelm)\J1300-J1399\J1389 - Cowan Creek EPL Study\8. Analysis\EPL Database\J1389_EPL_Database_V02\J1389_EPL_Database_V02
0 m Sea Level Projected WL

Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Patonga is **1.45** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5m will be the equivalent.

Mean Sea Level Rise Allowances taken from Council Policy **0.00** m to the year 2010
Freeboard of **0.3** m included in EPLs

Foreshore Location				100yrARI					Estuarine Planning Level (m)																	REDUCTION FACTORS NOT CALCULATED FOR 2010 LEVELS AS THE 0m SLR LEVELS ARE NOT BEING USED FOR PLANNING PURPOSES							
				Wave						Foreshore Type ##																							
										1					2					3					4								
										Crest Level (mAHD)																							
Location ID	Location	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	Local (Still) Water Level (mAHD) 2010	Local (Still) Water Level with 0.3m Freeboard (mAHD) 2010	Max EPL of all Foreshore Types and Crest Levels (mAHD)	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
AB_12	Akuna Bay	336416	6275767	0.28	1.65	0.05	1.50	1.80	2.08	1.94	2.00	2.00	2.00	2.00	1.94	2.01	2.01	2.01	2.01	1.94	2.08	2.08	2.08	2.08	1.80								
AB_13	Akuna Bay	336415	6275726	0.28	1.65	0.05	1.50	1.80	2.07	1.94	2.00	2.00	2.00	2.00	1.94	2.01	2.01	2.01	2.01	1.94	2.07	2.07	2.07	2.07	1.80								
AB_14	Akuna Bay	336376	6275737	0.27	1.65	0.05	1.50	1.80	2.07	1.94	1.99	1.99	1.99	1.99	1.94	2.00	2.00	2.00	2.00	1.94	2.07	2.07	2.07	2.07	1.80								
AB_15	Akuna Bay	336356	6275722	0.26	1.65	0.05	1.50	1.80	2.06	1.93	1.98	1.98	1.98	1.98	1.93	2.00	2.00	2.00	2.00	1.93	2.06	2.06	2.06	2.06	1.80								
AB_16	Akuna Bay	336357	6275763	0.26	1.28	0.05	1.50	1.80	2.05	1.93	1.98	1.98	1.98	1.98	1.93	1.95	1.95	1.95	1.95	1.93	2.05	2.05	2.05	2.05	1.80								
AB_17	Akuna Bay	336357	6275804	0.28	1.45	0.04	1.49	1.79	2.07	1.94	1.99	1.99	1.99	1.99	1.94	1.98	1.98	1.98	1.98	1.94	2.07	2.07	2.07	2.07	1.79								
AB_18	Akuna Bay	336377	6275819	0.29	1.45	0.04	1.49	1.79	2.09	1.95	2.01	2.01	2.01	2.01	1.95	1.98	1.98	1.98	1.98	1.95	2.09	2.09	2.09	2.09	1.79								
AB_19	Akuna Bay	336396	6275834	0.31	1.45	0.05	1.50	1.80	2.11	1.95	2.02	2.02	2.02	2.02	1.95	1.99	1.99	1.99	1.99	1.96	2.11	2.11	2.11	2.11	1.80								
AB_20	Akuna Bay	336397	6275875	0.32	1.65	0.04	1.49	1.79	2.12	1.96	2.03	2.03	2.03	2.03	1.96	2.02	2.02	2.02	2.02	1.96	2.12	2.12	2.12	2.12	1.79								
AB_21	Akuna Bay	336417	6275890	0.33	1.65	0.04	1.49	1.79	2.13	1.97	2.03	2.03	2.03	2.03	1.97	2.02	2.02	2.02	2.02	1.97	2.13	2.13	2.13	2.13	1.79								
AB_22	Akuna Bay	336417	6275930	0.34	1.65	0.04	1.49	1.79	2.13	1.97	2.04	2.04	2.04	2.04	1.97	2.02	2.02	2.02	2.02	1.97	2.13	2.13	2.13	2.13	1.79								
AB_23	Akuna Bay	336437	6275945	0.35	1.65	0.04	1.49	1.79	2.14	1.97	2.04	2.04	2.04	2.04	1.97	2.03	2.03	2.03	2.03	1.97	2.14	2.14	2.14	2.14	1.79								
AB_24	Akuna Bay	336437	6275986	0.36	1.65	0.04	1.49	1.79	2.15	1.98	2.05	2.05	2.05	2.05	1.98	2.03	2.03	2.03	2.03	1.98	2.15	2.15	2.15	2.15	1.79								
AB_25	Akuna Bay	336437	6276027	0.37	1.65	0.04	1.49	1.79	2.16	1.98	2.06	2.06	2.06	2.06	1.98	2.03	2.03	2.03	2.03	1.98	2.16	2.16	2.16	2.16	1.79								
AB_26	Akuna Bay	336437	6276068	0.38	1.87	0.04	1.49	1.79	2.17	1.99	2.06	2.06	2.06	2.06	1.99	2.06	2.06	2.06	2.06	1.99	2.17	2.17	2.17	2.17	1.79								

100yr ARI Planning Levels - 2050 Planning Period - 0.4m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Patonga is **1.45** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5m will be the equivalent.

Mean Sea Level Rise Allowances taken from Council Policy **0.40** m to the year 2010
Freeboard of **0.3** m included in EPLs

Foreshore Location				100yrARI					Estuarine Planning Level (m)																	Reduction Factor							
				Wave						Foreshore Type ##																							
							Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)	Max EPL of all Foreshore Types and Crest Levels (mAHD)	1					2					3					4								
										Crest Level (mAHD)																							
Location ID	Location	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	2050	2050		1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
CP_01	Cottage Point	333834	6278821	0.56	2.40	0.03	1.88	2.18	2.73	2.45	2.50	2.58	2.58	2.58	2.45	2.50	2.60	2.60	2.60	2.45	2.52	2.73	2.73	2.73	2.18	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
CP_02	Cottage Point	333794	6278832	0.55	2.40	0.03	1.88	2.18	2.73	2.45	2.49	2.57	2.57	2.57	2.45	2.50	2.60	2.60	2.60	2.45	2.52	2.73	2.73	2.73	2.18	0.07	0.14	0.21	0.28	0.34	0.41	0.48	0.55
CP_03	Cottage Point	333774	6278816	0.54	2.40	0.03	1.88	2.18	2.72	2.45	2.49	2.57	2.57	2.57	2.45	2.50	2.60	2.60	2.60	2.45	2.51	2.72	2.72	2.72	2.18	0.07	0.14	0.20	0.27	0.34	0.41	0.47	0.54
CP_04	Cottage Point	333734	6278827	0.52	2.40	0.03	1.88	2.18	2.70	2.44	2.48	2.55	2.55	2.55	2.44	2.49	2.59	2.59	2.59	2.44	2.50	2.70	2.70	2.70	2.18	0.07	0.13	0.20	0.26	0.33	0.39	0.46	0.52
CP_05	Cottage Point	333715	6278811	0.50	2.40	0.03	1.88	2.18	2.68	2.43	2.47	2.54	2.54	2.54	2.43	2.48	2.59	2.59	2.59	2.43	2.49	2.68	2.68	2.68	2.18	0.06	0.13	0.19	0.25	0.31	0.38	0.44	0.50
CP_06	Cottage Point	333695	6278796	0.48	2.40	0.03	1.88	2.18	2.66	2.42	2.46	2.53	2.53	2.53	2.42	2.47	2.58	2.58	2.58	2.42	2.48	2.66	2.66	2.66	2.18	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
CP_07	Cottage Point	333675	6278781	0.47	2.40	0.03	1.88	2.18	2.65	2.41	2.45	2.52	2.52	2.52	2.41	2.47	2.57	2.57	2.57	2.41	2.48	2.65	2.65	2.65	2.18	0.06	0.12	0.18	0.23	0.29	0.35	0.41	0.47
CP_08	Cottage Point	333656	6278766	0.45	2.40	0.03	1.88	2.18	2.64	2.41	2.45	2.51	2.51	2.51	2.41	2.46	2.57	2.57	2.57	2.41	2.47	2.64	2.64	2.64	2.18	0.06	0.11	0.17	0.23	0.28	0.34	0.40	0.45
CP_09	Cottage Point	333636	6278750	0.44	2.40	0.03	1.88	2.18	2.62	2.40	2.44	2.50	2.50	2.50	2.40	2.45	2.56	2.56	2.56	2.40	2.46	2.62	2.62	2.62	2.18	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44
CP_10	Cottage Point	333636	6278791	0.43	2.40	0.03	1.88	2.18	2.61	2.40	2.44	2.49	2.49	2.49	2.40	2.45	2.56	2.56	2.56	2.40	2.46	2.61	2.61	2.61	2.18	0.05	0.11	0.16	0.22	0.27	0.32	0.38	0.43
CP_11	Cottage Point	333635	6278832	0.42	2.40	0.03	1.88	2.18	2.61	2.39	2.43	2.49	2.49	2.49	2.39	2.45	2.55	2.55	2.55	2.39	2.46	2.61	2.61	2.61	2.18	0.05	0.11	0.16	0.21	0.27	0.32	0.37	0.42
CP_12	Cottage Point	333655	6278847	0.42	2.40	0.03	1.88	2.18	2.60	2.39	2.43	2.48	2.48	2.48	2.39	2.44	2.55	2.55	2.55	2.39	2.45	2.60	2.60	2.60	2.18	0.05	0.11	0.16	0.21	0.26	0.32	0.37	0.42
CP_13	Cottage Point	333674	6278862	0.43	1.87	0.03	1.88	2.18	2.61	2.39	2.43	2.49	2.49	2.49	2.39	2.43	2.47	2.47	2.47	2.39	2.46	2.61	2.61	2.61	2.18	0.05	0.11	0.16	0.22	0.27	0.32	0.38	0.43
CP_14	Cottage Point	333674	6278903	0.46	1.87	0.03	1.88	2.18	2.64	2.41	2.45	2.51	2.51	2.51	2.41	2.44	2.48	2.48	2.48	2.41	2.47	2.64	2.64	2.64	2.18	0.06	0.12	0.17	0.23	0.29	0.35	0.40	0.46
CP_15	Cottage Point	333713	6278933	0.49	1.87	0.03	1.88	2.18	2.67	2.42	2.46	2.53	2.53	2.53	2.42	2.45	2.49	2.49	2.49	2.42	2.49	2.67	2.67	2.67	2.18	0.06	0.12	0.18	0.25	0.31	0.37	0.43	0.49
CP_16	Cottage Point	333712	6278974	0.52	1.87	0.03	1.88	2.18	2.70	2.44	2.48	2.55	2.55	2.55	2.44	2.46	2.50	2.50	2.50	2.44	2.50	2.70	2.70	2.70	2.18	0.06	0.13	0.19	0.26	0.32	0.39	0.45	0.52
CP_17	Cottage Point	333732	6278989	0.54	1.87	0.03	1.88	2.18	2.72	2.45	2.49	2.57	2.57	2.57	2.45	2.47	2.51	2.51	2.51	2.45	2.51	2.72	2.72	2.72	2.18	0.07	0.14	0.20	0.27	0.34	0.41	0.47	0.54
CP_18	Cottage Point	333712	6279014	0.56	2.11	0.03	1.88	2.18	2.73	2.45	2.49	2.58	2.58	2.58	2.45	2.49	2.55	2.55	2.55	2.45	2.52	2.73	2.73	2.73	2.18	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
CP_19	Cottage Point	333711	6279055	0.58	2.11	0.02	1.87	2.17	2.75	2.46	2.51	2.59	2.59	2.59	2.46	2.50	2.56	2.56	2.56	2.46	2.53	2.75	2.75	2.75	2.17	0.07	0.14	0.22	0.29	0.36	0.43	0.50	0.58
CP_20	Cottage Point	333691	6279080	0.59	2.40	0.03	1.88	2.18	2.76	2.47	2.51	2.60	2.60	2.60	2.47	2.52	2.62	2.62	2.62	2.47	2.54	2.76	2.76	2.76	2.18	0.07	0.15	0.22	0.29	0.37	0.44	0.52	0.59
CP_21	Cottage Point	333671	6279065	0.56	1.87	0.02	1.87	2.17	2.74	2.45	2.50	2.58	2.58	2.58	2.45	2.48	2.51	2.51	2.51	2.45	2.52	2.74	2.74	2.74	2.17	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
CP_22	Cottage Point	333632	6279075	0.53	1.87	0.03	1.88	2.18	2.71	2.44	2.48	2.56	2.56	2.56	2.44	2.47	2.50	2.50	2.50	2.44	2.51	2.71	2.71	2.71	2.18	0.07	0.13	0.20	0.27	0.33	0.40	0.46	0.53
CP_23	Cottage Point	333612	6279060	0.50	2.11	0.03	1.88	2.18	2.68	2.43	2.47	2.54	2.54	2.54	2.43	2.47	2.54	2.54	2.54	2.43	2.49	2.68	2.68	2.68	2.18	0.06	0.13	0.19	0.25	0.32	0.38	0.44	0.50
CP_24	Cottage Point	333572	6279070	0.50	2.11	0.03	1.88	2.18	2.68	2.43	2.47	2.54	2.54	2.54	2.43	2.47	2.54	2.54	2.54	2.43	2.49	2.68	2.68	2.68	2.18	0.06	0.12	0.19	0.25	0.31	0.37	0.44	0.50
CP_25	Cottage Point	333552	6279055	0.49	2.11	0.03	1.88	2.18	2.67	2.42	2.46	2.53	2.53	2.53	2.42	2.46	2.53	2.53	2.53	2.42	2.49	2.67	2.67	2.67	2.18	0.06	0.12	0.19	0.25	0.31	0.37	0.43	0.49
CP_26	Cottage Point	333513	6279065	0.50	2.40	0.03	1.88	2.18	2.67	2.42	2.47	2.53	2.53	2.53	2.42	2.48	2.58	2.58	2.58	2.42	2.49	2.67	2.67	2.67	2.18	0.06	0.12	0.19	0.25	0.31	0.37	0.43	0.50
CP_27	Cottage Point	333493	6279050	0.52	2.40	0.03	1.88	2.18	2.70	2.44	2.48	2.55	2.55	2.55	2.44	2.49	2.59	2.59	2.59	2.44	2.50	2.70	2.70	2.70	2.18	0.07	0.13	0.20	0.26	0.33	0.39	0.46	0.52
CP_28	Cottage Point	333453	6279060	0.55	2.40	0.03	1.88	2.18	2.73	2.45	2.50	2.58	2.58	2.58	2.45	2.50	2.61	2.61	2.61	2.45	2.52	2.73	2.73	2.73	2.18	0.07	0.14	0.21	0.28	0.35	0.42	0.48	0.55
CP_29	Cottage Point	333434	6279045	0.56	2.40	0.03	1.88	2.18	2.74	2.46	2.50	2.58	2.58	2.58	2.46	2.51	2.61	2.61	2.61	2.46	2.52	2.74	2.74	2.74	2.18	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
CP_30	Cottage Point	333414	6279029	0.56	2.40	0.03	1.88	2.18	2.74	2.46	2.50	2.58	2.58	2.58	2.46	2.51	2.61	2.61	2.61	2.46	2.52	2.74	2.74	2.74	2.18	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
CP_31	Cottage Point	333394	6279014	0.56	2.40	0.03	1.88	2.18	2.74	2.46	2.50	2.58	2.58	2.58	2.46	2.51	2.61	2.61	2.61	2.46	2.52	2.74	2.74	2.74	2.18	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
CP_32	Cottage Point	333395	6278973	0.56	2.40	0.03	1.88	2.18	2.74	2.46	2.50	2.58	2.58	2.58	2.46	2.50	2.61	2.61	2.61	2.46	2.52	2.74	2.74	2.74	2.18	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
CP_33	Cottage Point	333375	6278958	0.55	2.40	0.03	1.88	2.18	2.73	2.45	2.50	2.58	2.58	2.58	2.45	2.50	2.61	2.61	2.61	2.45	2.52	2.73	2.73	2.73	2.18	0.07	0.14	0.21	0.28	0.35	0.42	0.48	0.55
CP_34	Cottage Point	333356	6278902	0.54	2.40	0.03	1.88	2.18	2.72	2.45	2.49	2.57	2.57	2.57	2.45	2.50	2.60	2.60	2.60	2.45	2.52	2.72	2.72	2.72	2.18	0.07	0.14	0.20	0.27	0.34	0.41	0.48	0.54
CP_35	Cottage Point	333337	6278887	0.53	2.11	0.03	1.88	2.18	2.71	2.44	2.48	2.56	2.56	2.56	2.44	2.48	2.55	2.55	2.55	2.44	2.51	2.71	2.71	2.71	2.18	0.07	0.13	0.20	0.26	0.33	0.40	0.46	0.53
CP_36	Cottage Point	333317	6278872	0.51	2.11	0.03	1.88	2.18	2.69	2.43	2.47	2.55	2.55	2.55	2.43	2.47	2.54	2.54	2.54	2.43	2.50	2.69	2.69	2.69	2.18	0.06	0.13	0.19	0.25	0.32	0.38	0.45	0.51
CP_37	Cottage Point	333298	6278856	0.49	2.11	0.03	1.88	2.18	2.67	2.43	2.47	2.53	2.53	2.53	2.43	2.47	2.53	2.53	2.53	2.43	2.49	2.67	2.67	2.67	2.18	0.06	0.12	0.18	0.25	0.31	0.37	0.43	0.49
CP_38	Cottage Point	333278	6278841	0.49	2.11	0.03	1.88	2.18	2.67	2.42	2.47	2.53	2.53	2.53	2.42	2.47	2.53	2.53	2.53	2.42	2.49	2.67	2.67	2.67	2.18	0.06	0.12	0.18	0.25	0.31	0.37	0.43	0.49
CP_39	Cottage Point	333238	6278851	0.52	2.40	0.03	1.88	2.18	2.70	2.44	2.48	2.55	2.55	2.55	2.44	2.49	2.59	2.59	2.59	2.44	2.50	2.70	2.70	2.70	2.18	0.06	0.13	0.19	0.26	0.32	0.39	0.45	0.52
CP_40	Cottage Point	333199	6278821	0.54	2.40	0.03	1.88	2.18	2.71	2.45	2.49	2.56	2.56	2.56	2.45	2.49	2.60	2.60	2.60	2.45	2.51	2.71	2.71	2.71	2.18	0.07	0.13	0.20	0.27	0.33	0.40	0.47	0.54
CP_41	Cottage Point	333179	6278805	0.54	2.40	0.03	1.88	2.18	2.72	2.45	2.49	2.57	2.57	2.57	2.45	2.50	2.60	2.60	2.60	2.45	2.51	2.72	2.72	2.72	2.18	0.07	0.13	0.20	0.27	0.34	0.40	0.47	0.54
CP_42	Cottage Point	333160	6278790	0.54	2.40	0.03	1.88	2.18	2.72	2.45	2.49	2.57	2.57	2.57	2.45	2.50	2.60	2.60	2.60	2.45	2.51	2.72	2.72	2.72	2.18	0.07	0.13	0.20	0.27	0.34	0.40	0.47	0.54
CP_43	Cottage Point	333140	6278775	0.53	2.40	0.03	1.88	2.18	2.71	2.45	2.49	2.56	2.56	2.56	2.45	2.49	2.60	2.60	2.60	2.45	2.51	2.71	2.71	2.71	2.18	0.07	0.13	0.20	0.27	0.33	0.40	0.47	0.53
CP_44	Cottage Point	333121	6278760	0.53	2.40	0.03	1.88	2.18	2.71	2.44	2.48	2.56	2.56	2.56	2.44	2.49	2.60	2.60	2.60	2.44	2.51	2.71	2.71	2.71	2.18	0.07	0.13	0.20	0.26	0.33	0.40	0.46	0.53
CP_45	Cottage Point	333081	6278729	0.53	2.40	0.03	1.88	2.18	2.70	2.44	2.48	2.56	2.56	2.56	2.44	2.49	2.60	2.60	2.60	2.44	2.51	2.70	2.70	2.70	2.18	0.07	0.13	0.20	0.26	0.33	0.39	0.46	0.53
CP_46	Cottage Point	333082	6278689	0.52	2.40	0.03	1.88	2.18	2.70	2.44	2.48	2.56	2.56	2.56	2.44	2.49	2.59	2.59	2.59	2.44	2.50	2.70	2.70	2.70	2.18	0.07	0.13	0.20	0.26	0.33	0.39	0.46	0.52
CP_47	Cottage Point	333062	6278673	0.52	2.40	0.03	1.88	2.18	2.70	2.44	2.48	2.55	2.55	2.55	2.44	2.49	2.59	2.59	2.59	2.44	2.50	2.70	2.70	2.70	2.18	0.06	0.13	0.19	0.26	0.32	0.39	0.45	0.52
CP_48	Cottage Point	333043	6278658	0.50	2.40	0.03	1.88	2.18	2.68	2.43	2.47	2.54	2.54	2.54	2.43	2.48	2.59	2.59	2.59	2.43	2.49	2.68	2.68	2.68	2.18	0.06	0.13	0.19	0.25	0.31	0.38	0.44	0.50
AB_1	Akuna Bay	336595	6276023	0.36	1.65	0.04	1.89	2.29	2.65	2.47	2.50	2.55	2.55	2.55	2.47	2.50	2.53	2.53	2.53	2.47	2.53	2.65	2.65	2.65	2.29	0.04	0.09	0.13	0.18	0.22	0.27	0.31	0.36
AB_2	Akuna Bay	336575	6276008	0.35	1.65	0.04	1.89	2.29	2.64	2.47	2.50	2.55	2.55	2.55	2.47	2.50	2.53	2.53	2.53	2.47	2.52	2.64	2.64	2.64	2.29	0.04	0.09	0.13	0.18	0.22	0.26	0.31	0.35
AB_3	Akuna Bay	336555	6275994	0.35	1.65	0.04	1.89	2.29	2.64	2.47	2.50	2.54	2.54	2.54	2.47	2.50	2.52	2.52	2.52	2.47	2.52	2.64	2.64	2.64	2.29	0.04	0.09	0.13	0.17	0.22	0.26	0.31	0.35
AB_4	Akuna Bay	336516	6275964	0.34	1.65	0.04	1.89	2.29	2.64	2.46	2.50	2.54	2.54	2.54	2.46	2.49	2.52	2.52	2.52	2.46	2.52	2.64	2.64	2.64	2.29	0.04	0.09	0.13	0.17	0.22	0.26	0.30	0.34
AB_5	Akuna Bay	336496	6275949	0.34	1.65	0.04	1.89	2.29	2.63	2.46	2.50	2.54	2.54	2.54	2.46	2.49	2.52	2.52	2.52	2.46	2.52	2.63	2.63	2.63	2.29	0.04	0.08	0.13	0.17	0.21	0.25	0.29	0.34
AB_6	Akuna Bay	336476	6275934	0.33	1.65	0.04	1.89	2.29	2.62	2.46	2.49	2.53	2.53	2.53	2.46	2.49	2.52	2.52	2.52	2.46	2.51	2.62	2.62	2.62	2.29	0.04	0.08	0.12	0.16	0.20	0.24	0.29	0.33
AB_7	Akuna Bay	336476	6275893	0.33	1.65	0.04	1.89	2.29	2.62	2.46	2.49	2.53	2.53	2.53	2.46	2.49	2.52	2.52	2.52	2.46	2.51	2.62	2.62	2.62	2.29	0.04	0.08	0.12	0.16	0.21	0.25	0.29	0.33
AB_8	Akuna Bay	336456	6275878	0.32	1.45	0.04	1.89	2.29	2.62	2.46	2.49	2.53	2.53	2.53	2.46	2.48	2.49	2.49	2.49	2.46	2.51	2.62	2.62	2.62	2.29	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32
AB_9	Akuna Bay	336456	6275838	0.31	1.45	0.05	1.90	2.30	2.61	2.45	2.48	2.52	2.52	2.52	2.45	2.47	2.49	2.49	2.49	2.45	2.51	2.61	2.61	2.61	2.30	0.04	0.08	0.12	0.16	0.19	0.23	0.27	0.31

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File Reference:
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0.4 m Sea Level Projected WL

100yr ARI Planning Levels - 2050 Planning Period - 0.4m Sea Level Rise

Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Patonga is **1.45** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5m will be the equivalent.

Mean Sea Level Rise Allowances taken from Council Policy **0.40** m to the year 2010
Freeboard of **0.3** m included in EPLs

Foreshore Location				100yrARI					Estuarine Planning Level (m)																	Reduction Factor							
				Wave						Foreshore Type ##																							
Location ID	Location	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)	Max EPL of all Foreshore Types and Crest Levels (mAHD)	1					2					3					4	5m	10m	15m	20m	25m	30m	35m	40m
										Crest Level (mAHD)																							
							2050	2050		1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A								
AB_10	Akuna Bay	336436	6275823	0.30	1.45	0.05	1.90	2.30	2.59	2.44	2.48	2.51	2.51	2.51	2.44	2.47	2.49	2.49	2.49	2.44	2.50	2.59	2.59	2.59	2.30	0.04	0.07	0.11	0.15	0.19	0.22	0.26	0.30
AB_11	Akuna Bay	336436	6275782	0.28	1.65	0.05	1.90	2.30	2.57	2.44	2.47	2.50	2.50	2.50	2.44	2.47	2.50	2.50	2.50	2.44	2.49	2.57	2.57	2.57	2.30	0.03	0.07	0.10	0.14	0.17	0.21	0.24	0.28
AB_12	Akuna Bay	336416	6275767	0.28	1.65	0.05	1.90	2.30	2.58	2.44	2.47	2.50	2.50	2.50	2.44	2.47	2.51	2.51	2.51	2.44	2.49	2.58	2.58	2.58	2.30	0.03	0.07	0.10	0.14	0.17	0.21	0.24	0.28
AB_13	Akuna Bay	336415	6275726	0.28	1.65	0.05	1.90	2.30	2.57	2.44	2.47	2.50	2.50	2.50	2.44	2.47	2.51	2.51	2.51	2.44	2.49	2.57	2.57	2.57	2.30	0.03	0.07	0.10	0.14	0.17	0.21	0.24	0.28
AB_14	Akuna Bay	336376	6275737	0.27	1.65	0.05	1.90	2.30	2.57	2.43	2.47	2.49	2.49	2.49	2.43	2.47	2.50	2.50	2.50	2.43	2.49	2.57	2.57	2.57	2.30	0.03	0.07	0.10	0.14	0.17	0.20	0.24	0.27
AB_15	Akuna Bay	336356	6275722	0.26	1.65	0.05	1.90	2.30	2.56	2.43	2.46	2.48	2.48	2.48	2.43	2.46	2.50	2.50	2.50	2.43	2.48	2.56	2.56	2.56	2.30	0.03	0.06	0.10	0.13	0.16	0.19	0.23	0.26
AB_16	Akuna Bay	336357	6275763	0.26	1.28	0.05	1.90	2.30	2.55	2.42	2.46	2.48	2.48	2.48	2.42	2.44	2.45	2.45	2.45	2.42	2.48	2.55	2.55	2.55	2.30	0.03	0.06	0.10	0.13	0.16	0.19	0.22	0.26
AB_17	Akuna Bay	336357	6275804	0.28	1.45	0.04	1.89	2.29	2.57	2.43	2.47	2.49	2.49	2.49	2.43	2.46	2.48	2.48	2.48	2.43	2.49	2.57	2.57	2.57	2.29	0.03	0.07	0.10	0.14	0.17	0.21	0.24	0.28
AB_18	Akuna Bay	336377	6275819	0.29	1.45	0.04	1.89	2.29	2.59	2.44	2.48	2.51	2.51	2.51	2.44	2.47	2.48	2.48	2.48	2.44	2.50	2.59	2.59	2.59	2.29	0.04	0.07	0.11	0.15	0.18	0.22	0.26	0.29
AB_19	Akuna Bay	336396	6275834	0.31	1.45	0.05	1.90	2.30	2.61	2.45	2.48	2.52	2.52	2.52	2.45	2.47	2.49	2.49	2.49	2.45	2.51	2.61	2.61	2.61	2.30	0.04	0.08	0.12	0.16	0.19	0.23	0.27	0.31
AB_20	Akuna Bay	336397	6275875	0.32	1.65	0.04	1.89	2.29	2.62	2.46	2.49	2.53	2.53	2.53	2.46	2.49	2.52	2.52	2.52	2.46	2.51	2.62	2.62	2.62	2.29	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32
AB_21	Akuna Bay	336417	6275890	0.33	1.65	0.04	1.89	2.29	2.63	2.46	2.50	2.53	2.53	2.53	2.46	2.49	2.52	2.52	2.52	2.46	2.52	2.63	2.63	2.63	2.29	0.04	0.08	0.13	0.17	0.21	0.25	0.29	0.33
AB_22	Akuna Bay	336417	6275930	0.34	1.65	0.04	1.89	2.29	2.63	2.46	2.50	2.54	2.54	2.54	2.46	2.49	2.52	2.52	2.52	2.46	2.52	2.63	2.63	2.63	2.29	0.04	0.09	0.13	0.17	0.21	0.26	0.30	0.34
AB_23	Akuna Bay	336437	6275945	0.35	1.65	0.04	1.89	2.29	2.64	2.47	2.50	2.54	2.54	2.54	2.47	2.50	2.53	2.53	2.53	2.47	2.52	2.64	2.64	2.64	2.29	0.04	0.09	0.13	0.17	0.22	0.26	0.30	0.35
AB_24	Akuna Bay	336437	6275986	0.36	1.65	0.04	1.89	2.29	2.65	2.47	2.51	2.55	2.55	2.55	2.47	2.50	2.53	2.53	2.53	2.47	2.53	2.65	2.65	2.65	2.29	0.04	0.09	0.13	0.18	0.22	0.27	0.31	0.36
AB_25	Akuna Bay	336437	6276027	0.37	1.65	0.04	1.89	2.29	2.66	2.47	2.51	2.56	2.56	2.56	2.47	2.50	2.53	2.53	2.53	2.47	2.53	2.66	2.66	2.66	2.29	0.05	0.09	0.14	0.18	0.23	0.28	0.32	0.37
AB_26	Akuna Bay	336437	6276068	0.38	1.87	0.04	1.89	2.29	2.67	2.48	2.51	2.56	2.56	2.56	2.48	2.52	2.56	2.56	2.56	2.48	2.54	2.67	2.67	2.67	2.29	0.05	0.09	0.14	0.19	0.24	0.28	0.33	0.38

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0.4 m Sea Level Projected WL

100yr ARI Planning Levels - 2100 Planning Period - 0.9m SLR
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

Mean Sea Level Rise Allowances taken from Council Policy **0.90** m to the year 2010
Freeboard of **0.3** m included in EPLs

100-year ARI Storm Tide at Patonga is **1.45** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5m will be the equivalent.

Foreshore Location				100yrARI						Estuarine Planning Level (m)																Reduction Factor							
				Wave						Foreshore Type ##																							
Location ID	Location	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)	Max EPL of all Foreshore Types and Crest Levels (mAHD)	1					2					3					4	5m	10m	15m	20m	25m	30m	35m	40m
										Crest Level (mAHD)																							
							2100	2100		1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A								
CP_01	Cottage Point	333834	6278821	0.56	2.40	0.03	2.38	2.68	3.23	2.95	2.95	3.00	3.08	3.08	2.95	2.95	3.00	3.10	3.10	2.95	2.95	3.02	3.23	3.23	2.68	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
CP_02	Cottage Point	333794	6278832	0.55	2.40	0.03	2.38	2.68	3.23	2.95	2.95	2.99	3.07	3.07	2.95	2.95	3.00	3.10	3.10	2.95	2.95	3.02	3.23	3.23	2.68	0.07	0.14	0.21	0.28	0.34	0.41	0.48	0.55
CP_03	Cottage Point	333774	6278816	0.54	2.40	0.03	2.38	2.68	3.22	2.95	2.95	2.99	3.07	3.07	2.95	2.95	3.00	3.10	3.10	2.95	2.95	3.01	3.22	3.22	2.68	0.07	0.14	0.20	0.27	0.34	0.41	0.47	0.54
CP_04	Cottage Point	333734	6278827	0.52	2.40	0.03	2.38	2.68	3.20	2.94	2.94	2.98	3.05	3.05	2.94	2.94	2.99	3.09	3.09	2.94	2.94	3.00	3.20	3.20	2.68	0.07	0.13	0.20	0.26	0.33	0.39	0.46	0.52
CP_05	Cottage Point	333715	6278811	0.50	2.40	0.03	2.38	2.68	3.18	2.93	2.93	2.97	3.04	3.04	2.93	2.93	2.98	3.09	3.09	2.93	2.93	2.99	3.18	3.18	2.68	0.06	0.13	0.19	0.25	0.31	0.38	0.44	0.50
CP_06	Cottage Point	333695	6278796	0.48	2.40	0.03	2.38	2.68	3.16	2.92	2.92	2.96	3.03	3.03	2.92	2.92	2.97	3.08	3.08	2.92	2.92	2.98	3.16	3.16	2.68	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
CP_07	Cottage Point	333675	6278781	0.47	2.40	0.03	2.38	2.68	3.15	2.91	2.91	2.95	3.02	3.02	2.91	2.91	2.97	3.07	3.07	2.91	2.91	2.98	3.15	3.15	2.68	0.06	0.12	0.18	0.23	0.29	0.35	0.41	0.47
CP_08	Cottage Point	333656	6278766	0.45	2.40	0.03	2.38	2.68	3.14	2.91	2.91	2.95	3.01	3.01	2.91	2.91	2.96	3.07	3.07	2.91	2.91	2.97	3.14	3.14	2.68	0.06	0.11	0.17	0.23	0.28	0.34	0.40	0.45
CP_09	Cottage Point	333636	6278750	0.44	2.40	0.03	2.38	2.68	3.12	2.90	2.90	2.94	3.00	3.00	2.90	2.90	2.95	3.06	3.06	2.90	2.90	2.96	3.12	3.12	2.68	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44
CP_10	Cottage Point	333636	6278791	0.43	2.40	0.03	2.38	2.68	3.11	2.90	2.90	2.94	2.99	2.99	2.90	2.90	2.95	3.06	3.06	2.90	2.90	2.96	3.11	3.11	2.68	0.05	0.11	0.16	0.22	0.27	0.32	0.38	0.43
CP_11	Cottage Point	333635	6278832	0.42	2.40	0.03	2.38	2.68	3.11	2.89	2.89	2.93	2.99	2.99	2.89	2.89	2.95	3.05	3.05	2.89	2.89	2.96	3.11	3.11	2.68	0.05	0.11	0.16	0.21	0.27	0.32	0.37	0.42
CP_12	Cottage Point	333655	6278847	0.42	2.40	0.03	2.38	2.68	3.10	2.89	2.89	2.93	2.98	2.98	2.89	2.89	2.94	3.05	3.05	2.89	2.89	2.95	3.10	3.10	2.68	0.05	0.11	0.16	0.21	0.26	0.32	0.37	0.42
CP_13	Cottage Point	333674	6278862	0.43	1.87	0.03	2.38	2.68	3.11	2.89	2.89	2.93	2.99	2.99	2.89	2.89	2.93	2.97	2.97	2.89	2.89	2.96	3.11	3.11	2.68	0.05	0.11	0.16	0.22	0.27	0.32	0.38	0.43
CP_14	Cottage Point	333674	6278903	0.46	1.87	0.03	2.38	2.68	3.14	2.91	2.91	2.95	3.01	3.01	2.91	2.91	2.94	2.98	2.98	2.91	2.91	2.97	3.14	3.14	2.68	0.06	0.12	0.17	0.23	0.29	0.35	0.40	0.46
CP_15	Cottage Point	333713	6278933	0.49	1.87	0.03	2.38	2.68	3.17	2.92	2.92	2.96	3.03	3.03	2.92	2.92	2.95	2.99	2.99	2.92	2.92	2.99	3.17	3.17	2.68	0.06	0.12	0.18	0.25	0.31	0.37	0.43	0.49
CP_16	Cottage Point	333712	6278974	0.52	1.87	0.03	2.38	2.68	3.20	2.94	2.94	2.98	3.05	3.05	2.94	2.94	2.96	3.00	3.00	2.94	2.94	3.00	3.20	3.20	2.68	0.06	0.13	0.19	0.26	0.32	0.39	0.45	0.52
CP_17	Cottage Point	333732	6278989	0.54	1.87	0.03	2.38	2.68	3.22	2.95	2.95	2.99	3.07	3.07	2.95	2.95	2.97	3.01	3.01	2.95	2.95	3.01	3.22	3.22	2.68	0.07	0.14	0.20	0.27	0.34	0.41	0.47	0.54
CP_18	Cottage Point	333712	6279014	0.56	2.11	0.03	2.38	2.68	3.23	2.95	2.95	2.99	3.08	3.08	2.95	2.95	2.99	3.05	3.05	2.95	2.95	3.02	3.23	3.23	2.68	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
CP_19	Cottage Point	333711	6279055	0.58	2.11	0.02	2.37	2.67	3.25	2.96	2.96	3.01	3.09	3.09	2.96	2.96	3.00	3.06	3.06	2.96	2.96	3.03	3.25	3.25	2.67	0.07	0.14	0.22	0.29	0.36	0.43	0.50	0.58
CP_20	Cottage Point	333691	6279080	0.59	2.40	0.03	2.38	2.68	3.26	2.97	2.97	3.01	3.10	3.10	2.97	2.97	3.02	3.12	3.12	2.97	2.97	3.04	3.26	3.26	2.68	0.07	0.15	0.22	0.29	0.37	0.44	0.52	0.59
CP_21	Cottage Point	333671	6279065	0.56	1.87	0.02	2.37	2.67	3.24	2.95	2.95	3.00	3.08	3.08	2.95	2.95	2.98	3.01	3.01	2.95	2.95	3.02	3.24	3.24	2.67	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
CP_22	Cottage Point	333632	6279075	0.53	1.87	0.03	2.38	2.68	3.21	2.94	2.94	2.98	3.06	3.06	2.94	2.94	2.97	3.00	3.00	2.94	2.94	3.01	3.21	3.21	2.68	0.07	0.13	0.20	0.27	0.33	0.40	0.46	0.53
CP_23	Cottage Point	333612	6279060	0.50	2.11	0.03	2.38	2.68	3.18	2.93	2.93	2.97	3.04	3.04	2.93	2.93	2.97	3.04	3.04	2.93	2.93	2.99	3.18	3.18	2.68	0.06	0.13	0.19	0.25	0.32	0.38	0.44	0.50
CP_24	Cottage Point	333572	6279070	0.50	2.11	0.03	2.38	2.68	3.18	2.93	2.93	2.97	3.04	3.04	2.93	2.93	2.97	3.04	3.04	2.93	2.93	2.99	3.18	3.18	2.68	0.06	0.12	0.19	0.25	0.31	0.37	0.44	0.50
CP_25	Cottage Point	333552	6279055	0.49	2.11	0.03	2.38	2.68	3.17	2.92	2.92	2.96	3.03	3.03	2.92	2.92	2.96	3.03	3.03	2.92	2.92	2.99	3.17	3.17	2.68	0.06	0.12	0.19	0.25	0.31	0.37	0.43	0.49
CP_26	Cottage Point	333513	6279065	0.50	2.40	0.03	2.38	2.68	3.17	2.92	2.92	2.97	3.03	3.03	2.92	2.92	2.98	3.08	3.08	2.92	2.92	2.99	3.17	3.17	2.68	0.06	0.12	0.19	0.25	0.31	0.37	0.43	0.50
CP_27	Cottage Point	333493	6279050	0.52	2.40	0.03	2.38	2.68	3.20	2.94	2.94	2.98	3.05	3.05	2.94	2.94	2.99	3.09	3.09	2.94	2.94	3.00	3.20	3.20	2.68	0.07	0.13	0.20	0.26	0.33	0.39	0.46	0.52
CP_28	Cottage Point	333453	6279060	0.55	2.40	0.03	2.38	2.68	3.23	2.95	2.95	3.00	3.08	3.08	2.95	2.95	3.00	3.11	3.11	2.95	2.95	3.02	3.23	3.23	2.68	0.07	0.14	0.21	0.28	0.35	0.42	0.48	0.55
CP_29	Cottage Point	333434	6279045	0.56	2.40	0.03	2.38	2.68	3.24	2.96	2.96	3.00	3.08	3.08	2.96	2.96	3.01	3.11	3.11	2.96	2.96	3.02	3.24	3.24	2.68	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
CP_30	Cottage Point	333414	6279029	0.56	2.40	0.03	2.38	2.68	3.24	2.96	2.96	3.00	3.08	3.08	2.96	2.96	3.01	3.11	3.11	2.96	2.96	3.02	3.24	3.24	2.68	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
CP_31	Cottage Point	333394	6279014	0.56	2.40	0.03	2.38	2.68	3.24	2.96	2.96	3.00	3.08	3.08	2.96	2.96	3.01	3.11	3.11	2.96	2.96	3.02	3.24	3.24	2.68	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
CP_32	Cottage Point	333395	6278973	0.56	2.40	0.03	2.38	2.68	3.24	2.96	2.96	3.00	3.08	3.08	2.96	2.96	3.00	3.11	3.11	2.96	2.96	3.02	3.24	3.24	2.68	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
CP_33	Cottage Point	333375	6278958	0.55	2.40	0.03	2.38	2.68	3.23	2.95	2.95	3.00	3.08	3.08	2.95	2.95	3.00	3.11	3.11	2.95	2.95	3.02	3.23	3.23	2.68	0.07	0.14	0.21	0.28	0.35	0.42	0.48	0.55
CP_34	Cottage Point	333356	6278902	0.54	2.40	0.03	2.38	2.68	3.22	2.95	2.95	2.99	3.07	3.07	2.95	2.95	3.00	3.10	3.10	2.95	2.95	3.02	3.22	3.22	2.68	0.07	0.14	0.20	0.27	0.34	0.41	0.48	0.54
CP_35	Cottage Point	333337	6278887	0.53	2.11	0.03	2.38	2.68	3.21	2.94	2.94	2.98	3.06	3.06	2.94	2.94	2.98	3.05	3.05	2.94	2.94	3.01	3.21	3.21	2.68	0.07	0.13	0.20	0.26	0.33	0.40	0.46	0.53
CP_36	Cottage Point	333317	6278872	0.51	2.11	0.03	2.38	2.68	3.19	2.93	2.93	2.97	3.05	3.05	2.93	2.93	2.97	3.04	3.04	2.93	2.93	3.00	3.19	3.19	2.68	0.06	0.13	0.19	0.25	0.32	0.38	0.45	0.51
CP_37	Cottage Point	333298	6278856	0.49	2.11	0.03	2.38	2.68	3.17	2.93	2.93	2.97	3.03	3.03	2.93	2.93	2.97	3.03	3.03	2.93	2.93	2.99	3.17	3.17	2.68	0.06	0.12	0.18	0.25	0.31	0.37	0.43	0.49
CP_38	Cottage Point	333278	6278841	0.49	2.11	0.03	2.38	2.68	3.17	2.92	2.92	2.97	3.03	3.03	2.92	2.92	2.97	3.03	3.03	2.92	2.92	2.99	3.17	3.17	2.68	0.06	0.12	0.18	0.25	0.31	0.37	0.43	0.49
CP_39	Cottage Point	333238	6278851	0.52	2.40	0.03	2.38	2.68	3.20	2.94	2.94	2.98	3.05	3.05	2.94	2.94	2.99	3.09	3.09	2.94	2.94	3.00	3.20	3.20	2.68	0.06	0.13	0.19	0.26	0.32	0.39	0.45	0.52
CP_40	Cottage Point	333199	6278821	0.54	2.40	0.03	2.38	2.68	3.21	2.95	2.95	2.99	3.06	3.06	2.95	2.95	2.99	3.10	3.10	2.95	2.95	3.01	3.21	3.21	2.68	0.07	0.13	0.20	0.27	0.33	0.40	0.47	0.54
CP_41	Cottage Point	333179	6278805	0.54	2.40	0.03	2.38	2.68	3.22	2.95	2.95	2.99	3.07	3.07	2.95	2.95	3.00	3.10	3.10	2.95	2.95	3.01	3.22	3.22	2.68	0.07	0.13	0.20	0.27	0.34	0.40	0.47	0.54
CP_42	Cottage Point	333160	6278790	0.54	2.40	0.03	2.38	2.68	3.22	2.95	2.95	2.99	3.07	3.07	2.95	2.95	3.00	3.10	3.10	2.95	2.95	3.01	3.22	3.22	2.68	0.07	0.13	0.20	0.27	0.34	0.40	0.47	0.54
CP_43	Cottage Point	333140	6278775	0.53	2.40	0.03	2.38	2.68	3.21	2.95	2.95	2.99	3.06	3.06	2.95	2.95	2.99	3.10	3.10	2.95	2.95	3.01	3.21	3.21	2.68	0.07	0.13	0.20	0.27	0.33	0.40	0.47	0.53
CP_44	Cottage Point	333121	6278760	0.53	2.40	0.03	2.38	2.68	3.21	2.94	2.94	2.98	3.06	3.06	2.94	2.94	2.99	3.10	3.10	2.94	2.94	3.01	3.21	3.21	2.68	0.07	0.13	0.20	0.26	0.33	0.40	0.46	0.53
CP_45	Cottage Point	333081	6278729	0.53	2.40	0.03	2.38	2.68	3.20	2.94	2.94	2.98	3.06	3.06	2.94	2.94	2.99	3.10	3.10	2.94	2.94	3.01	3.20	3.20	2.68	0.07	0.13	0.20	0.26	0.33	0.39	0.46	0.53
CP_46	Cottage Point	333082	6278689	0.52	2.40	0.03	2.38	2.68	3.20	2.94	2.94	2.98	3.06	3.06	2.94	2.94	2.99	3.09	3.09	2.94	2.94	3.00	3.20	3.20	2.68	0.07	0.13	0.20	0.26	0.33	0.39	0.46	0.52
CP_47	Cottage Point	333062	6278673	0.52	2.40	0.03	2.38	2.68	3.20	2.94	2.94	2.98	3.05	3.05	2.94	2.94	2.99	3.09	3.09	2.94	2.94	3.00	3.20	3.20	2.68	0.06	0.13	0.19	0.26	0.32	0.39	0.45	0.52
CP_48	Cottage Point	333043	6278658	0.50	2.40	0.03	2.38	2.68	3.18	2.93	2.93	2.97	3.04	3.04	2.93	2.93	2.98	3.09	3.09	2.93	2.93	2.99	3.18	3.18	2.68	0.06	0.13	0.19	0.25	0.31	0.38	0.44	0.50
AB_1	Akuna Bay	336595	6276023	0.36	1.65	0.04	2.39	2.69	3.05	2.87	2.87	2.90	2.95	2.95	2.87	2.87	2.90	2.93	2.93	2.87	2.87	2.93	3.05	3.05	2.69	0.04	0.09	0.13	0.18	0.22	0.27	0.31	0.36
AB_2	Akuna Bay	336575	6276008	0.35	1.65	0.04	2.39	2.69	3.04	2.87	2.87	2.90	2.95	2.95	2.87	2.87	2.90	2.93	2.93	2.87	2.87	2.92	3.04	3.04	2.69	0.04	0.09	0.13	0.18	0.22	0.26	0.31	0.35
AB_3	Akuna Bay	336555	6275994	0.35	1.65	0.04	2.39	2.69	3.04	2.87	2.87	2.90	2.94	2.94	2.87	2.87	2.90	2.92	2.92	2.87	2.87	2.92	3.04	3.04	2.69	0.04	0.09	0.13	0.17	0.22	0.26	0.31	0.35
AB_4	Akuna Bay	336516	6275964	0.34	1.65	0.04	2.39	2.69	3.04	2.86	2.86	2.90	2.94	2.94	2.86	2.86	2.89	2.92	2.92	2.86	2.86	2.92	3.04	3.04	2.69	0.04	0.09	0.13	0.17	0.22	0.26	0.30	0.34
AB_5	Akuna Bay	336496	6275949	0.34	1.65	0.04	2.39	2.69	3.03	2.86	2.86	2.90	2.94	2.94	2.86	2.86	2.89	2.92	2.92	2.86	2.86	2.92	3.03	3.03	2.69	0.04	0.08	0.13	0.17	0.21	0.25	0.29	0.34
AB_6	Akuna Bay	336476	6275934	0.33	1.65	0.04	2.39	2.69	3.02	2.86	2.86	2.89	2.93	2.93	2.86	2.86	2.89	2.92	2.92	2.86	2.86	2.91	3.02	3.02	2.69	0.04	0.08	0.12	0.16	0.20	0.24	0.29	0.33
AB_7	Akuna Bay	336476	6275893	0.33	1.65	0.04	2.39	2.69	3.02	2.86	2.86	2.89	2.93	2.93	2.86	2.86	2.89	2.92	2.92	2.86	2.86	2.91	3.02	3.02	2.69	0.04	0.08	0.12	0.16	0.21	0.25	0.29	0.33
AB_8	Akuna Bay	336456	6275878	0.32	1.45	0.04	2.39	2.69	3.02	2.86	2.86	2.89	2.93	2.93	2.86	2.86	2.88	2.89	2.89	2.86	2.86	2.91	3.02	3.02	2.69	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32
AB_9	Akuna Bay	336456	6275838	0.31	1.45	0.05	2.40	2.70	3.01	2.85	2.85	2.88	2.92	2.92	2.85	2.85	2.87	2.89	2.89	2.85	2.85	2.91	3.01	3.01	2.70	0.04	0.08	0.12	0.16	0.19	0.23	0.27	0.31

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10/02/2021

File Reference:
C:\Dropbox (Rhelm)\J1300-J1399\J1389 - Cowan Creek EPL Study\8. Analysis\EPL Database\J1389_EPL_Database_V02\J1389_EPL_Database_V02
0.9 m Sea Level Projected WL

100yr ARI Planning Levels - 2100 Planning Period - 0.9m SLR
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Patonga is **1.45** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5m will be the equivalent.

Mean Sea Level Rise Allowances taken from Council Policy **0.90** m to the year 2010
Freeboard of **0.3** m included in EPLs

Foreshore Location				100yrARI					
Location ID	Location	X MGAz56	Y MGAz56	Wave Hs (m)	Wave Tp (sec)	Local Wind Setup* (m)	Local (Still) Water Level (mAHD) 2100	Local (Still) Water Level with 0.3m Freeboard (mAHD) 2100	Max EPL of all Foreshore Types and Crest Levels (mAHD)
AB_10	Akuna Bay	336436	6275823	0.30	1.45	0.05	2.40	2.70	2.99
AB_11	Akuna Bay	336436	6275782	0.28	1.65	0.05	2.40	2.70	2.97
AB_12	Akuna Bay	336416	6275767	0.28	1.65	0.05	2.40	2.70	2.98
AB_13	Akuna Bay	336415	6275726	0.28	1.65	0.05	2.40	2.70	2.97
AB_14	Akuna Bay	336376	6275737	0.27	1.65	0.05	2.40	2.70	2.97
AB_15	Akuna Bay	336356	6275722	0.26	1.65	0.05	2.40	2.70	2.96
AB_16	Akuna Bay	336357	6275763	0.26	1.28	0.05	2.40	2.70	2.95
AB_17	Akuna Bay	336357	6275804	0.28	1.45	0.04	2.39	2.69	2.97
AB_18	Akuna Bay	336377	6275819	0.29	1.45	0.04	2.39	2.69	2.99
AB_19	Akuna Bay	336396	6275834	0.31	1.45	0.05	2.40	2.70	3.01
AB_20	Akuna Bay	336397	6275875	0.32	1.65	0.04	2.39	2.69	3.02
AB_21	Akuna Bay	336417	6275890	0.33	1.65	0.04	2.39	2.69	3.03
AB_22	Akuna Bay	336417	6275930	0.34	1.65	0.04	2.39	2.69	3.03
AB_23	Akuna Bay	336437	6275945	0.35	1.65	0.04	2.39	2.69	3.04
AB_24	Akuna Bay	336437	6275986	0.36	1.65	0.04	2.39	2.69	3.05
AB_25	Akuna Bay	336437	6276027	0.37	1.65	0.04	2.39	2.69	3.06
AB_26	Akuna Bay	336437	6276068	0.38	1.87	0.04	2.39	2.69	3.07

	Estuarine Planning Level (m) — Foreshore Type ## / Crest Level (mAHD)															
Location ID	1: 1.5	1: 2	1: 2.5	1: 3	1: 3.5	2: 1.5	2: 2	2: 2.5	2: 3	2: 3.5	3: 1.5	3: 2	3: 2.5	3: 3	3: 3.5	4: N/A
AB_10	2.84	2.84	2.88	2.91	2.91	2.84	2.84	2.87	2.89	2.89	2.84	2.84	2.90	2.99	2.99	2.70
AB_11	2.84	2.84	2.87	2.90	2.90	2.84	2.84	2.87	2.90	2.90	2.84	2.84	2.89	2.97	2.97	2.70
AB_12	2.84	2.84	2.87	2.90	2.90	2.84	2.84	2.87	2.91	2.91	2.84	2.84	2.89	2.98	2.98	2.70
AB_13	2.84	2.84	2.87	2.90	2.90	2.84	2.84	2.87	2.91	2.91	2.84	2.84	2.89	2.97	2.97	2.70
AB_14	2.83	2.83	2.87	2.89	2.89	2.83	2.83	2.87	2.90	2.90	2.83	2.83	2.89	2.97	2.97	2.70
AB_15	2.83	2.83	2.86	2.88	2.88	2.83	2.83	2.86	2.90	2.90	2.83	2.83	2.88	2.96	2.96	2.70
AB_16	2.82	2.82	2.86	2.88	2.88	2.82	2.82	2.84	2.85	2.85	2.82	2.82	2.88	2.95	2.95	2.70
AB_17	2.83	2.83	2.87	2.89	2.89	2.83	2.83	2.86	2.88	2.88	2.83	2.83	2.89	2.97	2.97	2.69
AB_18	2.84	2.84	2.88	2.91	2.91	2.84	2.84	2.87	2.88	2.88	2.84	2.84	2.90	2.99	2.99	2.69
AB_19	2.85	2.85	2.88	2.92	2.92	2.85	2.85	2.87	2.89	2.89	2.85	2.85	2.91	3.01	3.01	2.70
AB_20	2.86	2.86	2.89	2.93	2.93	2.86	2.86	2.89	2.92	2.92	2.86	2.86	2.91	3.02	3.02	2.69
AB_21	2.86	2.86	2.90	2.93	2.93	2.86	2.86	2.89	2.92	2.92	2.86	2.86	2.92	3.03	3.03	2.69
AB_22	2.86	2.86	2.90	2.94	2.94	2.86	2.86	2.89	2.92	2.92	2.86	2.86	2.92	3.03	3.03	2.69
AB_23	2.87	2.87	2.90	2.94	2.94	2.87	2.87	2.90	2.93	2.93	2.87	2.87	2.92	3.04	3.04	2.69
AB_24	2.87	2.87	2.91	2.95	2.95	2.87	2.87	2.90	2.93	2.93	2.87	2.87	2.93	3.05	3.05	2.69
AB_25	2.87	2.87	2.91	2.96	2.96	2.87	2.87	2.90	2.93	2.93	2.87	2.87	2.93	3.06	3.06	2.69
AB_26	2.88	2.88	2.91	2.96	2.96	2.88	2.88	2.92	2.96	2.96	2.88	2.88	2.94	3.07	3.07	2.69

	Reduction Factor							
Location ID	5m	10m	15m	20m	25m	30m	35m	40m
AB_10	0.04	0.07	0.11	0.15	0.19	0.22	0.26	0.30
AB_11	0.03	0.07	0.10	0.14	0.17	0.21	0.24	0.28
AB_12	0.03	0.07	0.10	0.14	0.17	0.21	0.24	0.28
AB_13	0.03	0.07	0.10	0.14	0.17	0.21	0.24	0.28
AB_14	0.03	0.07	0.10	0.14	0.17	0.20	0.24	0.27
AB_15	0.03	0.06	0.10	0.13	0.16	0.19	0.23	0.26
AB_16	0.03	0.06	0.10	0.13	0.16	0.19	0.22	0.26
AB_17	0.03	0.07	0.10	0.14	0.17	0.21	0.24	0.28
AB_18	0.04	0.07	0.11	0.15	0.18	0.22	0.26	0.29
AB_19	0.04	0.08	0.12	0.16	0.19	0.23	0.27	0.31
AB_20	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32
AB_21	0.04	0.08	0.13	0.17	0.21	0.25	0.29	0.33
AB_22	0.04	0.09	0.13	0.17	0.21	0.26	0.30	0.34
AB_23	0.04	0.09	0.13	0.17	0.22	0.26	0.30	0.35
AB_24	0.04	0.09	0.13	0.18	0.22	0.27	0.31	0.36
AB_25	0.05	0.09	0.14	0.18	0.23	0.28	0.32	0.37
AB_26	0.05	0.09	0.14	0.19	0.24	0.28	0.33	0.38

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0.9 m Sea Level Projected WL

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Appendix C

Properties that may Require Floor Survey

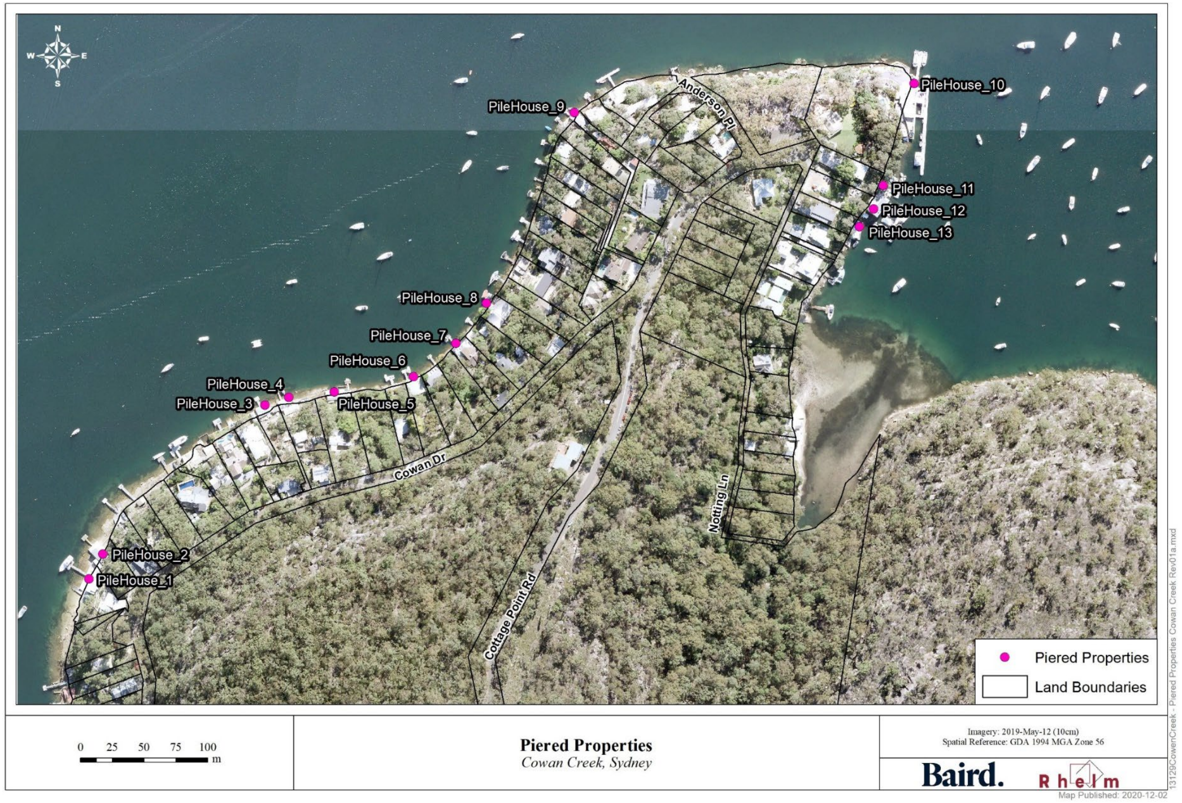

Figure C-1 Properties that may require floor survey

Table C-3 – Location of Identified Piered Properties, Cowan Creek (MGA z56)

Easting (m)	Northing (m)	Name
333056	6278648	PileHouse_1
333067	6278667	PileHouse_2
333194	6278784	PileHouse_3
333213	6278791	PileHouse_4
333249	6278795	PileHouse_5
333311	6278807	PileHouse_6
333344	6278833	PileHouse_7
333368	6278865	PileHouse_8
333437	6279014	PileHouse_9
333704	6279037	PileHouse_10
333680	6278957	PileHouse_11
333672	6278939	PileHouse_12
333661	6278925	PileHouse_13

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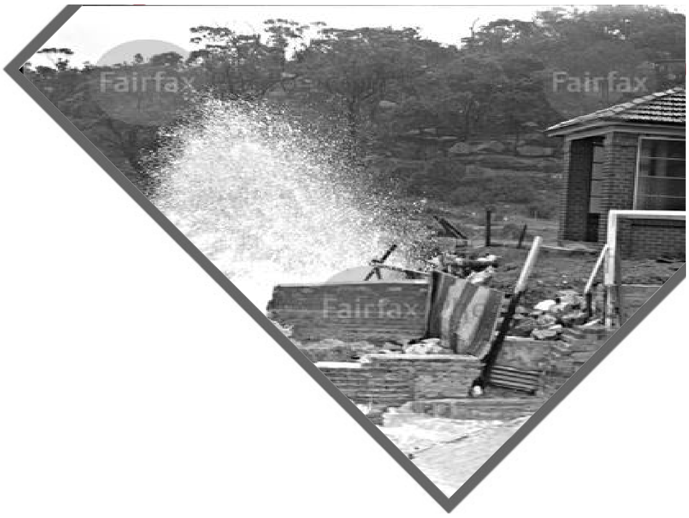

North and Middle Harbour Estuarine Planning Levels Study

Stage 1 and 2 Report

Northern Beaches Council | Stage 1 and 2 Report | July 2022

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Executive Summary

Foreshore areas of Sydney Harbour within the Northern Beaches Local Government Area (LGA) – being North Harbour and Middle Harbour are subject to periodic inundation by coastal and estuarine processes (coastal inundation is one aspect of coastal hazard). This document seeks to define the estuarine inundation risk on foreshore properties both under existing and future sea level conditions.

Coastal Inundation and Development

Coastal inundation (and subsequent impacts on property and infrastructure within this zone) can be caused by large waves and elevated water levels associated with a range of coastal and oceanographic responses to severe storms. Within this report this is referred to as 'Estuarine Inundation Risk' (Sydney Harbour being an estuary, which forms part of the overall coastal zone). The nature and extent of the inundation is dependent on the interactions between the ocean and the land. Thus, an understanding of the interactions of the ocean and the land is essential to identify the likely extent of coastal inundation.

In order to protect development from the effects of coastal inundation, it is necessary to ensure appropriate development controls are applied to proposed developments where consent is required under Part 4 of the Environmental Planning and Assessment Act, 1979 or where information is relevant to infrastructure planning (such as under the provisions of State Environmental Planning Policy (Infrastructure), 2007). Appropriate planning levels for the purposes of design and construction of buildings and other features are estimated from the best available information on water levels associated with either or both catchment flooding and coastal inundation (both types of flooding/inundation can occur on some properties). The planning levels are generally set to seek to minimise the potential for inundation and damage during rare and extreme inundation events. In this report the levels associated with Estuarine Inundation Risk are referred to as Estuarine Planning Levels (EPLs). Flood Planning Levels (FPLs) are those associated with catchment flooding.

The derivation of property-specific Estuarine Planning Levels (EPLs) is the primary objective of this document. The Estuarine Planning Levels derived from this study will inform the application of planning controls set out in Northern Beaches Council's environmental planning instruments and related planning documents (e.g. Local Environment Plan (LEP), Development Control Plan (DCP) and related Policies).

This EPLs study is being prepared in the following stages.

- **Stage 1 Coastal Modelling:** coastal and estuarine modelling to define the coastal inundation for various design inundation events.
- **Stage 2 Property Data:** application of the modelling outcomes at a property scale (i.e. defining the EPLs for each at-risk property).
- **Stage 3 Planning Controls:** a review of Council's existing policy and planning framework and recommendations for amendments to allow for the application of EPLs within the study area.

The outcomes of Stages 1 and 2 are presented in this document, Stage 3 will be undertaken separately.

Coastal Inundation Processes Overview

To calculate appropriate Estuarine Planning Levels (EPLs) it is necessary to understand the oceanographic and coastal processes impacting the foreshore. The following coastal processes have been considered in the determination of EPLs for Manly and Middle Harbour:

- Regional Processes (ocean scale of hundreds of kilometres);
- Local Processes (within North and Middle Harbour – scale a few kilometres); and

- Site Specific Processes (scales of tens of metres).

The following data and model inputs have been utilised in this study to complete numerical modelling required to define coastal inundation extent and levels in the study area:

- **Sydney Harbour Water Levels:** Sydney Harbour has a long, reliable data set of water levels measured at Fort Denison, and more recently also at Middle Harbour (near the study area). Present day extreme design still water levels are calculated at Fort Denison based on a statistical analysis of measured historical records. The extremes analysis is based on water level data measured continuously at Fort Denison for over 100 years. Based on this analysis a 100-year average recurrence interval (ARI) water level of 1.44 m AHD has been adopted for Sydney Harbour. The numerical modelling undertaken in this study has defined the additional wind setup that can occur at particular locations within Sydney Harbour. This additional wind setup was added to the 100-year Fort Denison water level of 1.44 m AHD.
- **Coastal Storm Winds:** A range of wind data sets have been analysed to define extreme winds which can generate enhanced storm surge and local sea waves in the study area. The key data sets reviewed in this study were:
  - Long-term measured wind speeds at Sydney Airport spanning a period of 68 years (1948-2016);
  - 23 years of wind measurements at Fort Denison (1990-2019); and
  - A synthetic East-Coast Low (ECL) wind dataset which was created using a 1,000 year independently derived Monte Carlo model (Taylor et al, 2017).
- **Extreme Coastal Waves**: NSW has good long-term wave measurements to assist with defining extreme coastal deepwater wave conditions for rare and extreme events. This study has adopted 100-year ARI wave conditions defined for the entrance to Sydney Harbour undertaken for the *NSW Coastal Wave Model: State Wide Nearshore Wave Transformation Tool* (Baird Australia, 2017). As part of this previous study Baird modelled 100-year ARI wave conditions at the entrance to Sydney Harbour using the NSW Coastal Wave model system and deepwater storm waves defined by Shand et al (2011).
- **Sydney Harbour Modelling**: Modelling of wind setup along the foreshore was undertaken using a calibrated hydrodynamic model covering the whole of Sydney Harbour (using the DELFT3D software) (Freewater, 2018). The model is comprised of ten subdomains for different areas of Sydney Harbour and is run as a 3D model with eight vertical (sigma) layers. The model has been validated for currents and water levels at multiple locations throughout the harbour. The model is forced with astronomical constituents plus a residual water level at the harbour entrance, winds over the harbour, and hydrological catchment flows around the harbour. The Department of Planning, Industry and Environment (DPIE, formerly OEH) provided permission for Northern Beaches Council to utilise the DELFT3D hydrodynamic model to undertake the storm surge and local sea wave modelling required in this study.

Coastal Inundation Numerical Modelling

The estuarine numerical modelling has been undertaken using three separate model systems to account for the varying processes that contribute to the calculation of EPL's. The three model systems are:

- **DELFT3D** – hydrodynamic model to model local wind setup that occurs within Sydney Harbour.

- **SWAN** – wave model, which adopts the same grid as the DELFT3D model, to model local sea waves generated within Sydney Harbour from local wind forcing.
- **MIKE-21BW** – Boussinesq Wave model which models the penetration of ocean (swell) waves into Sydney Harbour and can account for all wave transformation processes between the entrance to Sydney Harbour, and the shorelines of the study area.

Estuarine Planning Levels

Estuarine Planning Levels have been reported at 529 locations along the foreshore based on the outcomes of the estuarine modelling. Specifically, this includes:

- Identifying the 100 year ARI ocean tidal level for existing and future sea levels (i.e. incorporating sea level rise).
- Calculating the wind setup and wave heights (sea and swell) based on the model results.
- Calculating wave run-up and overtopping, which requires:
    - Defining the typical foreshore types around the Middle and North Harbour study area; and
    - Calculation of the reduction in overtopping wave heights as a result of distance from the foreshore.
- Applying a freeboard to allow for any uncertainties primarily associated with the water level and wave calculations.

The components of the EPLs are shown diagrammatically in **Figure E1-1**.

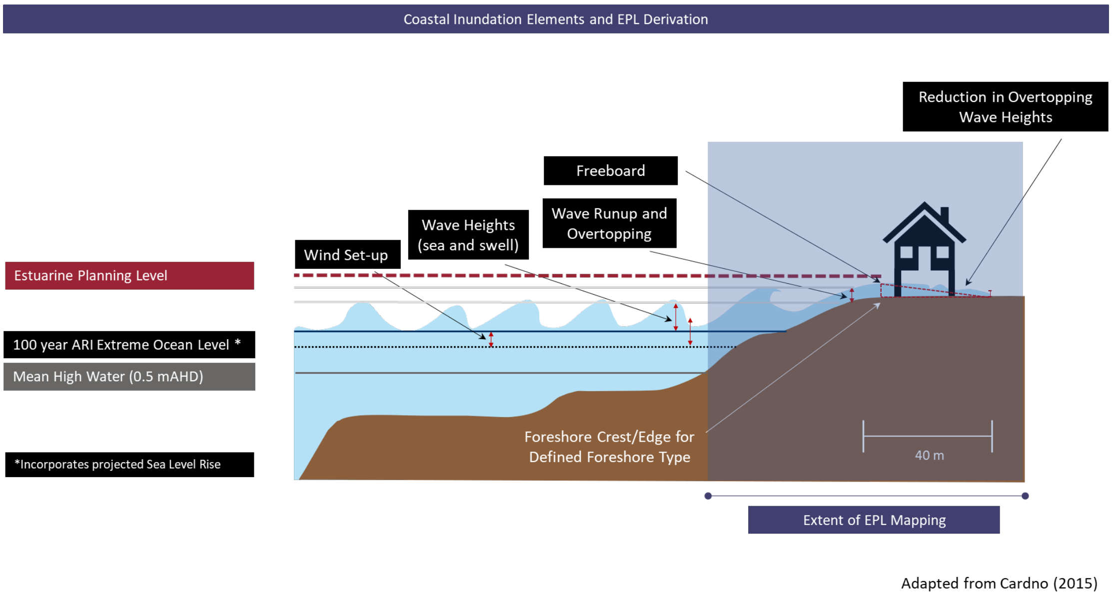

Figure E1-1 Estuarine Planning Level Components

Those properties affected by Estuarine Planning Levels (EPLs) have been identified using an 'EPL extent' generated from the EPL calculations described in this report and the Airborne Laser Scanning (ALS) ground survey for the study area.

The EPL for any proposed development on properties within 40m of the foreshore edge is calculated for the proposed foreshore type (or existing if it is to remain the same after the development) and the distance of the development from the foreshore edge. The resulting EPL will account for the 'local water level', wave run-up and overtopping and the reduction in the wave height as a result of distance from the foreshore, plus a freeboard of 0.3m.

The EPL for any proposed development on properties beyond 40m of the foreshore edge will be equal to the 'local water level' at the property location, plus a freeboard of 0.3m.

If the proposed development lies outside the EPL extent, then no EPL or estuarine hazard mitigation measures would be applied to the development.

This report provides for identification of 588 land parcels (as defined by cadastral boundaries) that would potentially have estuarine risk controls applied to development within these land parcels. Further this report identifies Estuarine Planning Levels for each of these land parcels.

It is recommended that Council review its current planning process with regards to the application of Estuarine Planning Levels within the study area and notification of estuarine risk on property planning certificates (issued under Section 10.7 of the Environmental Planning and Assessment Act, 1979). This would be undertaken as part of Stage 3 of this project.

It is recommended that community engagement be undertaken as part of future stages of this project.

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Glossary*

Australian Height Datum (AHD)	A common national surface level datum approximately corresponding to mean sea level.
Average recurrence interval (ARI)	The average time between which a threshold is reached or exceeded (e.g. large wave height or high water level) of a given value. Also known as Return Period.
Benchmarks	A standard by which something can be measured or judged. For example, predicted amounts of sea level rise to incorporate into planning considerations.
Cadastre, cadastral base	Information in map or digital form showing the extent and usage of land, including streets, lot boundaries, water courses etc.
Catchment	The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
Climate change	A process that occurs naturally in response to long-term variables, but often used to describe a change of climate that is directly attributable to human activity that alters the global atmosphere, increasing change beyond natural variability and trends.
Crest level	The level in metres Australian Height Datum (mAHD) of the top of a particular foreshore type.
Coast	A strip of land of variable width that extends from the shoreline inland to the first significant landform that is not influenced by coastal processes (such as waves, tides and associated currents).
Coastal inundation	Coastal inundation occurs when a combination of marine and atmospheric processes raises the water level at the coast above normal elevations, causing land that is usually 'dry' to become inundated by sea water. Alternatively, the elevated water level may result in wave run-up and overtopping of natural or built shoreline structures (e.g. dunes, seawalls). In the case of an estuary, coastal inundation may be caused by a combination of processes including high tides, storm surge and wave run-up onto the foreshore.
Coastal processes	Coastal processes are the set of mechanisms that operate at the land-water interface. These processes incorporate sediment transport and are governed by factors such as tide, wave and wind energy.

Coastal Zone	The coastal zone, as defined by the Coastal Management Act 2016, means the area of land comprised of the following coastal management areas: (a) the coastal wetlands and littoral rainforests area, (b) the coastal vulnerability area, (c) the coastal environment area, (d) the coastal use area.
Design storm event	A significant event to be considered in the planning process.
Development	As defined in the Environmental Planning and Assessment Act 1979 (EP&A Act). New development refers to development of a completely different nature to that associated with the former land use, e.g. the urban subdivision of an area previously used for rural purposes. New developments involve re-zoning and typically require major extensions of existing urban services, such as roads, water supply, sewerage and electric power. Infill development refers to the development of vacant blocks of land that are generally surrounded by already developed properties and is permissible under the current zoning of the land. Conditions such as minimum floor levels may be imposed on infill development Redevelopment refers to rebuilding in an area, e.g., as urban areas age, it may become necessary to demolish and reconstruct buildings on a relatively large scale. Redevelopment generally does not require either re-zoning or major extensions to urban services.
Estuarine Planning Level	The combinations of elevated estuarine water levels (derived from significant historical sea or ocean events or sea/ocean levels of specific ARIs) and freeboards selected for estuarine inundation risk management purposes.
Estuary	The CM Act defines an estuary as any part of a river, lake, lagoon, or coastal creek whose level is periodically or intermittently affected by coastal tides, up to the highest astronomical tide.
Extreme Ocean Water Level	The highest elevation reached by the sea/ocean as recorded by a tide gauge during a given period (after MHL, 2018).
Extreme Storm Event	Storm for which characteristics (wave height, period, water level etc.) were derived by statistical ‘extreme value’ analysis. Typically, these are storms with average recurrence intervals (ARI) ranging from one to 100 years.
Foreshore	The part of the shore, lying between the crest of the seaward berm (or upper limit of wave wash at high tide) and the ordinary low water mark, that is ordinarily traversed by the uprush and backrush of the waves as the tides rise and fall; or the beach face, the portion of the shore extending from the low water line up to the limit of wave uprush at high tide. The CM Act defines the

	foreshore as 'the area of land between highest astronomical tide and the lowest astronomical tide'.
Foreshore Crest/Edge	Generally, the landward limit of the foreshore. In some cases, it may be located higher than the upper limit of wave wash at high tide.
Foreshore type	The nature of the foreshore at any given location, e.g. retaining wall, sandy beach, rocky foreshore.
Flood	A general and temporary condition of partial or complete inundation of normally dry land areas, including inundation as a result of sea/ocean storms and other coastal processes or catchment flows.
Flood risk	Potential danger to personal safety and potential damage to property resulting from flooding. The degree of risk varies with circumstances across the full range of floods. Flood risk is divided into three types, existing, future and continuing risks as described below: ▪ Existing flood risk is the risk a community is exposed to as a result of its location on the floodplain. ▪ Future flood risk is the risk a community may be exposed to as a result of new development on the floodplain. ▪ Residual flood risk is the risk a community is exposed to after floodplain risk management measures have been implemented.
Freeboard	Provides reasonable certainty that the risk exposure selected in deciding on a particular flood chosen as the basis for the EPL is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest levels, etc. Freeboard is included in the flood planning level. As a component of the EPL, a freeboard is added to the local (still) water level.
Geographical information system (GIS)	A system of software and procedures designed to support the management, manipulation, analysis and display of spatially referenced data.
High Tide	The maximum height reached by a rising tide. The high water is due to the periodic tidal forces and the effects of meteorological, hydrologic, and/or oceanographic conditions.
Highest astronomical tide (HAT)	The highest level which can be predicted to occur under average meteorological conditions and any combination of astronomical conditions. In Australia HAT is calculated as the highest level from tide predictions over the tidal datum epoch (TDE), this is currently set to 1992 to 2011. The HAT and the Lowest Astronomical Tide (LAT) levels will not be reached every year. LAT and HAT are not the extreme water levels which can be reached, as storm surges may cause considerably higher and lower levels to occur.
Mean high water mark	The line of the medium high tide between the highest tide each lunar month (the springs) and the lowest tide each lunar month (the neap) averaged over out over the year. In NSW, the methods

	for determining the position of the MHWM are outlined in the *Crown Directions to Surveyors - No. 6 Water as a Boundary.*
Mean High Water Springs (MHWS)	The MHWS is the highest level which spring tides reach on the average over a period of time (usually several years).
Mean Low Water Springs (MLWS)	The MLWS is the lowest level which spring tides reach on the average over a time period (usually several years).
Mean Sea Level (MSL)	MSL is a measure of the average height of the sea or ocean's surface such as the halfway point between the mean high tide and the mean low tide. At present, mean sea level is approximately equivalent to 0mAHD (reported as 0.03 mAHD in MHL, 2019).
Probability	A statistical measure of the expected frequency or occurrence of flooding.
Risk	The chance of something happening that will have an impact on objectives, usually measured in terms of a combination of the consequences of an event and their likelihood.
Sea	Tasman Sea (interchangeably also referred to as Ocean in this report).
Sea level rise (SLR)	A rise in the level of the sea surface that has occurred or is projected to occur in the future, as measured from a point in time. The rise can be reported as a global mean or as measured at a specific point or estimated for a specific part of the sea or ocean.
Storm surge	The increase in coastal water level caused by the effects of storms. Storm surge consists of two components – the increase in water level caused by the reduction in barometric pressure and the increase in water level caused by the action of wind blowing over the sea surface (wind set-up).
Storm tide	An abnormally high water level that occurs when a storm surge combines with a high astronomical tide. The storm tide must be accurately predicted to determine the extent of coastal inundation.
Tidal inundation	The inundation of land by tidal action under average meteorological conditions and the incursion of sea water onto low lying land that is not normally inundated, during a high sea level event such as a king tide or due to longer-term sea level rise. For these planning controls, it is defined as the land that is inundated up to the level of Highest Astronomical Tide (HAT).
Wave run-up	The vertical distance above mean water level reached by the uprush of water from waves across a beach or up a structure.
Wave set-up	The rise in the water level above the still water level when a wave reaches the coast. It can be very important during storm events as it results in further increases in water level above the tide and surge levels.
Wind waves	Waves resulting from the action of the wind on the surface of the water.

*Many of the glossary terms here are derived or adapted from the *Coastal Management Glossary* (OEH, 2018).

Acronyms and Abbreviations

1D	One-Dimensional
2D	Two- Dimensional
3D	Three-Dimensional
AHD	Australian Height Datum
AEP	Annual Exceedance Probability
AIDR	Australian Institute for Disaster Resilience
ARI	Average Recurrence Interval
AR	Assessment Report (IPCC)
ARR	Australian Rainfall and Runoff
BoM	Bureau of Meteorology
CD	Chart Datum
CM Act	Coastal Management Act, 2016
CM SEPP	State Environmental Planning Policy (Coastal Management) 2018
DCP	Development Control Plan
DECC	Department of Environment and Climate Change (now largely DPIE)
DECCW	Department of Environment, Climate Change & Water (now largely DPIE)
DEM	Digital Elevation Model
DLWC	Department of Land and Water Conservation (now largely DPIE)
DoI (Water)	Department of Industry (Water) (formerly DPI Water) (now DPIE)
DPE	Department of Planning and Environment (now DPIE)
DPIE	Department of Planning, Industry and Environment
DPI Water	Department of Primary Industries – Water (Now DPIE)
ECL	East Coast Low
ENSO	El Niño-Southern Oscillation
EPL	Estuarine Planning Level
FFL	Finished Floor Level
FPL	Flood Planning Level
FRMP	Floodplain Risk Management Plan
FRMS	Floodplain Risk Management Study
GIS	Geographic Information System
Ha	Hectares

Hs	Significant Wave Height
Hm0	Significant Wave Height
IFD	Intensity-Frequency-Duration
IPCC	Intergovernmental Panel on Climate Change
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
km^2	Square kilometres
LAT	Lowest Astronomical Tide
LEP	Local Environment Plan
LGA	Local Government Area
LiDAR	Light Detention and Ranging
m^2	Square metres
m^3	Cubic metres
m/s	Metres per second
m^3/s	Cubic metres per second
mAHD	metres to Australian Height Datum
mm	Millimetres
m/s	Metres per second
NSW	New South Wales
OEH	Office of Environment and Heritage (now DPIE)
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
$R_{2\%}$	Two percent wave run up level. This is the run-up level, vertically measured with respect to the still water level, which is exceeded by two per cent of the incoming waves.
RCP	Representative Concentration Pathway
SES	State Emergency Service
SWL	Still Water Level
TN	True North
Tp	Wave period

1 Introduction

The foreshore areas of Sydney Harbour – being North Harbour and Middle Harbour within the Northern Beaches Local Government Area (LGA) are subject to inundation by coastal and estuarine processes. Coastal inundation is one aspect of coastal hazard (*Coastal Management Act*, 2016).

In order to protect future development from the effects of coastal inundation, it is necessary to ensure appropriate development controls are applied to proposed developments where consent is required under Part 4 of the Environmental Planning and Assessment Act, 1979 or where information is relevant to infrastructure planning (such as under the provisions of State Environmental Planning Policy (Infrastructure), 2007). Appropriate planning levels for the purposes of design and construction of buildings and other features are estimated from the best available information on water levels associated with either or both catchment flooding and coastal inundation (both types of flooding/inundation can occur on some properties). The planning levels are generally set to seek to minimise the potential for inundation and damage during rare and extreme inundation events.

Rhelm, with the assistance of Baird Australia, was engaged by Northern Beaches Council (Council) to determine appropriate planning levels for the foreshore areas of North Harbour and Middle Harbour based on a range of oceanic and estuarine processes (including ocean tide, wind set up and wave height, wave run-up, a freeboard and allowance for sea level rise).

1.1 Study Context

Inundation of the coastal zone (and subsequent impacts on property and infrastructure within this zone) can be caused by large waves and elevated water levels associated with a range of coastal and oceanographic process responses to severe storms. Within this report this is referred to as 'Estuarine Inundation Risk'. The nature and extent of the inundation is dependent on the interactions between the ocean and the land. Thus, an understanding of the interactions of the ocean and the land is essential to identify the extent of coastal inundation.

In order to protect future development within the coastal zone from coastal inundation, it is necessary to ensure appropriate controls are applied to development.

Estuarine Planning Levels (EPLs) are currently applied as a method for managing risk to property along the foreshore of Pittwater (in the north of the Northern Beaches LGA). EPLs are applied under the provisions of the Pittwater Local Environment Plan (LEP) 2014. More specifically, Northern Beaches Council's approach to managing this risk is set out in the *Estuarine Risk Management Policy for Development in Pittwater* (within the Pittwater Development Control Plan (DCP), 2018).

At the time of preparation of this study Northern Beaches Council had separate Local Environmental Plans (LEPs) and Development Control Plans (DCPs) operating for the three former LGA regions.

Coastal hazard is managed at the highest level through the *State Environmental Planning Policy (Coastal Management) 2018*. However, the coastal vulnerability provisions for the Northern Beaches LGA are not yet operational as vulnerability mapping was not in place for Middle or North Harbour at the time of the completion of this study.

The *Manly LEP 2013* (Clause 6.10) currently sets the defining provisions for coastal hazards for Middle and North Harbour. These clauses generally aim to reduce the impacts of coastal zone development on the natural coastal processes and manage risk to property and life associated with coastal hazards. *Manly LEP 2013* also contains; *Clause 6.8 Landslide risk*, which applies to properties containing geotechnical issues in North and Middle Harbour as identified in various coastline hazard definitions studies.

The *Manly DCP 2013* does not provide specific controls relating to coastal risk management but does have controls relating to setbacks enforced by the foreshore building line shown on the LEP Foreshore Building Line Map.

The Estuarine Planning Levels derived from this study will inform the planning controls set out in the documents described above and any new planning controls developed for the amalgamated Northern Beaches Council. This may be done in a similar manner to the existing *Pittwater LEP 2014* and *Pittwater 21 DCP*. This will be investigated and discussed further as part of Stage 3.

1.2 Study Approach

This Estuarine Planning Levels Study is being prepared in the following stages.

- **Stage 1 Coastal Modelling:** coastal and estuarine modelling to define coastal inundation.
- **Stage 2 Property Data:** application of the modelling outcomes at a property scale (i.e. defining the EPLs for each affected property).
- **Stage 3 Planning Controls:** a review of Council's existing policy and planning framework and recommendations for amendments to allow for the application of EPLs within the study area.

The outcomes of Stages 1 and 2 are presented in this document, Stage 3 will be undertaken separately.

The coastal modelling completed for Stage 1 adopted methods to generate coastal inundation results that are consistent with the *Pittwater Estuary Mapping of Sea Level Rise Impacts* (Cardno, 2015) which provided the coastal inundation data to inform coastal planning for the Pittwater estuary. This included the analysis of the impact of sea level rise values of 0.4m and 0.9m on estuarine inundation.

2 Study Area

The study area includes the foreshore areas of North Harbour and Middle Harbour that lie within the Northern Beaches LGA. This includes the suburbs of Manly, Fairlight, Balgowlah Heights, Clontarf, Seaforth and Killarney Heights. The study area is comprised of a range of land uses, including national park and nature reserves, public recreation, residential, commercial and light industrial. The study area is shown in **Figure 2-1**.

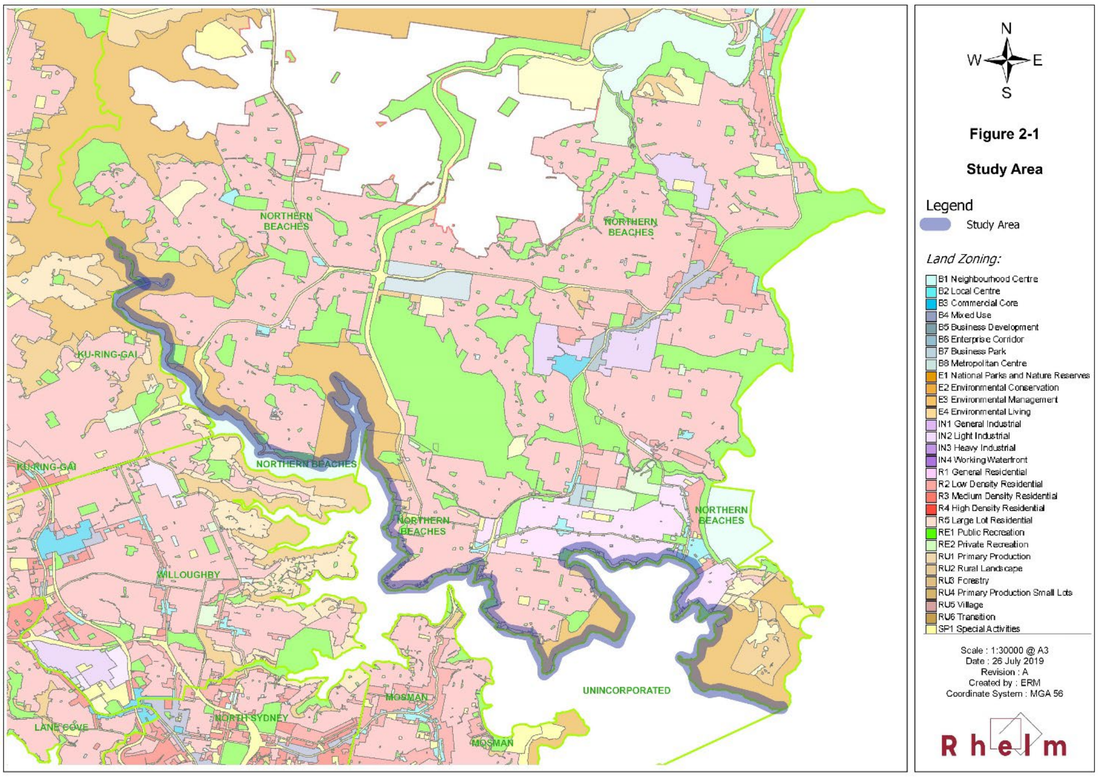

Figure 2-1 Study Area

2.1 Coastal Processes Summary

Sydney Harbour is a drowned river valley estuary which is dominated by tidal processes in the lower reaches where the Northern Beaches Council foreshore areas are located (see **Figure 2-1**). Diurnal tides with a range of 1 to 2 m flow through Sydney Harbour with minimal friction loss or transformation of the tide characteristics compared to the open ocean due to the relatively deep channels and open waters of the lower harbour.

Prevailing southerly and south-easterly swell (ocean) waves penetrate into Sydney Harbour and impact on shorelines between Clontarf, Middle Head and Many Cove. Large storms and swells occur several times per year resulting in swells of 1 to 2 m impacting on some shoreline areas. The most significant weather systems which can lead to coastal inundation of the Northern Beaches Council areas of Sydney Harbour are associated with East Coastal Low (ECL) storms that generate strong winds offshore and along the coastal fringe which result in large waves and elevated coastal water levels.

Elevated coastal water levels during the passage of a severe storm are the result of barometric effects and wind setup. The combined effect of barometric setup and wind setup is referred to as storm surge. Barometric setup occurs due to the intense low-pressure systems that generate large storms. This reduction in air pressure over the water surface results in a local rise of the water level. Wind setup is a result of the wind inducing wind shear stresses on the water, which in turn generate currents. When these currents are impeded by the coast, a resulting increase in the water level occurs.

The Northern Beaches Council foreshore areas of North Harbour and Middle Harbour can experience large shoreline waves from swells which penetrate the entrance of Sydney Harbour and also locally generated sea waters. Waves can be particularly significant for coastal inundation when wave or wave runup impact on coastal structures, for example seawalls. Waves can overtop these structures which can result in significant inundation of adjoining properties.

The coastal modelling completed in this study to define coastal inundation levels within Sydney Harbour have focused on spatially quantifying the following processes that result in coastal inundation of foreshore areas:

- Wind setup from winds acting over Sydney Harbour from all possible directions;
- Local sea waves generated over Sydney Harbour from all possible directions; and
- The penetration of ocean swells to foreshore areas for the most severe offshore wave direction where prevailing storm waves are observed offshore.

3 Discussion of Coastal Processes

To calculate appropriate Estuarine Planning Levels (EPLs) it is necessary to understand the oceanographic and coastal processes impacting the foreshore. The following coastal processes have been considered in the determination of EPLs for North Harbour and Middle Harbour:

- Regional Processes (ocean scale of hundreds of kilometres);
- Local Processes (within North and Middle Harbour - scale a few kilometres); and
- Site Specific Processes (scales of tens of metres).

These processes are consistent with those adopted for the Pittwater EPL study (Cardno, 2015) and are outlined schematically in **Figure 3-1** and described in more detail in the following sections.

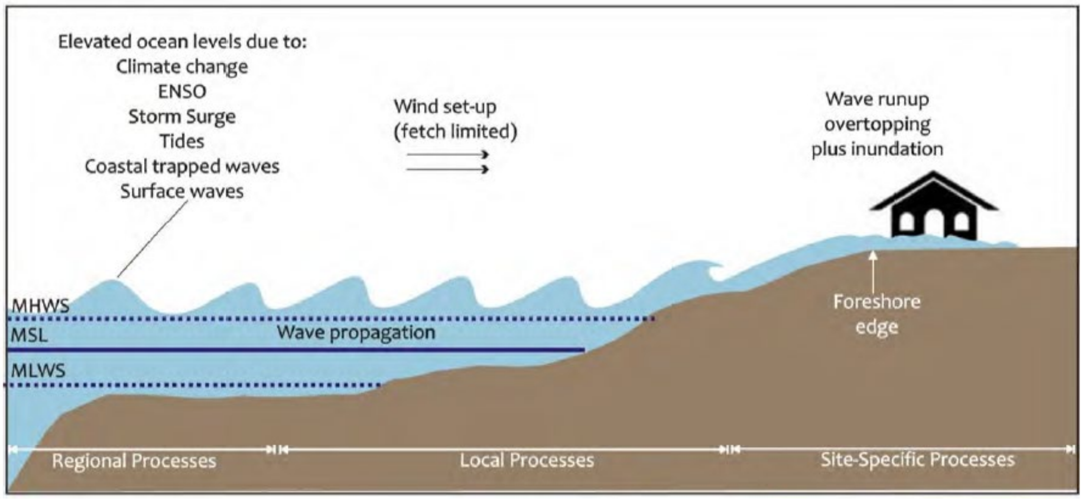

Figure 3-1 Coastal Processes Affecting Estuarine Planning Levels (from Cardno, 2015)

3.1 Regional Processes

Regional oceanographic processes relate to those ocean processes that are influenced by energy inputs causing sea level fluctuations over the larger scales of the NSW coastal waters and essentially affect coastal waters between Wollongong and Newcastle simultaneously (i.e. hundreds of kilometres of coastline). Coastal water levels in the study area region can be influenced by the following oceanographic processes:

- Astronomic Tides.
- Meteorological / Oceanographic Processes:
  - Storm Surge from wind setup and barometric setup.
  - Ocean Waves.
  - Coastal Trapped Waves.
  - El Niño-Southern Oscillation (ENSO).
  - Meteorological Oscillations.
- Climate Change and Sea Level Rise.
- Tectonic Processes.

Tectonic processes are not considered in this assessment as they play a very minor role (and hence low risk) in the study area, although though it is known that tectonic processes like tsunami created significant damage at Clontarf during the 1960 Chilean tsunami.

At times, these individual factors interact in complex ways to elevate water levels significantly above normal tidal levels. Storms, principally East Coast Lows, with low central atmospheric pressure (barometric setup), strong onshore winds (resulting in wind setup) and large waves superimposed on spring (or king) tides, are the most common cause of elevated water levels. This is shown diagrammatically in **Figure 3-2**. Taylor *et al* (2017) and Aldridge *et al* (2018) were able to replicate the extreme wave and water level probability distributions along the NSW coastline with a stochastic East Coast Low model. Those studies concluded along the NSW coast hazard models for the erosion and coastal inundation needed to include astronomical tide, storm surge and ocean waves. For the Sydney Region, those processes can all be defined from analysis of measured data. The combined probability of water levels from Astronomic Tides and Meteorological / Oceanographic Processes can be well defined from the long-term Fort Denison tide gauge data set (Watson and Lord, 2008). The deepwater probability of ocean wave conditions can be defined from the long-term measured wave data along the NSW coast (Shand *et al*, 2011). **Sections 4.1 and 4.2** present the regional scale water level and wave conditions adopted for this study.

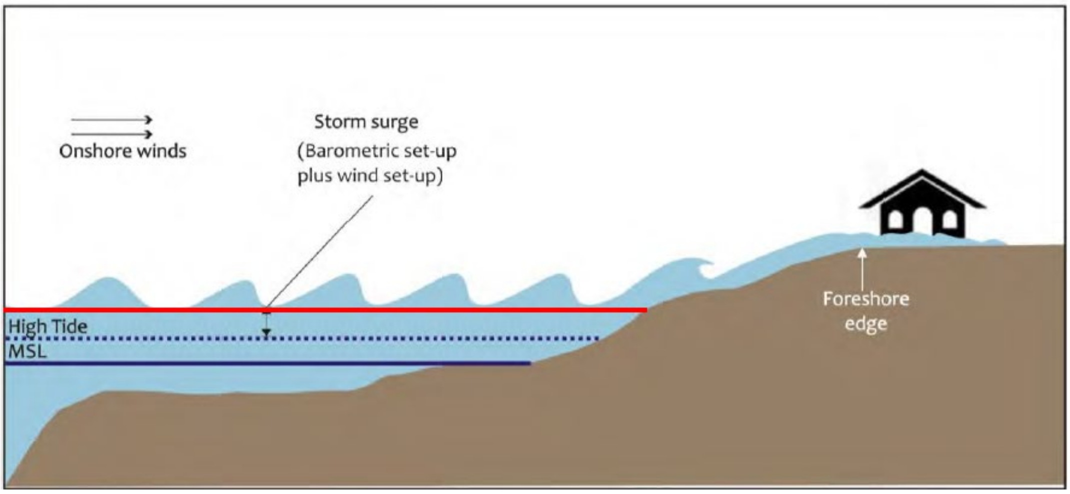

Figure 3-2 Regional Coastal Processes (from Cardno, 2015)

Determining a regional elevated water level for planning purposes depends on the probability of that level occurring and the risk associated with it. Planning benchmarks are generally determined on the basis of an average recurrence interval (ARI), which relates the probability of a particular water level occurring. Department of Planning (2007) advises that for flood prone land unless there are exceptional circumstances, councils should adopt the 100 Year ARI flood levels for planning of residential development. This relates to the water level associated with a storm event that has the probability of occurring once every hundred years. It is important to note that at the time of preparation of this study, the planning circular of 2007 (Department of Planning, 2007) was under review.

3.1.1 Sea Level Rise

Sea level rise will have an impact on coastal inundation levels in the future. It is noted that estuarine inundation is an existing risk as well as a future risk, sea level rise analysis was undertaken to understand how that risk may increase in the future.

The impact of two sea level rise scenarios has been assessed in this study. In the absence of a Council policy defining specific sea level rise values for this purpose, sea level rise of 0.4m and 0.9m have been selected for analysis to ensure consistency with many of Council's previous flood studies, and the Pittwater EPL approach (Cardno, 2015).

The selection of these values is supported by current science. In its fifth assessment report (2013), the IPCC (reported in Church et al, 2013) has developed a range of future sea level rise projections associated with different greenhouse gas emission scenarios (representative concentration pathways (RCPs)). These indicate that 0.4m sea level rise is almost certain by 2100 and 0.9m is likely. The application of these levels in this study is discussed in **Section 6.2**.

Table 3-1 Likely Global Sea Level Rise by 2100 (Church et al, 2013)

Scenario	***Likely* global mean sea level rise range by 2100 (relative to 1986-2005)**
Significantly Reduced Emissions (RCP 2.6)	0.24–0.61 m
Highest Emissions (RCP 8.5)	0.54–1.06 m

3.2 Local Processes

Local processes within the context of this study relate to the processes that cause variations in 'elevated local water levels' within the lower Sydney Harbour adjoining the Northern Beaches Council's foreshore areas (see **Figure 2-1**). Water levels within the lower Sydney Harbour (including North Harbour and Middle Harbour) will be influenced by local variations as a result of both wind strength and direction and waves.

Local Wind Setup

The same wind that adds to the regional storm surge in the form of wind setup has the potential to also cause further variation in the water level through wind setup developed over Sydney Harbour. This wind setup, however, is much smaller than the regional storm surge discussed in **Section 3.1** and is limited by the distance of water (fetch) over which the wind blows.

Wave Height

Ocean storms can contribute to elevated water levels along the coastline and inside Sydney Harbour. For the North and Middle Harbour foreshore areas, the most severe ocean storm waves come from the southeast to south sector. The ocean storm waves propagate from the deeper ocean into the shallow water of Sydney Harbour and the waves undergo changes caused by diffraction, refraction, shoaling, bed friction and wave breaking.

Local wind-generated waves can contribute to the elevated water levels as a result of ocean storms. The highest local wind-generated waves will occur during storms that have south to easterly winds that 'push' water onto the coast. In this way the two processes (regional and local) are correlated and the likelihood the highest ocean water levels and highest local wind-generated waves occurring together (joint occurrence) will be very rare on the westward-facing shorelines of the study area.

Numerical wave modelling of the swell and local wind waves is presented in **Section 5**. Wave heights will vary depending on the location along the Northern Beaches Council foreshore areas and some areas are exposed to relatively large storm swell waves.

3.3 Site Specific Processes

Site specific processes within the context of this study relate to the processes at the foreshore. The physical factors that will impact the elevated water level will be the nature of the foreshore (e.g. retaining wall or sandy beach, referred to in this report as "foreshore type") and the height of the foreshore.

As a wave reaches the foreshore an 'uprush' of water onto the foreshore will occur, this is called wave run-up. The height of wave run-up is affected by the nature of the foreshore. Should wave run-up be large, wave overtopping may occur, which results in the temporary inundation of the foreshore area. The inland extent of the wave inundation is assumed to be 40m from the foreshore crest. With the inclusion of a freeboard allowance (see **Section 6.5**) this is an appropriate distance to assess the impacts of waves on coastal inundation and has been verified from site observations following severe storms along the NSW coastline.

Wave run-up mechanisms in this study have been quantified in a manner consistent with the Pittwater EPL's described in **Figure 3-3**. Wave run-up for shoreline types in the study area is presented in **Section 6.4**.

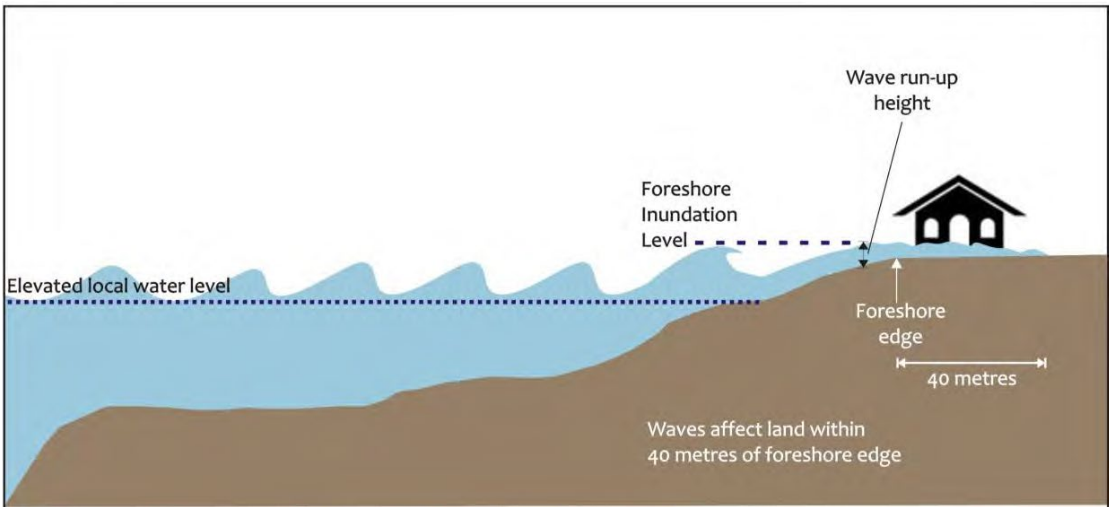

Figure 3-3 Site Specific Coastal Processes (from Cardno, 2015)

4 Data Compilation and Review

The following sections summarise the data and model inputs that have been utilised in this study to complete modelling required to define coastal inundation in the study area.

4.1 Sydney Harbour Water Levels

Sydney Harbour has a long, reliable data set of water levels measured at Fort Denison, and more recently at Middle Harbour (near the study area). Present day extreme design still water levels at Fort Denison based on a statistical analysis of measured historical records are provided in **Table 4-1** which are aligned with the outputs from the Fort Denison Sea Level Rise Vulnerability Study (Watson and Lord, 2008). The extremes analysis is based on water level data measured continuously at Fort Denison for over 100 years. The data reflects the astronomical tide levels as well as anomalies or variations from the predicted tide from storm surge and freshwater flows (assumed very minimal). Similarly, the data inherently incorporates climate-change and other seasonal-induced sea level rise over this timeframe. **Table 4-1** presents the extreme water levels for Fort Denison from Watson and Lord (2008) which have been adopted as the basis for the 100-year ARI ocean water level adopted in this study. A 100-year ARI water level of 1.44 m AHD has been adopted for Sydney Harbour, and the high-resolution modelling undertaken in this study has defined the additional wind setup that can occur at particularly locations within Sydney Harbour. This additional wind setup was added to the 100-year Fort Denison water level of 1.44 m AHD.

Table 4-1: Extreme water levels at Fort Denison, Sydney (Watson and Lord, 2008)

Average Recurrence Interval (ARI) (years)	Present Day Extreme Still Water Level	
	m CD*	m AHD
1	2.2	1.2
10	2.3	1.3
50	2.3	1.4
100	2.4	1.4
200	2.4	1.5

* CD = Chart Datum which approximates to LAT and is about 0.93m below AHD.

4.2 Coastal Storm Winds

A range of wind data sets have been analysed to define extreme winds which can generate enhanced storm surge and local sea waves in the study area. The key data sets reviewed in this study were:

- Long-term measured wind speeds at Sydney Airport spanning a period of 68 years (1948-2016);
- Wind measurements from at Fort Denison (1990-2019); and
- A synthetic East Coast Low (ECL) wind dataset which is derived from a 1,000 year independently derived Monte Carlo model (Taylor et al, 2017).

A review of all three datasets concluded that the Sydney Airport data was the most appropriate for use in defining extreme event winds. The directional extreme wind data from Sydney Airport has been adopted to define 100-year ARI sustained (10-minute average) winds for eight directional sectors as defined in **Table 4-2**. The strongest storm winds occur from a southerly direction, and this directional also correspondences to the longest fetch length exposure for most of the Northern Beaches Council foreshore areas in Sydney Harbour.

Table 4-2: Extreme wind speeds based on long-term Sydney Airport data (1948-2016)

Direction	100-year ARI wind speed (m/s)
Omni-Directional	28.2
North	15.4
Northeast	16.3
East	17.8
Southeast	20.4
South	27.5
Southwest	22.7
West	22.3
Northwest	20.8

4.3 Extreme Coastal Waves

NSW has good long-term wave measurements to assist with defining extreme coastal deepwater wave conditions for rare and extreme events. This study has adopted 100-year ARI wave conditions defined for the entrance to Sydney Harbour undertaken for the *NSW Coastal Wave Model: State Wide Nearshore Wave Transformation Tool* (Baird Australia, 2017). As part of Baird Australia (2017) 100-year ARI wave conditions were modelled at the entrance to Sydney Harbour using the NSW Coastal Wave model system and deepwater storm waves defined by Shand et al (2011). **Table 4-3** presents the 100-year ARI wave parameters (Hs – significant wave height, Tp – Wave period and mean direction at the entrance to the harbour in degrees True North) adopted for the entrance to Sydney Harbour.

Table 4-3: 100-year ARI extreme wave conditions for entrance to Sydney Harbour (Baird Australia, 2017)

Deepwater Direction	Hs (m)	Tp (s)	Mean Dir. @ Entrance to Harbour (deg TN)
South-southeast	7.47	13.7	123
East-southeast	6.81	12.4	104

4.4 Sydney Harbour Modelling (GSLLS)

Between 2012 and 2016, Baird in partnership with Cardno, undertook a series of modelling projects for the Greater Sydney Local Land Services (GSLLS) which informed the development of a preliminary estuary processes study for Sydney Harbour (Freewater, 2018). The estuary processes study is now being administered by the Department of Planning, Industry and Environment (DPIE, formerly the Office of Environment and Heritage, OEH).

Modelling of wind setup along the foreshore was undertaken using a calibrated DELFT3D hydrodynamic model covering the whole of Sydney Harbour (see **Figure 4-1**). The model is comprised of ten subdomains for different sections of Sydney Harbour and is run as a 3D model with eight vertical (sigma) layers. The model has been validated for currents and water levels at multiple locations throughout the harbour. The model is forced with astronomical constituents plus residual water level at the harbour entrance, winds over the harbour, and catchment hydrological flows from around the harbour.

DPIE has provided permission for Northern Beaches Council to utilise the DELFT3D hydrodynamic model to undertake the storm surge and local sea wave modelling required in this study.

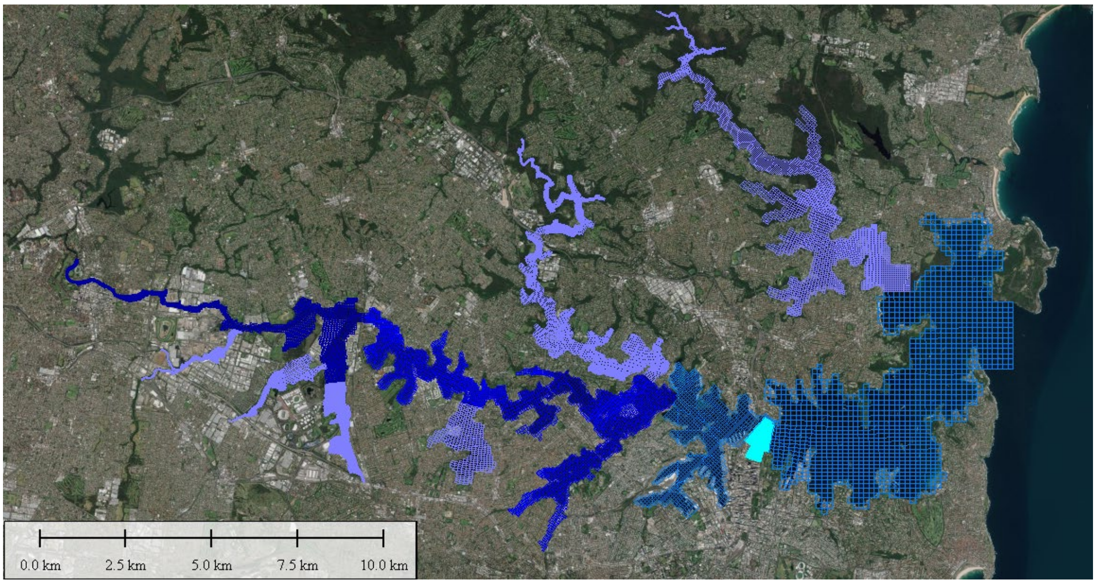

Figure 4-1 Delft3D Sydney Harbour Model

5 Estuarine Modelling

The estuarine modelling has been undertaken with three separate model systems to account for the following processes that contribute to the calculation of EPL's. The three model systems are:

- DELFT3D hydrodynamic model to model local wind setup that occurs within Sydney Harbour.
- SWAN wave model, which adopts the same grid as the DELFT3D model, to model local sea waves generated within Sydney Harbour from wind forcing.
- MIKE-21BW (Boussinesq Wave model) which models the penetration of ocean waves into Sydney Harbour and can account for all wave transformation processes between the entrance to Sydney Harbour, and the shorelines of the study area.

5.1 DELFT3D Modelling

The Fort Denison water level data provides a good basis to define extreme ocean water levels for return periods of 200-years ARI and greater. However, within embayment's and sections of Sydney Harbour, additional wind setup can occur which elevate water levels above Fort Denison levels.

Modelling of wind setup along the foreshore has been undertaken using a calibrated DELFT3D hydrodynamic model covering the whole of Sydney Harbour (**Section 4.4**) to quantify the variation in extreme water levels between Fort Denison and the study area. As outlined in **Section 4.4**, the model is comprised of ten subdomains for different sections of the harbour and is run as a 3D model with eight vertical (sigma) layers. The model has been calibrated for tidal and wind driven currents and water levels at selected sites around Sydney Harbour. For this study, the model resolution through Port Jackson between the entrance and the Sydney Harbour Bridge was increased to a maximum grid resolution of 50 m. Through the entire tidal extent of North Harbour and Middle Harbour, model resolution is typically 10 to 20 m.

The DELFT3D model was applied with spring tide and wind forcing to model wind setup for the eight directional sector winds defined in **Table 4-2**. The wind setup was calculated as the maximum difference between the maximum modelled water level and the boundary tide level for each of the calculation points. The largest wind setup from all direction scenarios were adopted as the 100-year ARI wind setup at each output location. The largest wind setup was generated by winds from southeasterly to southwesterly direction in the study area and this is consistent with the prevailing direction of storm waves for the study area. The 100 Year ARI south-east wind setup modelling results are shown in **Appendix A**.

5.2 SWAN Modelling

Local sea waves were calculated in a consistent manner using a SWAN wave model which adopted the same model grids and wind conditions as the DELFT3D model scenarios described in the previous section. The SWAN wave model adopted a fixed 100-year ARI water level for each model simulation and local sea waves defined by significant wave height (Hm0), wave period (Tp) and wave direction were computed for each output location. The largest wave heights from the defined in **Table 4-2** were adopted as the 100-year ARI local sea wave conditions. The largest waves were generated by winds from southeasterly to southwesterly direction in the study area and this is consistent with the prevailing direction of storm waves for the study areas. The 100 Year ARI south-east wind wave modelling results are shown in **Appendix A**.

5.3 MIKE21BW Modelling

Ocean swell penetration into Sydney Harbour were modelled using the MIKE-21BW model for the two 100-year ARI ocean wave scenarios described in **Table 4-3**. The MIKE-21BW adopted a constant 6 m grid resolution through the whole study area and the grid was rotated to align with the wave directions at the entrance to Sydney Harbour. The model adopted the same underlying bathymetry data set as the Delft3D/SWAN model (see **Section 4.4**) and a 100-year ARI static water level for the two wave scenarios. The swell wave parameters defined by significant wave height (Hm0), wave period (Tp) and wave direction were computed for each output location.

Figure 5-1 presents the wave penetration plot for a 100-year ARI wave condition into Sydney Harbour for a south-southeast deepwater wave direction which is typical of many severe storms on the mid-NSW coastline and which is the most severe wave direction for most of the Northern Beaches Council foreshore areas. The wave heights at Middle Head are very large and significant wave penetration occurs into Middle Harbour and Clontarf, and also into Manly Cove.

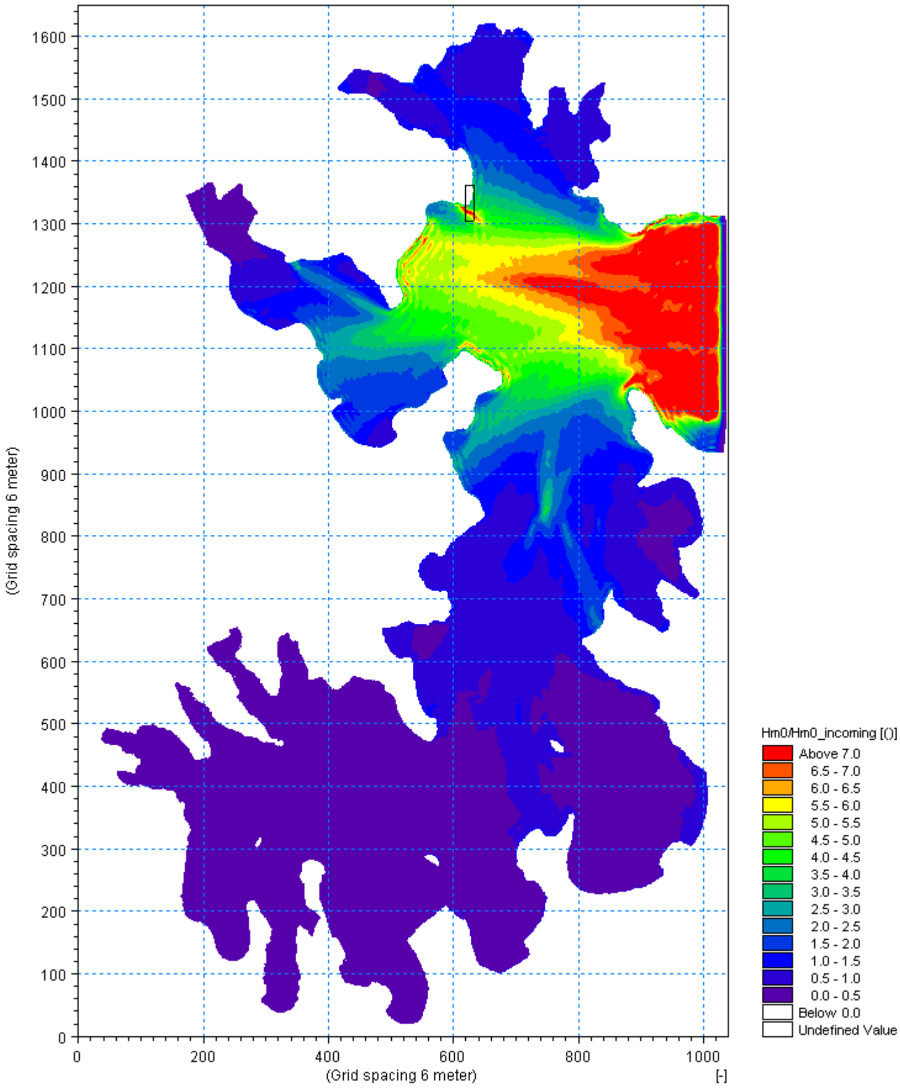

Figure 5-1 100-year ARI ocean wave condition penetration into Sydney Harbour, south-southeast deepwater wave direction

6 Calculation of Estuarine Planning Levels

6.1 Estuarine Planning Level Components

Estuarine Planning Levels have been reported at 529 locations along the foreshore based on the outcomes of the estuarine modelling (**Section 5**). Specifically, this includes:

- Identifying the 100 year ARI ocean tidal level for existing and future sea levels (i.e. incorporating sea level rise).
- Calculating the wind setup and wave heights (sea and swell) based on the model results described in **Section 5.1**.
- Calculating wave run-up and overtopping, which requires:
    - Defining the typical foreshore types around Sydney Harbour study area; and
    - Calculation of the reduction in overtopping wave heights as a result of distance from the foreshore.
- Applying a freeboard to allow for any uncertainties primarily associated with the water level and wave calculations.

The components of the EPLs are shown diagrammatically in **Figure 6-1**.

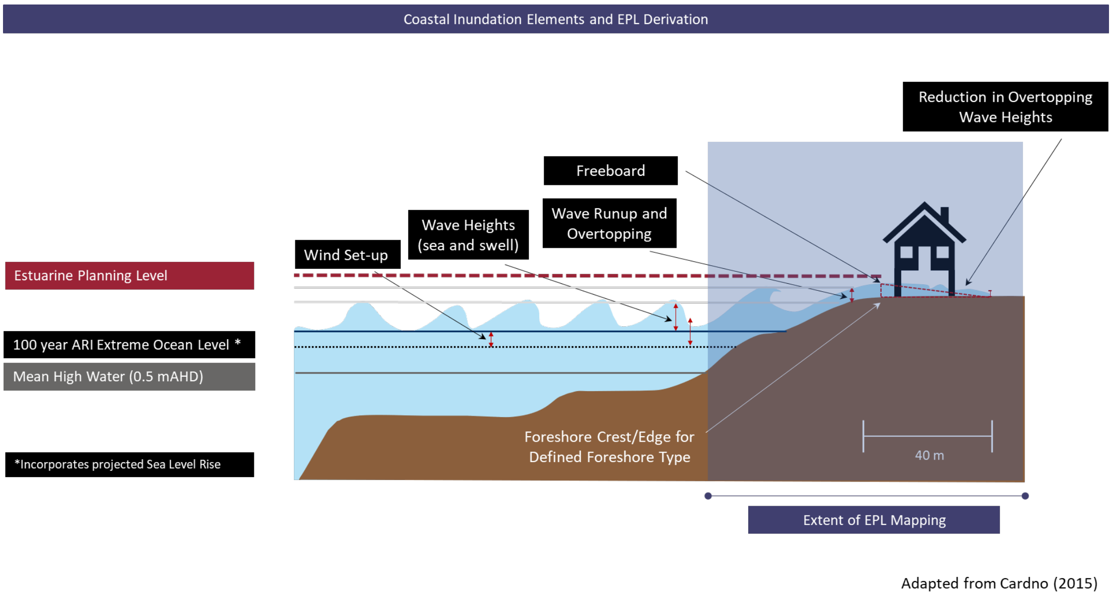

Figure 6-1 Estuarine Planning Level Components

6.2 Tidal Event Mapping and Sea Level Rise

It was considered appropriate to adopt the 100 Year ARI ocean water level event as the design event for planning purposes within the North Harbour and Middle Harbour coastal zone. In order to calculate the 100 Year ARI ocean water level, the Fort Denison tide gauge (Sydney Harbour) has been identified as an appropriate ocean water level gauge. As outlined in **Section 4.1**, extremal analysis of the Fort Denison tide gauge data reported in Watson and Lord (2008) has been applied. The extreme water levels provided from this gauge provide a historical record of the combined effects of the processes described above. The 100 Year ARI level at Fort Denison was determined to be 1.44 mAHD (to two decimal places).

To provide an estimation of the projected impact of sea level rise on these tidal events, predicted sea level rise of 0.4m and 0.9m have been applied (see **Section 3.1.1**, with those adopted for Pittwater, as per Cardno, 2015).

Table 6-1 provides the levels that were used with what is referred to here as the 'present-day levels', which are actually based on the analysis of recorded tidal levels for the period 1914 – 2006 (Watson and Lord, 2008). In reality, Watson and Lord (2008) note that sea level rise has been observed at a rate of 3.1 mm/year and so using this trend as a coarse guide then the actual present day reference point (at 2019 when the calculations for this study were conducted) is potentially up to 0.04 m higher (i.e. 3.1 mm/yr times 13 years that have elapsed since the calculations based on actual data were completed). Given the small nature of the variance, the present day values have been retained as those reported by Watson and Lord (2008), which is consistent with that adopted for Pittwater (Cardno, 2015). It is important to note that the ocean water level projections in **Table 6-1** for 2050 and 2100 are adjusted from the reference point of 1990 which has been the common basis for sea level rise projections by the Intergovernmental Panel for Climate Change (Church and Gregory, 2001; Church et al, 2013).

Table 6-1 Present Day, 2050 and 2100 Ocean Levels

	Present Day Level (aka Existing Level)	2050	2100
Predicted Sea Level Rise	0 m	0.4 m	0.9 m
100 Year ARI Ocean Water Level*	1.44 mAHD	1.84 mAHD	2.34 mAHD

*Does not include wind set up or wave run up.

Sea level rise has been incorporated into the determination of Estuarine Planning Levels (EPLs) by calculating EPLs for 0.4m and 0.9m of sea level rise (in addition to the existing sea level). The shoreline wave height has also been updated where appropriate for the sea level rise predictions.

6.3 Wave Height and Wind Set-up

When selecting a design event upon which to calculate local wave heights, the likelihood of those waves occurring at the same time as the 100 Year ARI ocean water level needs to be considered.

Since many of the shoreline areas in the study area experience the largest local sea waves and wind setup as a result of winds from a southeast to southwest direction, the maximum 100-year ARI ocean water level was adopted to be concurrent with the 100-year ARI wind setup, local sea and ocean swell waves modelled in the scenarios presented in **Section 5**.

The wind setup, local sea and swell waves were calculated at over 500 output locations along the foreshore.

6.4 Wave Run-up and Overtopping

As described in **Section 3.3**, the height of wave run-up and the depth of overtopping are dependent on the foreshore type and the height of the foreshore edge (crest level). The inland extent of the wave inundation is assumed to be 40m from the foreshore crest based on the study team's observations of inundation associated with severe storms in the Sydney region. Therefore, the EPL applied to a development depends on the distance of the development from the foreshore edge.

6.4.1 Foreshore Types

The nature of the foreshore (foreshore type) is critical in the calculation of wave run-up and overtopping. The Pittwater Estuarine Planning Levels (see Cardno, 2015) adopted the following foreshore types:

- Type 1 - 1 in 10 natural slope (representing grassed and sandy gently sloping foreshores);
- Type 2 - 1 in 5 rocky shoreline (representing natural rocky foreshore or sloped rip rap);
- Type 3 - Vertical sea wall (e.g. block work or other retaining walls); and
- Type 4 - Mangroves.

The shoreline types are also appropriate for Middle Harbour, although the mangrove type shoreline is not generally observed in this study area. However, for consistency with the Pittwater (Cardno, 2015) approach all four foreshore types have been applied to the calculation of EPLs for Middle Harbour.

For this study, modifications to the approach within Cardno (2015) were made with respect to the maximum vertical level (or 'crest') of shoreline structures and the toe level of structures based on information for the study area reported in WRL (2012). WRL (2012) reports the outcomes of survey and inspection of seawalls along the foreshore of the Northern Beaches Council area. Using this information, the following levels were assumed for the wave overtopping calculations:

- Structure crest levels up to 3.5 m AHD have been adopted. In wave exposed areas of Sydney Harbour seawalls particularly have higher crest elevations than most structures in Pittwater.
- Toe level of the shoreline seaward of the structure of -0.5 mAHD. This level was adopted to calculate breaking wave heights (where applicable).

For these foreshore type categories calculations were undertaken for five foreshore crest levels, being:

- 1.5 mAHD;
- 2.0 mAHD;
- 2.5 mAHD;
- 3.0 mAHD; and
- 3.5 mAHD.

The wave overtopping of the shore was calculated using methods described in USACE (2002) and CERC (1984). The methods and equations are briefly summarised below.

Firstly, wave run-up is computed for a scenario without overtopping to determine the maximum elevation of run-up for each shoreline type. This was calculated using the equations of De Waal and van der Meer (1992). The runup level equation is presented in equation 6.1:

$$\frac{R_{2\%}}{H_s} = 1.6\ \xi_{op}\ where\ 0.5 < \ \xi_{op} < 2, or\ 3.2\ where\ \xi_{op} > 2 \qquad (6.1)$$

$$Level = SWL + \ R_{2\%} \qquad (6.2)$$

ξ_{op} is the surf similarity parameter based on deepwater wave height and wavelength and includes the structure slopes that were specified in the paragraphs above. The 2% wave run-up level ($R_{2\%}$) is adjusted based on shoreline type using the following reduction factors:

- Smooth concrete or blocks: 1.0 (no reduction)
- Grassy or vegetated bank: 0.9
- Rocky shoreline: 0.6

Following calculation of the unobstructed maximum run-up level, wave run-up and overtopping is calculated using van der Meer and Janssen (1995):

$$K_{TO} = C\left(1 - \frac{R_c}{R_{2\%}}\right) \; where \; C = 0.51 \tag{6.3}$$

For vertical walls, Equation 6.3 is modified, and the shoreline wave height replaces the $R_{2\%}$ term. The wave height transmitted over the wall (H_{TO}) and flood level (Level) is then calculated as follows:

$$H_{TO} = K_{TO} \times H_s \tag{6.4}$$

$$Level = Crest\ Level + H_{TO} \tag{6.5}$$

If the still water level is above the structure crest, the following equation from NSW Government (1990) is adopted:

$$Level = SWL + \frac{H_s}{2} \tag{6.6}$$

6.4.2 Inland Extent of Wave Overtopping

Where a land parcel (allotment) slopes steeply back from the shoreline edge structure, the EPL may affect only a small part of the land parcel. However, where a land parcel is relatively flat, wave run-up may penetrate some distance inland, but is attenuated by percolation and friction. This landward reduction of wave inundation cannot be estimated with great confidence and has been based on observational experience.

It is assumed that wave run-up diminishes to zero at a point 40m inland from the edge structure. This means that at the foreshore, the EPL is set to the "maximum EPL" and at 40m from the foreshore the EPL is set at the local (still) water level. A linear interpolation has been used to calculate the EPL for areas between 0m and 40m from the foreshore, as shown in **Figure 6-2**.

The freeboard allowance accommodates the potential that some shallow, low velocity wave inundation may extend further than 40 m from the foreshore edge.

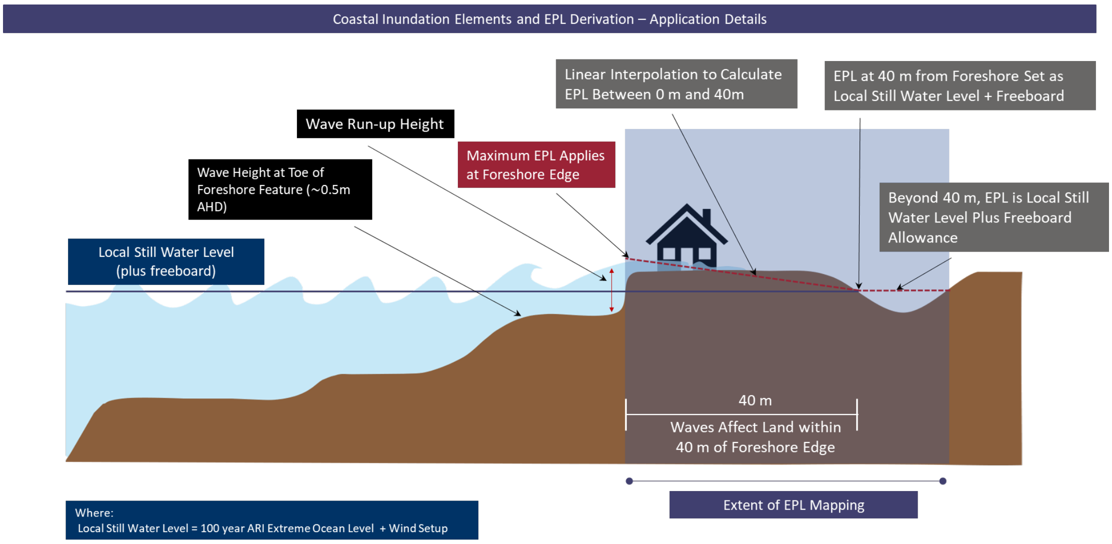

Figure 6-2 Calculation of Landward Reduction in Wave Inundation

Reduction factors have been calculated for each of the model reporting locations. The reduction factors vary for each of the localities due to the fact that the Design Still Water Levels (SWL) and Wave Height calculations vary between each locality.

Reduction factors have been calculated:

- At 5 metre increments with regards to distance from the foreshore edge (up to a maximum distance of 40 metres);
- For the foreshore type and height combination that produces the greatest amount of wave run-up (i.e. the highest EPL for that location); and
- For the 0.4m and 0.9m sea level rise scenarios (the existing or present day sea level rise scenario is not used for planning purposes and as such no reduction factors are required).

This results in a total of 16 reduction factors (8 for each sea level rise scenario) for each property within the 'existing' (or present day) sea level EPL database.

6.5 Freeboard

The estimation of all of the components that make up the EPL at each selected location includes some uncertainty, and the degree of uncertainty varies with each water level component. It is greatest for wave run-up; and wave run-up is normally the largest water level component, other than astronomical tide.

It is common practice to take some precaution over this uncertainty. This is generally achieved through the application of a freeboard.

Prior to explicit incorporation of provision for sea level rise in planning levels, a freeboard of 0.5 m was commonly been adopted in NSW, incorporating a 0.3 m freeboard with an additional 0.2 m to account for potential sea level rise (much less than the current projected sea level rise, see **Section 3.1.1** and **Section 6.2**).

A freeboard of 0.3m is considered appropriate for the definition of the EPL. This accounts for 0.05m uncertainty in wind setup, 0.15m (i.e. 10% variance on 1.5m) uncertainty on maximum wave height (swell), with the remaining 0.1m allowing for uncertainty in wave overtopping and runup.

It should be noted that the recommended 0.3 m freeboard has not been included in the provisions of estuarine inundation risk extent maps that identify inundation-affected properties. However, those properties identified as being affected by estuarine risk inundation will have a freeboard included in their EPL. The identification of "at risk" properties is discussed in more detail in **Section 7.1**.

6.6 Summary of Calculated EPL's

A summary of the significant EPL's parameters from the more than 500 calculation points is provided in **Table 6-2**. The full suite of EPL's are presented for all calculation points in **Appendix B** (also provided to Council in digital format).

Table 6-2 Summary of Significant EPL Parameters for Present Day, 2050 and 2100 Ocean Levels

Parameter	Location Name	Easting (MGA z56)	Northing (MGA z56)	Present Day (Existing Sea Level)	2050	2100
Maximum local wind setup	NBC_MHEPL_001	331865	6264756	0.45 m	0.45 m	0.45 m

Parameter	Location Name	Easting (MGA z56)	Northing (MGA z56)	Present Day (Existing Sea Level)	2050	2100
Maximum Wave Height – Swell Dominated	NBC_MHEPL_401	339706	6258829	1.47 m	1.76 m	2.12 m
Maximum Wave Height – Sea Dominated	NBC_MHEPL_429	340856	6258679	1.47 m	-	-
Maximum Wave Height – Sea Dominated	NBC_MHEPL_360	331865	6264756	-	1.73 m	1.77 m
Maximum EPL – Type 1 3.5 m AHD Crest (1 in 10 natural slope)	NBC_MHEPL_401	339706	6258829	4.19 mAHD	4.39 mAHD	4.65 mAHD
Maximum EPL – Type 1 3.5 m AHD Crest (1 in 5 rocky slope)	NBC_MHEPL_396	339556	6258829	4.03 mAHD	4.28 mAHD	4.60 mAHD
Maximum EPL – Type 3 3.5 m AHD Crest (Vertical sea wall)	NBC_MHEPL_396	339556	6258829	3.29 mAHD	3.65 mAHD	4.34 mAHD
Maximum EPL – Type 4 (Mangrove)	NBC_MHEPL_001	331865	6264756	2.19 mAHD	3.59 mAHD	3.09 mAHD

7 Properties Affected by Estuarine Planning Levels

7.1 Identifying Affected Properties

Those properties affected by Estuarine Planning Levels (EPLs) have been identified spatially using an 'EPL extent' generated as an area using the EPL calculations described in this report and the Airborne Laser Scanning (ALS) survey for the study area.

Properties have been identified as being affected if they are:

- Entirely or partially within the still water level map extent; and / or
- Entirely or partially within 'Worst Case' 'Maximum' EPL Extent within 40m of the foreshore - this is the highest wave run-up and overtopping level possible at that location. The foreshore type that produces the highest level of wave run up and over topping has been used for this purpose, rather the existing foreshore type.

Sea level rise of 0.9m has been used to identify the at-risk properties (**Section 3.1.1** and **6.2**).

It should be noted that no reduction factor has been applied to the overtopping height. For the purposes of identifying the 40m setback, it has been assumed that the foreshore crest/edge is located at the 0.5mAHD contour (which is approximately the mean high water (MHW) tide level of 0.52 mAHD, as measured at HMAS Penguin within Sydney Harbour for the period 1990-2010, see MHL, 2012). This is relevant as land below the mean high water mark is identified as Crown Land under the *Crown Land Management Act*, 2016 and is under the control of Transport for NSW (formerly the NSW Roads and Maritime Services).

It should be noted that no freeboard has been applied for the purposes of mapping the EPL extent. However, a freeboard of 0.3m will be applied for all planning levels issued to properties (as discussed in **Section 6.5**).

The estuarine inundation risk properties are shown on **Figure 7-1**, 588 land parcels in total. The estuarine inundation risk extent mapping for the affected residential properties are shown on **Figure 7-2** and **Figure 7-3**. The extent shown is for the 0.9m sea level rise scenario.

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North and Middle Harbour EPL Study

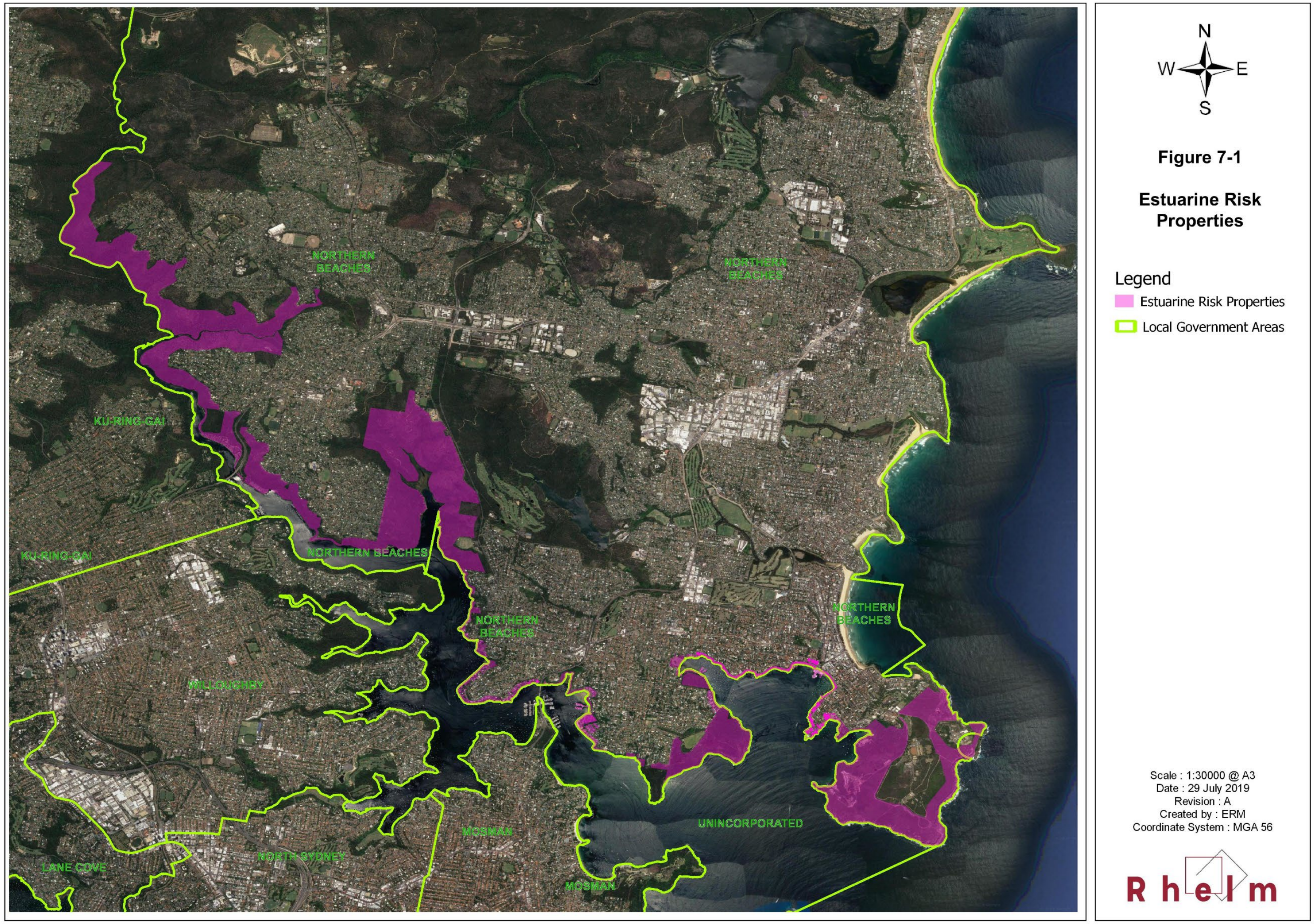

Figure 7-1 Estuarine Inundation Risk Properties

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North and Middle Harbour EPL Study

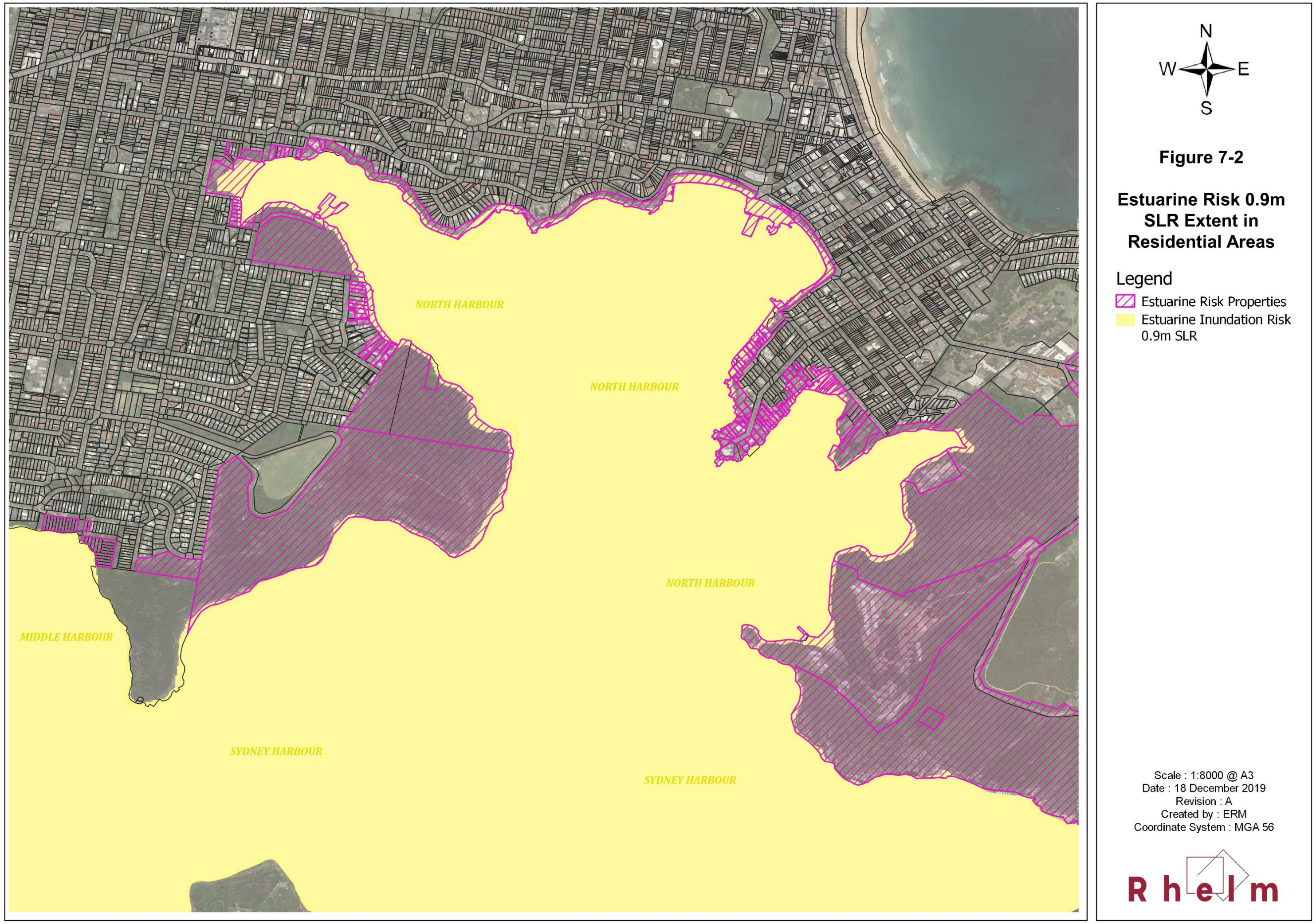

Figure 7-2 Estuarine Inundation Risk Extent (Map A)

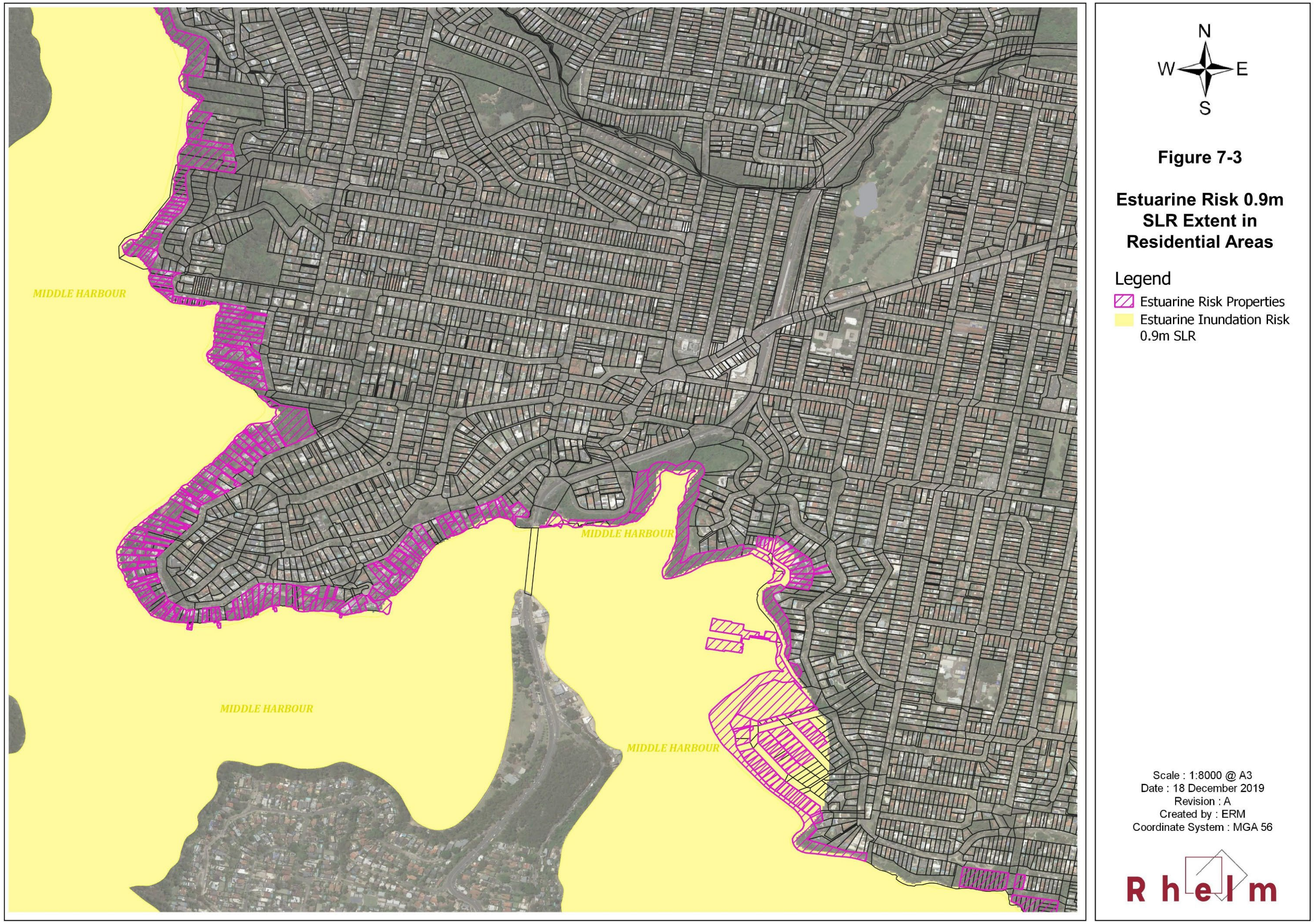

Figure 7-3 Estuarine Inundation Risk Extent (Map B)

7.2 Partially Affected Properties and Foreshore Reserves

Due to the relatively steep topography around the foreshore in the study area, there are a large number of land parcels (properties) where the estuarine inundation risk mapping only impacts the low lying portion of the property and the existing dwelling is located outside of the risk extent. Whilst there would be no estuarine inundation risk associated with the dwelling, the notification would still be present on the property's Section 10.7 planning certificate. This would ensure that any development or works proposed on the affected portion of the property (e.g. boatsheds, jetties or other structures) would consider the impacts of estuarine inundation risk.

A number of private properties are fronted by foreshore reserves or have domestic waterfront tenancy arrangements over Crown Land parcels. Where the estuarine inundation risk mapping is contained within these foreshore land parcels, no notification will be present for the adjacent private property. Where the estuarine inundation risk mapping includes even a small area of the private property, the relevant planning certificate notation would be present.

7.3 Application of Estuarine Planning Levels

The EPL for any proposed development on properties within 40m of the foreshore edge is calculated for the proposed foreshore type (or existing if to remain the same after the development) and the distance of the development from the foreshore edge. The resulting EPL will account for the 'local water level', wave run-up and overtopping and the reduction in the wave height as a result of distance from the foreshore, plus a freeboard of 0.3m, as described in **Sections 6.4 and 6.5**.

The EPL for any proposed development on properties beyond 40m of the foreshore edge will be equal to the 'local water level' at the property location, plus a freeboard of 0.3m.

If the proposed development lies outside the EPL extent, then no EPL or estuarine hazard mitigation measures would be applied to the development.

7.4 Estuarine Inundation Risk Related Development Controls

Estuarine Planning Levels (EPLs) are currently applied as a method for managing risk along the foreshore of Pittwater (in the north of the Northern Beaches LGA). EPLs are applied to this area under the provisions of the Pittwater Local Environment Plan (LEP) 2014. More specifically, Northern Beaches Council's approach to managing this risk is set out in the *Estuarine Risk Management Policy for Development in Pittwater* (within the Pittwater Development Control Plan (DCP) 2018).

At the time of preparation of this study Northern Beaches Council had separate Local Environmental Plans (LEPs) and Development Control Plans (DCPs) operating for the three former LGA regions.

Coastal hazard is managed at the highest level through the *State Environmental Planning Policy (Coastal Management) 2018*. However, the coastal vulnerability provisions for the Northern Beaches LGA are not yet operational as vulnerability mapping was not in place for Middle or North Harbour at the time of the completion of this study.

The *Manly LEP 2013* (Clause 6.10) currently sets the defining provisions for coastal hazards for Middle and North Harbour. These clauses generally aim to reduce the impacts of coastal zone development on the natural coastal processes and manage risk to property and life associated with coastal hazards. *Manly LEP 2013* also contains; *Clause 6.8 Landslide risk*, which applies to properties containing geotechnical issues in North and Middle Harbour as identified in various coastline hazard definitions studies.

The *Manly DCP 2013* does not provide specific controls relating to coastal risk management but does have controls relating to setbacks enforced by the foreshore building line shown on the LEP Foreshore Building Line Map.

The Estuarine Planning Levels derived from this study will inform the planning controls set out in the documents described above and any new planning controls developed for the amalgamated Northern Beaches Council. This may be done in a similar manner to the existing *Pittwater LEP 2014* and *Pittwater 21 DCP*. This will be investigated and discussed further as part of Stage 3.

8 Conclusions and Recommendations

This report provides for identification of land parcels that would potentially have estuarine inundation risk planning controls applied to development proposed within these land parcels. Further this report identifies Estuarine Planning Levels for each of these land parcels.

It is recommended that Council review its current planning process with regards to the application of Estuarine Planning Levels within the study area and notification of estuarine inundation risk on property planning certificates. This would be undertaken as part of Stage 3 of this project.

It is anticipated that community engagement will be an important aspect of future stages of this project.

9 Assumptions and Qualifications

The following assumptions and qualifications apply to this study:

- Storm climatology which processes storm surge and waves has been analysed as a stationary data record based on the available historical data sets for water levels and waves referenced in this report.
- A toe level of -0.5 m AHD was adopted for all shoreline and structure times. The toe level drives the wave run up and overtopping calculations. As such, where the toe level may be deeper than -0.5 m AHD, the EPL's may be non-conservative. Similarly, if a scoured toe level seaward of the edge treatment is higher than -0.5 m AHD, the EPL's may be more conservative.
- The EPL's have been calculated for a select number of edge treatments that comprise the majority of the shoreline area in the Northern Beach Council LGA. If a particular property has an edge treatment that significantly differs from the edge treatments considered in this study, a site specific assessment by a coastal engineer may be required.
- The hydrodynamic model used for the study has been calibrated for 2D and 3D currents at multiple sites around Sydney Harbour for tidally dominated conditions. No specific local wind setup validation has been completed for Sydney Harbour, but appropriate model coefficients are adopted based on similar models that have had site specific calibration.
- The swell penetration model has not been calibrated with data collected within the study area. Comparisons have been made with similar models that have previously been developed for Sydney Harbour.
- No changes to future storm climatology (such as those potentially associated with climate change) have been considered.

10 References

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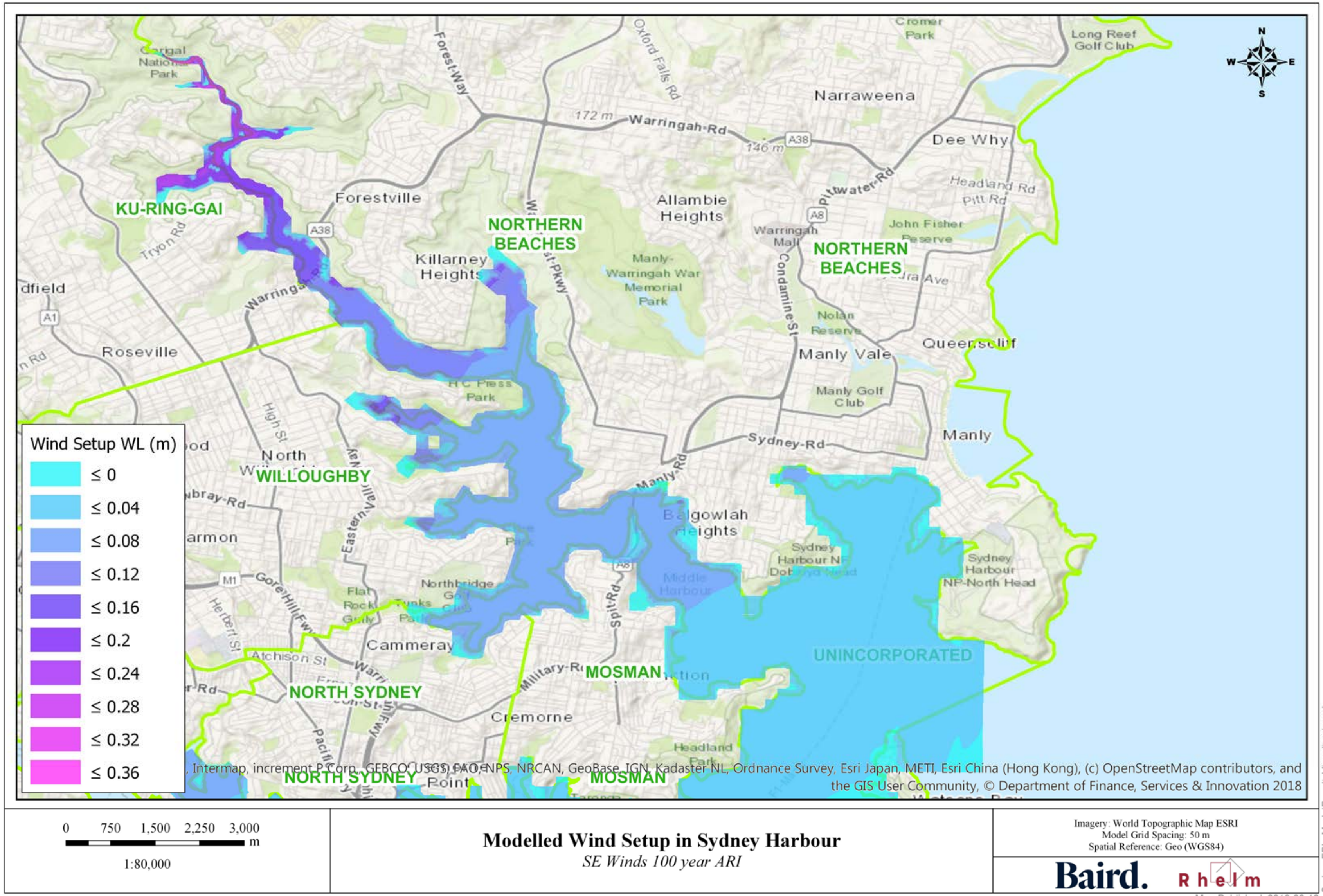
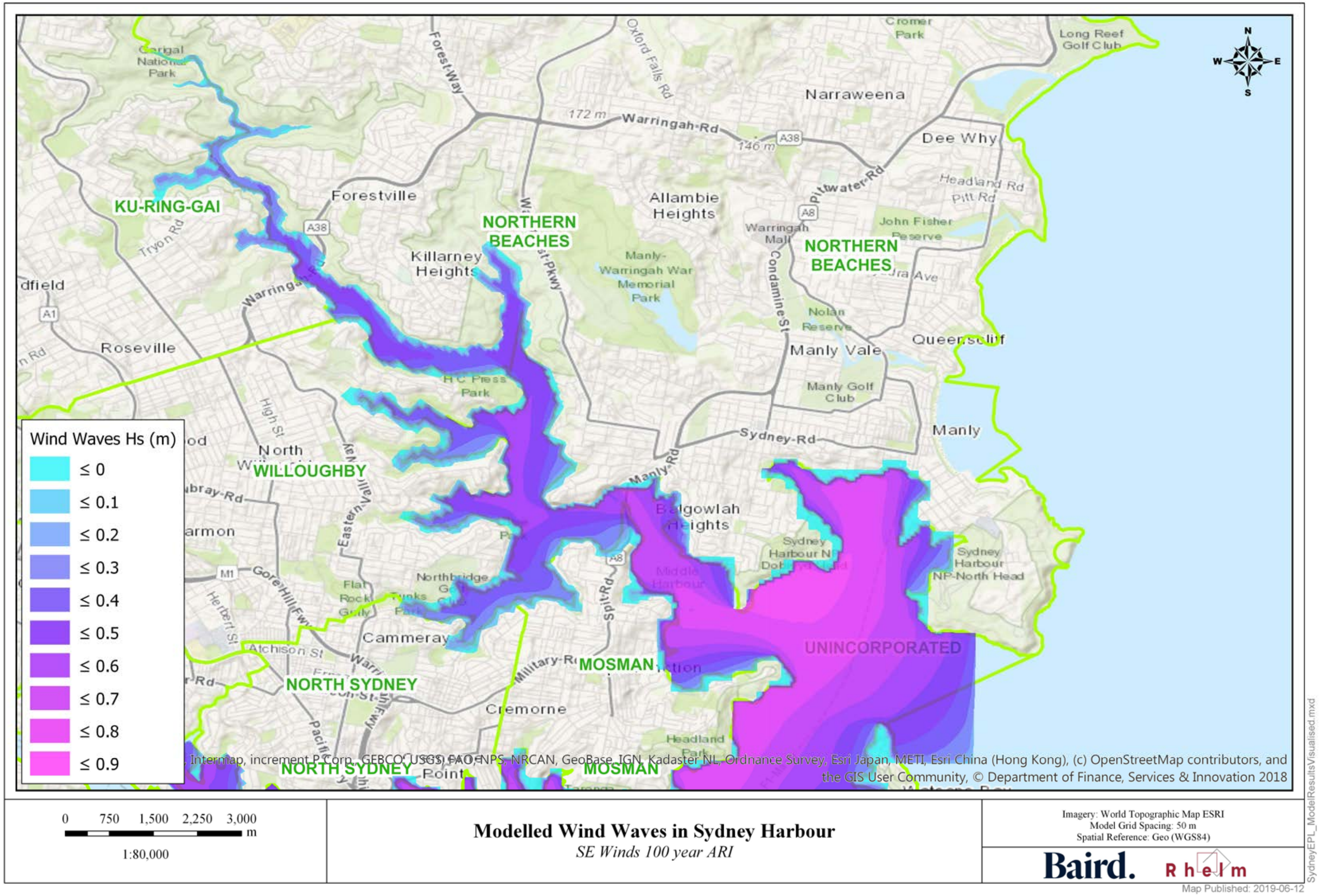
engineering | environmental | economics | engagement

APPENDIX A

Local Wind and Wave Results


Wind Setup WL (m)
≤ 0
≤ 0.04
≤ 0.08
≤ 0.12
≤ 0.16
≤ 0.2
≤ 0.24
≤ 0.28
≤ 0.32
≤ 0.36
KU-RING-GAI
NORTHERN BEACHES
NORTHERN BEACHES
WILLOUGHBY
NORTH SYDNEY
MOSMAN
UNINCORPORATED
Forestville
Killarney Heights
Allambie Heights
Narraweena
Dee Why
Roseville
Manly Vale
Queenscliff
Manly
Balgowlah Heights
Cammeray
Cremorne
Warringah Rd
Sydney Rd
Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community, © Department of Finance, Services & Innovation 2018
0 750 1,500 2,250 3,000 m
1:80,000
Modelled Wind Setup in Sydney Harbour
SE Winds 100 year ARI
Imagery: World Topographic Map ESRI
Model Grid Spacing: 50 m
Spatial Reference: Geo (WGS84)
Baird.
Rhelm
Map Published: 2019-06-12
SydneyEPL_ModelResultsVisualised.mxd

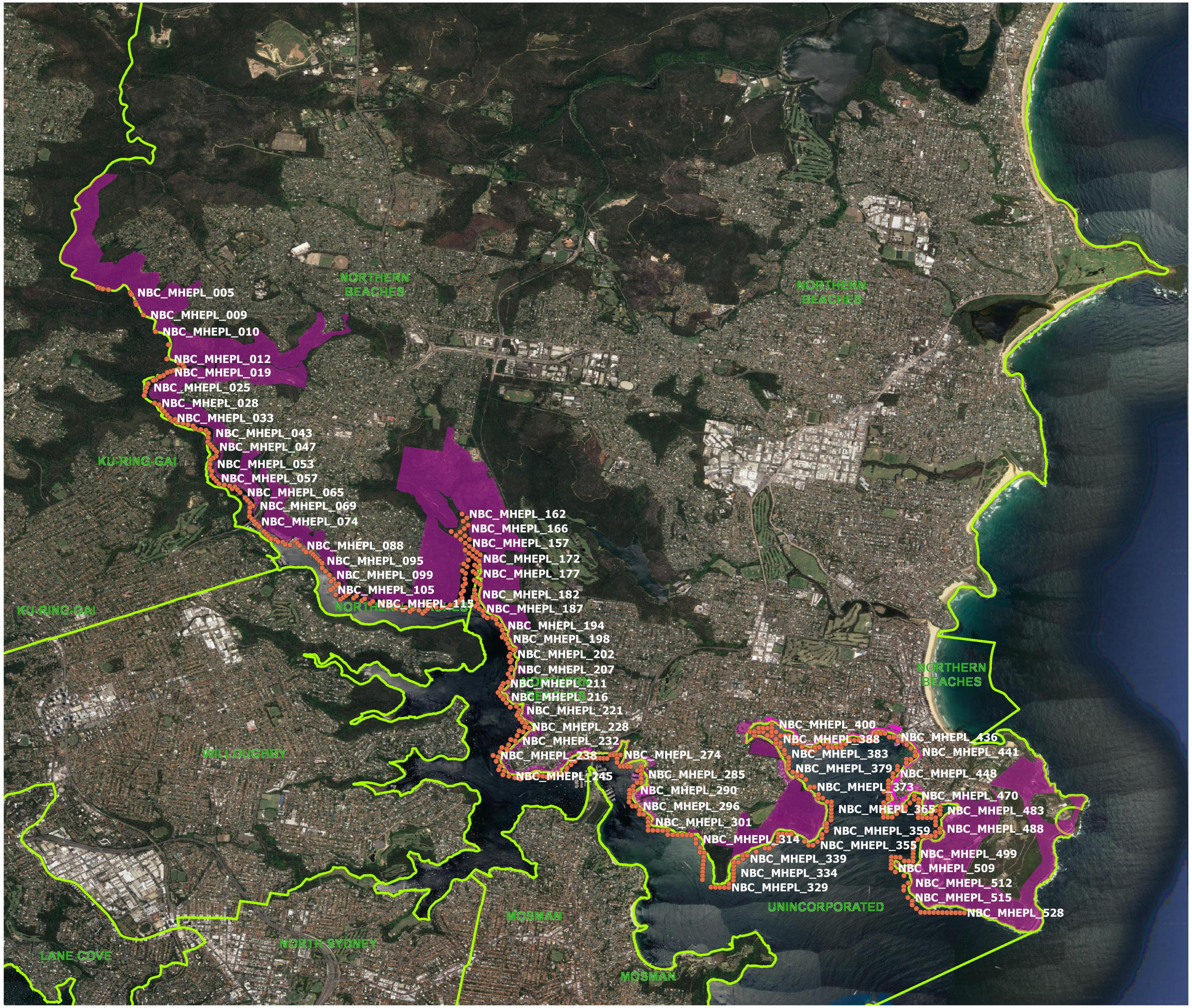


Modelled Wind Waves in Sydney Harbour

SE Winds 100 year ARI

APPENDIX B

Estuarine Planning Level Database



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W E
S

Figure B-1

EPL Model Reporting Locations

Legend
- Estuarine Risk Properties
- EPL Model Reporting Locations
- Local Government Areas

Scale : 1:30000 @ A3
Date : 6 August 2019
Revision : A
Created by : ERM
Coordinate System : MGA 56

Rhelm

100yr ARI Planning Levels - 0m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.00** m sea level rise projection
Freeboard of **0.3** m included in EPLs

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																	REDUCTION FACTORS NOT CALCULATED FOR 2010 LEVELS AS THE 0m SLR LEVELS ARE NOT BEING USED FOR PLANNING PURPOSES							
			Wave			Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)		Foreshore Type ##																						
									1					2					3					4							
									Crest Level (mAHD)																						
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	0 m Sea Level Projection	0 m Sea Level Projection	Max EPL of all Foreshore Types and Crest Levels (mAHD)	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_001	331865	6264756	0.10	1.00	0.45	1.89	2.19	2.30	2.25	2.27	2.27	2.27	2.27	2.25	2.27	2.27	2.27	2.27	2.25	2.30	2.30	2.30	2.30	2.19								
NBC_MHEPL_002	331895	6264742	0.11	1.00	0.40	1.84	2.14	2.25	2.19	2.22	2.22	2.22	2.22	2.19	2.22	2.22	2.22	2.22	2.19	2.25	2.25	2.25	2.25	2.14								
NBC_MHEPL_003	331926	6264732	0.12	1.13	0.40	1.84	2.14	2.26	2.20	2.23	2.23	2.23	2.23	2.20	2.23	2.23	2.23	2.23	2.20	2.26	2.26	2.26	2.26	2.14								
NBC_MHEPL_004	331991	6264724	0.14	1.13	0.39	1.83	2.13	2.27	2.20	2.23	2.23	2.23	2.23	2.20	2.23	2.23	2.23	2.23	2.20	2.27	2.27	2.27	2.27	2.13								
NBC_MHEPL_005	332243	6264687	0.20	1.28	0.39	1.83	2.13	2.33	2.23	2.27	2.27	2.27	2.27	2.23	2.27	2.27	2.27	2.27	2.23	2.31	2.33	2.33	2.33	2.13								
NBC_MHEPL_006	332257	6264662	0.18	1.28	0.39	1.83	2.13	2.31	2.22	2.26	2.26	2.26	2.26	2.22	2.26	2.26	2.26	2.26	2.22	2.30	2.31	2.31	2.31	2.13								
NBC_MHEPL_007	332305	6264553	0.19	1.13	0.38	1.82	2.12	2.31	2.21	2.26	2.26	2.26	2.26	2.21	2.24	2.24	2.24	2.24	2.21	2.30	2.31	2.31	2.31	2.12								
NBC_MHEPL_008	332316	6264523	0.19	1.28	0.38	1.82	2.12	2.30	2.21	2.25	2.25	2.25	2.25	2.21	2.25	2.25	2.25	2.25	2.21	2.30	2.30	2.30	2.30	2.12								
NBC_MHEPL_009	332399	6264382	0.17	1.28	0.36	1.80	2.10	2.27	2.19	2.23	2.23	2.23	2.23	2.19	2.23	2.23	2.23	2.23	2.19	2.27	2.27	2.27	2.27	2.10								
NBC_MHEPL_010	332541	6264155	0.16	1.28	0.34	1.78	2.08	2.24	2.16	2.20	2.20	2.20	2.20	2.16	2.20	2.20	2.20	2.20	2.16	2.24	2.24	2.24	2.24	2.08								
NBC_MHEPL_011	332693	6263979	0.22	1.13	0.31	1.75	2.05	2.28	2.17	2.22	2.22	2.22	2.22	2.17	2.18	2.18	2.18	2.18	2.17	2.28	2.28	2.28	2.28	2.05								
NBC_MHEPL_012	332679	6263782	0.17	1.45	0.30	1.74	2.04	2.21	2.12	2.16	2.16	2.16	2.16	2.12	2.18	2.18	2.18	2.18	2.12	2.21	2.21	2.21	2.21	2.04								
NBC_MHEPL_013	332816	6263730	0.25	1.28	0.29	1.73	2.03	2.28	2.16	2.21	2.21	2.21	2.21	2.16	2.19	2.19	2.19	2.19	2.16	2.28	2.28	2.28	2.28	2.03								
NBC_MHEPL_014	332860	6263715	0.29	1.45	0.29	1.73	2.03	2.32	2.18	2.24	2.24	2.24	2.24	2.18	2.22	2.22	2.22	2.22	2.18	2.31	2.32	2.32	2.32	2.03								
NBC_MHEPL_015	332878	6263668	0.31	1.45	0.29	1.73	2.03	2.34	2.18	2.25	2.25	2.25	2.25	2.18	2.22	2.22	2.22	2.22	2.18	2.32	2.34	2.34	2.34	2.03								
NBC_MHEPL_016	332816	6263647	0.28	1.45	0.29	1.73	2.03	2.31	2.17	2.23	2.23	2.23	2.23	2.17	2.21	2.21	2.21	2.21	2.17	2.30	2.31	2.31	2.31	2.03								
NBC_MHEPL_017	332759	6263626	0.19	1.65	0.29	1.73	2.03	2.22	2.12	2.17	2.17	2.17	2.17	2.12	2.20	2.20	2.20	2.20	2.12	2.22	2.22	2.22	2.22	2.03								
NBC_MHEPL_018	332723	6263611	0.33	1.65	0.28	1.72	2.02	2.35	2.19	2.26	2.26	2.26	2.26	2.19	2.25	2.25	2.25	2.25	2.19	2.33	2.35	2.35	2.35	2.02								
NBC_MHEPL_019	332687	6263597	0.32	1.65	0.28	1.72	2.02	2.35	2.18	2.26	2.26	2.26	2.26	2.18	2.25	2.25	2.25	2.25	2.18	2.32	2.35	2.35	2.35	2.02								
NBC_MHEPL_020	332643	6263554	0.34	1.65	0.28	1.72	2.02	2.36	2.19	2.26	2.26	2.26	2.26	2.19	2.25	2.25	2.25	2.25	2.19	2.33	2.36	2.36	2.36	2.02								
NBC_MHEPL_021	332602	6263538	0.34	1.65	0.27	1.71	2.01	2.36	2.18	2.26	2.26	2.26	2.26	2.18	2.24	2.24	2.24	2.24	2.18	2.33	2.36	2.36	2.36	2.01								
NBC_MHEPL_022	332558	6263498	0.35	1.65	0.27	1.71	2.01	2.36	2.18	2.26	2.26	2.26	2.26	2.18	2.24	2.24	2.24	2.24	2.18	2.33	2.36	2.36	2.36	2.01								
NBC_MHEPL_023	332529	6263487	0.35	1.65	0.27	1.71	2.01	2.36	2.19	2.26	2.26	2.26	2.26	2.19	2.24	2.24	2.24	2.24	2.19	2.33	2.36	2.36	2.36	2.01								
NBC_MHEPL_024	332469	6263439	0.37	1.87	0.27	1.71	2.01	2.37	2.19	2.27	2.27	2.27	2.27	2.19	2.27	2.27	2.27	2.27	2.19	2.34	2.37	2.37	2.37	2.01								
NBC_MHEPL_025	332451	6263386	0.37	1.65	0.26	1.70	2.00	2.37	2.19	2.27	2.27	2.27	2.27	2.19	2.24	2.24	2.24	2.24	2.19	2.34	2.37	2.37	2.37	2.00								
NBC_MHEPL_026	332438	6263327	0.33	1.87	0.25	1.69	1.99	2.33	2.16	2.23	2.23	2.23	2.23	2.16	2.25	2.25	2.25	2.25	2.16	2.31	2.33	2.33	2.33	1.99								
NBC_MHEPL_027	332426	6263276	0.29	1.65	0.25	1.69	1.99	2.28	2.13	2.20	2.20	2.20	2.20	2.13	2.20	2.20	2.20	2.20	2.13	2.28	2.28	2.28	2.28	1.99								
NBC_MHEPL_028	332548	6263174	0.37	1.65	0.24	1.68	1.98	2.35	2.16	2.24	2.24	2.24	2.24	2.16	2.22	2.22	2.22	2.22	2.16	2.32	2.35	2.35	2.35	1.98								
NBC_MHEPL_029	332600	6263152	0.36	1.65	0.24	1.68	1.98	2.34	2.16	2.24	2.24	2.24	2.24	2.16	2.22	2.22	2.22	2.22	2.16	2.32	2.34	2.34	2.34	1.98								
NBC_MHEPL_030	332632	6263103	0.34	1.65	0.24	1.68	1.98	2.32	2.15	2.22	2.22	2.22	2.22	2.15	2.20	2.20	2.20	2.20	2.15	2.31	2.32	2.32	2.32	1.98								
NBC_MHEPL_031	332662	6263060	0.32	1.65	0.23	1.67	1.97	2.29	2.13	2.20	2.20	2.20	2.20	2.13	2.20	2.20	2.20	2.20	2.13	2.29	2.29	2.29	2.29	1.97								
NBC_MHEPL_032	332696	6263014	0.30	1.65	0.23	1.67	1.97	2.27	2.12	2.19	2.19	2.19	2.19	2.12	2.19	2.19	2.19	2.19	2.12	2.27	2.27	2.27	2.27	1.97								
NBC_MHEPL_033	332727	6262972	0.29	1.45	0.23	1.67	1.97	2.26	2.11	2.18	2.18	2.18	2.18	2.11	2.15	2.15	2.15	2.15	2.11	2.26	2.26	2.26	2.26	1.97								
NBC_MHEPL_034	332757	6262932	0.29	1.65	0.22	1.66	1.96	2.25	2.11	2.17	2.17	2.17	2.17	2.11	2.18	2.18	2.18	2.18	2.11	2.25	2.25	2.25	2.25	1.96								
NBC_MHEPL_035	332788	6262955	0.29	1.65	0.23	1.67	1.97	2.26	2.11	2.18	2.18	2.18	2.18	2.11	2.18	2.18	2.18	2.18	2.11	2.26	2.26	2.26	2.26	1.97								
NBC_MHEPL_036	332818	6262915	0.30	1.65	0.22	1.66	1.96	2.27	2.12	2.18	2.18	2.18	2.18	2.12	2.18	2.18	2.18	2.18	2.12	2.27	2.27	2.27	2.27	1.96								
NBC_MHEPL_037	332877	6262900	0.32	1.65	0.22	1.66	1.96	2.28	2.12	2.19	2.19	2.19	2.19	2.12	2.18	2.18	2.18	2.18	2.12	2.28	2.28	2.28	2.28	1.96								
NBC_MHEPL_038	332936	6262884	0.32	1.65	0.22	1.66	1.96	2.28	2.12	2.19	2.19	2.19	2.19	2.12	2.18	2.18	2.18	2.18	2.12	2.28	2.28	2.28	2.28	1.96								
NBC_MHEPL_039	332996	6262868	0.33	1.65	0.22	1.66	1.96	2.28	2.12	2.19	2.19	2.19	2.19	2.12	2.18	2.18	2.18	2.18	2.12	2.28	2.28	2.28	2.28	1.96								
NBC_MHEPL_040	333024	6262831	0.40	2.11	0.22	1.66	1.96	2.36	2.16	2.24	2.24	2.24	2.24	2.16	2.27	2.27	2.27	2.27	2.16	2.33	2.36	2.36	2.36	1.96								
NBC_MHEPL_041	333084	6262819	0.44	2.11	0.22	1.66	1.96	2.39	2.17	2.27	2.27	2.27	2.27	2.17	2.28	2.28	2.28	2.28	2.17	2.35	2.39	2.39	2.39	1.96								
NBC_MHEPL_042	333144	6262808	0.47	2.11	0.21	1.65	1.95	2.43	2.19	2.30	2.30	2.30	2.30	2.19	2.30	2.30	2.30	2.30	2.19	2.37	2.43	2.43	2.43	1.95								
NBC_MHEPL_043	333174	6262772	0.47	2.11	0.21	1.65	1.95	2.42	2.19	2.29	2.29	2.29	2.29	2.19	2.29	2.29	2.29	2.29	2.19	2.36	2.42	2.42	2.42	1.95								
NBC_MHEPL_044	333171	6262710	0.48	2.11	0.21	1.65	1.95	2.43	2.19	2.29	2.29	2.29	2.29	2.19	2.29	2.29	2.29	2.29	2.19	2.37	2.43	2.43	2.43	1.95								
NBC_MHEPL_045	333167	6262651	0.48	2.11	0.20	1.64	1.94	2.42	2.18	2.29	2.29	2.29	2.29	2.18	2.29	2.29	2.29	2.29	2.18	2.36	2.42	2.42	2.42	1.94								
NBC_MHEPL_046	333194	6262618	0.47	2.11	0.20	1.64	1.94	2.41	2.18	2.28	2.28	2.28	2.28	2.18	2.28	2.28	2.28	2.28	2.18	2.36	2.41	2.41	2.41	1.94								
NBC_MHEPL_047	333220	6262584	0.47	2.11	0.20	1.64	1.94	2.40	2.17	2.27	2.27	2.27	2.27	2.17	2.27	2.27	2.27	2.27	2.17	2.35	2.40	2.40	2.40	1.94								
NBC_MHEPL_048	333246	6262550	0.46	2.11	0.19	1.63	1.93	2.39	2.16	2.26	2.26	2.26	2.26	2.16	2.27	2.27	2.27	2.27	2.16	2.35	2.39	2.39	2.39	1.93								
NBC_MHEPL_049	333272	6262516	0.43	1.87	0.19	1.63	1.93	2.37	2.15	2.25	2.25	2.25	2.25	2.15	2.22	2.22	2.22	2.22	2.15	2.33	2.37	2.37	2.37	1.93								
NBC_MHEPL_050	333268	6262456	0.41	1.87	0.19	1.63	1.93	2.34	2.13	2.23	2.23	2.23	2.23	2.13	2.21	2.21	2.21	2.21	2.13	2.32	2.34	2.34	2.34	1.93								
NBC_MHEPL_051	333236	6262431	0.41	1.87	0.19	1.63	1.93	2.34	2.13	2.22	2.22	2.22	2.22	2.13	2.21	2.21	2.21	2.21	2.13	2.32	2.34	2.34	2.34	1.93								
NBC_MHEPL_052	333204	6262407	0.41	1.87	0.18	1.62	1.92	2.34	2.13	2.22	2.22	2.22	2.22	2.13	2.21	2.21	2.21	2.21	2.13	2.32	2.34	2.34	2.34	1.92								
NBC_MHEPL_053	333199	6262347	0.45	2.11	0.18	1.62	1.92	2.37	2.14	2.24	2.24	2.24	2.24	2.14	2.25	2.25	2.25	2.25	2.14	2.33	2.37	2.37	2.37	1.92								
NBC_MHEPL_054	333194	6262286	0.49	2.40	0.18	1.62	1.92	2.41	2.16	2.27	2.27	2.27	2.27	2.16	2.30	2.30	2.30	2.30	2.16	2.35	2.41	2.41	2.41	1.92								
NBC_MHEPL_055	333222	6262250	0.48	2.11	0.17	1.61	1.91	2.39	2.15	2.26	2.26	2.26	2.26	2.15	2.26	2.26	2.26	2.26	2.15	2.35	2.39	2.39	2.39	1.91								
NBC_MHEPL_056	333219	6262189	0.47	2.11	0.17	1.61	1.91	2.37	2.14	2.24	2.24	2.24	2.24	2.14	2.25	2.25	2.25	2.25	2.14	2.34	2.37	2.37	2.37	1.91								
NBC_MHEPL_057	333248	6262152	0.45	2.11	0.16	1.60	1.90	2.35	2.13	2.23	2.23	2.23	2.23	2.13	2.24	2.24	2.24	2.24	2.13	2.33	2.35	2.35	2.35	1.90								

100yr ARI Planning Levels - 0m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

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EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.00** m sea level rise projection
Freeboard of **0.3** m included in EPLs

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																	REDUCTION FACTORS NOT CALCULATED FOR 2010 LEVELS AS THE 0m SLR LEVELS ARE NOT BEING USED FOR PLANNING PURPOSES							
			Wave						Foreshore Type ##																							
									1					2					3					4								
									Crest Level (mAHD)																							
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	Local (Still) Water Level (mAHD) 0 m Sea Level Projection	Local (Still) Water Level with 0.3m Freeboard (mAHD) 0 m Sea Level Projection	Max EPL of all Foreshore Types and Crest Levels (mAHD)	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_058	333277	6262115	0.44	2.11	0.16	1.60	1.90	2.34	2.12	2.22	2.22	2.22	2.22	2.12	2.23	2.23	2.23	2.23	2.12	2.32	2.34	2.34	2.34	1.90								
NBC_MHEPL_059	333307	6262077	0.46	2.11	0.16	1.60	1.90	2.36	2.13	2.23	2.23	2.23	2.23	2.13	2.24	2.24	2.24	2.24	2.13	2.33	2.36	2.36	2.36	1.90								
NBC_MHEPL_060	333368	6262063	0.48	2.40	0.16	1.60	1.90	2.38	2.14	2.24	2.24	2.24	2.24	2.14	2.28	2.28	2.28	2.28	2.14	2.34	2.38	2.38	2.38	1.90								
NBC_MHEPL_061	333429	6262050	0.50	2.40	0.16	1.60	1.90	2.39	2.15	2.26	2.26	2.26	2.26	2.15	2.29	2.29	2.29	2.29	2.15	2.35	2.39	2.39	2.39	1.90								
NBC_MHEPL_062	333459	6262013	0.50	2.40	0.16	1.60	1.90	2.40	2.15	2.26	2.26	2.26	2.26	2.15	2.29	2.29	2.29	2.29	2.15	2.35	2.40	2.40	2.40	1.90								
NBC_MHEPL_063	333490	6262038	0.51	2.40	0.16	1.60	1.90	2.40	2.15	2.26	2.26	2.26	2.26	2.15	2.29	2.29	2.29	2.29	2.15	2.35	2.40	2.40	2.40	1.90								
NBC_MHEPL_064	333520	6262001	0.51	2.40	0.15	1.59	1.89	2.40	2.15	2.26	2.26	2.26	2.26	2.15	2.29	2.29	2.29	2.29	2.15	2.35	2.40	2.40	2.40	1.89								
NBC_MHEPL_065	333550	6261964	0.51	2.11	0.15	1.59	1.89	2.40	2.15	2.26	2.26	2.26	2.26	2.15	2.24	2.24	2.24	2.24	2.15	2.35	2.40	2.40	2.40	1.89								
NBC_MHEPL_066	333609	6261891	0.50	2.11	0.15	1.59	1.89	2.38	2.14	2.24	2.24	2.24	2.24	2.14	2.24	2.24	2.24	2.24	2.14	2.34	2.38	2.38	2.38	1.89								
NBC_MHEPL_067	333639	6261854	0.48	2.11	0.15	1.59	1.89	2.37	2.13	2.23	2.23	2.23	2.23	2.13	2.23	2.23	2.23	2.23	2.13	2.33	2.37	2.37	2.37	1.89								
NBC_MHEPL_068	333668	6261818	0.46	2.11	0.14	1.58	1.88	2.35	2.12	2.22	2.22	2.22	2.22	2.12	2.22	2.22	2.22	2.22	2.12	2.32	2.35	2.35	2.35	1.88								
NBC_MHEPL_069	333698	6261781	0.45	1.87	0.14	1.58	1.88	2.33	2.11	2.20	2.20	2.20	2.20	2.11	2.18	2.18	2.18	2.18	2.11	2.31	2.33	2.33	2.33	1.88								
NBC_MHEPL_070	333667	6261756	0.48	2.11	0.14	1.58	1.88	2.36	2.12	2.23	2.23	2.23	2.23	2.12	2.22	2.22	2.22	2.22	2.12	2.33	2.36	2.36	2.36	1.88								
NBC_MHEPL_071	333665	6261696	0.50	2.11	0.14	1.58	1.88	2.38	2.13	2.24	2.24	2.24	2.24	2.13	2.23	2.23	2.23	2.23	2.13	2.34	2.38	2.38	2.38	1.88								
NBC_MHEPL_072	333664	6261636	0.50	2.11	0.13	1.57	1.87	2.37	2.12	2.23	2.23	2.23	2.23	2.12	2.22	2.22	2.22	2.22	2.12	2.34	2.37	2.37	2.37	1.87								
NBC_MHEPL_073	333692	6261601	0.49	2.11	0.13	1.57	1.87	2.36	2.12	2.23	2.23	2.23	2.23	2.12	2.22	2.22	2.22	2.22	2.12	2.33	2.36	2.36	2.36	1.87								
NBC_MHEPL_074	333720	6261566	0.48	2.11	0.13	1.57	1.87	2.35	2.11	2.22	2.22	2.22	2.22	2.11	2.21	2.21	2.21	2.21	2.11	2.33	2.35	2.35	2.35	1.87								
NBC_MHEPL_075	333748	6261532	0.48	2.11	0.13	1.57	1.87	2.35	2.11	2.21	2.21	2.21	2.21	2.11	2.21	2.21	2.21	2.21	2.11	2.32	2.35	2.35	2.35	1.87								
NBC_MHEPL_076	333777	6261498	0.47	2.11	0.13	1.57	1.87	2.34	2.10	2.21	2.21	2.21	2.21	2.10	2.21	2.21	2.21	2.21	2.10	2.32	2.34	2.34	2.34	1.87								
NBC_MHEPL_077	333833	6261431	0.46	2.11	0.12	1.56	1.86	2.33	2.10	2.20	2.20	2.20	2.20	2.10	2.20	2.20	2.20	2.20	2.10	2.31	2.33	2.33	2.33	1.86								
NBC_MHEPL_078	333860	6261397	0.47	2.11	0.12	1.56	1.86	2.33	2.09	2.20	2.20	2.20	2.20	2.09	2.20	2.20	2.20	2.20	2.09	2.31	2.33	2.33	2.33	1.86								
NBC_MHEPL_079	333888	6261364	0.47	2.11	0.12	1.56	1.86	2.34	2.10	2.20	2.20	2.20	2.20	2.10	2.20	2.20	2.20	2.20	2.10	2.32	2.34	2.34	2.34	1.86								
NBC_MHEPL_080	333915	6261332	0.48	2.11	0.12	1.56	1.86	2.34	2.10	2.21	2.21	2.21	2.21	2.10	2.20	2.20	2.20	2.20	2.10	2.32	2.34	2.34	2.34	1.86								
NBC_MHEPL_081	333971	6261325	0.49	2.11	0.12	1.56	1.86	2.35	2.10	2.21	2.21	2.21	2.21	2.10	2.20	2.20	2.20	2.20	2.10	2.32	2.35	2.35	2.35	1.86								
NBC_MHEPL_082	333998	6261294	0.49	1.87	0.12	1.56	1.86	2.35	2.10	2.21	2.21	2.21	2.21	2.10	2.17	2.17	2.17	2.17	2.10	2.33	2.35	2.35	2.35	1.86								
NBC_MHEPL_083	334054	6261287	0.50	1.87	0.12	1.56	1.86	2.36	2.11	2.22	2.22	2.22	2.22	2.11	2.17	2.17	2.17	2.17	2.11	2.33	2.36	2.36	2.36	1.86								
NBC_MHEPL_084	334080	6261257	0.51	1.87	0.11	1.55	1.85	2.37	2.11	2.22	2.22	2.22	2.22	2.11	2.17	2.17	2.17	2.17	2.11	2.33	2.37	2.37	2.37	1.85								
NBC_MHEPL_085	334135	6261252	0.54	2.11	0.11	1.55	1.85	2.40	2.13	2.24	2.24	2.24	2.24	2.13	2.22	2.22	2.22	2.22	2.13	2.35	2.40	2.40	2.40	1.85								
NBC_MHEPL_086	334197	6261304	0.56	2.11	0.12	1.56	1.86	2.42	2.14	2.26	2.26	2.26	2.26	2.14	2.23	2.23	2.23	2.23	2.14	2.36	2.42	2.42	2.42	1.86								
NBC_MHEPL_087	334222	6261274	0.56	2.11	0.11	1.55	1.85	2.42	2.14	2.26	2.26	2.26	2.26	2.14	2.22	2.22	2.22	2.22	2.14	2.36	2.42	2.42	2.42	1.85								
NBC_MHEPL_088	334247	6261245	0.56	2.40	0.11	1.55	1.85	2.41	2.13	2.26	2.26	2.26	2.26	2.13	2.27	2.27	2.27	2.27	2.13	2.36	2.41	2.41	2.41	1.85								
NBC_MHEPL_089	334297	6261186	0.56	2.40	0.11	1.55	1.85	2.41	2.13	2.25	2.25	2.25	2.25	2.13	2.26	2.26	2.26	2.26	2.13	2.36	2.41	2.41	2.41	1.85								
NBC_MHEPL_090	334322	6261157	0.56	2.40	0.11	1.55	1.85	2.41	2.13	2.25	2.25	2.25	2.25	2.13	2.26	2.26	2.26	2.26	2.13	2.36	2.41	2.41	2.41	1.85								
NBC_MHEPL_091	334378	6261155	0.56	2.40	0.11	1.55	1.85	2.41	2.13	2.26	2.26	2.26	2.26	2.13	2.27	2.27	2.27	2.27	2.13	2.36	2.41	2.41	2.41	1.85								
NBC_MHEPL_092	334403	6261127	0.56	2.40	0.11	1.55	1.85	2.41	2.13	2.25	2.25	2.25	2.25	2.13	2.26	2.26	2.26	2.26	2.13	2.36	2.41	2.41	2.41	1.85								
NBC_MHEPL_093	334428	6261098	0.55	2.40	0.11	1.55	1.85	2.40	2.13	2.25	2.25	2.25	2.25	2.13	2.26	2.26	2.26	2.26	2.13	2.35	2.40	2.40	2.40	1.85								
NBC_MHEPL_094	334453	6261069	0.55	2.40	0.11	1.55	1.85	2.40	2.12	2.25	2.25	2.25	2.25	2.12	2.26	2.26	2.26	2.26	2.12	2.35	2.40	2.40	2.40	1.85								
NBC_MHEPL_095	334480	6261039	0.55	2.40	0.11	1.55	1.85	2.39	2.12	2.24	2.24	2.24	2.24	2.12	2.26	2.26	2.26	2.26	2.12	2.35	2.39	2.39	2.39	1.85								
NBC_MHEPL_096	334508	6261007	0.54	2.40	0.11	1.55	1.85	2.39	2.12	2.24	2.24	2.24	2.24	2.12	2.25	2.25	2.25	2.25	2.12	2.34	2.39	2.39	2.39	1.85								
NBC_MHEPL_097	334510	6260943	0.53	2.11	0.10	1.54	1.84	2.38	2.11	2.23	2.23	2.23	2.23	2.11	2.20	2.20	2.20	2.20	2.11	2.34	2.38	2.38	2.38	1.84								
NBC_MHEPL_098	334549	6260899	0.53	2.11	0.10	1.54	1.84	2.37	2.10	2.22	2.22	2.22	2.22	2.10	2.20	2.20	2.20	2.20	2.10	2.34	2.37	2.37	2.37	1.84								
NBC_MHEPL_099	334594	6260848	0.52	2.11	0.10	1.54	1.84	2.36	2.10	2.22	2.22	2.22	2.22	2.10	2.20	2.20	2.20	2.20	2.10	2.33	2.36	2.36	2.36	1.84								
NBC_MHEPL_100	334646	6260790	0.52	2.11	0.10	1.54	1.84	2.36	2.10	2.21	2.21	2.21	2.21	2.10	2.19	2.19	2.19	2.19	2.10	2.33	2.36	2.36	2.36	1.84								
NBC_MHEPL_101	334615	6260762	0.52	2.11	0.10	1.54	1.84	2.35	2.09	2.21	2.21	2.21	2.21	2.09	2.19	2.19	2.19	2.19	2.09	2.33	2.35	2.35	2.35	1.84								
NBC_MHEPL_102	334703	6260726	0.50	2.11	0.09	1.53	1.83	2.33	2.08	2.19	2.19	2.19	2.19	2.08	2.18	2.18	2.18	2.18	2.08	2.32	2.33	2.33	2.33	1.83								
NBC_MHEPL_103	334672	6260698	0.50	1.87	0.09	1.53	1.83	2.34	2.09	2.20	2.20	2.20	2.20	2.09	2.15	2.15	2.15	2.15	2.09	2.32	2.34	2.34	2.34	1.83								
NBC_MHEPL_104	334641	6260670	0.49	1.87	0.09	1.53	1.83	2.32	2.08	2.19	2.19	2.19	2.19	2.08	2.14	2.14	2.14	2.14	2.08	2.31	2.32	2.32	2.32	1.83								
NBC_MHEPL_105	334611	6260644	0.47	1.87	0.09	1.53	1.83	2.30	2.07	2.17	2.17	2.17	2.17	2.07	2.13	2.13	2.13	2.13	2.07	2.30	2.30	2.30	2.30	1.83								
NBC_MHEPL_106	334671	6260577	0.45	1.87	0.09	1.53	1.83	2.28	2.06	2.15	2.15	2.15	2.15	2.06	2.13	2.13	2.13	2.13	2.06	2.28	2.28	2.28	2.28	1.83								
NBC_MHEPL_107	334729	6260513	0.44	2.11	0.09	1.53	1.83	2.27	2.05	2.15	2.15	2.15	2.15	2.05	2.16	2.16	2.16	2.16	2.05	2.27	2.27	2.27	2.27	1.83								
NBC_MHEPL_108	334759	6260540	0.45	1.87	0.09	1.53	1.83	2.28	2.06	2.15	2.15	2.15	2.15	2.06	2.13	2.13	2.13	2.13	2.06	2.28	2.28	2.28	2.28	1.83								
NBC_MHEPL_109	334789	6260568	0.46	1.87	0.09	1.53	1.83	2.30	2.06	2.17	2.17	2.17	2.17	2.06	2.13	2.13	2.13	2.13	2.06	2.30	2.30	2.30	2.30	1.83								
NBC_MHEPL_110	334820	6260597	0.48	1.87	0.09	1.53	1.83	2.31	2.07	2.18	2.18	2.18	2.18	2.07	2.14	2.14	2.14	2.14	2.07	2.30	2.31	2.31	2.31	1.83								
NBC_MHEPL_111	334878	6260534	0.48	1.87	0.09	1.53	1.83	2.31	2.07	2.17	2.17	2.17	2.17	2.07	2.14	2.14	2.14	2.14	2.07	2.30	2.31	2.31	2.31	1.83								
NBC_MHEPL_112	334910	6260564	0.47	1.87	0.09	1.53	1.83	2.30	2.07	2.17	2.17	2.17	2.17	2.07	2.13	2.13	2.13	2.13	2.07	2.30	2.30	2.30	2.30	1.83								
NBC_MHEPL_113	334972	6260498	0.46	1.87	0.09	1.53	1.83	2.29	2.06	2.16	2.16	2.16	2.16	2.06	2.13	2.13	2.13	2.13	2.06	2.29	2.29	2.29	2.29	1.83								
NBC_MHEPL_114	335004	6260528	0.45	1.87	0.09	1.53	1.83	2.28	2.05	2.15	2.15	2.15	2.15	2.05	2.13	2.13	2.13	2.13	2.05	2.28	2.28	2.28	2.28	1.83								

100yr ARI Planning Levels - 0m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.00** m sea level rise projection
Freeboard of **0.3** m included in EPLs

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																	REDUCTION FACTORS NOT CALCULATED FOR 2010 LEVELS AS THE 0m SLR LEVELS ARE NOT BEING USED FOR PLANNING PURPOSES							
			Wave						Foreshore Type ##																							
						Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)	Max EPL of all Foreshore Types and Crest Levels (mAHD)	1					2					3					4								
					Local Wind Setup* (m)				Crest Level (mAHD)																							
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)		0 m Sea Level Projection	0 m Sea Level Projection		1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_115	335067	6260462	0.44	1.87	0.09	1.53	1.83	2.27	2.05	2.15	2.15	2.15	2.15	2.05	2.12	2.12	2.12	2.12	2.05	2.27	2.27	2.27	2.27	1.83								
NBC_MHEPL_116	335099	6260492	0.45	1.87	0.09	1.53	1.83	2.28	2.06	2.16	2.16	2.16	2.16	2.06	2.13	2.13	2.13	2.13	2.06	2.28	2.28	2.28	2.28	1.83								
NBC_MHEPL_117	335191	6260457	0.47	1.87	0.09	1.53	1.83	2.29	2.06	2.16	2.16	2.16	2.16	2.06	2.13	2.13	2.13	2.13	2.06	2.29	2.29	2.29	2.29	1.83								
NBC_MHEPL_118	335221	6260486	0.47	1.87	0.09	1.53	1.83	2.30	2.06	2.16	2.16	2.16	2.16	2.06	2.13	2.13	2.13	2.13	2.06	2.30	2.30	2.30	2.30	1.83								
NBC_MHEPL_119	335278	6260427	0.45	1.87	0.09	1.53	1.83	2.28	2.06	2.16	2.16	2.16	2.16	2.06	2.13	2.13	2.13	2.13	2.06	2.28	2.28	2.28	2.28	1.83								
NBC_MHEPL_120	335308	6260457	0.45	1.87	0.09	1.53	1.83	2.28	2.05	2.15	2.15	2.15	2.15	2.05	2.13	2.13	2.13	2.13	2.05	2.28	2.28	2.28	2.28	1.83								
NBC_MHEPL_121	335363	6260402	0.45	2.11	0.09	1.53	1.83	2.28	2.05	2.15	2.15	2.15	2.15	2.05	2.16	2.16	2.16	2.16	2.05	2.28	2.28	2.28	2.28	1.83								
NBC_MHEPL_122	335394	6260434	0.46	2.11	0.09	1.53	1.83	2.29	2.06	2.16	2.16	2.16	2.16	2.06	2.16	2.16	2.16	2.16	2.06	2.29	2.29	2.29	2.29	1.83								
NBC_MHEPL_123	335447	6260381	0.45	2.11	0.09	1.53	1.83	2.28	2.06	2.16	2.16	2.16	2.16	2.06	2.16	2.16	2.16	2.16	2.06	2.28	2.28	2.28	2.28	1.83								
NBC_MHEPL_124	335476	6260411	0.45	1.87	0.09	1.53	1.83	2.28	2.05	2.15	2.15	2.15	2.15	2.05	2.12	2.12	2.12	2.12	2.05	2.28	2.28	2.28	2.28	1.83								
NBC_MHEPL_125	335526	6260362	0.46	2.11	0.09	1.53	1.83	2.29	2.06	2.16	2.16	2.16	2.16	2.06	2.16	2.16	2.16	2.16	2.06	2.29	2.29	2.29	2.29	1.83								
NBC_MHEPL_126	335555	6260392	0.47	2.11	0.09	1.53	1.83	2.30	2.06	2.17	2.17	2.17	2.17	2.06	2.17	2.17	2.17	2.17	2.06	2.30	2.30	2.30	2.30	1.83								
NBC_MHEPL_127	335630	6260379	0.48	2.11	0.09	1.53	1.83	2.31	2.07	2.17	2.17	2.17	2.17	2.07	2.17	2.17	2.17	2.17	2.07	2.30	2.31	2.31	2.31	1.83								
NBC_MHEPL_128	335674	6260338	0.47	2.11	0.09	1.53	1.83	2.30	2.06	2.17	2.17	2.17	2.17	2.06	2.17	2.17	2.17	2.17	2.06	2.30	2.30	2.30	2.30	1.83								
NBC_MHEPL_129	335702	6260370	0.44	2.11	0.09	1.53	1.83	2.26	2.05	2.14	2.14	2.14	2.14	2.05	2.15	2.15	2.15	2.15	2.05	2.26	2.26	2.26	2.26	1.83								
NBC_MHEPL_130	335730	6260402	0.46	1.87	0.09	1.53	1.83	2.29	2.06	2.16	2.16	2.16	2.16	2.06	2.13	2.13	2.13	2.13	2.06	2.29	2.29	2.29	2.29	1.83								
NBC_MHEPL_131	335757	6260433	0.47	1.87	0.09	1.53	1.83	2.30	2.06	2.17	2.17	2.17	2.17	2.06	2.13	2.13	2.13	2.13	2.06	2.30	2.30	2.30	2.30	1.83								
NBC_MHEPL_132	335714	6260471	0.48	1.87	0.09	1.53	1.83	2.31	2.07	2.18	2.18	2.18	2.18	2.07	2.14	2.14	2.14	2.14	2.07	2.31	2.31	2.31	2.31	1.83								
NBC_MHEPL_133	335783	6260463	0.50	1.87	0.09	1.53	1.83	2.33	2.08	2.19	2.19	2.19	2.19	2.08	2.14	2.14	2.14	2.14	2.08	2.31	2.33	2.33	2.33	1.83								
NBC_MHEPL_134	335826	6260427	0.48	1.87	0.09	1.53	1.83	2.31	2.07	2.17	2.17	2.17	2.17	2.07	2.13	2.13	2.13	2.13	2.07	2.30	2.31	2.31	2.31	1.83								
NBC_MHEPL_135	335894	6260424	0.50	1.87	0.09	1.53	1.83	2.33	2.08	2.19	2.19	2.19	2.19	2.08	2.14	2.14	2.14	2.14	2.08	2.31	2.33	2.33	2.33	1.83								
NBC_MHEPL_136	335961	6260425	0.53	1.87	0.09	1.53	1.83	2.36	2.10	2.21	2.21	2.21	2.21	2.10	2.15	2.15	2.15	2.15	2.10	2.33	2.36	2.36	2.36	1.83								
NBC_MHEPL_137	335988	6260459	0.57	2.11	0.09	1.53	1.83	2.40	2.12	2.24	2.24	2.24	2.24	2.12	2.20	2.20	2.20	2.20	2.12	2.35	2.40	2.40	2.40	1.83								
NBC_MHEPL_138	336052	6260461	0.61	2.40	0.09	1.53	1.83	2.44	2.13	2.27	2.27	2.27	2.27	2.13	2.26	2.26	2.26	2.26	2.13	2.37	2.44	2.44	2.44	1.83								
NBC_MHEPL_139	336077	6260494	0.64	2.40	0.09	1.53	1.83	2.47	2.15	2.29	2.29	2.29	2.29	2.15	2.27	2.27	2.27	2.27	2.15	2.39	2.47	2.47	2.47	1.83								
NBC_MHEPL_140	336100	6260525	0.68	2.71	0.09	1.53	1.83	2.51	2.17	2.31	2.32	2.32	2.32	2.17	2.33	2.34	2.34	2.34	2.17	2.40	2.51	2.51	2.51	1.83								
NBC_MHEPL_141	336123	6260557	0.70	2.71	0.09	1.53	1.83	2.53	2.18	2.32	2.33	2.33	2.33	2.18	2.34	2.35	2.35	2.35	2.18	2.42	2.53	2.53	2.53	1.83								
NBC_MHEPL_142	336110	6260620	0.70	2.71	0.09	1.53	1.83	2.53	2.18	2.33	2.34	2.34	2.34	2.18	2.34	2.35	2.35	2.35	2.18	2.42	2.53	2.53	2.53	1.83								
NBC_MHEPL_143	336138	6260656	0.71	2.71	0.09	1.53	1.83	2.54	2.19	2.33	2.34	2.34	2.34	2.19	2.34	2.36	2.36	2.36	2.19	2.42	2.54	2.54	2.54	1.83								
NBC_MHEPL_144	336130	6260722	0.70	2.71	0.09	1.53	1.83	2.53	2.18	2.32	2.33	2.33	2.33	2.18	2.34	2.35	2.35	2.35	2.18	2.42	2.53	2.53	2.53	1.83								
NBC_MHEPL_145	336158	6260757	0.70	3.08	0.09	1.53	1.83	2.53	2.18	2.33	2.34	2.34	2.34	2.18	2.37	2.42	2.42	2.42	2.18	2.42	2.53	2.53	2.53	1.83								
NBC_MHEPL_146	336150	6260820	0.68	3.08	0.09	1.53	1.83	2.51	2.17	2.31	2.32	2.32	2.32	2.17	2.37	2.41	2.41	2.41	2.17	2.41	2.51	2.51	2.51	1.83								
NBC_MHEPL_147	336155	6260897	0.69	3.08	0.10	1.54	1.84	2.53	2.18	2.32	2.33	2.33	2.33	2.18	2.37	2.42	2.42	2.42	2.18	2.42	2.53	2.53	2.53	1.84								
NBC_MHEPL_148	336119	6260932	0.68	3.08	0.10	1.54	1.84	2.52	2.18	2.32	2.33	2.33	2.33	2.18	2.37	2.42	2.42	2.42	2.18	2.41	2.52	2.52	2.52	1.84								
NBC_MHEPL_149	336172	6260988	0.67	3.08	0.10	1.54	1.84	2.51	2.17	2.31	2.32	2.32	2.32	2.17	2.37	2.41	2.41	2.41	2.17	2.41	2.51	2.51	2.51	1.84								
NBC_MHEPL_150	336134	6261026	0.71	3.08	0.10	1.54	1.84	2.54	2.19	2.33	2.35	2.35	2.35	2.19	2.38	2.43	2.43	2.43	2.19	2.42	2.54	2.54	2.54	1.84								
NBC_MHEPL_151	336185	6261080	0.74	3.08	0.10	1.54	1.84	2.58	2.21	2.35	2.37	2.37	2.37	2.21	2.39	2.44	2.44	2.44	2.21	2.44	2.58	2.58	2.58	1.84								
NBC_MHEPL_152	336185	6261080	0.74	3.08	0.10	1.54	1.84	2.58	2.21	2.35	2.37	2.37	2.37	2.21	2.39	2.44	2.44	2.44	2.21	2.44	2.58	2.58	2.58	1.84								
NBC_MHEPL_153	336234	6261134	0.74	3.08	0.10	1.54	1.84	2.58	2.21	2.35	2.37	2.37	2.37	2.21	2.39	2.45	2.45	2.45	2.21	2.44	2.58	2.58	2.58	1.84								
NBC_MHEPL_154	336191	6261174	0.72	2.71	0.10	1.54	1.84	2.56	2.20	2.34	2.36	2.36	2.36	2.20	2.35	2.37	2.37	2.37	2.20	2.43	2.56	2.56	2.56	1.84								
NBC_MHEPL_155	336145	6261217	0.70	2.71	0.10	1.54	1.84	2.54	2.19	2.33	2.34	2.34	2.34	2.19	2.34	2.36	2.36	2.36	2.19	2.42	2.54	2.54	2.54	1.84								
NBC_MHEPL_156	336193	6261269	0.66	2.71	0.10	1.54	1.84	2.51	2.17	2.31	2.32	2.32	2.32	2.17	2.33	2.35	2.35	2.35	2.17	2.41	2.51	2.51	2.51	1.84								
NBC_MHEPL_157	336146	6261313	0.57	2.71	0.10	1.54	1.84	2.41	2.13	2.25	2.25	2.25	2.25	2.13	2.31	2.31	2.31	2.31	2.13	2.36	2.41	2.41	2.41	1.84								
NBC_MHEPL_158	336094	6261362	0.54	2.71	0.10	1.54	1.84	2.38	2.11	2.23	2.23	2.23	2.23	2.11	2.30	2.30	2.30	2.30	2.11	2.34	2.38	2.38	2.38	1.84								
NBC_MHEPL_159	336085	6261464	0.52	2.71	0.11	1.55	1.85	2.37	2.11	2.22	2.22	2.22	2.22	2.11	2.30	2.30	2.30	2.30	2.11	2.33	2.37	2.37	2.37	1.85								
NBC_MHEPL_160	336038	6261414	0.48	2.71	0.11	1.55	1.85	2.33	2.09	2.19	2.19	2.19	2.19	2.09	2.28	2.28	2.28	2.28	2.09	2.31	2.33	2.33	2.33	1.85								
NBC_MHEPL_161	335982	6261468	0.42	2.71	0.12	1.56	1.86	2.27	2.06	2.16	2.16	2.16	2.16	2.06	2.26	2.26	2.26	2.26	2.06	2.27	2.27	2.27	2.27	1.86								
NBC_MHEPL_162	336102	6261711	0.50	2.40	0.16	1.60	1.90	2.40	2.15	2.26	2.26	2.26	2.26	2.15	2.29	2.29	2.29	2.29	2.15	2.35	2.40	2.40	2.40	1.90								
NBC_MHEPL_163	336159	6261658	0.50	2.11	0.15	1.59	1.89	2.39	2.14	2.25	2.25	2.25	2.25	2.14	2.24	2.24	2.24	2.24	2.14	2.35	2.39	2.39	2.39	1.89								
NBC_MHEPL_164	336117	6261612	0.52	2.40	0.14	1.58	1.88	2.40	2.14	2.25	2.25	2.25	2.25	2.14	2.28	2.28	2.28	2.28	2.14	2.35	2.40	2.40	2.40	1.88								
NBC_MHEPL_165	336174	6261560	0.51	2.40	0.13	1.57	1.87	2.38	2.13	2.24	2.24	2.24	2.24	2.13	2.27	2.27	2.27	2.27	2.13	2.34	2.38	2.38	2.38	1.87								
NBC_MHEPL_166	336130	6261512	0.55	2.71	0.12	1.56	1.86	2.41	2.14	2.26	2.26	2.26	2.26	2.14	2.31	2.32	2.32	2.32	2.14	2.36	2.41	2.41	2.41	1.86								
NBC_MHEPL_167	336141	6261412	0.58	2.71	0.11	1.55	1.85	2.43	2.14	2.27	2.27	2.27	2.27	2.14	2.31	2.32	2.32	2.32	2.14	2.37	2.43	2.43	2.43	1.85								
NBC_MHEPL_168	336192	6261364	0.62	2.71	0.10	1.54	1.84	2.47	2.16	2.29	2.29	2.29	2.29	2.16	2.32	2.34	2.34	2.34	2.16	2.39	2.47	2.47	2.47	1.84								
NBC_MHEPL_169	336239	6261227	0.72	2.71	0.10	1.54	1.84	2.56	2.20	2.34	2.36	2.36	2.36	2.20	2.35	2.37	2.37	2.37	2.20	2.43	2.56	2.56	2.56	1.84								
NBC_MHEPL_170	336283	6261188	0.71	2.71	0.10	1.54	1.84	2.55	2.20	2.34	2.35	2.35	2.35	2.20	2.34	2.36	2.36	2.36	2.20	2.43	2.55	2.55	2.55	1.84								
NBC_MHEPL_171	336321	6261155	0.65	2.71	0.10	1.54	1.84	2.49	2.17	2.31	2.31	2.31	2.31	2.17	2.33	2.34	2.34	2.34	2.17	2.40	2.49	2.49	2.49	1.84								

APPENDIX B

20220706_EPL_Database
0 m Sea Level Projected WL

100yr ARI Planning Levels - 0m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.00** m sea level rise projection
Freeboard of **0.3** m included in EPLs

Foreshore Location (X,Y Coordinates @ Wave Output Location): Name	X MGAz56	Y MGAz56	100yrARI: Wave Hs (m)	Wave Tp (sec)	Local Wind Setup* (m)	Local (Still) Water Level (mAHD) 0 m Sea Level Projection	Local (Still) Water Level with 0.3m Freeboard (mAHD) 0 m Sea Level Projection	Estuarine Planning Level (m): Max EPL of all Foreshore Types and Crest Levels (mAHD)	Foreshore Type ## 1, Crest Level (mAHD) 1.5	1: 2	1: 2.5	1: 3	1: 3.5	2: 1.5	2: 2	2: 2.5	2: 3	2: 3.5	3: 1.5	3: 2	3: 2.5	3: 3	3: 3.5	4: N/A	REDUCTION FACTORS NOT CALCULATED FOR 2010 LEVELS AS THE 0m SLR LEVELS ARE NOT BEING USED FOR PLANNING PURPOSES: 5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_172	336273	6261099	0.67	2.71	0.10	1.54	1.84	2.51	2.17	2.32	2.32	2.32	2.32	2.17	2.33	2.35	2.35	2.35	2.17	2.41	2.51	2.51	2.51	1.84								
NBC_MHEPL_173	336309	6261068	0.67	2.71	0.10	1.54	1.84	2.50	2.17	2.31	2.32	2.32	2.32	2.17	2.33	2.35	2.35	2.35	2.17	2.40	2.50	2.50	2.50	1.84								
NBC_MHEPL_174	336259	6261012	0.67	2.71	0.10	1.54	1.84	2.50	2.17	2.31	2.32	2.32	2.32	2.17	2.33	2.35	2.35	2.35	2.17	2.40	2.50	2.50	2.50	1.84								
NBC_MHEPL_175	336294	6260982	0.66	2.71	0.10	1.54	1.84	2.49	2.16	2.31	2.31	2.31	2.31	2.16	2.33	2.34	2.34	2.34	2.16	2.40	2.49	2.49	2.49	1.84								
NBC_MHEPL_176	336243	6260923	0.67	2.71	0.10	1.54	1.84	2.51	2.17	2.31	2.32	2.32	2.32	2.17	2.33	2.35	2.35	2.35	2.17	2.40	2.51	2.51	2.51	1.84								
NBC_MHEPL_177	336277	6260894	0.69	2.71	0.10	1.54	1.84	2.52	2.18	2.32	2.33	2.33	2.33	2.18	2.33	2.35	2.35	2.35	2.18	2.41	2.52	2.52	2.52	1.84								
NBC_MHEPL_178	336259	6260804	0.69	2.71	0.09	1.53	1.83	2.53	2.18	2.32	2.33	2.33	2.33	2.18	2.34	2.35	2.35	2.35	2.18	2.42	2.53	2.53	2.53	1.83								
NBC_MHEPL_179	336292	6260776	0.66	2.71	0.09	1.53	1.83	2.50	2.17	2.31	2.31	2.31	2.31	2.17	2.33	2.34	2.34	2.34	2.17	2.40	2.50	2.50	2.50	1.83								
NBC_MHEPL_180	336325	6260750	0.65	2.71	0.09	1.53	1.83	2.48	2.16	2.30	2.30	2.30	2.30	2.16	2.32	2.33	2.33	2.33	2.16	2.39	2.48	2.48	2.48	1.83								
NBC_MHEPL_181	336263	6260670	0.68	2.71	0.09	1.53	1.83	2.51	2.17	2.31	2.32	2.32	2.32	2.17	2.33	2.34	2.34	2.34	2.17	2.41	2.51	2.51	2.51	1.83								
NBC_MHEPL_182	336274	6260608	0.69	2.71	0.09	1.53	1.83	2.52	2.17	2.32	2.33	2.33	2.33	2.17	2.33	2.35	2.35	2.35	2.17	2.41	2.52	2.52	2.52	1.83								
NBC_MHEPL_183	336249	6260573	0.73	3.08	0.09	1.53	1.83	2.56	2.19	2.34	2.35	2.35	2.35	2.19	2.38	2.43	2.43	2.43	2.19	2.43	2.56	2.56	2.56	1.83								
NBC_MHEPL_184	336288	6260545	0.73	3.08	0.09	1.53	1.83	2.56	2.20	2.34	2.36	2.36	2.36	2.20	2.38	2.43	2.43	2.43	2.20	2.43	2.56	2.56	2.56	1.83								
NBC_MHEPL_185	336305	6260480	0.75	3.08	0.09	1.53	1.83	2.58	2.20	2.35	2.37	2.37	2.37	2.20	2.39	2.44	2.44	2.44	2.20	2.44	2.58	2.58	2.58	1.83								
NBC_MHEPL_186	336280	6260445	0.76	3.08	0.09	1.53	1.83	2.59	2.21	2.35	2.37	2.37	2.37	2.21	2.39	2.44	2.44	2.44	2.21	2.45	2.59	2.59	2.59	1.83								
NBC_MHEPL_187	336323	6260414	0.77	3.08	0.09	1.53	1.83	2.60	2.21	2.36	2.38	2.38	2.38	2.21	2.39	2.45	2.45	2.45	2.21	2.45	2.60	2.60	2.60	1.83								
NBC_MHEPL_188	336363	6260383	0.77	3.08	0.09	1.53	1.83	2.60	2.21	2.36	2.38	2.38	2.38	2.21	2.39	2.45	2.45	2.45	2.21	2.45	2.60	2.60	2.60	1.83								
NBC_MHEPL_189	336377	6260320	0.78	3.08	0.09	1.53	1.83	2.61	2.22	2.36	2.39	2.39	2.39	2.22	2.40	2.45	2.45	2.45	2.22	2.46	2.61	2.61	2.61	1.83								
NBC_MHEPL_190	336416	6260291	0.80	3.48	0.09	1.53	1.83	2.63	2.23	2.37	2.40	2.40	2.40	2.23	2.44	2.55	2.55	2.55	2.23	2.47	2.63	2.63	2.63	1.83								
NBC_MHEPL_191	336478	6260297	0.81	3.48	0.09	1.53	1.83	2.64	2.23	2.38	2.41	2.41	2.41	2.23	2.44	2.55	2.55	2.55	2.23	2.47	2.64	2.64	2.64	1.83								
NBC_MHEPL_192	336516	6260271	0.81	3.48	0.09	1.53	1.83	2.64	2.23	2.38	2.41	2.41	2.41	2.23	2.44	2.55	2.55	2.55	2.23	2.47	2.64	2.64	2.64	1.83								
NBC_MHEPL_193	336531	6260211	0.80	3.48	0.09	1.53	1.83	2.63	2.23	2.37	2.40	2.40	2.40	2.23	2.44	2.55	2.55	2.55	2.23	2.47	2.63	2.63	2.63	1.83								
NBC_MHEPL_194	336570	6260186	0.81	3.08	0.09	1.53	1.83	2.63	2.23	2.38	2.41	2.41	2.41	2.23	2.40	2.46	2.46	2.46	2.23	2.47	2.63	2.63	2.63	1.83								
NBC_MHEPL_195	336591	6260125	0.81	3.08	0.08	1.52	1.82	2.64	2.23	2.38	2.41	2.41	2.41	2.23	2.40	2.46	2.46	2.46	2.23	2.47	2.64	2.64	2.64	1.82								
NBC_MHEPL_196	336612	6260063	0.81	3.08	0.08	1.52	1.82	2.64	2.23	2.38	2.41	2.41	2.41	2.23	2.40	2.46	2.46	2.46	2.23	2.47	2.64	2.64	2.64	1.82								
NBC_MHEPL_197	336592	6260029	0.84	3.08	0.08	1.52	1.82	2.66	2.24	2.39	2.43	2.43	2.43	2.24	2.41	2.47	2.47	2.47	2.24	2.48	2.66	2.66	2.66	1.82								
NBC_MHEPL_198	336636	6260003	0.84	3.08	0.08	1.52	1.82	2.66	2.24	2.39	2.43	2.43	2.43	2.24	2.41	2.47	2.47	2.47	2.24	2.48	2.66	2.66	2.66	1.82								
NBC_MHEPL_199	336659	6259943	0.84	3.08	0.08	1.52	1.82	2.66	2.24	2.39	2.42	2.42	2.42	2.24	2.41	2.47	2.47	2.47	2.24	2.48	2.66	2.66	2.66	1.82								
NBC_MHEPL_200	336682	6259883	0.83	3.08	0.08	1.52	1.82	2.65	2.23	2.38	2.42	2.42	2.42	2.23	2.41	2.46	2.46	2.46	2.23	2.48	2.65	2.65	2.65	1.82								
NBC_MHEPL_201	336725	6259857	0.80	3.08	0.08	1.52	1.82	2.62	2.22	2.37	2.40	2.40	2.40	2.22	2.40	2.45	2.45	2.45	2.22	2.46	2.62	2.62	2.62	1.82								
NBC_MHEPL_202	336689	6259794	0.79	3.08	0.08	1.52	1.82	2.61	2.22	2.36	2.39	2.39	2.39	2.22	2.40	2.45	2.45	2.45	2.22	2.46	2.61	2.61	2.61	1.82								
NBC_MHEPL_203	336674	6259766	0.77	2.71	0.08	1.52	1.82	2.59	2.21	2.35	2.37	2.37	2.37	2.21	2.35	2.37	2.37	2.37	2.21	2.45	2.59	2.59	2.59	1.82								
NBC_MHEPL_204	336703	6259716	0.71	2.71	0.08	1.52	1.82	2.53	2.18	2.32	2.33	2.33	2.33	2.18	2.33	2.35	2.35	2.35	2.18	2.42	2.53	2.53	2.53	1.82								
NBC_MHEPL_205	336690	6259689	0.70	2.71	0.08	1.52	1.82	2.52	2.17	2.32	2.32	2.32	2.32	2.17	2.33	2.34	2.34	2.34	2.17	2.41	2.52	2.52	2.52	1.82								
NBC_MHEPL_206	336708	6259612	0.66	2.71	0.08	1.52	1.82	2.48	2.15	2.30	2.30	2.30	2.30	2.15	2.32	2.33	2.33	2.33	2.15	2.39	2.48	2.48	2.48	1.82								
NBC_MHEPL_207	336696	6259584	0.66	2.71	0.08	1.52	1.82	2.48	2.15	2.30	2.30	2.30	2.30	2.15	2.32	2.33	2.33	2.33	2.15	2.39	2.48	2.48	2.48	1.82								
NBC_MHEPL_208	336670	6259522	0.63	2.71	0.08	1.52	1.82	2.45	2.13	2.27	2.27	2.27	2.27	2.13	2.31	2.31	2.31	2.31	2.13	2.38	2.45	2.45	2.45	1.82								
NBC_MHEPL_209	336697	6259475	0.60	2.71	0.08	1.52	1.82	2.42	2.12	2.25	2.25	2.25	2.25	2.12	2.30	2.30	2.30	2.30	2.12	2.36	2.42	2.42	2.42	1.82								
NBC_MHEPL_210	336669	6259409	0.61	3.08	0.08	1.52	1.82	2.42	2.12	2.25	2.25	2.25	2.25	2.12	2.34	2.37	2.37	2.37	2.12	2.36	2.42	2.42	2.42	1.82								
NBC_MHEPL_211	336615	6259391	0.65	3.08	0.08	1.52	1.82	2.47	2.14	2.29	2.29	2.29	2.29	2.14	2.35	2.39	2.39	2.39	2.14	2.39	2.47	2.47	2.47	1.82								
NBC_MHEPL_212	336599	6259355	0.73	3.08	0.08	1.52	1.82	2.55	2.18	2.33	2.34	2.34	2.34	2.18	2.37	2.42	2.42	2.42	2.18	2.43	2.55	2.55	2.55	1.82								
NBC_MHEPL_213	336584	6259321	0.80	3.08	0.08	1.52	1.82	2.61	2.22	2.36	2.39	2.39	2.39	2.22	2.39	2.45	2.45	2.45	2.22	2.46	2.61	2.61	2.61	1.82								
NBC_MHEPL_214	336557	6259265	0.82	3.08	0.07	1.51	1.81	2.64	2.23	2.38	2.41	2.41	2.41	2.23	2.40	2.46	2.46	2.46	2.23	2.47	2.64	2.64	2.64	1.81								
NBC_MHEPL_215	336587	6259221	0.82	3.08	0.07	1.51	1.81	2.63	2.22	2.37	2.40	2.40	2.40	2.22	2.40	2.45	2.45	2.45	2.22	2.47	2.63	2.63	2.63	1.81								
NBC_MHEPL_216	336628	6259205	0.81	3.08	0.08	1.52	1.82	2.62	2.22	2.37	2.40	2.40	2.40	2.22	2.40	2.45	2.45	2.45	2.22	2.46	2.62	2.62	2.62	1.82								
NBC_MHEPL_217	336618	6259177	0.80	3.08	0.07	1.51	1.81	2.62	2.22	2.37	2.39	2.39	2.39	2.22	2.39	2.45	2.45	2.45	2.22	2.46	2.62	2.62	2.62	1.81								
NBC_MHEPL_218	336657	6259126	0.80	3.08	0.07	1.51	1.81	2.61	2.21	2.36	2.39	2.39	2.39	2.21	2.39	2.44	2.44	2.44	2.21	2.46	2.61	2.61	2.61	1.81								
NBC_MHEPL_219	336701	6259068	0.78	3.08	0.07	1.51	1.81	2.59	2.20	2.35	2.37	2.37	2.37	2.20	2.39	2.44	2.44	2.44	2.20	2.45	2.59	2.59	2.59	1.81								
NBC_MHEPL_220	336771	6259079	0.75	2.71	0.07	1.51	1.81	2.56	2.19	2.34	2.35	2.35	2.35	2.19	2.34	2.35	2.35	2.35	2.19	2.43	2.56	2.56	2.56	1.81								
NBC_MHEPL_221	336806	6259023	0.71	2.71	0.07	1.51	1.81	2.53	2.17	2.32	2.33	2.33	2.33	2.17	2.33	2.34	2.34	2.34	2.17	2.42	2.53	2.53	2.53	1.81								
NBC_MHEPL_222	336792	6258989	0.71	2.71	0.07	1.51	1.81	2.52	2.17	2.32	2.32	2.32	2.32	2.17	2.33	2.34	2.34	2.34	2.17	2.41	2.52	2.52	2.52	1.81								
NBC_MHEPL_223	336779	6258957	0.70	2.71	0.07	1.51	1.81	2.51	2.16	2.31	2.31	2.31	2.31	2.16	2.32	2.33	2.33	2.33	2.16	2.41	2.51	2.51	2.51	1.81								
NBC_MHEPL_224	336813	6258909	0.66	2.71	0.07	1.51	1.81	2.47	2.14	2.29	2.29	2.29	2.29	2.14	2.31	2.32	2.32	2.32	2.14	2.39	2.47	2.47	2.47	1.81								
NBC_MHEPL_225	336844	6258864	0.60	2.40	0.07	1.51	1.81	2.41	2.11	2.24	2.24	2.24	2.24	2.11	2.24	2.24	2.24	2.24	2.11	2.36	2.41	2.41	2.41	1.81								
NBC_MHEPL_226	336888	6258851	0.58	2.40	0.07	1.51	1.81	2.39	2.10	2.23	2.23	2.23	2.23	2.10	2.23	2.23	2.23	2.23	2.10	2.34	2.39	2.39	2.39	1.81								
NBC_MHEPL_227	336920	6258786	0.57	2.11	0.07	1.51	1.81	2.38	2.10	2.22	2.22	2.22	2.22	2.10	2.18	2.18	2.18	2.18	2.10	2.34	2.38	2.38	2.38	1.81								
NBC_MHEPL_228	336874	6258799	0.58	2.11	0.07	1.51	1.81	2.39	2.10	2.23	2.23	2.23	2.23	2.10	2.19	2.19	2.19	2.19	2.10	2.35	2.39	2.39	2.39	1.81								

100yr ARI Planning Levels - 0m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

Mean Sea Level Rise Allowance **0.00** m sea level rise projection
Freeboard of **0.3** m included in EPLs

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Foreshore Location (X,Y Coordinates @ Wave Output Location): Name	X MGAz56	Y MGAz56	100yrARI: Wave Hs (m)	Wave Tp (sec)	Local Wind Setup* (m)	Local (Still) Water Level (mAHD): 0 m Sea Level Projection	Local (Still) Water Level with 0.3m Freeboard (mAHD): 0 m Sea Level Projection	Estuarine Planning Level (m): Max EPL of all Foreshore Types and Crest Levels (mAHD)	Foreshore Type ## 1, Crest Level (mAHD): 1.5	1: 2	1: 2.5	1: 3	1: 3.5	2: 1.5	2: 2	2: 2.5	2: 3	2: 3.5	3: 1.5	3: 2	3: 2.5	3: 3	3: 3.5	4: N/A	REDUCTION FACTORS NOT CALCULATED FOR 2010 LEVELS AS THE 0m SLR LEVELS ARE NOT BEING USED FOR PLANNING PURPOSES: 5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_229	336854	6258728	0.58	2.11	0.07	1.51	1.81	2.39	2.10	2.22	2.22	2.22	2.22	2.10	2.18	2.18	2.18	2.18	2.10	2.34	2.39	2.39	2.39	1.81								
NBC_MHEPL_230	336807	6258743	0.57	2.11	0.07	1.51	1.81	2.38	2.09	2.22	2.22	2.22	2.22	2.09	2.18	2.18	2.18	2.18	2.09	2.34	2.38	2.38	2.38	1.81								
NBC_MHEPL_231	336787	6258677	0.56	2.11	0.07	1.51	1.81	2.37	2.09	2.21	2.21	2.21	2.21	2.09	2.18	2.18	2.18	2.18	2.09	2.33	2.37	2.37	2.37	1.81								
NBC_MHEPL_232	336766	6258604	0.55	2.11	0.07	1.51	1.81	2.36	2.08	2.20	2.20	2.20	2.20	2.08	2.17	2.17	2.17	2.17	2.08	2.33	2.36	2.36	2.36	1.81								
NBC_MHEPL_233	336715	6258621	0.55	2.40	0.07	1.51	1.81	2.36	2.08	2.20	2.20	2.20	2.20	2.08	2.22	2.22	2.22	2.22	2.08	2.33	2.36	2.36	2.36	1.81								
NBC_MHEPL_234	336690	6258548	0.56	2.40	0.07	1.51	1.81	2.37	2.09	2.22	2.22	2.22	2.22	2.09	2.22	2.22	2.22	2.22	2.09	2.34	2.37	2.37	2.37	1.81								
NBC_MHEPL_235	336671	6258489	0.64	2.71	0.07	1.51	1.81	2.45	2.13	2.27	2.27	2.27	2.27	2.13	2.30	2.31	2.31	2.31	2.13	2.38	2.45	2.45	2.45	1.81								
NBC_MHEPL_236	336615	6258509	0.71	2.71	0.07	1.51	1.81	2.52	2.16	2.31	2.32	2.32	2.32	2.16	2.32	2.33	2.33	2.33	2.16	2.41	2.52	2.52	2.52	1.81								
NBC_MHEPL_237	336595	6258449	0.73	2.71	0.07	1.51	1.81	2.54	2.18	2.33	2.34	2.34	2.34	2.18	2.33	2.34	2.34	2.34	2.18	2.42	2.54	2.54	2.54	1.81								
NBC_MHEPL_238	336515	6258400	0.76	2.71	0.07	1.51	1.81	2.57	2.19	2.34	2.36	2.36	2.36	2.19	2.34	2.35	2.35	2.35	2.19	2.44	2.57	2.57	2.57	1.81								
NBC_MHEPL_239	336573	6258380	0.76	2.71	0.07	1.51	1.81	2.57	2.19	2.34	2.35	2.35	2.35	2.19	2.34	2.35	2.35	2.35	2.19	2.44	2.57	2.57	2.57	1.81								
NBC_MHEPL_240	336553	6258320	0.77	2.71	0.07	1.51	1.81	2.58	2.19	2.35	2.36	2.36	2.36	2.19	2.34	2.36	2.36	2.36	2.19	2.44	2.58	2.58	2.58	1.81								
NBC_MHEPL_241	336597	6258254	0.78	2.71	0.07	1.51	1.81	2.59	2.20	2.35	2.37	2.37	2.37	2.20	2.34	2.36	2.36	2.36	2.20	2.45	2.59	2.59	2.59	1.81								
NBC_MHEPL_242	336583	6258205	0.78	2.71	0.07	1.51	1.81	2.59	2.20	2.35	2.37	2.37	2.37	2.20	2.34	2.36	2.36	2.36	2.20	2.45	2.59	2.59	2.59	1.81								
NBC_MHEPL_243	336646	6258187	0.78	2.71	0.07	1.51	1.81	2.59	2.20	2.35	2.37	2.37	2.37	2.20	2.34	2.36	2.36	2.36	2.20	2.45	2.59	2.59	2.59	1.81								
NBC_MHEPL_244	336632	6258136	0.78	2.71	0.07	1.51	1.81	2.59	2.20	2.35	2.37	2.37	2.37	2.20	2.34	2.36	2.36	2.36	2.20	2.45	2.59	2.59	2.59	1.81								
NBC_MHEPL_245	336701	6258118	0.77	2.71	0.07	1.51	1.81	2.58	2.19	2.35	2.37	2.37	2.37	2.19	2.34	2.36	2.36	2.36	2.19	2.44	2.58	2.58	2.58	1.81								
NBC_MHEPL_246	336770	6258099	0.77	2.71	0.07	1.51	1.81	2.58	2.19	2.34	2.36	2.36	2.36	2.19	2.34	2.35	2.35	2.35	2.19	2.44	2.58	2.58	2.58	1.81								
NBC_MHEPL_247	336833	6258082	0.75	2.71	0.07	1.51	1.81	2.56	2.18	2.34	2.35	2.35	2.35	2.18	2.33	2.35	2.35	2.35	2.18	2.43	2.56	2.56	2.56	1.81								
NBC_MHEPL_248	336901	6258115	0.74	2.71	0.07	1.51	1.81	2.55	2.18	2.33	2.34	2.34	2.34	2.18	2.33	2.34	2.34	2.34	2.18	2.43	2.55	2.55	2.55	1.81								
NBC_MHEPL_249	336949	6258104	0.74	2.71	0.07	1.51	1.81	2.55	2.18	2.33	2.34	2.34	2.34	2.18	2.33	2.34	2.34	2.34	2.18	2.43	2.55	2.55	2.55	1.81								
NBC_MHEPL_250	337001	6258143	0.74	2.71	0.07	1.51	1.81	2.55	2.18	2.33	2.34	2.34	2.34	2.18	2.33	2.34	2.34	2.34	2.18	2.43	2.55	2.55	2.55	1.81								
NBC_MHEPL_251	337045	6258134	0.74	2.71	0.07	1.51	1.81	2.55	2.18	2.33	2.34	2.34	2.34	2.18	2.33	2.34	2.34	2.34	2.18	2.43	2.55	2.55	2.55	1.81								
NBC_MHEPL_252	337091	6258125	0.74	2.71	0.07	1.51	1.81	2.54	2.17	2.33	2.34	2.34	2.34	2.17	2.33	2.34	2.34	2.34	2.17	2.42	2.54	2.54	2.54	1.81								
NBC_MHEPL_253	337136	6258117	0.73	2.71	0.07	1.51	1.81	2.54	2.17	2.32	2.33	2.33	2.33	2.17	2.33	2.34	2.34	2.34	2.17	2.42	2.54	2.54	2.54	1.81								
NBC_MHEPL_254	337178	6258109	0.72	2.40	0.07	1.51	1.81	2.53	2.17	2.32	2.32	2.32	2.32	2.17	2.27	2.27	2.27	2.27	2.17	2.42	2.53	2.53	2.53	1.81								
NBC_MHEPL_255	337227	6258153	0.72	2.40	0.07	1.51	1.81	2.52	2.16	2.32	2.32	2.32	2.32	2.16	2.27	2.27	2.27	2.27	2.16	2.41	2.52	2.52	2.52	1.81								
NBC_MHEPL_256	337268	6258148	0.71	2.40	0.06	1.50	1.80	2.52	2.16	2.31	2.32	2.32	2.32	2.16	2.27	2.27	2.27	2.27	2.16	2.41	2.52	2.52	2.52	1.80								
NBC_MHEPL_257	337311	6258143	0.72	2.40	0.06	1.50	1.80	2.53	2.17	2.32	2.32	2.32	2.32	2.17	2.27	2.27	2.27	2.27	2.17	2.42	2.53	2.53	2.53	1.80								
NBC_MHEPL_258	337359	6258191	0.75	2.40	0.07	1.51	1.81	2.55	2.18	2.33	2.34	2.34	2.34	2.18	2.28	2.28	2.28	2.28	2.18	2.43	2.55	2.55	2.55	1.81								
NBC_MHEPL_259	337364	6258242	0.75	2.40	0.07	1.51	1.81	2.56	2.19	2.34	2.35	2.35	2.35	2.19	2.29	2.29	2.29	2.29	2.19	2.43	2.56	2.56	2.56	1.81								
NBC_MHEPL_260	337411	6258289	0.75	2.40	0.07	1.51	1.81	2.56	2.18	2.33	2.35	2.35	2.35	2.18	2.29	2.29	2.29	2.29	2.18	2.43	2.56	2.56	2.56	1.81								
NBC_MHEPL_261	337414	6258339	0.72	2.40	0.07	1.51	1.81	2.53	2.17	2.32	2.33	2.33	2.33	2.17	2.28	2.28	2.28	2.28	2.17	2.42	2.53	2.53	2.53	1.81								
NBC_MHEPL_262	337456	6258337	0.73	2.40	0.07	1.51	1.81	2.54	2.18	2.33	2.34	2.34	2.34	2.18	2.28	2.28	2.28	2.28	2.18	2.42	2.54	2.54	2.54	1.81								
NBC_MHEPL_263	337500	6258387	0.76	2.40	0.07	1.51	1.81	2.57	2.19	2.34	2.36	2.36	2.36	2.19	2.29	2.29	2.29	2.29	2.19	2.44	2.57	2.57	2.57	1.81								
NBC_MHEPL_264	337543	6258385	0.80	2.71	0.07	1.51	1.81	2.61	2.21	2.36	2.39	2.39	2.39	2.21	2.35	2.37	2.37	2.37	2.21	2.46	2.61	2.61	2.61	1.81								
NBC_MHEPL_265	337585	6258436	0.84	2.71	0.08	1.52	1.82	2.65	2.23	2.38	2.42	2.42	2.42	2.23	2.36	2.38	2.38	2.38	2.23	2.48	2.65	2.65	2.65	1.82								
NBC_MHEPL_266	337623	6258383	0.86	2.71	0.07	1.51	1.81	2.68	2.25	2.40	2.44	2.44	2.44	2.25	2.37	2.39	2.39	2.39	2.25	2.49	2.68	2.68	2.68	1.81								
NBC_MHEPL_267	337664	6258384	0.87	2.71	0.07	1.51	1.81	2.68	2.25	2.40	2.44	2.44	2.44	2.25	2.37	2.39	2.39	2.39	2.25	2.50	2.68	2.68	2.68	1.81								
NBC_MHEPL_268	337705	6258383	0.87	3.08	0.07	1.51	1.81	2.68	2.25	2.40	2.44	2.44	2.44	2.25	2.41	2.47	2.47	2.47	2.25	2.49	2.68	2.68	2.68	1.81								
NBC_MHEPL_269	337746	6258383	0.86	3.08	0.07	1.51	1.81	2.67	2.24	2.39	2.43	2.43	2.43	2.24	2.41	2.47	2.47	2.47	2.24	2.49	2.67	2.67	2.67	1.81								
NBC_MHEPL_270	337785	6258382	0.86	3.08	0.07	1.51	1.81	2.67	2.24	2.39	2.43	2.43	2.43	2.24	2.41	2.47	2.47	2.47	2.24	2.49	2.67	2.67	2.67	1.81								
NBC_MHEPL_271	337824	6258382	0.85	3.08	0.07	1.51	1.81	2.66	2.24	2.39	2.43	2.43	2.43	2.24	2.41	2.46	2.46	2.46	2.24	2.49	2.66	2.66	2.66	1.81								
NBC_MHEPL_272	337862	6258433	0.85	3.08	0.07	1.51	1.81	2.67	2.24	2.39	2.43	2.43	2.43	2.24	2.41	2.46	2.46	2.46	2.24	2.49	2.67	2.67	2.67	1.81								
NBC_MHEPL_273	337899	6258433	0.85	3.08	0.07	1.51	1.81	2.66	2.24	2.39	2.43	2.43	2.43	2.24	2.41	2.46	2.46	2.46	2.24	2.49	2.66	2.66	2.66	1.81								
NBC_MHEPL_274	337937	6258433	0.84	3.08	0.07	1.51	1.81	2.65	2.23	2.38	2.42	2.42	2.42	2.23	2.40	2.46	2.46	2.46	2.23	2.48	2.65	2.65	2.65	1.81								
NBC_MHEPL_275	337976	6258433	0.80	2.71	0.07	1.51	1.81	2.62	2.21	2.36	2.39	2.39	2.39	2.21	2.35	2.37	2.37	2.37	2.21	2.46	2.62	2.62	2.62	1.81								
NBC_MHEPL_276	337938	6258381	0.83	2.71	0.07	1.51	1.81	2.64	2.23	2.38	2.41	2.41	2.41	2.23	2.36	2.38	2.38	2.38	2.23	2.47	2.64	2.64	2.64	1.81								
NBC_MHEPL_277	337938	6258329	0.84	2.71	0.07	1.51	1.81	2.65	2.23	2.38	2.41	2.41	2.41	2.23	2.36	2.38	2.38	2.38	2.23	2.48	2.65	2.65	2.65	1.81								
NBC_MHEPL_278	337977	6258276	0.84	2.71	0.07	1.51	1.81	2.65	2.23	2.38	2.41	2.41	2.41	2.23	2.36	2.38	2.38	2.38	2.23	2.48	2.65	2.65	2.65	1.81								
NBC_MHEPL_279	338016	6258276	0.83	2.71	0.07	1.51	1.81	2.64	2.22	2.37	2.40	2.40	2.40	2.22	2.36	2.38	2.38	2.38	2.22	2.47	2.64	2.64	2.64	1.81								
NBC_MHEPL_280	338055	6258276	0.82	2.71	0.07	1.51	1.81	2.63	2.22	2.37	2.40	2.40	2.40	2.22	2.35	2.37	2.37	2.37	2.22	2.47	2.63	2.63	2.63	1.81								
NBC_MHEPL_281	338094	6258276	0.80	2.71	0.07	1.51	1.81	2.61	2.21	2.36	2.38	2.38	2.38	2.21	2.35	2.37	2.37	2.37	2.21	2.46	2.61	2.61	2.61	1.81								
NBC_MHEPL_282	338217	6258276	0.69	2.40	0.08	1.52	1.82	2.50	2.16	2.31	2.31	2.31	2.31	2.16	2.27	2.27	2.27	2.27	2.16	2.40	2.50	2.50	2.50	1.82								
NBC_MHEPL_283	338175	6258222	0.72	2.40	0.07	1.51	1.81	2.53	2.17	2.32	2.33	2.33	2.33	2.17	2.28	2.28	2.28	2.28	2.17	2.42	2.53	2.53	2.53	1.81								
NBC_MHEPL_284	338218	6258222	0.71	2.40	0.07	1.51	1.81	2.52	2.17	2.32	2.33	2.33	2.33	2.17	2.28	2.28	2.28	2.28	2.17	2.41	2.52	2.52	2.52	1.81								
NBC_MHEPL_285	338218	6258167	0.68	2.40	0.07	1.51	1.81	2.49	2.15	2.30	2.30	2.30	2.30	2.15	2.27	2.27	2.27	2.27	2.15	2.40	2.49	2.49	2.49	1.81								

100yr ARI Planning Levels - 0m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.00** m sea level rise projection
Freeboard of **0.3** m included in EPLs

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																	REDUCTION FACTORS NOT CALCULATED FOR 2010 LEVELS AS THE 0m SLR LEVELS ARE NOT BEING USED FOR PLANNING PURPOSES							
			Wave			Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)	Max EPL of all Foreshore Types and Crest Levels (mAHD)	Foreshore Type ##																							
									1					2					3					4								
					Local Wind Setup* (m)				Crest Level (mAHD)																							
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)		0 m Sea Level Projection	0 m Sea Level Projection		1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_286	338218	6258112	0.65	2.40	0.07	1.51	1.81	2.45	2.13	2.27	2.27	2.27	2.27	2.13	2.25	2.25	2.25	2.25	2.13	2.38	2.45	2.45	2.45	1.81								
NBC_MHEPL_287	338217	6258055	0.62	2.40	0.07	1.51	1.81	2.43	2.12	2.26	2.26	2.26	2.26	2.12	2.24	2.24	2.24	2.24	2.12	2.37	2.43	2.43	2.43	1.81								
NBC_MHEPL_288	338174	6258056	0.65	2.40	0.07	1.51	1.81	2.46	2.13	2.27	2.27	2.27	2.27	2.13	2.25	2.25	2.25	2.25	2.13	2.38	2.46	2.46	2.46	1.81								
NBC_MHEPL_289	338131	6258003	0.69	2.40	0.07	1.51	1.81	2.49	2.15	2.30	2.30	2.30	2.30	2.15	2.26	2.26	2.26	2.26	2.15	2.40	2.49	2.49	2.49	1.81								
NBC_MHEPL_290	338129	6257949	0.73	2.71	0.06	1.50	1.80	2.53	2.17	2.32	2.33	2.33	2.33	2.17	2.32	2.34	2.34	2.34	2.17	2.42	2.53	2.53	2.53	1.80								
NBC_MHEPL_291	338090	6257950	0.76	2.71	0.07	1.51	1.81	2.57	2.19	2.34	2.36	2.36	2.36	2.19	2.34	2.35	2.35	2.35	2.19	2.44	2.57	2.57	2.57	1.81								
NBC_MHEPL_292	338088	6257896	0.79	3.08	0.07	1.51	1.81	2.60	2.20	2.35	2.38	2.38	2.38	2.20	2.39	2.43	2.43	2.43	2.20	2.45	2.60	2.60	2.60	1.81								
NBC_MHEPL_293	338087	6257842	0.81	3.08	0.06	1.50	1.80	2.62	2.21	2.36	2.39	2.39	2.39	2.21	2.39	2.44	2.44	2.44	2.21	2.46	2.62	2.62	2.62	1.80								
NBC_MHEPL_294	338085	6257788	0.82	3.08	0.06	1.50	1.80	2.63	2.22	2.37	2.40	2.40	2.40	2.22	2.39	2.44	2.44	2.44	2.22	2.47	2.63	2.63	2.63	1.80								
NBC_MHEPL_295	338123	6257732	0.83	3.08	0.06	1.50	1.80	2.63	2.21	2.37	2.40	2.40	2.40	2.21	2.39	2.44	2.44	2.44	2.21	2.47	2.63	2.63	2.63	1.80								
NBC_MHEPL_296	338165	6257731	0.83	3.08	0.06	1.50	1.80	2.63	2.22	2.37	2.40	2.40	2.40	2.22	2.39	2.44	2.44	2.44	2.22	2.47	2.63	2.63	2.63	1.80								
NBC_MHEPL_297	338208	6257676	0.83	3.08	0.06	1.50	1.80	2.63	2.22	2.37	2.40	2.40	2.40	2.22	2.39	2.44	2.44	2.44	2.22	2.47	2.63	2.63	2.63	1.80								
NBC_MHEPL_298	338207	6257623	0.83	3.08	0.06	1.50	1.80	2.63	2.22	2.37	2.40	2.40	2.40	2.22	2.39	2.44	2.44	2.44	2.22	2.47	2.63	2.63	2.63	1.80								
NBC_MHEPL_299	338257	6257622	0.83	3.08	0.06	1.50	1.80	2.62	2.22	2.37	2.39	2.39	2.39	2.22	2.39	2.44	2.44	2.44	2.22	2.47	2.62	2.62	2.62	1.80								
NBC_MHEPL_300	338309	6257567	0.82	3.08	0.06	1.50	1.80	2.62	2.22	2.36	2.39	2.39	2.39	2.22	2.39	2.44	2.44	2.44	2.22	2.46	2.62	2.62	2.62	1.80								
NBC_MHEPL_301	338309	6257513	0.85	3.08	0.05	1.49	1.79	2.64	2.23	2.37	2.40	2.40	2.40	2.23	2.40	2.44	2.44	2.44	2.23	2.47	2.64	2.64	2.64	1.79								
NBC_MHEPL_302	338310	6257458	0.86	3.08	0.05	1.49	1.79	2.65	2.23	2.38	2.41	2.41	2.41	2.23	2.40	2.45	2.45	2.45	2.24	2.48	2.65	2.65	2.65	1.79								
NBC_MHEPL_303	338311	6257403	0.88	3.08	0.05	1.49	1.79	2.67	2.24	2.39	2.43	2.43	2.43	2.24	2.41	2.46	2.46	2.46	2.25	2.49	2.67	2.67	2.67	1.79								
NBC_MHEPL_304	338365	6257403	0.89	3.08	0.06	1.50	1.80	2.68	2.25	2.39	2.43	2.43	2.43	2.25	2.41	2.46	2.46	2.46	2.25	2.49	2.68	2.68	2.68	1.80								
NBC_MHEPL_305	338421	6257402	0.89	3.08	0.06	1.50	1.80	2.68	2.25	2.40	2.44	2.44	2.44	2.25	2.41	2.46	2.46	2.46	2.25	2.50	2.68	2.68	2.68	1.80								
NBC_MHEPL_306	338478	6257402	0.88	3.08	0.06	1.50	1.80	2.68	2.24	2.40	2.44	2.44	2.44	2.24	2.41	2.46	2.46	2.46	2.24	2.50	2.68	2.68	2.68	1.80								
NBC_MHEPL_307	338536	6257402	0.89	3.08	0.06	1.50	1.80	2.69	2.25	2.40	2.44	2.44	2.44	2.25	2.41	2.47	2.47	2.47	2.25	2.50	2.69	2.69	2.69	1.80								
NBC_MHEPL_308	338536	6257346	0.90	3.08	0.06	1.50	1.80	2.70	2.25	2.40	2.45	2.45	2.45	2.25	2.42	2.47	2.47	2.47	2.25	2.50	2.70	2.70	2.70	1.80								
NBC_MHEPL_309	338593	6257346	0.89	3.08	0.06	1.50	1.80	2.69	2.25	2.40	2.44	2.44	2.44	2.25	2.42	2.47	2.47	2.47	2.25	2.50	2.69	2.69	2.69	1.80								
NBC_MHEPL_310	338649	6257345	0.88	3.08	0.06	1.50	1.80	2.69	2.25	2.40	2.44	2.44	2.44	2.25	2.41	2.47	2.47	2.47	2.25	2.50	2.69	2.69	2.69	1.80								
NBC_MHEPL_311	338704	6257345	0.88	3.08	0.07	1.51	1.81	2.68	2.25	2.40	2.44	2.44	2.44	2.25	2.41	2.47	2.47	2.47	2.25	2.50	2.68	2.68	2.68	1.81								
NBC_MHEPL_312	338757	6257344	0.87	3.08	0.07	1.51	1.81	2.68	2.24	2.40	2.44	2.44	2.44	2.24	2.41	2.47	2.47	2.47	2.24	2.49	2.68	2.68	2.68	1.81								
NBC_MHEPL_313	338809	6257344	0.85	3.08	0.07	1.51	1.81	2.66	2.24	2.39	2.43	2.43	2.43	2.24	2.41	2.46	2.46	2.46	2.24	2.49	2.66	2.66	2.66	1.81								
NBC_MHEPL_314	338861	6257289	0.84	3.08	0.07	1.51	1.81	2.65	2.23	2.38	2.41	2.41	2.41	2.23	2.40	2.46	2.46	2.46	2.23	2.48	2.65	2.65	2.65	1.81								
NBC_MHEPL_315	338862	6257232	0.83	2.71	0.06	1.50	1.80	2.63	2.22	2.37	2.40	2.40	2.40	2.22	2.35	2.37	2.37	2.37	2.22	2.47	2.63	2.63	2.63	1.80								
NBC_MHEPL_316	338912	6257172	0.83	2.71	0.06	1.50	1.80	2.63	2.22	2.37	2.39	2.39	2.39	2.22	2.35	2.36	2.36	2.36	2.22	2.47	2.63	2.63	2.63	1.80								
NBC_MHEPL_317	338910	6257109	0.81	2.71	0.05	1.49	1.79	2.61	2.21	2.36	2.38	2.38	2.38	2.21	2.34	2.36	2.36	2.36	2.21	2.46	2.61	2.61	2.61	1.79								
NBC_MHEPL_318	338958	6257106	0.80	2.71	0.05	1.49	1.79	2.59	2.20	2.35	2.37	2.37	2.37	2.20	2.34	2.35	2.35	2.35	2.20	2.45	2.59	2.59	2.59	1.79								
NBC_MHEPL_319	338955	6257045	0.77	2.71	0.05	1.49	1.79	2.56	2.19	2.33	2.35	2.35	2.35	2.19	2.33	2.34	2.34	2.34	2.19	2.43	2.56	2.56	2.56	1.79								
NBC_MHEPL_320	338951	6256989	0.77	2.71	0.04	1.48	1.78	2.55	2.18	2.33	2.34	2.34	2.34	2.18	2.32	2.33	2.33	2.33	2.18	2.43	2.55	2.55	2.55	1.78								
NBC_MHEPL_321	338949	6256938	0.77	2.71	0.04	1.48	1.78	2.55	2.18	2.33	2.34	2.34	2.34	2.18	2.32	2.33	2.33	2.33	2.18	2.43	2.55	2.55	2.55	1.78								
NBC_MHEPL_322	338947	6256887	0.78	2.71	0.04	1.48	1.78	2.56	2.18	2.33	2.34	2.34	2.34	2.18	2.32	2.33	2.33	2.33	2.19	2.43	2.56	2.56	2.56	1.78								
NBC_MHEPL_323	338946	6256837	0.78	2.71	0.03	1.47	1.77	2.56	2.18	2.33	2.34	2.34	2.34	2.18	2.32	2.32	2.32	2.32	2.19	2.43	2.56	2.56	2.56	1.77								
NBC_MHEPL_324	338945	6256787	0.80	2.71	0.04	1.48	1.78	2.58	2.19	2.34	2.35	2.35	2.35	2.19	2.33	2.33	2.33	2.33	2.20	2.44	2.58	2.58	2.58	1.78								
NBC_MHEPL_325	338945	6256736	0.86	2.71	0.03	1.47	1.77	2.63	2.21	2.36	2.39	2.39	2.39	2.21	2.33	2.34	2.34	2.34	2.22	2.47	2.63	2.63	2.63	1.77								
NBC_MHEPL_326	339045	6256633	0.89	2.71	0.03	1.47	1.77	2.66	2.23	2.38	2.41	2.41	2.41	2.23	2.34	2.36	2.36	2.36	2.24	2.48	2.66	2.66	2.66	1.77								
NBC_MHEPL_327	339096	6256633	0.90	2.71	0.03	1.47	1.77	2.67	2.23	2.38	2.42	2.42	2.42	2.23	2.35	2.36	2.36	2.36	2.24	2.49	2.67	2.67	2.67	1.77								
NBC_MHEPL_328	339147	6256633	0.90	2.71	0.03	1.47	1.77	2.67	2.24	2.38	2.42	2.42	2.42	2.24	2.35	2.36	2.36	2.36	2.24	2.49	2.67	2.67	2.67	1.77								
NBC_MHEPL_329	339198	6256632	0.92	2.71	0.03	1.47	1.77	2.68	2.24	2.39	2.43	2.43	2.43	2.24	2.35	2.36	2.36	2.36	2.25	2.50	2.68	2.68	2.68	1.77								
NBC_MHEPL_330	339248	6256632	0.93	2.71	0.03	1.47	1.77	2.70	2.25	2.40	2.44	2.44	2.44	2.25	2.35	2.37	2.37	2.37	2.26	2.50	2.70	2.70	2.70	1.77								
NBC_MHEPL_331	339249	6256682	0.96	3.08	0.03	1.47	1.77	2.72	2.26	2.41	2.46	2.46	2.46	2.26	2.41	2.46	2.46	2.46	2.27	2.52	2.72	2.72	2.72	1.77								
NBC_MHEPL_332	339300	6256732	0.98	3.08	0.03	1.47	1.77	2.75	2.28	2.42	2.47	2.47	2.47	2.28	2.42	2.47	2.47	2.47	2.28	2.53	2.75	2.75	2.75	1.77								
NBC_MHEPL_333	339300	6256782	0.99	3.08	0.03	1.47	1.77	2.76	2.28	2.43	2.48	2.48	2.48	2.28	2.42	2.47	2.47	2.47	2.29	2.54	2.76	2.76	2.76	1.77								
NBC_MHEPL_334	339301	6256832	0.99	3.08	0.03	1.47	1.77	2.76	2.29	2.43	2.49	2.49	2.49	2.29	2.43	2.47	2.47	2.47	2.29	2.54	2.76	2.76	2.76	1.77								
NBC_MHEPL_335	339301	6256881	0.97	3.08	0.03	1.47	1.77	2.74	2.27	2.42	2.47	2.47	2.47	2.27	2.42	2.47	2.47	2.47	2.28	2.53	2.74	2.74	2.74	1.77								
NBC_MHEPL_336	339302	6256931	0.97	3.08	0.03	1.47	1.77	2.74	2.28	2.42	2.47	2.47	2.47	2.28	2.42	2.47	2.47	2.47	2.28	2.53	2.74	2.74	2.74	1.77								
NBC_MHEPL_337	339302	6256980	1.00	3.08	0.04	1.48	1.78	2.78	2.29	2.44	2.50	2.50	2.50	2.29	2.43	2.48	2.48	2.48	2.30	2.54	2.78	2.78	2.78	1.78								
NBC_MHEPL_338	339353	6256980	1.03	3.08	0.03	1.47	1.77	2.80	2.31	2.45	2.51	2.51	2.51	2.31	2.44	2.49	2.49	2.49	2.31	2.56	2.80	2.80	2.80	1.77								
NBC_MHEPL_339	339403	6257029	1.03	3.48	0.04	1.48	1.78	2.81	2.31	2.45	2.52	2.52	2.52	2.31	2.49	2.59	2.59	2.59	2.31	2.56	2.80	2.81	2.81	1.78								
NBC_MHEPL_340	339404	6257079	1.07	3.48	0.04	1.48	1.78	2.85	2.33	2.48	2.55	2.55	2.55	2.33	2.50	2.61	2.61	2.61	2.33	2.58	2.82	2.85	2.85	1.78								
NBC_MHEPL_341	339454	6257079	1.05	3.48	0.04	1.48	1.78	2.83	2.32	2.47	2.53	2.53	2.53	2.32	2.50	2.60	2.60	2.60	2.32	2.57	2.81	2.83	2.83	1.78								
NBC_MHEPL_342	339554	6257129	1.08	3.48	0.03	1.47	1.77	2.85	2.33	2.48	2.55	2.55	2.55	2.33	2.50	2.61	2.61	2.61	2.34	2.58	2.83	2.85	2.85	1.77								

100yr ARI Planning Levels - 0m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.00** m sea level rise projection
Freeboard of **0.3** m included in EPLs

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																
			Wave						Foreshore Type ##															
									1					2					3					4
									Crest Level (mAHD)															
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	Local (Still) Water Level (mAHD) 0 m Sea Level Projection	Local (Still) Water Level with 0.3m Freeboard (mAHD) 0 m Sea Level Projection	Max EPL of all Foreshore Types and Crest Levels (mAHD)	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A
NBC_MHEPL_343	339654	6257178	1.13	3.48	0.03	1.47	1.77	2.90	2.36	2.50	2.59	2.59	2.59	2.36	2.52	2.63	2.63	2.63	2.36	2.61	2.85	2.90	2.90	1.77
NBC_MHEPL_344	339704	6257178	1.17	3.48	0.03	1.47	1.77	2.94	2.38	2.52	2.61	2.61	2.61	2.38	2.54	2.64	2.64	2.64	2.38	2.63	2.87	2.94	2.94	1.77
NBC_MHEPL_345	339754	6257228	1.19	3.48	0.04	1.48	1.78	2.96	2.39	2.53	2.63	2.63	2.63	2.39	2.54	2.65	2.65	2.65	2.39	2.64	2.88	2.96	2.96	1.78
NBC_MHEPL_346	339804	6257278	1.15	3.48	0.04	1.48	1.78	2.93	2.37	2.52	2.61	2.61	2.61	2.37	2.53	2.64	2.64	2.64	2.38	2.62	2.87	2.93	2.93	1.78
NBC_MHEPL_347	339804	6257328	1.14	3.48	0.04	1.48	1.78	2.92	2.37	2.52	2.60	2.60	2.60	2.37	2.53	2.64	2.64	2.64	2.37	2.62	2.86	2.92	2.92	1.78
NBC_MHEPL_348	339804	6257378	1.13	3.48	0.05	1.49	1.79	2.92	2.37	2.51	2.60	2.60	2.60	2.37	2.53	2.64	2.64	2.64	2.37	2.62	2.86	2.92	2.92	1.79
NBC_MHEPL_349	339854	6257379	1.17	3.48	0.05	1.49	1.79	2.96	2.39	2.53	2.63	2.63	2.63	2.39	2.55	2.66	2.66	2.66	2.39	2.64	2.88	2.96	2.96	1.79
NBC_MHEPL_350	339904	6257379	1.17	3.48	0.05	1.49	1.79	2.96	2.39	2.53	2.63	2.63	2.63	2.39	2.55	2.66	2.66	2.66	2.39	2.64	2.88	2.96	2.96	1.79
NBC_MHEPL_351	339954	6257379	1.22	3.48	0.04	1.48	1.78	3.00	2.41	2.56	2.66	2.66	2.66	2.41	2.56	2.67	2.67	2.67	2.41	2.66	2.90	3.00	3.00	1.78
NBC_MHEPL_352	340004	6257329	1.23	3.95	0.04	1.48	1.78	3.01	2.42	2.56	2.67	2.67	2.67	2.42	2.61	2.80	2.81	2.81	2.42	2.66	2.91	3.01	3.01	1.78
NBC_MHEPL_353	340105	6257279	1.20	3.48	0.03	1.47	1.77	2.97	2.39	2.54	2.63	2.63	2.63	2.39	2.54	2.65	2.65	2.65	2.40	2.64	2.89	2.97	2.97	1.77
NBC_MHEPL_354	340155	6257229	1.33	3.95	0.02	1.46	1.76	3.09	2.45	2.60	2.72	2.72	2.72	2.45	2.64	2.82	2.83	2.83	2.46	2.70	2.95	3.09	3.09	1.76
NBC_MHEPL_355	340205	6257229	1.37	3.95	0.02	1.46	1.76	3.13	2.47	2.62	2.75	2.75	2.75	2.47	2.65	2.83	2.84	2.84	2.48	2.72	2.97	3.13	3.13	1.76
NBC_MHEPL_356	340255	6257279	1.40	3.95	0.03	1.47	1.77	3.17	2.49	2.64	2.78	2.78	2.78	2.49	2.67	2.84	2.86	2.86	2.50	2.74	2.99	3.17	3.17	1.77
NBC_MHEPL_357	340305	6257329	1.44	3.95	0.03	1.47	1.77	3.21	2.51	2.66	2.80	2.81	2.81	2.51	2.68	2.85	2.88	2.88	2.52	2.76	3.01	3.21	3.21	1.77
NBC_MHEPL_358	340305	6257380	1.44	12.96	0.03	1.47	1.77	4.10	2.53	2.92	3.32	3.71	4.10	2.53	2.89	3.26	3.63	4.00	2.52	2.76	3.01	3.21	3.21	1.77
NBC_MHEPL_359	340355	6257430	1.44	12.96	0.03	1.47	1.77	4.11	2.53	2.92	3.32	3.71	4.11	2.53	2.89	3.26	3.63	4.00	2.52	2.77	3.01	3.21	3.21	1.77
NBC_MHEPL_360	340355	6257480	1.44	3.95	0.03	1.47	1.77	3.22	2.52	2.66	2.81	2.81	2.81	2.52	2.69	2.86	2.88	2.88	2.52	2.77	3.01	3.22	3.22	1.77
NBC_MHEPL_361	340355	6257530	1.44	3.95	0.04	1.48	1.78	3.22	2.52	2.66	2.81	2.81	2.81	2.52	2.69	2.86	2.89	2.89	2.52	2.77	3.01	3.22	3.22	1.78
NBC_MHEPL_362	340406	6257579	1.44	3.95	0.04	1.48	1.78	3.22	2.52	2.66	2.81	2.81	2.81	2.52	2.69	2.86	2.89	2.89	2.52	2.77	3.01	3.22	3.22	1.78
NBC_MHEPL_363	340406	6257629	1.44	3.95	0.04	1.48	1.78	3.22	2.52	2.66	2.81	2.81	2.81	2.52	2.69	2.86	2.89	2.89	2.52	2.77	3.01	3.22	3.22	1.78
NBC_MHEPL_364	340406	6257679	1.44	3.95	0.04	1.48	1.78	3.22	2.52	2.67	2.81	2.82	2.82	2.52	2.69	2.86	2.89	2.89	2.52	2.77	3.01	3.22	3.22	1.78
NBC_MHEPL_365	340406	6257728	1.36	3.95	0.04	1.48	1.78	3.14	2.48	2.63	2.76	2.76	2.76	2.48	2.66	2.84	2.86	2.86	2.48	2.73	2.97	3.14	3.14	1.78
NBC_MHEPL_366	340406	6257778	1.30	3.95	0.04	1.48	1.78	3.08	2.45	2.59	2.72	2.72	2.72	2.45	2.64	2.82	2.83	2.83	2.45	2.70	2.94	3.08	3.08	1.78
NBC_MHEPL_367	340406	6257828	1.22	3.95	0.04	1.48	1.78	3.00	2.41	2.56	2.66	2.66	2.66	2.41	2.61	2.80	2.80	2.80	2.41	2.66	2.90	3.00	3.00	1.78
NBC_MHEPL_368	340356	6257828	0.94	3.95	0.04	1.48	1.78	2.71	2.26	2.41	2.45	2.45	2.45	2.26	2.50	2.67	2.67	2.67	2.27	2.51	2.71	2.71	2.71	1.78
NBC_MHEPL_369	340306	6257878	0.78	3.95	0.04	1.48	1.78	2.60	2.19	2.36	2.39	2.39	2.39	2.19	2.44	2.60	2.60	2.60	2.19	2.43	2.56	2.56	2.56	1.78
NBC_MHEPL_370	340256	6257878	0.79	3.95	0.04	1.48	1.78	2.60	2.19	2.36	2.39	2.39	2.39	2.19	2.45	2.60	2.60	2.60	2.19	2.44	2.57	2.57	2.57	1.78
NBC_MHEPL_371	340256	6257928	0.84	3.95	0.04	1.48	1.78	2.63	2.22	2.38	2.42	2.42	2.42	2.22	2.46	2.63	2.63	2.63	2.22	2.46	2.62	2.62	2.62	1.78
NBC_MHEPL_372	340206	6258029	0.80	3.95	0.04	1.48	1.78	2.61	2.20	2.37	2.40	2.40	2.40	2.20	2.45	2.61	2.61	2.61	2.20	2.45	2.59	2.59	2.59	1.78
NBC_MHEPL_373	340156	6258029	0.72	3.95	0.04	1.48	1.78	2.57	2.16	2.34	2.37	2.37	2.37	2.16	2.43	2.57	2.57	2.57	2.16	2.40	2.50	2.50	2.50	1.78
NBC_MHEPL_374	340106	6258129	0.89	15.35	0.04	1.48	1.78	3.90	2.25	2.66	3.07	3.48	3.90	2.25	2.62	2.98	3.35	3.49	2.24	2.49	2.67	2.67	2.67	1.78
NBC_MHEPL_375	340056	6258179	1.01	14.36	0.04	1.48	1.78	3.96	2.31	2.72	3.14	3.55	3.96	2.31	2.68	3.05	3.41	3.73	2.31	2.55	2.80	2.80	2.80	1.78
NBC_MHEPL_376	340006	6258179	1.08	14.40	0.04	1.48	1.78	3.99	2.34	2.76	3.17	3.58	3.99	2.34	2.71	3.08	3.45	3.81	2.34	2.59	2.83	2.86	2.86	1.78
NBC_MHEPL_377	340006	6258229	1.45	14.40	0.05	1.49	1.79	4.16	2.54	2.94	3.35	3.76	4.16	2.54	2.90	3.27	3.64	4.01	2.53	2.78	3.02	3.24	3.24	1.79
NBC_MHEPL_378	339956	6258229	1.45	14.40	0.05	1.49	1.79	4.16	2.54	2.94	3.35	3.76	4.16	2.54	2.90	3.27	3.64	4.01	2.53	2.78	3.02	3.24	3.24	1.79
NBC_MHEPL_379	339906	6258279	1.45	14.29	0.05	1.49	1.79	4.16	2.54	2.94	3.35	3.76	4.16	2.54	2.90	3.27	3.64	4.01	2.54	2.78	3.03	3.24	3.24	1.79
NBC_MHEPL_380	339906	6258329	1.45	13.65	0.05	1.49	1.79	4.14	2.54	2.94	3.34	3.74	4.14	2.54	2.90	3.27	3.64	4.01	2.54	2.78	3.03	3.24	3.24	1.79
NBC_MHEPL_381	339906	6258379	1.45	12.19	0.05	1.49	1.79	4.08	2.54	2.92	3.31	3.69	4.08	2.54	2.91	3.27	3.64	4.01	2.54	2.78	3.03	3.24	3.24	1.79
NBC_MHEPL_382	339906	6258429	1.45	13.63	0.05	1.49	1.79	4.14	2.54	2.94	3.34	3.74	4.14	2.54	2.91	3.27	3.64	4.01	2.54	2.78	3.03	3.24	3.24	1.79
NBC_MHEPL_383	339856	6258479	1.45	13.23	0.05	1.49	1.79	4.12	2.54	2.94	3.33	3.73	4.12	2.54	2.91	3.27	3.64	4.01	2.54	2.78	3.03	3.25	3.25	1.79
NBC_MHEPL_384	339856	6258529	1.46	14.89	0.06	1.50	1.80	4.18	2.54	2.95	3.36	3.77	4.18	2.54	2.91	3.28	3.64	4.01	2.54	2.79	3.03	3.25	3.25	1.80
NBC_MHEPL_385	339806	6258579	1.46	13.95	0.06	1.50	1.80	4.15	2.54	2.95	3.35	3.75	4.15	2.54	2.91	3.28	3.65	4.01	2.54	2.79	3.03	3.26	3.26	1.80
NBC_MHEPL_386	339806	6258629	1.46	14.41	0.06	1.50	1.80	4.17	2.53	2.95	3.36	3.76	4.17	2.53	2.91	3.28	3.65	4.01	2.53	2.79	3.04	3.26	3.26	1.80
NBC_MHEPL_387	339756	6258629	1.46	13.13	0.06	1.50	1.80	4.13	2.53	2.94	3.34	3.73	4.13	2.53	2.91	3.28	3.65	4.01	2.53	2.79	3.04	3.26	3.26	1.80
NBC_MHEPL_388	339756	6258679	1.46	13.79	0.07	1.51	1.81	4.15	2.54	2.95	3.35	3.75	4.15	2.54	2.92	3.28	3.65	4.02	2.54	2.79	3.04	3.27	3.27	1.81
NBC_MHEPL_389	339706	6258729	1.46	13.39	0.07	1.51	1.81	4.14	2.54	2.94	3.34	3.74	4.14	2.54	2.92	3.28	3.65	4.02	2.54	2.79	3.04	3.27	3.27	1.81
NBC_MHEPL_390	339656	6258729	1.46	13.13	0.06	1.50	1.80	4.13	2.54	2.94	3.34	3.73	4.13	2.54	2.91	3.28	3.65	4.02	2.54	2.79	3.04	3.27	3.27	1.80
NBC_MHEPL_391	339606	6258779	1.47	14.30	0.07	1.51	1.81	4.17	2.54	2.95	3.36	3.77	4.17	2.54	2.92	3.28	3.65	4.02	2.54	2.80	3.04	3.28	3.28	1.81
NBC_MHEPL_392	339556	6258779	1.47	13.13	0.07	1.51	1.81	4.13	2.54	2.95	3.34	3.73	4.13	2.54	2.92	3.29	3.65	4.02	2.54	2.80	3.04	3.28	3.28	1.81
NBC_MHEPL_393	339506	6258729	1.45	13.13	0.05	1.49	1.79	4.12	2.54	2.94	3.33	3.73	4.12	2.54	2.91	3.27	3.64	4.01	2.54	2.78	3.03	3.25	3.25	1.79
NBC_MHEPL_394	339456	6258779	1.42	13.21	0.00	1.44	1.74	4.10	2.51	2.91	3.31	3.70	4.10	2.51	2.87	3.24	3.61	3.98	2.49	2.74	2.98	3.16	3.16	1.74
NBC_MHEPL_395	339506	6258779	1.47	14.28	0.07	1.51	1.81	4.17	2.55	2.96	3.36	3.77	4.17	2.55	2.92	3.29	3.65	4.02	2.55	2.80	3.05	3.28	3.28	1.81
NBC_MHEPL_396	339556	6258829	1.47	13.49	0.08	1.52	1.82	4.15	2.56	2.95	3.35	3.75	4.15	2.56	2.92	3.29	3.66	4.03	2.56	2.81	3.05	3.29	3.29	1.82
NBC_MHEPL_397	339556	6258829	1.47	12.84	0.08	1.52	1.82	4.12	2.56	2.95	3.34	3.73	4.12	2.56	2.92	3.29	3.66	4.03	2.56	2.81	3.05	3.29	3.29	1.82
NBC_MHEPL_398	339606	6258829	1.47	14.02	0.07	1.51	1.81	4.16	2.55	2.95	3.36	3.76	4.16	2.55	2.92	3.29	3.65	4.02	2.55	2.80	3.05	3.28	3.28	1.81
NBC_MHEPL_399	339656	6258829	1.47	13.65	0.07	1.51	1.81	4.15	2.54	2.95	3.35	3.75	4.15	2.54	2.92	3.28	3.65	4.02	2.54	2.80	3.04	3.28	3.28	1.81

REDUCTION FACTORS NOT CALCULATED FOR 2010 LEVELS AS THE 0m SLR LEVELS ARE NOT BEING USED FOR PLANNING PURPOSES							
5m	10m	15m	20m	25m	30m	35m	40m

100yr ARI Planning Levels - 0m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.00** m sea level rise projection
Freeboard of **0.3** m included in EPLs

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																	REDUCTION FACTORS NOT CALCULATED FOR 2010 LEVELS AS THE 0m SLR LEVELS ARE NOT BEING USED FOR PLANNING PURPOSES							
			Wave			Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)	Max EPL of all Foreshore Types and Crest Levels (mAHD)	Foreshore Type ## 1					2					3					4								
									Crest Level (mAHD)																							
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	0 m Sea Level Projection	0 m Sea Level Projection		1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_400	339706	6258879	1.47	14.06	0.07	1.51	1.81	4.16	2.55	2.96	3.36	3.76	4.16	2.55	2.92	3.29	3.65	4.02	2.55	2.80	3.05	3.28	3.28	1.81								
NBC_MHEPL_401	339706	6258829	1.47	15.28	0.07	1.51	1.81	4.19	2.54	2.96	3.37	3.78	4.19	2.54	2.92	3.28	3.65	4.02	2.54	2.80	3.04	3.27	3.27	1.81								
NBC_MHEPL_402	339706	6258779	1.46	12.98	0.07	1.51	1.81	4.12	2.54	2.94	3.33	3.73	4.12	2.54	2.92	3.28	3.65	4.02	2.54	2.79	3.04	3.27	3.27	1.81								
NBC_MHEPL_403	339756	6258779	1.46	15.28	0.07	1.51	1.81	4.19	2.54	2.96	3.37	3.78	4.19	2.54	2.92	3.28	3.65	4.02	2.54	2.80	3.04	3.27	3.27	1.81								
NBC_MHEPL_404	339806	6258729	1.46	15.28	0.07	1.51	1.81	4.19	2.54	2.96	3.37	3.78	4.19	2.54	2.92	3.28	3.65	4.02	2.54	2.79	3.04	3.27	3.27	1.81								
NBC_MHEPL_405	339856	6258729	1.46	15.28	0.06	1.50	1.80	4.19	2.54	2.96	3.37	3.78	4.19	2.54	2.91	3.28	3.65	4.02	2.54	2.79	3.04	3.27	3.27	1.80								
NBC_MHEPL_406	339906	6258729	1.46	14.88	0.06	1.50	1.80	4.19	2.54	2.96	3.37	3.78	4.19	2.54	2.91	3.28	3.65	4.02	2.54	2.79	3.04	3.27	3.27	1.80								
NBC_MHEPL_407	339956	6258679	1.46	13.49	0.06	1.50	1.80	4.14	2.53	2.94	3.34	3.74	4.14	2.53	2.91	3.28	3.65	4.01	2.53	2.79	3.04	3.26	3.26	1.80								
NBC_MHEPL_408	339956	6258629	1.46	14.38	0.06	1.50	1.80	4.17	2.54	2.95	3.36	3.76	4.17	2.54	2.91	3.28	3.65	4.01	2.54	2.79	3.03	3.26	3.26	1.80								
NBC_MHEPL_409	340006	6258629	1.46	13.61	0.06	1.50	1.80	4.14	2.54	2.94	3.34	3.74	4.14	2.54	2.91	3.28	3.65	4.01	2.54	2.79	3.03	3.26	3.26	1.80								
NBC_MHEPL_410	340056	6258579	1.46	13.37	0.05	1.49	1.79	4.13	2.54	2.94	3.34	3.73	4.13	2.54	2.91	3.28	3.64	4.01	2.54	2.78	3.03	3.25	3.25	1.79								
NBC_MHEPL_411	340106	6258529	1.45	13.36	0.05	1.49	1.79	4.13	2.54	2.94	3.33	3.73	4.13	2.54	2.91	3.27	3.64	4.01	2.54	2.78	3.03	3.25	3.25	1.79								
NBC_MHEPL_412	340156	6258529	1.45	13.36	0.05	1.49	1.79	4.13	2.54	2.94	3.33	3.73	4.13	2.54	2.91	3.27	3.64	4.01	2.54	2.78	3.03	3.24	3.24	1.79								
NBC_MHEPL_413	340206	6258529	1.45	13.36	0.05	1.49	1.79	4.13	2.54	2.94	3.33	3.73	4.13	2.54	2.91	3.27	3.64	4.01	2.54	2.78	3.03	3.24	3.24	1.79								
NBC_MHEPL_414	340206	6258579	1.45	13.47	0.05	1.49	1.79	4.13	2.54	2.94	3.34	3.74	4.13	2.54	2.91	3.27	3.64	4.01	2.54	2.78	3.03	3.25	3.25	1.79								
NBC_MHEPL_415	340256	6258579	1.46	13.47	0.05	1.49	1.79	4.13	2.54	2.94	3.34	3.74	4.13	2.54	2.91	3.28	3.64	4.01	2.54	2.78	3.03	3.25	3.25	1.79								
NBC_MHEPL_416	340306	6258629	1.46	14.21	0.06	1.50	1.80	4.16	2.54	2.95	3.35	3.76	4.16	2.54	2.91	3.28	3.65	4.01	2.54	2.79	3.03	3.26	3.26	1.80								
NBC_MHEPL_417	340356	6258629	1.46	13.15	0.06	1.50	1.80	4.12	2.54	2.94	3.33	3.73	4.12	2.54	2.91	3.28	3.64	4.01	2.54	2.79	3.03	3.26	3.26	1.80								
NBC_MHEPL_418	340356	6258579	1.46	14.11	0.05	1.49	1.79	4.16	2.54	2.95	3.35	3.75	4.16	2.54	2.91	3.28	3.64	4.01	2.54	2.78	3.03	3.25	3.25	1.79								
NBC_MHEPL_419	340406	6258579	1.46	14.42	0.05	1.49	1.79	4.17	2.54	2.95	3.35	3.76	4.17	2.54	2.91	3.28	3.64	4.01	2.54	2.78	3.03	3.25	3.25	1.79								
NBC_MHEPL_420	340456	6258579	1.46	14.42	0.05	1.49	1.79	4.17	2.54	2.95	3.35	3.76	4.17	2.54	2.91	3.28	3.64	4.01	2.54	2.78	3.03	3.25	3.25	1.79								
NBC_MHEPL_421	340506	6258579	1.46	14.42	0.05	1.49	1.79	4.17	2.54	2.95	3.35	3.76	4.17	2.54	2.91	3.28	3.64	4.01	2.54	2.79	3.03	3.25	3.25	1.79								
NBC_MHEPL_422	340506	6258629	1.46	14.42	0.06	1.50	1.80	4.17	2.54	2.95	3.36	3.76	4.17	2.54	2.91	3.28	3.64	4.01	2.54	2.79	3.03	3.26	3.26	1.80								
NBC_MHEPL_423	340556	6258629	1.46	14.42	0.06	1.50	1.80	4.17	2.54	2.95	3.36	3.76	4.17	2.54	2.91	3.28	3.64	4.01	2.54	2.79	3.03	3.26	3.26	1.80								
NBC_MHEPL_424	340606	6258679	1.46	14.02	0.06	1.50	1.80	4.16	2.53	2.95	3.35	3.75	4.16	2.53	2.91	3.28	3.65	4.01	2.53	2.79	3.03	3.26	3.26	1.80								
NBC_MHEPL_425	340656	6258679	1.46	14.25	0.06	1.50	1.80	4.16	2.54	2.95	3.35	3.76	4.16	2.54	2.91	3.28	3.65	4.01	2.54	2.79	3.03	3.26	3.26	1.80								
NBC_MHEPL_426	340706	6258679	1.46	14.42	0.06	1.50	1.80	4.17	2.54	2.95	3.36	3.76	4.17	2.54	2.91	3.28	3.65	4.01	2.54	2.79	3.03	3.26	3.26	1.80								
NBC_MHEPL_427	340756	6258679	1.46	14.41	0.06	1.50	1.80	4.17	2.54	2.95	3.36	3.76	4.17	2.54	2.91	3.28	3.64	4.01	2.54	2.79	3.03	3.26	3.26	1.80								
NBC_MHEPL_428	340806	6258679	1.46	14.52	0.06	1.50	1.80	4.17	2.54	2.95	3.36	3.76	4.17	2.54	2.91	3.28	3.64	4.01	2.54	2.79	3.03	3.25	3.25	1.80								
NBC_MHEPL_429	340856	6258679	1.46	3.95	0.06	1.50	1.80	3.26	2.54	2.69	2.84	2.85	2.85	2.54	2.71	2.88	2.91	2.91	2.54	2.79	3.03	3.26	3.26	1.80								
NBC_MHEPL_430	340906	6258679	1.41	3.95	0.06	1.50	1.80	3.22	2.51	2.67	2.81	2.82	2.82	2.51	2.69	2.87	2.90	2.90	2.51	2.77	3.01	3.22	3.22	1.80								
NBC_MHEPL_431	340906	6258729	1.33	4.47	0.07	1.51	1.81	3.13	2.47	2.63	2.76	2.76	2.76	2.47	2.70	2.93	3.03	3.03	2.47	2.73	2.97	3.13	3.13	1.81								
NBC_MHEPL_432	340906	6258779	1.30	3.95	0.07	1.51	1.81	3.11	2.46	2.62	2.75	2.75	2.75	2.46	2.66	2.84	2.86	2.86	2.46	2.71	2.96	3.11	3.11	1.81								
NBC_MHEPL_433	340956	6258779	1.33	3.95	0.07	1.51	1.81	3.15	2.48	2.63	2.77	2.77	2.77	2.48	2.67	2.85	2.88	2.88	2.48	2.73	2.98	3.15	3.15	1.81								
NBC_MHEPL_434	341006	6258779	1.38	3.95	0.07	1.51	1.81	3.19	2.50	2.66	2.80	2.80	2.80	2.50	2.69	2.86	2.90	2.90	2.50	2.75	3.00	3.19	3.19	1.81								
NBC_MHEPL_435	341056	6258729	1.26	3.95	0.07	1.51	1.81	3.07	2.44	2.60	2.72	2.72	2.72	2.44	2.64	2.83	2.85	2.85	2.44	2.69	2.94	3.07	3.07	1.81								
NBC_MHEPL_436	341106	6258729	1.05	3.95	0.06	1.50	1.80	2.86	2.33	2.49	2.56	2.56	2.56	2.33	2.56	2.75	2.75	2.75	2.33	2.58	2.83	2.86	2.86	1.80								
NBC_MHEPL_437	341156	6258679	0.56	14.11	0.07	1.51	1.81	3.43	2.09	2.50	2.91	3.32	3.43	2.09	2.46	2.82	2.89	2.89	2.09	2.34	2.37	2.37	2.37	1.81								
NBC_MHEPL_438	341206	6258679	0.51	14.41	0.07	1.51	1.81	3.29	2.07	2.48	2.89	3.29	3.29	2.07	2.43	2.80	2.80	2.80	2.07	2.31	2.32	2.32	2.32	1.81								
NBC_MHEPL_439	341256	6258629	0.94	3.95	0.07	1.51	1.81	2.75	2.28	2.43	2.49	2.49	2.49	2.28	2.52	2.71	2.71	2.71	2.28	2.53	2.75	2.75	2.75	1.81								
NBC_MHEPL_440	341306	6258579	0.87	3.95	0.07	1.51	1.81	2.68	2.24	2.41	2.45	2.45	2.45	2.24	2.49	2.67	2.67	2.67	2.24	2.49	2.68	2.68	2.68	1.81								
NBC_MHEPL_441	341356	6258529	0.81	2.71	0.07	1.51	1.81	2.62	2.21	2.36	2.39	2.39	2.39	2.21	2.35	2.37	2.37	2.37	2.21	2.46	2.62	2.62	2.62	1.81								
NBC_MHEPL_442	341356	6258479	0.73	2.71	0.06	1.50	1.80	2.53	2.17	2.32	2.33	2.33	2.33	2.17	2.32	2.33	2.33	2.33	2.17	2.42	2.53	2.53	2.53	1.80								
NBC_MHEPL_443	341306	6258429	0.74	2.71	0.05	1.49	1.79	2.54	2.17	2.32	2.33	2.33	2.33	2.17	2.32	2.33	2.33	2.33	2.18	2.42	2.54	2.54	2.54	1.79								
NBC_MHEPL_444	341256	6258429	0.69	2.40	0.06	1.50	1.80	2.48	2.15	2.29	2.29	2.29	2.29	2.15	2.25	2.25	2.25	2.25	2.15	2.39	2.48	2.48	2.48	1.80								
NBC_MHEPL_445	341256	6258379	0.68	3.48	0.05	1.49	1.79	2.47	2.14	2.29	2.29	2.29	2.29	2.14	2.38	2.46	2.46	2.46	2.14	2.39	2.47	2.47	2.47	1.79								
NBC_MHEPL_446	341156	6258329	0.77	3.48	0.05	1.49	1.79	2.56	2.19	2.33	2.35	2.35	2.35	2.19	2.41	2.50	2.50	2.50	2.19	2.43	2.56	2.56	2.56	1.79								
NBC_MHEPL_447	341156	6258279	0.80	3.95	0.05	1.49	1.79	2.61	2.20	2.37	2.41	2.41	2.41	2.20	2.45	2.61	2.61	2.61	2.20	2.45	2.59	2.59	2.59	1.79								
NBC_MHEPL_448	341106	6258229	0.83	3.95	0.04	1.48	1.78	2.63	2.22	2.38	2.42	2.42	2.42	2.22	2.46	2.63	2.63	2.63	2.22	2.46	2.61	2.61	2.61	1.78								
NBC_MHEPL_449	341106	6258179	0.88	3.95	0.04	1.48	1.78	2.66	2.24	2.39	2.43	2.43	2.43	2.24	2.48	2.65	2.65	2.65	2.24	2.48	2.66	2.66	2.66	1.78								
NBC_MHEPL_450	341056	6258129	0.97	3.95	0.04	1.48	1.78	2.75	2.28	2.43	2.48	2.48	2.48	2.28	2.51	2.69	2.69	2.69	2.29	2.53	2.75	2.75	2.75	1.78								
NBC_MHEPL_451	341056	6258079	1.03	3.95	0.04	1.48	1.78	2.81	2.32	2.46	2.52	2.52	2.52	2.32	2.54	2.72	2.72	2.72	2.32	2.56	2.81	2.81	2.81	1.78								
NBC_MHEPL_452	341056	6258029	1.06	3.95	0.04	1.48	1.78	2.84	2.33	2.47	2.54	2.54	2.54	2.33	2.55	2.73	2.73	2.73	2.33	2.57	2.82	2.84	2.84	1.78								
NBC_MHEPL_453	341006	6257979	1.09	3.95	0.04	1.48	1.78	2.87	2.35	2.49	2.57	2.57	2.57	2.35	2.56	2.75	2.75	2.75	2.35	2.59	2.84	2.87	2.87	1.78								
NBC_MHEPL_454	341056	6257979	1.05	3.95	0.04	1.48	1.78	2.83	2.32	2.47	2.54	2.54	2.54	2.32	2.54	2.73	2.73	2.73	2.33	2.57	2.82	2.83	2.83	1.78								
NBC_MHEPL_455	341056	6257929	0.93	3.95	0.04	1.48	1.78	2.71	2.27	2.41	2.45	2.45	2.45	2.27	2.50	2.67	2.67	2.67	2.27	2.51	2.71	2.71	2.71	1.78								
NBC_MHEPL_456	341056	6257879	1.09	3.95	0.04	1.48	1.78	2.87	2.34	2.49	2.56	2.56	2.56	2.34	2.55	2.74	2.74	2.74	2.34	2.59	2.83	2.87	2.87	1.78								

APPENDIX B

20220706_EPL_Database
0 m Sea Level Projected WL

100yr ARI Planning Levels - 0m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.00** m sea level rise projection
Freeboard of **0.3** m included in EPLs

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																	REDUCTION FACTORS NOT CALCULATED FOR 2010 LEVELS AS THE 0m SLR LEVELS ARE NOT BEING USED FOR PLANNING PURPOSES							
			Wave						Foreshore Type ## 1					2					3					4								
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	Local (Still) Water Level (mAHD) 0 m Sea Level Projection	Local (Still) Water Level with 0.3m Freeboard (mAHD) 0 m Sea Level Projection	Max EPL of all Foreshore Types and Crest Levels (mAHD)	Crest Level (mAHD) 1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_457	341006	6257828	1.22	3.95	0.04	1.48	1.78	3.00	2.41	2.55	2.66	2.66	2.66	2.41	2.61	2.80	2.80	2.80	2.41	2.66	2.90	3.00	3.00	1.78								
NBC_MHEPL_458	341006	6257778	1.26	3.95	0.04	1.48	1.78	3.04	2.43	2.57	2.68	2.68	2.68	2.43	2.62	2.81	2.82	2.82	2.43	2.67	2.92	3.04	3.04	1.78								
NBC_MHEPL_459	341006	6257728	1.27	3.95	0.04	1.48	1.78	3.05	2.43	2.58	2.69	2.69	2.69	2.43	2.62	2.81	2.82	2.82	2.44	2.68	2.93	3.05	3.05	1.78								
NBC_MHEPL_460	341006	6257679	1.30	3.95	0.04	1.48	1.78	3.08	2.45	2.59	2.71	2.71	2.71	2.45	2.63	2.82	2.83	2.83	2.45	2.70	2.94	3.08	3.08	1.78								
NBC_MHEPL_461	341006	6257629	1.29	3.95	0.03	1.47	1.77	3.06	2.44	2.59	2.70	2.70	2.70	2.44	2.63	2.82	2.82	2.82	2.44	2.69	2.93	3.06	3.06	1.77								
NBC_MHEPL_462	341056	6257629	1.29	3.95	0.03	1.47	1.77	3.06	2.44	2.58	2.70	2.70	2.70	2.44	2.63	2.81	2.82	2.82	2.44	2.69	2.93	3.06	3.06	1.77								
NBC_MHEPL_463	341106	6257629	1.27	3.95	0.04	1.48	1.78	3.05	2.43	2.58	2.69	2.69	2.69	2.43	2.62	2.81	2.82	2.82	2.44	2.68	2.93	3.05	3.05	1.78								
NBC_MHEPL_464	341156	6257679	1.20	3.95	0.04	1.48	1.78	2.97	2.40	2.54	2.64	2.64	2.64	2.40	2.59	2.79	2.79	2.79	2.40	2.64	2.89	2.97	2.97	1.78								
NBC_MHEPL_465	341206	6257729	1.12	3.95	0.04	1.48	1.78	2.90	2.36	2.50	2.59	2.59	2.59	2.36	2.57	2.76	2.76	2.76	2.36	2.61	2.85	2.90	2.90	1.78								
NBC_MHEPL_466	341256	6257729	1.15	3.95	0.04	1.48	1.78	2.93	2.38	2.52	2.61	2.61	2.61	2.38	2.58	2.77	2.77	2.77	2.38	2.62	2.87	2.93	2.93	1.78								
NBC_MHEPL_467	341256	6257779	1.12	3.95	0.04	1.48	1.78	2.90	2.36	2.51	2.59	2.59	2.59	2.36	2.57	2.76	2.76	2.76	2.36	2.61	2.85	2.90	2.90	1.78								
NBC_MHEPL_468	341306	6257829	1.13	3.95	0.05	1.49	1.79	2.92	2.37	2.51	2.60	2.60	2.60	2.37	2.58	2.77	2.77	2.77	2.37	2.61	2.86	2.92	2.92	1.79								
NBC_MHEPL_469	341356	6257879	1.45	14.32	0.05	1.49	1.79	4.16	2.54	2.94	3.35	3.76	4.16	2.54	2.90	3.27	3.64	4.01	2.53	2.78	3.02	3.24	3.24	1.79								
NBC_MHEPL_470	341356	6257929	1.42	14.50	0.05	1.49	1.79	4.16	2.52	2.93	3.34	3.75	4.16	2.52	2.89	3.26	3.63	3.99	2.52	2.77	3.01	3.21	3.21	1.79								
NBC_MHEPL_471	341406	6257879	1.45	14.30	0.05	1.49	1.79	4.16	2.54	2.94	3.35	3.76	4.16	2.54	2.90	3.27	3.64	4.01	2.53	2.78	3.02	3.24	3.24	1.79								
NBC_MHEPL_472	341406	6257829	1.45	14.42	0.04	1.48	1.78	4.16	2.54	2.94	3.35	3.76	4.16	2.54	2.90	3.27	3.64	4.00	2.53	2.78	3.02	3.23	3.23	1.78								
NBC_MHEPL_473	341406	6257779	1.45	13.99	0.04	1.48	1.78	4.15	2.53	2.94	3.34	3.75	4.15	2.53	2.90	3.27	3.64	4.00	2.53	2.77	3.02	3.23	3.23	1.78								
NBC_MHEPL_474	341406	6257729	1.45	14.42	0.04	1.48	1.78	4.16	2.53	2.94	3.35	3.75	4.16	2.53	2.90	3.27	3.63	4.00	2.53	2.77	3.02	3.23	3.23	1.78								
NBC_MHEPL_475	341406	6257679	1.44	14.19	0.04	1.48	1.78	4.15	2.53	2.94	3.34	3.75	4.15	2.53	2.90	3.27	3.63	4.00	2.53	2.77	3.02	3.22	3.22	1.78								
NBC_MHEPL_476	341406	6257629	1.42	3.95	0.04	1.48	1.78	3.20	2.51	2.66	2.80	2.80	2.80	2.51	2.68	2.85	2.88	2.88	2.51	2.76	3.00	3.20	3.20	1.78								
NBC_MHEPL_477	341456	6257629	1.26	3.95	0.04	1.48	1.78	3.04	2.43	2.57	2.69	2.69	2.69	2.43	2.62	2.81	2.82	2.82	2.43	2.68	2.92	3.04	3.04	1.78								
NBC_MHEPL_478	341506	6257629	1.32	3.95	0.04	1.48	1.78	3.10	2.46	2.60	2.73	2.73	2.73	2.46	2.64	2.83	2.84	2.84	2.46	2.71	2.95	3.10	3.10	1.78								
NBC_MHEPL_479	341556	6257629	1.25	3.95	0.04	1.48	1.78	3.03	2.43	2.57	2.68	2.68	2.68	2.43	2.62	2.81	2.81	2.81	2.43	2.67	2.92	3.03	3.03	1.78								
NBC_MHEPL_480	341556	6257679	1.18	3.95	0.04	1.48	1.78	2.96	2.39	2.53	2.63	2.63	2.63	2.39	2.59	2.78	2.78	2.78	2.39	2.63	2.88	2.96	2.96	1.78								
NBC_MHEPL_481	341606	6257729	1.21	14.42	0.04	1.48	1.78	4.06	2.41	2.82	3.24	3.65	4.06	2.41	2.78	3.15	3.51	3.88	2.41	2.65	2.90	2.99	2.99	1.78								
NBC_MHEPL_482	341656	6257779	0.86	14.11	0.04	1.48	1.78	3.88	2.24	2.65	3.06	3.47	3.88	2.24	2.60	2.97	3.34	3.44	2.23	2.48	2.65	2.65	2.65	1.78								
NBC_MHEPL_483	341656	6257729	1.10	3.95	0.04	1.48	1.78	2.88	2.35	2.49	2.57	2.57	2.57	2.35	2.56	2.75	2.75	2.75	2.35	2.60	2.84	2.88	2.88	1.78								
NBC_MHEPL_484	341656	6257679	1.06	3.48	0.04	1.48	1.78	2.84	2.33	2.47	2.54	2.54	2.54	2.33	2.50	2.61	2.61	2.61	2.33	2.57	2.82	2.84	2.84	1.78								
NBC_MHEPL_485	341606	6257629	1.07	3.48	0.04	1.48	1.78	2.85	2.33	2.48	2.55	2.55	2.55	2.33	2.50	2.61	2.61	2.61	2.33	2.58	2.82	2.85	2.85	1.78								
NBC_MHEPL_486	341606	6257579	0.99	3.48	0.04	1.48	1.78	2.77	2.29	2.44	2.49	2.49	2.49	2.29	2.48	2.58	2.58	2.58	2.29	2.54	2.77	2.77	2.77	1.78								
NBC_MHEPL_487	341606	6257529	0.93	3.48	0.04	1.48	1.78	2.71	2.26	2.40	2.45	2.45	2.45	2.26	2.45	2.55	2.55	2.55	2.26	2.51	2.71	2.71	2.71	1.78								
NBC_MHEPL_488	341656	6257479	0.89	3.08	0.03	1.47	1.77	2.67	2.24	2.38	2.42	2.42	2.42	2.24	2.40	2.44	2.44	2.44	2.24	2.49	2.67	2.67	2.67	1.77								
NBC_MHEPL_489	341656	6257429	0.82	3.08	0.03	1.47	1.77	2.59	2.20	2.34	2.36	2.36	2.36	2.20	2.37	2.41	2.41	2.41	2.20	2.45	2.59	2.59	2.59	1.77								
NBC_MHEPL_490	341606	6257429	0.90	3.08	0.03	1.47	1.77	2.67	2.24	2.39	2.42	2.42	2.42	2.24	2.40	2.44	2.44	2.44	2.25	2.49	2.67	2.67	2.67	1.77								
NBC_MHEPL_491	341606	6257379	0.93	3.08	0.03	1.47	1.77	2.71	2.26	2.40	2.44	2.44	2.44	2.26	2.41	2.45	2.45	2.45	2.26	2.51	2.71	2.71	2.71	1.77								
NBC_MHEPL_492	341556	6257379	0.99	3.08	0.03	1.47	1.77	2.77	2.29	2.43	2.49	2.49	2.49	2.29	2.43	2.48	2.48	2.48	2.29	2.54	2.77	2.77	2.77	1.77								
NBC_MHEPL_493	341506	6257379	1.04	3.48	0.03	1.47	1.77	2.82	2.31	2.46	2.52	2.52	2.52	2.31	2.49	2.60	2.60	2.60	2.32	2.56	2.81	2.82	2.82	1.77								
NBC_MHEPL_494	341456	6257379	1.09	3.48	0.03	1.47	1.77	2.86	2.34	2.48	2.56	2.56	2.56	2.34	2.51	2.61	2.61	2.61	2.34	2.59	2.83	2.86	2.86	1.77								
NBC_MHEPL_495	341406	6257329	0.94	3.48	0.03	1.47	1.77	2.71	2.26	2.40	2.45	2.45	2.45	2.26	2.45	2.55	2.55	2.55	2.26	2.51	2.71	2.71	2.71	1.77								
NBC_MHEPL_496	341356	6257279	0.91	3.48	0.03	1.47	1.77	2.68	2.25	2.39	2.43	2.43	2.43	2.25	2.45	2.54	2.54	2.54	2.25	2.50	2.68	2.68	2.68	1.77								
NBC_MHEPL_497	341356	6257229	0.91	3.08	0.03	1.47	1.77	2.68	2.24	2.39	2.43	2.43	2.43	2.24	2.40	2.44	2.44	2.44	2.25	2.49	2.68	2.68	2.68	1.77								
NBC_MHEPL_498	341356	6257179	0.93	3.08	0.03	1.47	1.77	2.70	2.25	2.40	2.44	2.44	2.44	2.25	2.40	2.45	2.45	2.45	2.26	2.50	2.70	2.70	2.70	1.77								
NBC_MHEPL_499	341356	6257129	0.85	3.08	0.03	1.47	1.77	2.62	2.21	2.36	2.38	2.38	2.38	2.21	2.38	2.42	2.42	2.42	2.22	2.46	2.62	2.62	2.62	1.77								
NBC_MHEPL_500	341356	6257078	0.76	2.71	0.03	1.47	1.77	2.53	2.17	2.31	2.32	2.32	2.32	2.17	2.31	2.31	2.31	2.31	2.17	2.42	2.53	2.53	2.53	1.77								
NBC_MHEPL_501	341356	6257028	0.65	2.71	0.03	1.47	1.77	2.42	2.11	2.24	2.24	2.24	2.24	2.11	2.27	2.27	2.27	2.27	2.12	2.36	2.42	2.42	2.42	1.77								
NBC_MHEPL_502	341306	6257028	0.64	2.71	0.03	1.47	1.77	2.41	2.10	2.23	2.23	2.23	2.23	2.10	2.26	2.26	2.26	2.26	2.11	2.35	2.41	2.41	2.41	1.77								
NBC_MHEPL_503	341256	6257028	0.63	2.71	0.03	1.47	1.77	2.39	2.10	2.22	2.22	2.22	2.22	2.10	2.26	2.26	2.26	2.26	2.10	2.35	2.39	2.39	2.39	1.77								
NBC_MHEPL_504	341206	6257079	0.83	3.08	0.03	1.47	1.77	2.60	2.20	2.35	2.37	2.37	2.37	2.20	2.37	2.41	2.41	2.41	2.21	2.45	2.60	2.60	2.60	1.77								
NBC_MHEPL_505	341156	6257079	1.01	3.95	0.03	1.47	1.77	2.78	2.30	2.44	2.50	2.50	2.50	2.30	2.52	2.70	2.70	2.70	2.30	2.55	2.78	2.78	2.78	1.77								
NBC_MHEPL_506	341106	6257079	1.28	3.95	0.03	1.47	1.77	3.05	2.43	2.58	2.69	2.69	2.69	2.43	2.62	2.81	2.81	2.81	2.44	2.68	2.93	3.05	3.05	1.77								
NBC_MHEPL_507	341106	6257029	1.33	3.95	0.03	1.47	1.77	3.09	2.46	2.60	2.72	2.72	2.72	2.46	2.64	2.82	2.83	2.83	2.46	2.70	2.95	3.09	3.09	1.77								
NBC_MHEPL_508	341106	6256978	1.37	3.95	0.03	1.47	1.77	3.14	2.48	2.62	2.75	2.75	2.75	2.48	2.65	2.83	2.85	2.85	2.48	2.73	2.97	3.14	3.14	1.77								
NBC_MHEPL_509	341106	6256928	1.37	3.95	0.02	1.46	1.76	3.14	2.48	2.62	2.75	2.75	2.75	2.48	2.65	2.83	2.85	2.85	2.48	2.73	2.97	3.14	3.14	1.76								
NBC_MHEPL_510	341156	6256878	1.37	3.95	0.02	1.46	1.76	3.14	2.48	2.62	2.75	2.75	2.75	2.48	2.65	2.83	2.85	2.85	2.48	2.73	2.97	3.14	3.14	1.76								
NBC_MHEPL_511	341256	6256828	1.38	3.95	0.02	1.46	1.76	3.14	2.48	2.62	2.75	2.75	2.75	2.48	2.65	2.83	2.84	2.84	2.48	2.73	2.97	3.14	3.14	1.76								
NBC_MHEPL_512	341305	6256728	1.32	3.48	0.02	1.46	1.76	3.07	2.44	2.59	2.71	2.71	2.71	2.44	2.58	2.68	2.68	2.68	2.45	2.69	2.94	3.07	3.07	1.76								
NBC_MHEPL_513	341255	6256679	1.43	3.48	0.02	1.46	1.76	3.18	2.50	2.64	2.78	2.78	2.78	2.50	2.62	2.72	2.72	2.72	2.51	2.75	3.00	3.18	3.18	1.76								

100yr ARI Planning Levels - 0m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.00** m sea level rise projection
Freeboard of **0.3** m included in EPLs

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																	REDUCTION FACTORS NOT CALCULATED FOR 2010 LEVELS AS THE 0m SLR LEVELS ARE NOT BEING USED FOR PLANNING PURPOSES							
			Wave			Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)	Max EPL of all Foreshore Types and Crest Levels (mAHD)	Foreshore Type ##																							
									1					2					3					4								
									Crest Level (mAHD)																							
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	0 m Sea Level Projection	0 m Sea Level Projection		1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_514	341255	6256629	1.43	3.48	0.02	1.46	1.76	3.18	2.50	2.64	2.78	2.78	2.78	2.50	2.62	2.72	2.72	2.72	2.51	2.75	3.00	3.18	3.18	1.76								
NBC_MHEPL_515	341305	6256529	1.43	3.48	0.01	1.45	1.75	3.18	2.49	2.64	2.78	2.78	2.78	2.49	2.61	2.72	2.72	2.72	2.50	2.75	2.99	3.18	3.18	1.75								
NBC_MHEPL_516	341355	6256479	1.43	3.95	0.01	1.45	1.75	3.18	2.50	2.64	2.78	2.78	2.78	2.50	2.67	2.84	2.86	2.86	2.50	2.75	2.99	3.18	3.18	1.75								
NBC_MHEPL_517	341355	6256429	1.43	3.95	0.01	1.45	1.75	3.18	2.50	2.64	2.78	2.78	2.78	2.50	2.67	2.84	2.86	2.86	2.50	2.75	2.99	3.18	3.18	1.75								
NBC_MHEPL_518	341405	6256378	1.42	3.95	0.01	1.45	1.75	3.17	2.49	2.63	2.77	2.77	2.77	2.49	2.66	2.83	2.85	2.85	2.50	2.74	2.99	3.17	3.17	1.75								
NBC_MHEPL_519	341455	6256328	1.40	3.95	0.01	1.45	1.75	3.15	2.48	2.63	2.76	2.76	2.76	2.48	2.66	2.83	2.85	2.85	2.49	2.73	2.98	3.15	3.15	1.75								
NBC_MHEPL_520	341505	6256328	1.37	3.95	0.01	1.45	1.75	3.12	2.47	2.61	2.74	2.74	2.74	2.47	2.64	2.82	2.83	2.83	2.47	2.72	2.96	3.12	3.12	1.75								
NBC_MHEPL_521	341555	6256328	1.34	3.95	0.00	1.44	1.74	3.08	2.45	2.59	2.71	2.71	2.71	2.45	2.63	2.81	2.82	2.82	2.46	2.70	2.95	3.08	3.08	1.74								
NBC_MHEPL_522	341605	6256328	1.32	3.95	0.00	1.44	1.74	3.06	2.44	2.58	2.69	2.69	2.69	2.44	2.62	2.80	2.80	2.80	2.44	2.69	2.93	3.06	3.06	1.74								
NBC_MHEPL_523	341655	6256328	1.26	3.95	0.00	1.44	1.74	3.01	2.41	2.55	2.65	2.65	2.65	2.41	2.60	2.78	2.78	2.78	2.42	2.66	2.91	3.01	3.01	1.74								
NBC_MHEPL_524	341705	6256328	1.25	3.95	0.00	1.44	1.74	2.99	2.40	2.54	2.64	2.64	2.64	2.40	2.59	2.78	2.78	2.78	2.41	2.65	2.90	2.99	2.99	1.74								
NBC_MHEPL_525	341755	6256328	1.22	3.95	0.00	1.44	1.74	2.97	2.39	2.53	2.63	2.63	2.63	2.39	2.59	2.77	2.77	2.77	2.40	2.64	2.89	2.97	2.97	1.74								
NBC_MHEPL_526	341805	6256328	1.24	3.48	0.00	1.44	1.74	2.98	2.39	2.54	2.63	2.63	2.63	2.39	2.54	2.64	2.64	2.64	2.40	2.65	2.89	2.98	2.98	1.74								
NBC_MHEPL_527	341855	6256328	1.29	3.48	0.00	1.44	1.74	3.03	2.42	2.56	2.67	2.67	2.67	2.42	2.56	2.66	2.66	2.66	2.43	2.67	2.92	3.03	3.03	1.74								
NBC_MHEPL_528	341906	6256328	1.30	3.48	0.00	1.44	1.74	3.04	2.42	2.57	2.68	2.68	2.68	2.42	2.56	2.66	2.66	2.66	2.43	2.68	2.92	3.04	3.04	1.74								
NBC_MHEPL_529	341956	6256328	1.28	3.48	0.00	1.44	1.74	3.03	2.41	2.56	2.67	2.67	2.67	2.41	2.55	2.66	2.66	2.66	2.43	2.67	2.92	3.03	3.03	1.74								

APPENDIX B

20220706_EPL_Database
0 m Sea Level Projected WL

100yr ARI Planning Levels - 0.4m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.40** m sea level rise projection
Freeboard of **0.3** m included in EPLs

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																	Reduction Factor Note: The application of the Reduction Factor should not reduce the EPL below the Local (Still) Water Level							
Name	X MGAz56	Y MGAz56	Wave		Local Wind Setup* (m)	Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)	Max EPL of all Foreshore Types and Crest Levels (mAHD)	Foreshore Type ##																5m	10m	15m	20m	25m	30m	35m	40m
			Hs (m)	Tp (sec)					1					2					3					4								
									Crest Level (mAHD)																							
						0.4 m Sea Level Projection	0.4 m Sea Level Projection		1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A								
NBC_MHEPL_070	333667	6261756	0.48	2.11	0.14	1.98	2.28	2.76	2.52	2.53	2.63	2.63	2.63	2.52	2.53	2.62	2.62	2.62	2.52	2.53	2.76	2.76	2.76	2.28	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_071	333665	6261696	0.50	2.11	0.14	1.98	2.28	2.78	2.53	2.54	2.64	2.64	2.64	2.53	2.54	2.63	2.63	2.63	2.53	2.54	2.78	2.78	2.78	2.28	0.06	0.13	0.19	0.25	0.31	0.38	0.44	0.50
NBC_MHEPL_072	333664	6261636	0.50	2.11	0.13	1.97	2.27	2.77	2.52	2.54	2.63	2.63	2.63	2.52	2.54	2.62	2.62	2.62	2.52	2.54	2.77	2.77	2.77	2.27	0.06	0.12	0.19	0.25	0.31	0.37	0.44	0.50
NBC_MHEPL_073	333692	6261601	0.49	2.11	0.13	1.97	2.27	2.76	2.52	2.53	2.63	2.63	2.63	2.52	2.53	2.62	2.62	2.62	2.52	2.54	2.76	2.76	2.76	2.27	0.06	0.12	0.18	0.25	0.31	0.37	0.43	0.49
NBC_MHEPL_074	333720	6261566	0.48	2.11	0.13	1.97	2.27	2.75	2.51	2.53	2.62	2.62	2.62	2.51	2.53	2.61	2.61	2.61	2.51	2.53	2.75	2.75	2.75	2.27	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_075	333748	6261532	0.48	2.11	0.13	1.97	2.27	2.75	2.51	2.52	2.61	2.61	2.61	2.51	2.52	2.61	2.61	2.61	2.51	2.53	2.75	2.75	2.75	2.27	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_076	333777	6261498	0.47	2.11	0.13	1.97	2.27	2.74	2.50	2.52	2.61	2.61	2.61	2.50	2.52	2.61	2.61	2.61	2.50	2.52	2.74	2.74	2.74	2.27	0.06	0.12	0.18	0.24	0.29	0.35	0.41	0.47
NBC_MHEPL_077	333833	6261431	0.46	2.11	0.12	1.96	2.26	2.73	2.50	2.51	2.60	2.60	2.60	2.50	2.51	2.60	2.60	2.60	2.50	2.52	2.73	2.73	2.73	2.26	0.06	0.12	0.17	0.23	0.29	0.35	0.41	0.46
NBC_MHEPL_078	333860	6261397	0.47	2.11	0.12	1.96	2.26	2.73	2.49	2.51	2.60	2.60	2.60	2.49	2.51	2.60	2.60	2.60	2.49	2.52	2.73	2.73	2.73	2.26	0.06	0.12	0.17	0.23	0.29	0.35	0.41	0.47
NBC_MHEPL_079	333888	6261364	0.47	2.11	0.12	1.96	2.26	2.74	2.50	2.51	2.60	2.60	2.60	2.50	2.51	2.60	2.60	2.60	2.50	2.52	2.74	2.74	2.74	2.26	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.47
NBC_MHEPL_080	333915	6261332	0.48	2.11	0.12	1.96	2.26	2.74	2.50	2.52	2.61	2.61	2.61	2.50	2.52	2.60	2.60	2.60	2.50	2.52	2.74	2.74	2.74	2.26	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_081	333971	6261325	0.49	2.11	0.12	1.96	2.26	2.75	2.50	2.52	2.61	2.61	2.61	2.50	2.52	2.60	2.60	2.60	2.50	2.53	2.75	2.75	2.75	2.26	0.06	0.12	0.18	0.24	0.31	0.37	0.43	0.49
NBC_MHEPL_082	333998	6261294	0.49	1.87	0.12	1.96	2.26	2.75	2.50	2.52	2.61	2.61	2.61	2.50	2.52	2.57	2.57	2.57	2.50	2.53	2.75	2.75	2.75	2.26	0.06	0.12	0.18	0.25	0.31	0.37	0.43	0.49
NBC_MHEPL_083	334054	6261287	0.50	1.87	0.12	1.96	2.26	2.76	2.51	2.53	2.62	2.62	2.62	2.51	2.52	2.57	2.57	2.57	2.51	2.53	2.76	2.76	2.76	2.26	0.06	0.13	0.19	0.25	0.31	0.38	0.44	0.50
NBC_MHEPL_084	334080	6261257	0.51	1.87	0.11	1.95	2.25	2.77	2.51	2.53	2.62	2.62	2.62	2.51	2.52	2.57	2.57	2.57	2.51	2.54	2.77	2.77	2.77	2.25	0.06	0.13	0.19	0.26	0.32	0.38	0.45	0.51
NBC_MHEPL_085	334135	6261252	0.54	2.11	0.11	1.95	2.25	2.80	2.53	2.54	2.64	2.64	2.64	2.53	2.54	2.62	2.62	2.62	2.53	2.55	2.80	2.80	2.80	2.25	0.07	0.14	0.20	0.27	0.34	0.41	0.47	0.54
NBC_MHEPL_086	334197	6261304	0.56	2.11	0.12	1.96	2.26	2.82	2.54	2.56	2.66	2.66	2.66	2.54	2.55	2.63	2.63	2.63	2.54	2.56	2.81	2.82	2.82	2.26	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
NBC_MHEPL_087	334222	6261274	0.56	2.11	0.11	1.95	2.25	2.82	2.54	2.55	2.66	2.66	2.66	2.54	2.55	2.62	2.62	2.62	2.54	2.56	2.81	2.82	2.82	2.25	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
NBC_MHEPL_088	334247	6261245	0.56	2.40	0.11	1.95	2.25	2.81	2.53	2.55	2.66	2.66	2.66	2.53	2.55	2.67	2.67	2.67	2.53	2.56	2.81	2.81	2.81	2.25	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
NBC_MHEPL_089	334297	6261186	0.56	2.40	0.11	1.95	2.25	2.81	2.53	2.55	2.65	2.65	2.65	2.53	2.55	2.66	2.66	2.66	2.53	2.56	2.80	2.81	2.81	2.25	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
NBC_MHEPL_090	334322	6261157	0.56	2.40	0.11	1.95	2.25	2.81	2.53	2.55	2.65	2.65	2.65	2.53	2.55	2.66	2.66	2.66	2.53	2.56	2.80	2.81	2.81	2.25	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
NBC_MHEPL_091	334378	6261155	0.56	2.40	0.11	1.95	2.25	2.81	2.53	2.55	2.66	2.66	2.66	2.53	2.55	2.67	2.67	2.67	2.53	2.56	2.81	2.81	2.81	2.25	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
NBC_MHEPL_092	334403	6261127	0.56	2.40	0.11	1.95	2.25	2.81	2.53	2.55	2.65	2.65	2.65	2.53	2.55	2.66	2.66	2.66	2.53	2.56	2.81	2.81	2.81	2.25	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
NBC_MHEPL_093	334428	6261098	0.55	2.40	0.11	1.95	2.25	2.80	2.53	2.55	2.65	2.65	2.65	2.53	2.55	2.66	2.66	2.66	2.53	2.56	2.80	2.80	2.80	2.25	0.07	0.14	0.21	0.28	0.35	0.42	0.48	0.55
NBC_MHEPL_094	334453	6261069	0.55	2.40	0.11	1.95	2.25	2.80	2.52	2.54	2.65	2.65	2.65	2.52	2.55	2.66	2.66	2.66	2.52	2.56	2.80	2.80	2.80	2.25	0.07	0.14	0.21	0.28	0.34	0.41	0.48	0.55
NBC_MHEPL_095	334480	6261039	0.55	2.40	0.11	1.95	2.25	2.79	2.52	2.54	2.64	2.64	2.64	2.52	2.54	2.66	2.66	2.66	2.52	2.55	2.79	2.79	2.79	2.25	0.07	0.14	0.21	0.27	0.34	0.41	0.48	0.55
NBC_MHEPL_096	334508	6261007	0.54	2.40	0.11	1.95	2.25	2.79	2.52	2.54	2.64	2.64	2.64	2.52	2.54	2.65	2.65	2.65	2.52	2.55	2.79	2.79	2.79	2.25	0.07	0.14	0.20	0.27	0.34	0.41	0.47	0.54
NBC_MHEPL_097	334510	6260943	0.53	2.11	0.10	1.94	2.24	2.78	2.51	2.53	2.63	2.63	2.63	2.51	2.53	2.60	2.60	2.60	2.51	2.54	2.78	2.78	2.78	2.24	0.07	0.13	0.20	0.27	0.33	0.40	0.47	0.53
NBC_MHEPL_098	334549	6260899	0.53	2.11	0.10	1.94	2.24	2.77	2.50	2.53	2.62	2.62	2.62	2.50	2.52	2.60	2.60	2.60	2.50	2.54	2.77	2.77	2.77	2.24	0.07	0.13	0.20	0.26	0.33	0.40	0.46	0.53
NBC_MHEPL_099	334594	6260848	0.52	2.11	0.10	1.94	2.24	2.76	2.50	2.52	2.62	2.62	2.62	2.50	2.52	2.60	2.60	2.60	2.50	2.54	2.76	2.76	2.76	2.24	0.07	0.13	0.20	0.26	0.33	0.39	0.46	0.52
NBC_MHEPL_100	334646	6260790	0.52	2.11	0.10	1.94	2.24	2.76	2.50	2.52	2.61	2.61	2.61	2.50	2.52	2.59	2.59	2.59	2.50	2.53	2.76	2.76	2.76	2.24	0.07	0.13	0.20	0.26	0.33	0.39	0.46	0.52
NBC_MHEPL_101	334615	6260762	0.52	2.11	0.10	1.94	2.24	2.75	2.49	2.52	2.61	2.61	2.61	2.49	2.52	2.59	2.59	2.59	2.49	2.53	2.75	2.75	2.75	2.24	0.06	0.13	0.19	0.26	0.32	0.39	0.45	0.52
NBC_MHEPL_102	334703	6260726	0.50	2.11	0.09	1.93	2.23	2.73	2.48	2.51	2.59	2.59	2.59	2.48	2.51	2.58	2.58	2.58	2.48	2.52	2.73	2.73	2.73	2.23	0.06	0.12	0.19	0.25	0.31	0.37	0.44	0.50
NBC_MHEPL_103	334672	6260698	0.50	1.87	0.09	1.93	2.23	2.74	2.49	2.51	2.60	2.60	2.60	2.49	2.50	2.55	2.55	2.55	2.49	2.52	2.74	2.74	2.74	2.23	0.06	0.13	0.19	0.25	0.31	0.38	0.44	0.50
NBC_MHEPL_104	334641	6260670	0.49	1.87	0.09	1.93	2.23	2.72	2.48	2.50	2.59	2.59	2.59	2.48	2.50	2.54	2.54	2.54	2.48	2.52	2.72	2.72	2.72	2.23	0.06	0.12	0.18	0.24	0.31	0.37	0.43	0.49
NBC_MHEPL_105	334611	6260644	0.47	1.87	0.09	1.93	2.23	2.70	2.47	2.49	2.57	2.57	2.57	2.47	2.49	2.53	2.53	2.53	2.47	2.50	2.70	2.70	2.70	2.23	0.06	0.12	0.18	0.23	0.29	0.35	0.41	0.47
NBC_MHEPL_106	334671	6260577	0.45	1.87	0.09	1.93	2.23	2.68	2.46	2.48	2.55	2.55	2.55	2.46	2.48	2.53	2.53	2.53	2.46	2.49	2.68	2.68	2.68	2.23	0.06	0.11	0.17	0.22	0.28	0.34	0.39	0.45
NBC_MHEPL_107	334729	6260513	0.44	2.11	0.09	1.93	2.23	2.67	2.45	2.47	2.55	2.55	2.55	2.45	2.48	2.56	2.56	2.56	2.45	2.49	2.67	2.67	2.67	2.23	0.05	0.11	0.16	0.22	0.27	0.33	0.38	0.44
NBC_MHEPL_108	334759	6260540	0.45	1.87	0.09	1.93	2.23	2.68	2.46	2.48	2.55	2.55	2.55	2.46	2.48	2.53	2.53	2.53	2.46	2.49	2.68	2.68	2.68	2.23	0.06	0.11	0.17	0.22	0.28	0.34	0.39	0.45
NBC_MHEPL_109	334789	6260568	0.46	1.87	0.09	1.93	2.23	2.70	2.46	2.49	2.57	2.57	2.57	2.46	2.48	2.53	2.53	2.53	2.46	2.50	2.70	2.70	2.70	2.23	0.06	0.12	0.17	0.23	0.29	0.35	0.41	0.46
NBC_MHEPL_005	332243	6264687	0.20	1.28	0.39	2.23	2.53	2.73	2.63	2.63	2.67	2.67	2.67	2.63	2.63	2.67	2.67	2.67	2.63	2.63	2.73	2.73	2.73	2.53	0.02	0.05	0.07	0.10	0.12	0.15	0.17	0.20
NBC_MHEPL_110	334820	6260597	0.48	1.87	0.09	1.93	2.23	2.71	2.47	2.50	2.58	2.58	2.58	2.47	2.49	2.54	2.54	2.54	2.47	2.51	2.71	2.71	2.71	2.23	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_111	334878	6260534	0.48	1.87	0.09	1.93	2.23	2.71	2.47	2.49	2.57	2.57	2.57	2.47	2.49	2.54	2.54	2.54	2.47	2.51	2.71	2.71	2.71	2.23	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_112	334910	6260564	0.47	1.87	0.09	1.93	2.23	2.70	2.47	2.49	2.57	2.57	2.57	2.47	2.49	2.53	2.53	2.53	2.47	2.51	2.70	2.70	2.70	2.23	0.06	0.12	0.18	0.24	0.30	0.36	0.41	0.47
NBC_MHEPL_113	334972	6260498	0.46	1.87	0.09	1.93	2.23	2.69	2.46	2.49	2.56	2.56	2.56	2.46	2.48	2.53	2.53	2.53	2.46	2.50	2.69	2.69	2.69	2.23	0.06	0.12	0.17	0.23	0.29	0.35	0.40	0.46
NBC_MHEPL_114	335004	6260528	0.45	1.87	0.09	1.93	2.23	2.68	2.45	2.48	2.55	2.55	2.55	2.45	2.47	2.53	2.53	2.53	2.45	2.49	2.68	2.68	2.68	2.23	0.06	0.11	0.17	0.22	0.28	0.34	0.39	0.45
NBC_MHEPL_115	335067	6260462	0.44	1.87	0.09	1.93	2.23	2.67	2.45	2.48	2.55	2.55	2.55	2.45	2.47	2.52	2.52	2.52	2.45	2.49	2.67	2.67	2.67	2.23	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44
NBC_MHEPL_116	335099	6260492	0.45	1.87	0.09	1.93	2.23	2.68	2.46	2.48	2.56	2.56	2.56	2.46	2.48	2.53	2.53	2.53	2.46	2.50	2.68	2.68	2.68	2.23	0.06	0.11	0.17	0.23	0.28	0.34	0.40	0.45
NBC_MHEPL_117	335191	6260457	0.47	1.87	0.09	1.93	2.23	2.69	2.46	2.49	2.56	2.56	2.56	2.46	2.48	2.53	2.53	2.53	2.46	2.50	2.69	2.69	2.69	2.23	0.06	0.12	0.17	0.23	0.29	0.35	0.41	0.47
NBC_MHEPL_118	335221	6260486	0.47	1.87	0.09	1.93	2.23	2.70	2.46	2.49	2.56	2.56	2.56	2.46	2.48	2.53	2.53	2.53	2.46	2.50	2.70	2.70	2.70	2.23	0.06	0.12	0.17	0.23	0.29	0.35	0.41	0.47
NBC_MHEPL_119	335278	6260427	0.45	1.87	0.09	1.93	2.23	2.68	2.46	2.48	2.56	2.56	2.56	2.46	2.48	2.53	2.53	2.53	2.46	2.49	2.68	2.68	2.68	2.23	0.06	0.11	0.17	0.23	0.28	0.34	0.40	0.45
NBC_MHEPL_006	332257	6264662	0.18	1.28	0.39	2.23	2.53	2.71	2.62	2.62	2.66	2.66	2.66	2.62	2.62	2.66	2.66	2.66	2.62	2.62	2.71	2.71	2.71	2.53	0.02	0.05	0.07	0.09	0.11	0.14	0.16	0.18
NBC_MHEPL_120	335308	6260457	0.45	1.87	0.09	1.93	2.23	2.68	2.45	2.48	2.55	2.55	2.55	2.45	2.47	2.53	2.53	2.53	2.45	2.49	2.68	2.68	2.68	2.23	0.06	0.11	0.17	0.23	0.28	0.34	0.39	0.45
NBC_MHEPL_121	335363	6260402	0.45	2.11	0.09	1.93	2.23	2.68	2.45	2.48	2.55	2.55	2.55	2.45	2.48	2.56	2.56	2.56	2.45	2.49	2.68	2.68	2.68	2.23	0.06	0.11	0.17	0.23	0.28	0.34	0.40	0.45

APENDIX B

20220706_EPL_Database
0.4 m Sea Level Projected WL

100yr ARI Planning Levels - 0.4m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

Mean Sea Level Rise Allowance **0.40** m sea level rise projection
Freeboard of **0.3** m included in EPLs

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																	Reduction Factor (Note: The application of the Reduction Factor should not reduce the EPL below the Local (Still) Water Level)							
			Wave			Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)		Foreshore Type ##																							
									1					2					3					4								
									Crest Level (mAHD)																							
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	0.4 m Sea Level Projection	0.4 m Sea Level Projection	Max EPL of all Foreshore Types and Crest Levels (mAHD)	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_122	335394	6260434	0.46	2.11	0.09	1.93	2.23	2.69	2.46	2.48	2.56	2.56	2.56	2.46	2.48	2.56	2.56	2.56	2.46	2.50	2.69	2.69	2.69	2.23	0.06	0.11	0.17	0.23	0.29	0.34	0.40	0.46
NBC_MHEPL_123	335447	6260381	0.45	2.11	0.09	1.93	2.23	2.68	2.46	2.48	2.56	2.56	2.56	2.46	2.48	2.56	2.56	2.56	2.46	2.50	2.68	2.68	2.68	2.23	0.06	0.11	0.17	0.23	0.28	0.34	0.40	0.45
NBC_MHEPL_124	335476	6260411	0.45	1.87	0.09	1.93	2.23	2.68	2.45	2.48	2.55	2.55	2.55	2.45	2.47	2.52	2.52	2.52	2.45	2.49	2.68	2.68	2.68	2.23	0.06	0.11	0.17	0.23	0.28	0.34	0.39	0.45
NBC_MHEPL_125	335526	6260362	0.46	2.11	0.09	1.93	2.23	2.69	2.46	2.48	2.56	2.56	2.56	2.46	2.48	2.56	2.56	2.56	2.46	2.50	2.69	2.69	2.69	2.23	0.06	0.11	0.17	0.23	0.29	0.34	0.40	0.46
NBC_MHEPL_126	335555	6260392	0.47	2.11	0.09	1.93	2.23	2.70	2.46	2.49	2.57	2.57	2.57	2.46	2.49	2.57	2.57	2.57	2.46	2.50	2.70	2.70	2.70	2.23	0.06	0.12	0.18	0.24	0.30	0.36	0.41	0.47
NBC_MHEPL_127	335630	6260379	0.48	2.11	0.09	1.93	2.23	2.71	2.47	2.49	2.57	2.57	2.57	2.47	2.49	2.57	2.57	2.57	2.47	2.51	2.71	2.71	2.71	2.23	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_128	335674	6260338	0.47	2.11	0.09	1.93	2.23	2.70	2.46	2.49	2.57	2.57	2.57	2.46	2.49	2.57	2.57	2.57	2.46	2.50	2.70	2.70	2.70	2.23	0.06	0.12	0.18	0.24	0.29	0.35	0.41	0.47
NBC_MHEPL_129	335702	6260370	0.44	2.11	0.09	1.93	2.23	2.66	2.45	2.47	2.54	2.54	2.54	2.45	2.47	2.55	2.55	2.55	2.45	2.49	2.66	2.66	2.66	2.23	0.05	0.11	0.16	0.22	0.27	0.33	0.38	0.44
NBC_MHEPL_130	335730	6260402	0.46	1.87	0.09	1.93	2.23	2.69	2.46	2.48	2.56	2.56	2.56	2.46	2.48	2.53	2.53	2.53	2.46	2.50	2.69	2.69	2.69	2.23	0.06	0.11	0.17	0.23	0.29	0.34	0.40	0.46
NBC_MHEPL_131	335757	6260433	0.47	1.87	0.09	1.93	2.23	2.70	2.46	2.49	2.57	2.57	2.57	2.46	2.48	2.53	2.53	2.53	2.46	2.50	2.70	2.70	2.70	2.23	0.06	0.12	0.18	0.24	0.30	0.35	0.41	0.47
NBC_MHEPL_132	335714	6260471	0.48	1.87	0.09	1.93	2.23	2.71	2.47	2.50	2.58	2.58	2.58	2.47	2.49	2.54	2.54	2.54	2.47	2.51	2.71	2.71	2.71	2.23	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_133	335783	6260463	0.50	1.87	0.09	1.93	2.23	2.73	2.48	2.50	2.59	2.59	2.59	2.48	2.50	2.54	2.54	2.54	2.48	2.52	2.73	2.73	2.73	2.23	0.06	0.12	0.19	0.25	0.31	0.37	0.43	0.50
NBC_MHEPL_134	335826	6260427	0.48	1.87	0.09	1.93	2.23	2.71	2.47	2.49	2.57	2.57	2.57	2.47	2.49	2.53	2.53	2.53	2.47	2.51	2.71	2.71	2.71	2.23	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_135	335894	6260424	0.50	1.87	0.09	1.93	2.23	2.73	2.48	2.50	2.59	2.59	2.59	2.48	2.50	2.54	2.54	2.54	2.48	2.52	2.73	2.73	2.73	2.23	0.06	0.12	0.19	0.25	0.31	0.37	0.43	0.50
NBC_MHEPL_136	335961	6260425	0.53	1.87	0.09	1.93	2.23	2.76	2.50	2.52	2.61	2.61	2.61	2.50	2.51	2.55	2.55	2.55	2.50	2.54	2.76	2.76	2.76	2.23	0.07	0.13	0.20	0.27	0.33	0.40	0.47	0.53
NBC_MHEPL_137	335988	6260459	0.57	2.11	0.09	1.93	2.23	2.80	2.52	2.54	2.64	2.64	2.64	2.52	2.54	2.60	2.60	2.60	2.52	2.56	2.80	2.80	2.80	2.23	0.07	0.14	0.21	0.29	0.36	0.43	0.50	0.57
NBC_MHEPL_138	336052	6260461	0.61	2.40	0.09	1.93	2.23	2.84	2.53	2.56	2.67	2.67	2.67	2.53	2.56	2.66	2.66	2.66	2.53	2.57	2.82	2.84	2.84	2.23	0.08	0.15	0.23	0.30	0.38	0.46	0.53	0.61
NBC_MHEPL_139	336077	6260494	0.64	2.40	0.09	1.93	2.23	2.87	2.55	2.58	2.69	2.69	2.69	2.55	2.58	2.67	2.67	2.67	2.55	2.59	2.84	2.87	2.87	2.23	0.08	0.16	0.24	0.32	0.40	0.48	0.56	0.64
NBC_MHEPL_007	332305	6264553	0.19	1.13	0.38	2.22	2.52	2.71	2.61	2.61	2.66	2.66	2.66	2.61	2.61	2.64	2.64	2.64	2.61	2.61	2.71	2.71	2.71	2.52	0.02	0.05	0.07	0.10	0.12	0.14	0.17	0.19
NBC_MHEPL_140	336100	6260525	0.68	2.71	0.09	1.93	2.23	2.91	2.57	2.59	2.72	2.72	2.72	2.57	2.60	2.74	2.74	2.74	2.57	2.61	2.85	2.91	2.91	2.23	0.08	0.17	0.25	0.34	0.42	0.51	0.59	0.68
NBC_MHEPL_141	336123	6260557	0.70	2.71	0.09	1.93	2.23	2.93	2.58	2.61	2.73	2.73	2.73	2.58	2.61	2.75	2.75	2.75	2.58	2.62	2.87	2.93	2.93	2.23	0.09	0.18	0.26	0.35	0.44	0.53	0.61	0.70
NBC_MHEPL_142	336110	6260620	0.70	2.71	0.09	1.93	2.23	2.93	2.58	2.61	2.74	2.74	2.74	2.58	2.61	2.75	2.75	2.75	2.58	2.62	2.87	2.93	2.93	2.23	0.09	0.18	0.26	0.35	0.44	0.53	0.61	0.70
NBC_MHEPL_143	336138	6260656	0.71	2.71	0.09	1.93	2.23	2.94	2.59	2.61	2.74	2.74	2.74	2.59	2.61	2.76	2.76	2.76	2.59	2.63	2.87	2.94	2.94	2.23	0.09	0.18	0.27	0.35	0.44	0.53	0.62	0.71
NBC_MHEPL_144	336130	6260722	0.70	2.71	0.09	1.93	2.23	2.93	2.58	2.61	2.73	2.73	2.73	2.58	2.61	2.75	2.75	2.75	2.58	2.62	2.87	2.93	2.93	2.23	0.09	0.17	0.26	0.35	0.44	0.52	0.61	0.70
NBC_MHEPL_145	336158	6260757	0.70	3.08	0.09	1.93	2.23	2.93	2.58	2.61	2.74	2.74	2.74	2.58	2.62	2.81	2.82	2.82	2.58	2.62	2.87	2.93	2.93	2.23	0.09	0.18	0.26	0.35	0.44	0.53	0.61	0.70
NBC_MHEPL_146	336150	6260820	0.68	3.08	0.09	1.93	2.23	2.91	2.57	2.60	2.72	2.72	2.72	2.57	2.61	2.81	2.81	2.81	2.57	2.61	2.86	2.91	2.91	2.23	0.08	0.17	0.25	0.34	0.42	0.51	0.59	0.68
NBC_MHEPL_147	336155	6260897	0.69	3.08	0.10	1.94	2.24	2.93	2.58	2.61	2.73	2.73	2.73	2.58	2.61	2.81	2.82	2.82	2.58	2.62	2.87	2.93	2.93	2.24	0.09	0.17	0.26	0.35	0.43	0.52	0.61	0.69
NBC_MHEPL_148	336119	6260932	0.68	3.08	0.10	1.94	2.24	2.92	2.58	2.60	2.73	2.73	2.73	2.58	2.61	2.81	2.82	2.82	2.58	2.61	2.86	2.92	2.92	2.24	0.09	0.17	0.26	0.34	0.43	0.51	0.60	0.68
NBC_MHEPL_149	336172	6260988	0.67	3.08	0.10	1.94	2.24	2.91	2.57	2.60	2.72	2.72	2.72	2.57	2.60	2.81	2.81	2.81	2.57	2.61	2.85	2.91	2.91	2.24	0.08	0.17	0.25	0.34	0.42	0.50	0.59	0.67
NBC_MHEPL_008	332316	6264523	0.19	1.28	0.38	2.22	2.52	2.70	2.61	2.61	2.65	2.65	2.65	2.61	2.61	2.65	2.65	2.65	2.61	2.61	2.70	2.70	2.70	2.52	0.02	0.05	0.07	0.09	0.12	0.14	0.17	0.19
NBC_MHEPL_150	336134	6261026	0.71	3.08	0.10	1.94	2.24	2.94	2.59	2.62	2.75	2.75	2.75	2.59	2.62	2.82	2.83	2.83	2.59	2.63	2.87	2.94	2.94	2.24	0.09	0.18	0.27	0.35	0.44	0.53	0.62	0.71
NBC_MHEPL_151	336185	6261080	0.74	3.08	0.10	1.94	2.24	2.98	2.61	2.63	2.77	2.77	2.77	2.61	2.64	2.83	2.84	2.84	2.61	2.64	2.89	2.98	2.98	2.24	0.09	0.18	0.28	0.37	0.46	0.55	0.65	0.74
NBC_MHEPL_152	336185	6261080	0.74	3.08	0.10	1.94	2.24	2.98	2.61	2.63	2.77	2.77	2.77	2.61	2.64	2.83	2.84	2.84	2.61	2.64	2.89	2.98	2.98	2.24	0.09	0.18	0.28	0.37	0.46	0.55	0.65	0.74
NBC_MHEPL_153	336234	6261134	0.74	3.08	0.10	1.94	2.24	2.98	2.61	2.64	2.77	2.77	2.77	2.61	2.64	2.83	2.85	2.85	2.61	2.65	2.89	2.98	2.98	2.24	0.09	0.19	0.28	0.37	0.46	0.56	0.65	0.74
NBC_MHEPL_154	336191	6261174	0.72	2.71	0.10	1.94	2.24	2.96	2.60	2.62	2.76	2.76	2.76	2.60	2.63	2.77	2.77	2.77	2.60	2.64	2.88	2.96	2.96	2.24	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72
NBC_MHEPL_155	336145	6261217	0.70	2.71	0.10	1.94	2.24	2.94	2.59	2.61	2.74	2.74	2.74	2.59	2.62	2.76	2.76	2.76	2.59	2.63	2.87	2.94	2.94	2.24	0.09	0.17	0.26	0.35	0.44	0.52	0.61	0.70
NBC_MHEPL_156	336193	6261269	0.66	2.71	0.10	1.94	2.24	2.91	2.57	2.60	2.72	2.72	2.72	2.57	2.60	2.75	2.75	2.75	2.57	2.61	2.85	2.91	2.91	2.24	0.08	0.17	0.25	0.33	0.42	0.50	0.58	0.66
NBC_MHEPL_157	336146	6261313	0.57	2.71	0.10	1.94	2.24	2.81	2.53	2.55	2.65	2.65	2.65	2.53	2.55	2.71	2.71	2.71	2.53	2.56	2.81	2.81	2.81	2.24	0.07	0.14	0.21	0.28	0.35	0.43	0.50	0.57
NBC_MHEPL_158	336094	6261362	0.54	2.71	0.10	1.94	2.24	2.78	2.51	2.53	2.63	2.63	2.63	2.51	2.54	2.70	2.70	2.70	2.51	2.55	2.78	2.78	2.78	2.24	0.07	0.13	0.20	0.27	0.34	0.40	0.47	0.54
NBC_MHEPL_159	336085	6261464	0.52	2.71	0.11	1.95	2.25	2.77	2.51	2.53	2.62	2.62	2.62	2.51	2.54	2.70	2.70	2.70	2.51	2.54	2.77	2.77	2.77	2.25	0.06	0.13	0.19	0.26	0.32	0.39	0.45	0.52
NBC_MHEPL_160	336038	6261414	0.48	2.71	0.11	1.95	2.25	2.73	2.49	2.51	2.59	2.59	2.59	2.49	2.52	2.68	2.68	2.68	2.49	2.52	2.73	2.73	2.73	2.25	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_161	335982	6261468	0.42	2.71	0.12	1.96	2.26	2.67	2.46	2.48	2.56	2.56	2.56	2.46	2.49	2.66	2.66	2.66	2.46	2.49	2.67	2.67	2.67	2.26	0.05	0.10	0.16	0.21	0.26	0.31	0.37	0.42
NBC_MHEPL_162	336102	6261711	0.50	2.40	0.16	2.00	2.30	2.80	2.55	2.55	2.66	2.66	2.66	2.55	2.55	2.69	2.69	2.69	2.55	2.55	2.80	2.80	2.80	2.30	0.06	0.13	0.19	0.25	0.31	0.38	0.44	0.50
NBC_MHEPL_163	336159	6261658	0.50	2.11	0.15	1.99	2.29	2.79	2.54	2.55	2.65	2.65	2.65	2.54	2.55	2.64	2.64	2.64	2.54	2.55	2.79	2.79	2.79	2.29	0.06	0.13	0.19	0.25	0.31	0.38	0.44	0.50
NBC_MHEPL_164	336117	6261612	0.52	2.40	0.14	1.98	2.28	2.80	2.54	2.55	2.65	2.65	2.65	2.54	2.55	2.68	2.68	2.68	2.54	2.55	2.80	2.80	2.80	2.28	0.06	0.13	0.19	0.26	0.32	0.39	0.45	0.52
NBC_MHEPL_165	336174	6261560	0.51	2.40	0.13	1.97	2.27	2.78	2.53	2.54	2.64	2.64	2.64	2.53	2.54	2.67	2.67	2.67	2.53	2.55	2.78	2.78	2.78	2.27	0.06	0.13	0.19	0.26	0.32	0.38	0.45	0.51
NBC_MHEPL_166	336130	6261512	0.55	2.71	0.12	1.96	2.26	2.81	2.54	2.55	2.66	2.66	2.66	2.54	2.56	2.72	2.72	2.72	2.54	2.56	2.81	2.81	2.81	2.26	0.07	0.14	0.21	0.28	0.35	0.42	0.48	0.55
NBC_MHEPL_167	336141	6261412	0.58	2.71	0.11	1.95	2.25	2.83	2.54	2.56	2.67	2.67	2.67	2.54	2.56	2.72	2.72	2.72	2.54	2.57	2.81	2.83	2.83	2.25	0.07	0.15	0.22	0.29	0.36	0.44	0.51	0.58
NBC_MHEPL_168	336192	6261364	0.62	2.71	0.10	1.94	2.24	2.87	2.56	2.58	2.69	2.69	2.69	2.56	2.58	2.74	2.74	2.74	2.56	2.59	2.83	2.87	2.87	2.24	0.08	0.16	0.23	0.31	0.39	0.47	0.55	0.62
NBC_MHEPL_169	336239	6261227	0.72	2.71	0.10	1.94	2.24	2.96	2.60	2.63	2.76	2.76	2.76	2.60	2.63	2.77	2.77	2.77	2.60	2.64	2.88	2.96	2.96	2.24	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72
NBC_MHEPL_170	336283	6261188	0.71	2.71	0.10	1.94	2.24	2.95	2.60	2.62	2.75	2.75	2.75	2.60	2.62	2.76	2.76	2.76	2.60	2.63	2.88	2.95	2.95	2.24	0.09	0.18	0.27	0.36	0.44	0.53	0.62	0.71
NBC_MHEPL_171	336321	6261155	0.65	2.71	0.10	1.94	2.24	2.89	2.57	2.59	2.71	2.71	2.71	2.57	2.59	2.74	2.74	2.74	2.57	2.60	2.85	2.89	2.89	2.24	0.08	0.16	0.25	0.33	0.41	0.49	0.57	0.65
NBC_MHEPL_172	336273	6261099	0.67	2.71	0.10	1.94	2.24	2.91	2.57	2.60	2.72	2.72	2.72	2.57	2.60	2.75	2.75	2.75	2.57	2.61	2.86	2.91	2.91	2.24	0.08	0.17	0.25	0.34	0.42	0.50	0.59	0.67
NBC_MHEPL_173	336309	6261068	0.67	2.71	0.10	1.94	2.24	2.90	2.57	2.60	2.72	2.72	2.72	2.57	2.60	2.75	2.75	2.75	2.57	2.61	2.85	2.90	2.90	2.24	0.08	0.17	0.25	0.33	0.42	0.50	0.58	0.67

APENDIX B

20220706_EPL_Database
0.4 m Sea Level Projected WL

100yr ARI Planning Levels - 0.4m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.40** m sea level rise projection
Freeboard of **0.3** m included in EPLs

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																	Reduction Factor. Note: The application of the Reduction Factor should not reduce the EPL below the Local (Still) Water Level							
			Wave			Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)		Foreshore Type ##: 1					2					3					4								
									Crest Level (mAHD)																							
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	0.4 m Sea Level Projection	0.4 m Sea Level Projection	Max EPL of all Foreshore Types and Crest Levels (mAHD)	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_009	332399	6264382	0.17	1.28	0.36	2.20	2.50	2.67	2.59	2.59	2.63	2.63	2.63	2.59	2.59	2.63	2.63	2.63	2.59	2.59	2.67	2.67	2.67	2.50	0.02	0.04	0.06	0.08	0.11	0.13	0.15	0.17
NBC_MHEPL_174	336259	6261012	0.67	2.71	0.10	1.94	2.24	2.90	2.57	2.59	2.72	2.72	2.72	2.57	2.60	2.75	2.75	2.75	2.57	2.61	2.85	2.90	2.90	2.24	0.08	0.17	0.25	0.33	0.42	0.50	0.58	0.67
NBC_MHEPL_175	336294	6260982	0.66	2.71	0.10	1.94	2.24	2.89	2.56	2.59	2.71	2.71	2.71	2.56	2.59	2.74	2.74	2.74	2.56	2.60	2.85	2.89	2.89	2.24	0.08	0.16	0.25	0.33	0.41	0.49	0.57	0.66
NBC_MHEPL_176	336243	6260923	0.67	2.71	0.10	1.94	2.24	2.91	2.57	2.60	2.72	2.72	2.72	2.57	2.60	2.75	2.75	2.75	2.57	2.61	2.85	2.91	2.91	2.24	0.08	0.17	0.25	0.33	0.42	0.50	0.59	0.67
NBC_MHEPL_177	336277	6260894	0.69	2.71	0.10	1.94	2.24	2.92	2.58	2.60	2.73	2.73	2.73	2.58	2.61	2.75	2.75	2.75	2.58	2.62	2.86	2.92	2.92	2.24	0.09	0.17	0.26	0.34	0.43	0.51	0.60	0.69
NBC_MHEPL_178	336259	6260804	0.69	2.71	0.09	1.93	2.23	2.93	2.58	2.61	2.73	2.73	2.73	2.58	2.61	2.75	2.75	2.75	2.58	2.62	2.87	2.93	2.93	2.23	0.09	0.17	0.26	0.35	0.43	0.52	0.61	0.69
NBC_MHEPL_179	336292	6260776	0.66	2.71	0.09	1.93	2.23	2.90	2.57	2.59	2.71	2.71	2.71	2.57	2.59	2.74	2.74	2.74	2.57	2.60	2.85	2.90	2.90	2.23	0.08	0.17	0.25	0.33	0.41	0.50	0.58	0.66
NBC_MHEPL_180	336325	6260750	0.65	2.71	0.09	1.93	2.23	2.88	2.56	2.58	2.70	2.70	2.70	2.56	2.59	2.73	2.73	2.73	2.56	2.60	2.84	2.88	2.88	2.23	0.08	0.16	0.24	0.32	0.40	0.49	0.57	0.65
NBC_MHEPL_181	336263	6260670	0.68	2.71	0.09	1.93	2.23	2.91	2.57	2.60	2.72	2.72	2.72	2.57	2.60	2.74	2.74	2.74	2.57	2.61	2.85	2.91	2.91	2.23	0.08	0.17	0.25	0.34	0.42	0.51	0.59	0.68
NBC_MHEPL_182	336274	6260608	0.69	2.71	0.09	1.93	2.23	2.92	2.57	2.60	2.73	2.73	2.73	2.57	2.60	2.75	2.75	2.75	2.57	2.61	2.86	2.92	2.92	2.23	0.09	0.17	0.26	0.34	0.43	0.51	0.60	0.69
NBC_MHEPL_183	336249	6260573	0.73	3.08	0.09	1.93	2.23	2.96	2.59	2.62	2.75	2.75	2.75	2.59	2.63	2.82	2.83	2.83	2.59	2.64	2.88	2.96	2.96	2.23	0.09	0.18	0.27	0.36	0.45	0.55	0.64	0.73
NBC_MHEPL_184	336288	6260545	0.73	3.08	0.09	1.93	2.23	2.96	2.60	2.62	2.76	2.76	2.76	2.60	2.63	2.82	2.83	2.83	2.60	2.64	2.88	2.96	2.96	2.23	0.09	0.18	0.27	0.37	0.46	0.55	0.64	0.73
NBC_MHEPL_185	336305	6260480	0.75	3.08	0.09	1.93	2.23	2.98	2.60	2.63	2.77	2.77	2.77	2.60	2.64	2.82	2.84	2.84	2.60	2.64	2.89	2.98	2.98	2.23	0.09	0.19	0.28	0.37	0.47	0.56	0.65	0.75
NBC_MHEPL_186	336280	6260445	0.76	3.08	0.09	1.93	2.23	2.99	2.61	2.64	2.77	2.77	2.77	2.61	2.64	2.83	2.84	2.84	2.61	2.65	2.89	2.99	2.99	2.23	0.09	0.19	0.28	0.38	0.47	0.57	0.66	0.76
NBC_MHEPL_187	336323	6260414	0.77	3.08	0.09	1.93	2.23	3.00	2.61	2.64	2.78	2.78	2.78	2.61	2.65	2.83	2.85	2.85	2.61	2.66	2.90	3.00	3.00	2.23	0.10	0.19	0.29	0.38	0.48	0.58	0.67	0.77
NBC_MHEPL_188	336363	6260383	0.77	3.08	0.09	1.93	2.23	3.00	2.61	2.64	2.78	2.78	2.78	2.61	2.65	2.83	2.85	2.85	2.61	2.66	2.90	3.00	3.00	2.23	0.10	0.19	0.29	0.39	0.48	0.58	0.67	0.77
NBC_MHEPL_189	336377	6260320	0.78	3.08	0.09	1.93	2.23	3.01	2.62	2.65	2.79	2.79	2.79	2.62	2.65	2.83	2.85	2.85	2.62	2.66	2.91	3.01	3.01	2.23	0.10	0.20	0.29	0.39	0.49	0.59	0.69	0.78
NBC_MHEPL_190	336416	6260291	0.80	3.48	0.09	1.93	2.23	3.03	2.63	2.66	2.80	2.80	2.80	2.63	2.67	2.88	2.95	2.95	2.63	2.67	2.92	3.03	3.03	2.23	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_191	336478	6260297	0.81	3.48	0.09	1.93	2.23	3.04	2.63	2.66	2.81	2.81	2.81	2.63	2.67	2.89	2.95	2.95	2.63	2.68	2.92	3.04	3.04	2.23	0.10	0.20	0.30	0.41	0.51	0.61	0.71	0.81
NBC_MHEPL_192	336516	6260271	0.81	3.48	0.09	1.93	2.23	3.04	2.63	2.66	2.81	2.81	2.81	2.63	2.67	2.89	2.95	2.95	2.63	2.68	2.92	3.04	3.04	2.23	0.10	0.20	0.31	0.41	0.51	0.61	0.71	0.81
NBC_MHEPL_193	336531	6260211	0.80	3.48	0.09	1.93	2.23	3.03	2.63	2.66	2.80	2.80	2.80	2.63	2.67	2.88	2.95	2.95	2.63	2.67	2.92	3.03	3.03	2.23	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_194	336570	6260186	0.81	3.08	0.09	1.93	2.23	3.03	2.63	2.66	2.80	2.81	2.81	2.63	2.66	2.84	2.86	2.86	2.63	2.67	2.92	3.03	3.03	2.23	0.10	0.20	0.30	0.40	0.50	0.61	0.71	0.81
NBC_MHEPL_195	336591	6260125	0.81	3.08	0.08	1.92	2.22	3.04	2.63	2.66	2.81	2.81	2.81	2.63	2.66	2.84	2.86	2.86	2.63	2.68	2.92	3.04	3.04	2.22	0.10	0.20	0.30	0.41	0.51	0.61	0.71	0.81
NBC_MHEPL_196	336612	6260063	0.81	3.08	0.08	1.92	2.22	3.04	2.63	2.66	2.81	2.81	2.81	2.63	2.67	2.84	2.86	2.86	2.63	2.68	2.92	3.04	3.04	2.22	0.10	0.20	0.30	0.41	0.51	0.61	0.71	0.81
NBC_MHEPL_197	336592	6260029	0.84	3.08	0.08	1.92	2.22	3.06	2.64	2.67	2.82	2.83	2.83	2.64	2.68	2.85	2.87	2.87	2.64	2.69	2.93	3.06	3.06	2.22	0.10	0.21	0.31	0.42	0.52	0.63	0.73	0.84
NBC_MHEPL_198	336636	6260003	0.84	3.08	0.08	1.92	2.22	3.06	2.64	2.67	2.82	2.83	2.83	2.64	2.68	2.85	2.87	2.87	2.64	2.69	2.93	3.06	3.06	2.22	0.10	0.21	0.31	0.42	0.52	0.63	0.73	0.84
NBC_MHEPL_199	336659	6259943	0.84	3.08	0.08	1.92	2.22	3.06	2.64	2.67	2.82	2.82	2.82	2.64	2.68	2.85	2.87	2.87	2.64	2.69	2.93	3.06	3.06	2.22	0.10	0.21	0.31	0.42	0.52	0.63	0.73	0.84
NBC_MHEPL_200	336682	6259883	0.83	3.08	0.08	1.92	2.22	3.05	2.63	2.67	2.81	2.82	2.82	2.63	2.67	2.84	2.86	2.86	2.63	2.68	2.93	3.05	3.05	2.22	0.10	0.21	0.31	0.41	0.52	0.62	0.72	0.83
NBC_MHEPL_201	336725	6259857	0.80	3.08	0.08	1.92	2.22	3.02	2.62	2.65	2.80	2.80	2.80	2.62	2.66	2.83	2.85	2.85	2.62	2.67	2.91	3.02	3.02	2.22	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_202	336689	6259794	0.79	3.08	0.08	1.92	2.22	3.01	2.62	2.65	2.79	2.79	2.79	2.62	2.65	2.83	2.85	2.85	2.62	2.66	2.91	3.01	3.01	2.22	0.10	0.20	0.30	0.40	0.49	0.59	0.69	0.79
NBC_MHEPL_203	336674	6259766	0.77	2.71	0.08	1.92	2.22	2.99	2.61	2.64	2.77	2.77	2.77	2.61	2.64	2.77	2.77	2.77	2.61	2.65	2.90	2.99	2.99	2.22	0.10	0.19	0.29	0.38	0.48	0.58	0.67	0.77
NBC_MHEPL_204	336703	6259716	0.71	2.71	0.08	1.92	2.22	2.93	2.58	2.61	2.73	2.73	2.73	2.58	2.61	2.75	2.75	2.75	2.58	2.62	2.87	2.93	2.93	2.22	0.09	0.18	0.27	0.36	0.44	0.53	0.62	0.71
NBC_MHEPL_205	336690	6259689	0.70	2.71	0.08	1.92	2.22	2.92	2.57	2.60	2.72	2.72	2.72	2.57	2.60	2.74	2.74	2.74	2.57	2.61	2.86	2.92	2.92	2.22	0.09	0.17	0.26	0.35	0.44	0.52	0.61	0.70
NBC_MHEPL_206	336708	6259612	0.66	2.71	0.08	1.92	2.22	2.88	2.55	2.58	2.70	2.70	2.70	2.55	2.58	2.73	2.73	2.73	2.55	2.60	2.84	2.88	2.88	2.22	0.08	0.17	0.25	0.33	0.42	0.50	0.58	0.66
NBC_MHEPL_207	336696	6259584	0.66	2.71	0.08	1.92	2.22	2.88	2.55	2.58	2.70	2.70	2.70	2.55	2.58	2.73	2.73	2.73	2.55	2.60	2.84	2.88	2.88	2.22	0.08	0.17	0.25	0.33	0.42	0.50	0.58	0.66
NBC_MHEPL_208	336670	6259522	0.63	2.71	0.08	1.92	2.22	2.85	2.53	2.56	2.67	2.67	2.67	2.53	2.57	2.71	2.71	2.71	2.53	2.58	2.82	2.85	2.85	2.22	0.08	0.16	0.24	0.31	0.39	0.47	0.55	0.63
NBC_MHEPL_209	336697	6259475	0.60	2.71	0.08	1.92	2.22	2.82	2.52	2.55	2.65	2.65	2.65	2.52	2.55	2.70	2.70	2.70	2.52	2.56	2.81	2.82	2.82	2.22	0.07	0.15	0.22	0.30	0.37	0.45	0.52	0.60
NBC_MHEPL_210	336669	6259409	0.61	3.08	0.08	1.92	2.22	2.82	2.52	2.55	2.65	2.65	2.65	2.52	2.56	2.77	2.77	2.77	2.52	2.57	2.81	2.82	2.82	2.22	0.08	0.15	0.23	0.30	0.38	0.45	0.53	0.61
NBC_MHEPL_211	336615	6259391	0.65	3.08	0.08	1.92	2.22	2.87	2.54	2.57	2.69	2.69	2.69	2.54	2.58	2.79	2.79	2.79	2.54	2.59	2.83	2.87	2.87	2.22	0.08	0.16	0.24	0.32	0.41	0.49	0.57	0.65
NBC_MHEPL_212	336599	6259355	0.73	3.08	0.08	1.92	2.22	2.95	2.58	2.61	2.74	2.74	2.74	2.58	2.62	2.81	2.82	2.82	2.58	2.63	2.88	2.95	2.95	2.22	0.09	0.18	0.27	0.37	0.46	0.55	0.64	0.73
NBC_MHEPL_213	336584	6259321	0.80	3.08	0.08	1.92	2.22	3.01	2.62	2.65	2.79	2.79	2.79	2.62	2.65	2.83	2.85	2.85	2.62	2.66	2.91	3.01	3.01	2.22	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_214	336557	6259265	0.82	3.08	0.07	1.91	2.21	3.04	2.63	2.66	2.81	2.81	2.81	2.63	2.66	2.84	2.86	2.86	2.63	2.68	2.92	3.04	3.04	2.21	0.10	0.21	0.31	0.41	0.51	0.62	0.72	0.82
NBC_MHEPL_215	336587	6259221	0.82	3.08	0.07	1.91	2.21	3.03	2.62	2.66	2.80	2.80	2.80	2.62	2.66	2.83	2.85	2.85	2.62	2.67	2.92	3.03	3.03	2.21	0.10	0.20	0.31	0.41	0.51	0.61	0.72	0.82
NBC_MHEPL_216	336628	6259205	0.81	3.08	0.08	1.92	2.22	3.02	2.62	2.65	2.80	2.80	2.80	2.62	2.66	2.83	2.85	2.85	2.62	2.67	2.91	3.02	3.02	2.22	0.10	0.20	0.30	0.40	0.50	0.61	0.71	0.81
NBC_MHEPL_217	336618	6259177	0.80	3.08	0.07	1.91	2.21	3.02	2.62	2.65	2.79	2.79	2.79	2.62	2.65	2.83	2.85	2.85	2.62	2.67	2.91	3.02	3.02	2.21	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_218	336657	6259126	0.80	3.08	0.07	1.91	2.21	3.01	2.61	2.64	2.79	2.79	2.79	2.61	2.65	2.83	2.84	2.84	2.61	2.66	2.91	3.01	3.01	2.21	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_219	336701	6259068	0.78	3.08	0.07	1.91	2.21	2.99	2.60	2.64	2.77	2.77	2.77	2.60	2.64	2.82	2.84	2.84	2.60	2.65	2.90	2.99	2.99	2.21	0.10	0.19	0.29	0.39	0.49	0.58	0.68	0.78
NBC_MHEPL_220	336771	6259079	0.75	2.71	0.07	1.91	2.21	2.96	2.59	2.62	2.75	2.75	2.75	2.59	2.62	2.75	2.75	2.75	2.59	2.64	2.88	2.96	2.96	2.21	0.09	0.19	0.28	0.38	0.47	0.56	0.66	0.75
NBC_MHEPL_221	336806	6259023	0.71	2.71	0.07	1.91	2.21	2.93	2.57	2.60	2.73	2.73	2.73	2.57	2.60	2.74	2.74	2.74	2.57	2.62	2.86	2.93	2.93	2.21	0.09	0.18	0.27	0.36	0.45	0.54	0.62	0.71
NBC_MHEPL_222	336792	6258989	0.71	2.71	0.07	1.91	2.21	2.92	2.57	2.60	2.72	2.72	2.72	2.57	2.60	2.74	2.74	2.74	2.57	2.62	2.86	2.92	2.92	2.21	0.09	0.18	0.27	0.36	0.44	0.53	0.62	0.71
NBC_MHEPL_223	336779	6258957	0.70	2.71	0.07	1.91	2.21	2.91	2.56	2.59	2.71	2.71	2.71	2.56	2.60	2.73	2.73	2.73	2.56	2.61	2.86	2.91	2.91	2.21	0.09	0.17	0.26	0.35	0.44	0.52	0.61	0.70
NBC_MHEPL_224	336813	6258909	0.66	2.71	0.07	1.91	2.21	2.87	2.54	2.57	2.69	2.69	2.69	2.54	2.58	2.72	2.72	2.72	2.54	2.59	2.84	2.87	2.87	2.21	0.08	0.17	0.25	0.33	0.41	0.50	0.58	0.66
NBC_MHEPL_225	336844	6258864	0.60	2.40	0.07	1.91	2.21	2.81	2.51	2.54	2.64	2.64	2.64	2.51	2.54	2.64	2.64	2.64	2.51	2.56	2.81	2.81	2.81	2.21	0.07	0.15	0.22	0.30	0.37	0.45	0.52	0.60
NBC_MHEPL_226	336888	6258851	0.58	2.40	0.07	1.91	2.21	2.79	2.50	2.53	2.63	2.63	2.63	2.50	2.53	2.63	2.63	2.63	2.50	2.55	2.79	2.79	2.79	2.21	0.07	0.14	0.22	0.29	0.36	0.43	0.50	0.58

100yr ARI Planning Levels - 0.4m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.40** m sea level rise projection
Freeboard of **0.3** m included in EPLs

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																	Reduction Factor Note: The application of the Reduction Factor should not reduce the EPL below the Local (Still) Water Level							
Name	X MGAz56	Y MGAz56	Wave		Local Wind Setup* (m)	Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)	Max EPL of all Foreshore Types and Crest Levels (mAHD)	Foreshore Type ##																5m	10m	15m	20m	25m	30m	35m	40m
			Hs (m)	Tp (sec)					1					2					3					4								
									Crest Level (mAHD)																							
						0.4 m Sea Level Projection	0.4 m Sea Level Projection		1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A								
NBC_MHEPL_227	336920	6258786	0.57	2.11	0.07	1.91	2.21	2.78	2.50	2.53	2.62	2.62	2.62	2.50	2.52	2.58	2.58	2.58	2.50	2.55	2.78	2.78	2.78	2.21	0.07	0.14	0.21	0.29	0.36	0.43	0.50	0.57
NBC_MHEPL_228	336874	6258799	0.58	2.11	0.07	1.91	2.21	2.79	2.50	2.53	2.63	2.63	2.63	2.50	2.52	2.59	2.59	2.59	2.50	2.55	2.79	2.79	2.79	2.21	0.07	0.14	0.22	0.29	0.36	0.43	0.51	0.58
NBC_MHEPL_229	336854	6258728	0.58	2.11	0.07	1.91	2.21	2.79	2.50	2.53	2.62	2.62	2.62	2.50	2.52	2.58	2.58	2.58	2.50	2.55	2.79	2.79	2.79	2.21	0.07	0.14	0.22	0.29	0.36	0.43	0.50	0.58
NBC_MHEPL_230	336807	6258743	0.57	2.11	0.07	1.91	2.21	2.78	2.49	2.53	2.62	2.62	2.62	2.49	2.52	2.58	2.58	2.58	2.49	2.54	2.78	2.78	2.78	2.21	0.07	0.14	0.21	0.29	0.36	0.43	0.50	0.57
NBC_MHEPL_231	336787	6258677	0.56	2.11	0.07	1.91	2.21	2.77	2.49	2.52	2.61	2.61	2.61	2.49	2.51	2.58	2.58	2.58	2.49	2.54	2.77	2.77	2.77	2.21	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
NBC_MHEPL_232	336766	6258604	0.55	2.11	0.07	1.91	2.21	2.76	2.48	2.52	2.60	2.60	2.60	2.48	2.51	2.57	2.57	2.57	2.48	2.53	2.76	2.76	2.76	2.21	0.07	0.14	0.21	0.27	0.34	0.41	0.48	0.55
NBC_MHEPL_233	336715	6258621	0.55	2.40	0.07	1.91	2.21	2.76	2.48	2.51	2.60	2.60	2.60	2.48	2.52	2.62	2.62	2.62	2.48	2.53	2.76	2.76	2.76	2.21	0.07	0.14	0.20	0.27	0.34	0.41	0.48	0.55
NBC_MHEPL_234	336690	6258548	0.56	2.40	0.07	1.91	2.21	2.77	2.49	2.52	2.62	2.62	2.62	2.49	2.52	2.62	2.62	2.62	2.49	2.54	2.77	2.77	2.77	2.21	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
NBC_MHEPL_235	336671	6258489	0.64	2.71	0.07	1.91	2.21	2.85	2.53	2.56	2.67	2.67	2.67	2.53	2.57	2.71	2.71	2.71	2.53	2.58	2.82	2.85	2.85	2.21	0.08	0.16	0.24	0.32	0.40	0.48	0.56	0.64
NBC_MHEPL_236	336615	6258509	0.71	2.71	0.07	1.91	2.21	2.92	2.56	2.60	2.72	2.72	2.72	2.56	2.60	2.73	2.73	2.73	2.56	2.61	2.86	2.92	2.92	2.21	0.09	0.18	0.27	0.35	0.44	0.53	0.62	0.71
NBC_MHEPL_237	336595	6258449	0.73	2.71	0.07	1.91	2.21	2.94	2.58	2.61	2.74	2.74	2.74	2.58	2.61	2.74	2.74	2.74	2.58	2.63	2.87	2.94	2.94	2.21	0.09	0.18	0.28	0.37	0.46	0.55	0.64	0.73
NBC_MHEPL_238	336515	6258400	0.76	2.71	0.07	1.91	2.21	2.97	2.59	2.62	2.76	2.76	2.76	2.59	2.62	2.75	2.75	2.75	2.59	2.64	2.89	2.97	2.97	2.21	0.10	0.19	0.29	0.38	0.48	0.57	0.67	0.76
NBC_MHEPL_239	336573	6258380	0.76	2.71	0.07	1.91	2.21	2.97	2.59	2.62	2.75	2.75	2.75	2.59	2.62	2.75	2.75	2.75	2.59	2.64	2.89	2.97	2.97	2.21	0.09	0.19	0.28	0.38	0.47	0.57	0.66	0.76
NBC_MHEPL_240	336553	6258320	0.77	2.71	0.07	1.91	2.21	2.98	2.59	2.63	2.76	2.76	2.76	2.59	2.63	2.76	2.76	2.76	2.59	2.65	2.89	2.98	2.98	2.21	0.10	0.19	0.29	0.39	0.48	0.58	0.67	0.77
NBC_MHEPL_241	336597	6258254	0.78	2.71	0.07	1.91	2.21	2.99	2.60	2.63	2.77	2.77	2.77	2.60	2.63	2.76	2.76	2.76	2.60	2.65	2.90	2.99	2.99	2.21	0.10	0.19	0.29	0.39	0.49	0.58	0.68	0.78
NBC_MHEPL_242	336583	6258205	0.78	2.71	0.07	1.91	2.21	2.99	2.60	2.63	2.77	2.77	2.77	2.60	2.63	2.76	2.76	2.76	2.60	2.65	2.90	2.99	2.99	2.21	0.10	0.20	0.29	0.39	0.49	0.59	0.68	0.78
NBC_MHEPL_243	336646	6258187	0.78	2.71	0.07	1.91	2.21	2.99	2.60	2.63	2.77	2.77	2.77	2.60	2.63	2.76	2.76	2.76	2.60	2.65	2.90	2.99	2.99	2.21	0.10	0.20	0.29	0.39	0.49	0.59	0.68	0.78
NBC_MHEPL_010	332541	6264155	0.16	1.28	0.34	2.18	2.48	2.64	2.56	2.56	2.60	2.60	2.60	2.56	2.56	2.60	2.60	2.60	2.56	2.56	2.64	2.64	2.64	2.48	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16
NBC_MHEPL_244	336632	6258136	0.78	2.71	0.07	1.91	2.21	2.99	2.60	2.63	2.77	2.77	2.77	2.60	2.63	2.76	2.76	2.76	2.60	2.65	2.90	2.99	2.99	2.21	0.10	0.20	0.29	0.39	0.49	0.59	0.68	0.78
NBC_MHEPL_245	336701	6258118	0.77	2.71	0.07	1.91	2.21	2.98	2.59	2.63	2.77	2.77	2.77	2.59	2.63	2.76	2.76	2.76	2.59	2.65	2.89	2.98	2.98	2.21	0.10	0.19	0.29	0.39	0.48	0.58	0.68	0.77
NBC_MHEPL_246	336770	6258099	0.77	2.71	0.07	1.91	2.21	2.98	2.59	2.63	2.76	2.76	2.76	2.59	2.63	2.75	2.75	2.75	2.59	2.64	2.89	2.98	2.98	2.21	0.10	0.19	0.29	0.38	0.48	0.58	0.67	0.77
NBC_MHEPL_247	336833	6258082	0.75	2.71	0.07	1.91	2.21	2.96	2.58	2.62	2.75	2.75	2.75	2.58	2.62	2.75	2.75	2.75	2.58	2.64	2.88	2.96	2.96	2.21	0.09	0.19	0.28	0.38	0.47	0.57	0.66	0.75
NBC_MHEPL_248	336901	6258115	0.74	2.71	0.07	1.91	2.21	2.95	2.58	2.61	2.74	2.74	2.74	2.58	2.61	2.74	2.74	2.74	2.58	2.63	2.88	2.95	2.95	2.21	0.09	0.19	0.28	0.37	0.46	0.56	0.65	0.74
NBC_MHEPL_249	336949	6258104	0.74	2.71	0.07	1.91	2.21	2.95	2.58	2.61	2.74	2.74	2.74	2.58	2.61	2.74	2.74	2.74	2.58	2.63	2.88	2.95	2.95	2.21	0.09	0.19	0.28	0.37	0.46	0.56	0.65	0.74
NBC_MHEPL_250	337001	6258143	0.74	2.71	0.07	1.91	2.21	2.95	2.58	2.61	2.74	2.74	2.74	2.58	2.61	2.74	2.74	2.74	2.58	2.63	2.88	2.95	2.95	2.21	0.09	0.19	0.28	0.37	0.46	0.56	0.65	0.74
NBC_MHEPL_251	337045	6258134	0.74	2.71	0.07	1.91	2.21	2.95	2.58	2.61	2.74	2.74	2.74	2.58	2.61	2.74	2.74	2.74	2.58	2.63	2.87	2.95	2.95	2.21	0.09	0.19	0.28	0.37	0.46	0.56	0.65	0.74
NBC_MHEPL_252	337091	6258125	0.74	2.71	0.07	1.91	2.21	2.94	2.57	2.61	2.74	2.74	2.74	2.57	2.61	2.74	2.74	2.74	2.57	2.63	2.87	2.94	2.94	2.21	0.09	0.18	0.28	0.37	0.46	0.55	0.64	0.74
NBC_MHEPL_253	337136	6258117	0.73	2.71	0.07	1.91	2.21	2.94	2.57	2.61	2.73	2.73	2.73	2.57	2.61	2.74	2.74	2.74	2.57	2.62	2.87	2.94	2.94	2.21	0.09	0.18	0.27	0.37	0.46	0.55	0.64	0.73
NBC_MHEPL_254	337178	6258109	0.72	2.40	0.07	1.91	2.21	2.93	2.57	2.60	2.72	2.72	2.72	2.57	2.59	2.67	2.67	2.67	2.57	2.62	2.86	2.93	2.93	2.21	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72
NBC_MHEPL_255	337227	6258153	0.72	2.40	0.07	1.91	2.21	2.92	2.56	2.60	2.72	2.72	2.72	2.56	2.59	2.67	2.67	2.67	2.56	2.62	2.86	2.92	2.92	2.21	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72
NBC_MHEPL_256	337268	6258148	0.71	2.40	0.06	1.90	2.20	2.92	2.56	2.60	2.72	2.72	2.72	2.56	2.59	2.67	2.67	2.67	2.56	2.62	2.86	2.92	2.92	2.20	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.71
NBC_MHEPL_257	337311	6258143	0.72	2.40	0.06	1.90	2.20	2.93	2.57	2.60	2.72	2.72	2.72	2.57	2.59	2.67	2.67	2.67	2.57	2.62	2.86	2.93	2.93	2.20	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72
NBC_MHEPL_258	337359	6258191	0.75	2.40	0.07	1.91	2.21	2.95	2.58	2.61	2.74	2.74	2.74	2.58	2.61	2.68	2.68	2.68	2.58	2.63	2.88	2.95	2.95	2.21	0.09	0.19	0.28	0.37	0.47	0.56	0.65	0.75
NBC_MHEPL_259	337364	6258242	0.75	2.40	0.07	1.91	2.21	2.96	2.59	2.62	2.75	2.75	2.75	2.59	2.61	2.69	2.69	2.69	2.59	2.64	2.88	2.96	2.96	2.21	0.09	0.19	0.28	0.38	0.47	0.56	0.66	0.75
NBC_MHEPL_260	337411	6258289	0.75	2.40	0.07	1.91	2.21	2.96	2.58	2.62	2.75	2.75	2.75	2.58	2.61	2.69	2.69	2.69	2.58	2.64	2.88	2.96	2.96	2.21	0.09	0.19	0.28	0.37	0.47	0.56	0.65	0.75
NBC_MHEPL_261	337414	6258339	0.72	2.40	0.07	1.91	2.21	2.93	2.57	2.61	2.73	2.73	2.73	2.57	2.60	2.68	2.68	2.68	2.57	2.62	2.87	2.93	2.93	2.21	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72
NBC_MHEPL_262	337456	6258337	0.73	2.40	0.07	1.91	2.21	2.94	2.58	2.61	2.74	2.74	2.74	2.58	2.60	2.68	2.68	2.68	2.58	2.63	2.87	2.94	2.94	2.21	0.09	0.18	0.27	0.37	0.46	0.55	0.64	0.73
NBC_MHEPL_263	337500	6258387	0.76	2.40	0.07	1.91	2.21	2.97	2.59	2.62	2.76	2.76	2.76	2.59	2.62	2.69	2.69	2.69	2.59	2.64	2.89	2.97	2.97	2.21	0.09	0.19	0.28	0.38	0.47	0.57	0.66	0.76
NBC_MHEPL_264	337543	6258385	0.80	2.71	0.07	1.91	2.21	3.01	2.61	2.65	2.79	2.79	2.79	2.61	2.64	2.77	2.77	2.77	2.61	2.66	2.91	3.01	3.01	2.21	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_265	337585	6258436	0.84	2.71	0.08	1.92	2.22	3.05	2.63	2.67	2.81	2.82	2.82	2.63	2.66	2.78	2.78	2.78	2.63	2.68	2.93	3.05	3.05	2.22	0.10	0.21	0.31	0.42	0.52	0.63	0.73	0.84
NBC_MHEPL_266	337623	6258383	0.86	2.71	0.07	1.91	2.21	3.08	2.65	2.68	2.82	2.84	2.84	2.65	2.67	2.79	2.79	2.79	2.65	2.70	2.94	3.08	3.08	2.21	0.11	0.22	0.32	0.43	0.54	0.65	0.76	0.86
NBC_MHEPL_267	337664	6258384	0.87	2.71	0.07	1.91	2.21	3.08	2.65	2.68	2.83	2.84	2.84	2.65	2.68	2.79	2.79	2.79	2.65	2.70	2.95	3.08	3.08	2.21	0.11	0.22	0.33	0.44	0.54	0.65	0.76	0.87
NBC_MHEPL_268	337705	6258383	0.87	3.08	0.07	1.91	2.21	3.08	2.65	2.68	2.83	2.84	2.84	2.65	2.68	2.85	2.87	2.87	2.65	2.70	2.94	3.08	3.08	2.21	0.11	0.22	0.33	0.43	0.54	0.65	0.76	0.87
NBC_MHEPL_269	337746	6258383	0.86	3.08	0.07	1.91	2.21	3.07	2.64	2.68	2.82	2.83	2.83	2.64	2.68	2.85	2.87	2.87	2.64	2.69	2.94	3.07	3.07	2.21	0.11	0.22	0.32	0.43	0.54	0.65	0.75	0.86
NBC_MHEPL_270	337785	6258382	0.86	3.08	0.07	1.91	2.21	3.07	2.64	2.67	2.82	2.83	2.83	2.64	2.68	2.84	2.87	2.87	2.64	2.69	2.94	3.07	3.07	2.21	0.11	0.21	0.32	0.43	0.53	0.64	0.75	0.86
NBC_MHEPL_271	337824	6258382	0.85	3.08	0.07	1.91	2.21	3.06	2.64	2.67	2.82	2.83	2.83	2.64	2.68	2.84	2.86	2.86	2.64	2.69	2.93	3.06	3.06	2.21	0.11	0.21	0.32	0.43	0.53	0.64	0.75	0.85
NBC_MHEPL_272	337862	6258433	0.85	3.08	0.07	1.91	2.21	3.07	2.64	2.67	2.82	2.83	2.83	2.64	2.68	2.84	2.86	2.86	2.64	2.69	2.94	3.07	3.07	2.21	0.11	0.21	0.32	0.43	0.53	0.64	0.75	0.85
NBC_MHEPL_273	337899	6258433	0.85	3.08	0.07	1.91	2.21	3.06	2.64	2.67	2.82	2.83	2.83	2.64	2.68	2.84	2.86	2.86	2.64	2.69	2.93	3.06	3.06	2.21	0.11	0.21	0.32	0.43	0.53	0.64	0.74	0.85
NBC_MHEPL_274	337937	6258433	0.84	3.08	0.07	1.91	2.21	3.05	2.63	2.66	2.81	2.82	2.82	2.63	2.67	2.84	2.86	2.86	2.63	2.68	2.93	3.05	3.05	2.21	0.10	0.21	0.31	0.42	0.52	0.63	0.73	0.84
NBC_MHEPL_275	337976	6258433	0.80	2.71	0.07	1.91	2.21	3.02	2.61	2.65	2.79	2.79	2.79	2.61	2.65	2.77	2.77	2.77	2.61	2.66	2.91	3.02	3.02	2.21	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_276	337938	6258381	0.83	2.71	0.07	1.91	2.21	3.04	2.63	2.66	2.81	2.81	2.81	2.63	2.66	2.78	2.78	2.78	2.63	2.68	2.92	3.04	3.04	2.21	0.10	0.21	0.31	0.41	0.52	0.62	0.73	0.83
NBC_MHEPL_277	337938	6258329	0.84	2.71	0.07	1.91	2.21	3.05	2.63	2.66	2.81	2.81	2.81	2.63	2.66	2.78	2.78	2.78	2.63	2.68	2.93	3.05	3.05	2.21	0.10	0.21	0.31	0.42	0.52	0.63	0.73	0.84
NBC_MHEPL_278	337977	6258276	0.84	2.71	0.07	1.91	2.21	3.05	2.63	2.66	2.81	2.81	2.81	2.63	2.66	2.78	2.78	2.78	2.63	2.68	2.93	3.05	3.05	2.21	0.10	0.21	0.31	0.42	0.52	0.63	0.73	0.84
NBC_MHEPL_279	338016	6258276	0.83	2.71	0.07	1.91	2.21	3.04	2.62	2.66	2.80	2.80	2.80	2.62	2.65	2.78	2.78	2.78	2.62	2.68	2.92	3.04	3.04	2.21	0.10	0.21	0.31	0.41	0.52	0.62	0.72	0.83

100yr ARI Planning Levels - 0.4m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.40** m sea level rise projection
Freeboard of **0.3** m included in EPLs

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																	Reduction Factor. Note: The application of the Reduction Factor should not reduce the EPL below the Local (Still) Water Level							
Name	X MGAz56	Y MGAz56	Wave		Local Wind Setup* (m)	Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)	Max EPL of all Foreshore Types and Crest Levels (mAHD)	Foreshore Type ## 1					2					3					4	5m	10m	15m	20m	25m	30m	35m	40m
			Hs (m)	Tp (sec)		0.4 m Sea Level Projection	0.4 m Sea Level Projection		Crest Level (mAHD) 1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A								
NBC_MHEPL_280	338055	6258276	0.82	2.71	0.07	1.91	2.21	3.03	2.62	2.65	2.80	2.80	2.80	2.62	2.65	2.77	2.77	2.77	2.62	2.67	2.91	3.03	3.03	2.21	0.10	0.20	0.31	0.41	0.51	0.61	0.71	0.82
NBC_MHEPL_281	338094	6258276	0.80	2.71	0.07	1.91	2.21	3.01	2.61	2.64	2.78	2.78	2.78	2.61	2.64	2.77	2.77	2.77	2.61	2.66	2.91	3.01	3.01	2.21	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_282	338217	6258276	0.69	2.40	0.08	1.92	2.22	2.90	2.56	2.59	2.71	2.71	2.71	2.56	2.59	2.67	2.67	2.67	2.56	2.61	2.85	2.90	2.90	2.22	0.09	0.17	0.26	0.34	0.43	0.51	0.60	0.69
NBC_MHEPL_283	338175	6258222	0.72	2.40	0.07	1.91	2.21	2.93	2.57	2.60	2.73	2.73	2.73	2.57	2.60	2.68	2.68	2.68	2.57	2.62	2.87	2.93	2.93	2.21	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72
NBC_MHEPL_284	338218	6258222	0.71	2.40	0.07	1.91	2.21	2.92	2.57	2.60	2.73	2.73	2.73	2.57	2.59	2.68	2.68	2.68	2.57	2.62	2.86	2.92	2.92	2.21	0.09	0.18	0.27	0.36	0.45	0.54	0.62	0.71
NBC_MHEPL_285	338218	6258167	0.68	2.40	0.07	1.91	2.21	2.89	2.55	2.58	2.70	2.70	2.70	2.55	2.58	2.67	2.67	2.67	2.55	2.60	2.85	2.89	2.89	2.21	0.09	0.17	0.26	0.34	0.43	0.51	0.60	0.68
NBC_MHEPL_286	338218	6258112	0.65	2.40	0.07	1.91	2.21	2.85	2.53	2.56	2.67	2.67	2.67	2.53	2.56	2.65	2.65	2.65	2.53	2.58	2.83	2.85	2.85	2.21	0.08	0.16	0.24	0.32	0.40	0.48	0.56	0.65
NBC_MHEPL_287	338217	6258055	0.62	2.40	0.07	1.91	2.21	2.83	2.52	2.55	2.66	2.66	2.66	2.52	2.55	2.64	2.64	2.64	2.52	2.57	2.82	2.83	2.83	2.21	0.08	0.16	0.23	0.31	0.39	0.47	0.55	0.62
NBC_MHEPL_288	338174	6258056	0.65	2.40	0.07	1.91	2.21	2.86	2.53	2.57	2.67	2.67	2.67	2.53	2.56	2.65	2.65	2.65	2.53	2.58	2.83	2.86	2.86	2.21	0.08	0.16	0.24	0.33	0.41	0.49	0.57	0.65
NBC_MHEPL_289	338131	6258003	0.69	2.40	0.07	1.91	2.21	2.89	2.55	2.58	2.70	2.70	2.70	2.55	2.58	2.66	2.66	2.66	2.55	2.60	2.85	2.89	2.89	2.21	0.09	0.17	0.26	0.34	0.43	0.52	0.60	0.69
NBC_MHEPL_290	338129	6257949	0.73	2.71	0.06	1.90	2.20	2.93	2.57	2.60	2.73	2.73	2.73	2.57	2.60	2.74	2.74	2.74	2.57	2.62	2.87	2.93	2.93	2.20	0.09	0.18	0.27	0.36	0.45	0.54	0.64	0.73
NBC_MHEPL_291	338090	6257950	0.76	2.71	0.07	1.91	2.21	2.97	2.59	2.62	2.76	2.76	2.76	2.59	2.62	2.75	2.75	2.75	2.59	2.64	2.89	2.97	2.97	2.21	0.10	0.19	0.29	0.38	0.48	0.57	0.67	0.76
NBC_MHEPL_011	332693	6263979	0.22	1.13	0.31	2.15	2.45	2.68	2.57	2.57	2.62	2.62	2.62	2.57	2.57	2.58	2.58	2.58	2.57	2.57	2.68	2.68	2.68	2.45	0.03	0.06	0.08	0.11	0.14	0.17	0.20	0.22
NBC_MHEPL_292	338088	6257896	0.79	3.08	0.07	1.91	2.21	3.00	2.60	2.64	2.78	2.78	2.78	2.60	2.64	2.82	2.83	2.83	2.60	2.66	2.90	3.00	3.00	2.21	0.10	0.20	0.30	0.40	0.50	0.59	0.69	0.79
NBC_MHEPL_293	338087	6257842	0.81	3.08	0.06	1.90	2.20	3.02	2.61	2.65	2.79	2.79	2.79	2.61	2.65	2.83	2.84	2.84	2.61	2.67	2.91	3.02	3.02	2.20	0.10	0.20	0.30	0.41	0.51	0.61	0.71	0.81
NBC_MHEPL_294	338085	6257788	0.82	3.08	0.06	1.90	2.20	3.03	2.62	2.65	2.80	2.80	2.80	2.62	2.66	2.83	2.84	2.84	2.62	2.67	2.92	3.03	3.03	2.20	0.10	0.21	0.31	0.41	0.51	0.62	0.72	0.82
NBC_MHEPL_295	338123	6257732	0.83	3.08	0.06	1.90	2.20	3.03	2.61	2.65	2.80	2.80	2.80	2.61	2.66	2.83	2.84	2.84	2.61	2.67	2.92	3.03	3.03	2.20	0.10	0.21	0.31	0.41	0.52	0.62	0.72	0.83
NBC_MHEPL_296	338165	6257731	0.83	3.08	0.06	1.90	2.20	3.03	2.61	2.65	2.80	2.80	2.80	2.61	2.66	2.83	2.84	2.84	2.61	2.67	2.92	3.03	3.03	2.20	0.10	0.21	0.31	0.42	0.52	0.62	0.73	0.83
NBC_MHEPL_297	338208	6257676	0.83	3.08	0.06	1.90	2.20	3.03	2.61	2.65	2.80	2.80	2.80	2.61	2.66	2.83	2.84	2.84	2.61	2.67	2.92	3.03	3.03	2.20	0.10	0.21	0.31	0.41	0.52	0.62	0.73	0.83
NBC_MHEPL_298	338207	6257623	0.83	3.08	0.06	1.90	2.20	3.03	2.61	2.65	2.80	2.80	2.80	2.61	2.66	2.83	2.84	2.84	2.61	2.67	2.92	3.03	3.03	2.20	0.10	0.21	0.31	0.42	0.52	0.62	0.73	0.83
NBC_MHEPL_299	338257	6257622	0.83	3.08	0.06	1.90	2.20	3.02	2.61	2.65	2.79	2.79	2.79	2.61	2.65	2.83	2.84	2.84	2.61	2.67	2.91	3.02	3.02	2.20	0.10	0.21	0.31	0.41	0.52	0.62	0.72	0.83
NBC_MHEPL_300	338309	6257567	0.82	3.08	0.06	1.90	2.20	3.02	2.61	2.65	2.79	2.79	2.79	2.61	2.65	2.82	2.84	2.84	2.61	2.67	2.91	3.02	3.02	2.20	0.10	0.20	0.31	0.41	0.51	0.61	0.72	0.82
NBC_MHEPL_301	338309	6257513	0.85	3.08	0.05	1.89	2.19	3.04	2.62	2.66	2.80	2.80	2.80	2.62	2.66	2.83	2.84	2.84	2.62	2.68	2.92	3.04	3.04	2.19	0.11	0.21	0.32	0.42	0.53	0.63	0.74	0.85
NBC_MHEPL_302	338310	6257458	0.86	3.08	0.05	1.89	2.19	3.05	2.62	2.66	2.81	2.81	2.81	2.62	2.67	2.83	2.85	2.85	2.62	2.68	2.93	3.05	3.05	2.19	0.11	0.21	0.32	0.43	0.54	0.64	0.75	0.86
NBC_MHEPL_303	338311	6257403	0.88	3.08	0.05	1.89	2.19	3.07	2.63	2.67	2.82	2.83	2.83	2.63	2.68	2.84	2.86	2.86	2.63	2.69	2.94	3.07	3.07	2.19	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88
NBC_MHEPL_304	338365	6257403	0.89	3.08	0.06	1.90	2.20	3.08	2.64	2.68	2.82	2.83	2.83	2.64	2.68	2.84	2.86	2.86	2.64	2.70	2.94	3.08	3.08	2.20	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.89
NBC_MHEPL_305	338421	6257402	0.89	3.08	0.06	1.90	2.20	3.08	2.64	2.68	2.83	2.84	2.84	2.64	2.68	2.84	2.86	2.86	2.64	2.70	2.94	3.08	3.08	2.20	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.89
NBC_MHEPL_306	338478	6257402	0.88	3.08	0.06	1.90	2.20	3.08	2.64	2.68	2.83	2.84	2.84	2.64	2.68	2.84	2.86	2.86	2.64	2.70	2.94	3.08	3.08	2.20	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88
NBC_MHEPL_307	338536	6257402	0.89	3.08	0.06	1.90	2.20	3.09	2.65	2.68	2.83	2.84	2.84	2.65	2.69	2.85	2.87	2.87	2.65	2.70	2.95	3.09	3.09	2.20	0.11	0.22	0.33	0.44	0.55	0.67	0.78	0.89
NBC_MHEPL_308	338536	6257346	0.90	3.08	0.06	1.90	2.20	3.10	2.65	2.69	2.83	2.85	2.85	2.65	2.69	2.85	2.87	2.87	2.65	2.71	2.95	3.10	3.10	2.20	0.11	0.22	0.34	0.45	0.56	0.67	0.78	0.90
NBC_MHEPL_309	338593	6257346	0.89	3.08	0.06	1.90	2.20	3.09	2.65	2.69	2.83	2.84	2.84	2.65	2.69	2.85	2.87	2.87	2.65	2.70	2.95	3.09	3.09	2.20	0.11	0.22	0.33	0.45	0.56	0.67	0.78	0.89
NBC_MHEPL_310	338649	6257345	0.88	3.08	0.06	1.90	2.20	3.09	2.65	2.68	2.83	2.84	2.84	2.65	2.69	2.85	2.87	2.87	2.65	2.70	2.95	3.09	3.09	2.20	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88
NBC_MHEPL_311	338704	6257345	0.88	3.08	0.07	1.91	2.21	3.08	2.65	2.68	2.83	2.84	2.84	2.65	2.68	2.85	2.87	2.87	2.65	2.70	2.94	3.08	3.08	2.21	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88
NBC_MHEPL_312	338757	6257344	0.87	3.08	0.07	1.91	2.21	3.08	2.64	2.68	2.83	2.84	2.84	2.64	2.68	2.85	2.87	2.87	2.64	2.70	2.94	3.08	3.08	2.21	0.11	0.22	0.33	0.43	0.54	0.65	0.76	0.87
NBC_MHEPL_313	338809	6257344	0.85	3.08	0.07	1.91	2.21	3.06	2.64	2.67	2.82	2.83	2.83	2.64	2.68	2.84	2.86	2.86	2.64	2.69	2.93	3.06	3.06	2.21	0.11	0.21	0.32	0.43	0.53	0.64	0.74	0.85
NBC_MHEPL_314	338861	6257289	0.84	3.08	0.07	1.91	2.21	3.05	2.63	2.66	2.81	2.81	2.81	2.63	2.67	2.84	2.86	2.86	2.63	2.68	2.93	3.05	3.05	2.21	0.10	0.21	0.31	0.42	0.52	0.63	0.73	0.84
NBC_MHEPL_315	338862	6257232	0.83	2.71	0.06	1.90	2.20	3.03	2.62	2.66	2.80	2.80	2.80	2.62	2.65	2.77	2.77	2.77	2.62	2.67	2.92	3.03	3.03	2.20	0.10	0.21	0.31	0.42	0.52	0.62	0.73	0.83
NBC_MHEPL_316	338912	6257172	0.83	2.71	0.06	1.90	2.20	3.03	2.61	2.65	2.79	2.79	2.79	2.61	2.65	2.76	2.76	2.76	2.61	2.67	2.92	3.03	3.03	2.20	0.10	0.21	0.31	0.41	0.52	0.62	0.72	0.83
NBC_MHEPL_317	338910	6257109	0.81	2.71	0.05	1.89	2.19	3.01	2.60	2.64	2.78	2.78	2.78	2.60	2.64	2.76	2.76	2.76	2.60	2.66	2.91	3.01	3.01	2.19	0.10	0.20	0.31	0.41	0.51	0.61	0.71	0.81
NBC_MHEPL_318	338958	6257106	0.80	2.71	0.05	1.89	2.19	2.99	2.59	2.63	2.77	2.77	2.77	2.59	2.63	2.75	2.75	2.75	2.59	2.65	2.90	2.99	2.99	2.19	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_319	338955	6257045	0.77	2.71	0.05	1.89	2.19	2.96	2.58	2.62	2.75	2.75	2.75	2.58	2.61	2.74	2.74	2.74	2.58	2.64	2.88	2.96	2.96	2.19	0.10	0.19	0.29	0.39	0.48	0.58	0.68	0.77
NBC_MHEPL_320	338951	6256989	0.77	2.71	0.04	1.88	2.18	2.95	2.57	2.61	2.74	2.74	2.74	2.57	2.61	2.73	2.73	2.73	2.57	2.63	2.88	2.95	2.95	2.18	0.10	0.19	0.29	0.38	0.48	0.58	0.67	0.77
NBC_MHEPL_321	338949	6256938	0.77	2.71	0.04	1.88	2.18	2.95	2.57	2.61	2.74	2.74	2.74	2.57	2.61	2.73	2.73	2.73	2.57	2.63	2.88	2.95	2.95	2.18	0.10	0.19	0.29	0.39	0.48	0.58	0.68	0.77
NBC_MHEPL_322	338947	6256887	0.78	2.71	0.04	1.88	2.18	2.96	2.57	2.61	2.74	2.74	2.74	2.57	2.61	2.73	2.73	2.73	2.57	2.63	2.88	2.96	2.96	2.18	0.10	0.19	0.29	0.39	0.49	0.58	0.68	0.78
NBC_MHEPL_323	338946	6256837	0.78	2.71	0.03	1.87	2.17	2.96	2.56	2.61	2.74	2.74	2.74	2.56	2.61	2.72	2.72	2.72	2.56	2.63	2.88	2.96	2.96	2.17	0.10	0.20	0.29	0.39	0.49	0.59	0.68	0.78
NBC_MHEPL_324	338945	6256787	0.80	2.71	0.04	1.88	2.18	2.98	2.58	2.62	2.75	2.75	2.75	2.58	2.62	2.73	2.73	2.73	2.58	2.65	2.89	2.98	2.98	2.18	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_325	338945	6256736	0.86	2.71	0.03	1.87	2.17	3.03	2.60	2.64	2.79	2.79	2.79	2.60	2.64	2.74	2.74	2.74	2.60	2.67	2.92	3.03	3.03	2.17	0.11	0.22	0.32	0.43	0.54	0.65	0.76	0.86
NBC_MHEPL_326	339045	6256633	0.89	2.71	0.03	1.87	2.17	3.06	2.62	2.66	2.81	2.81	2.81	2.62	2.65	2.76	2.76	2.76	2.62	2.69	2.93	3.06	3.06	2.17	0.11	0.22	0.33	0.45	0.56	0.67	0.78	0.89
NBC_MHEPL_327	339096	6256633	0.90	2.71	0.03	1.87	2.17	3.07	2.62	2.67	2.81	2.82	2.82	2.62	2.66	2.76	2.76	2.76	2.62	2.69	2.94	3.07	3.07	2.17	0.11	0.22	0.34	0.45	0.56	0.67	0.79	0.90
NBC_MHEPL_328	339147	6256633	0.90	2.71	0.03	1.87	2.17	3.07	2.62	2.67	2.81	2.82	2.82	2.62	2.66	2.76	2.76	2.76	2.62	2.69	2.94	3.07	3.07	2.17	0.11	0.23	0.34	0.45	0.56	0.68	0.79	0.90
NBC_MHEPL_329	339198	6256632	0.92	2.71	0.03	1.87	2.17	3.08	2.62	2.67	2.82	2.83	2.83	2.62	2.66	2.76	2.76	2.76	2.62	2.70	2.94	3.08	3.08	2.17	0.11	0.23	0.34	0.46	0.57	0.69	0.80	0.92
NBC_MHEPL_330	339248	6256632	0.93	2.71	0.03	1.87	2.17	3.10	2.63	2.68	2.83	2.84	2.84	2.63	2.67	2.77	2.77	2.77	2.63	2.71	2.95	3.10	3.10	2.17	0.12	0.23	0.35	0.47	0.58	0.70	0.82	0.93
NBC_MHEPL_012	332679	6263782	0.17	1.45	0.30	2.14	2.44	2.61	2.52	2.52	2.56	2.56	2.56	2.52	2.52	2.58	2.58	2.58	2.52	2.52	2.61	2.61	2.61	2.44	0.02	0.04	0.07	0.09	0.11	0.13	0.15	0.17
NBC_MHEPL_331	339249	6256682	0.96	3.08	0.03	1.87	2.17	3.12	2.65	2.69	2.84	2.86	2.86	2.65	2.69	2.84	2.86	2.86	2.65	2.72	2.97	3.12	3.12	2.17	0.12	0.24	0.36	0.48	0.60	0.72	0.84	0.96

APENDIX B

20220706_EPL_Database
0.4 m Sea Level Projected WL

100yr ARI Planning Levels - 0.4m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

Mean Sea Level Rise Allowance **0.40** m sea level rise projection
Freeboard of **0.3** m included in EPLs

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																	Reduction Factor — Note: The application of the Reduction Factor should not reduce the EPL below the Local (Still) Water Level							
Name	X MGAz56	Y MGAz56	Wave Hs (m)	Wave Tp (sec)	Local Wind Setup* (m)	Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)	Max EPL of all Foreshore Types and Crest Levels (mAHD)	Foreshore Type ## 1					2					3					4	5m	10m	15m	20m	25m	30m	35m	40m
						0.4 m Sea Level Projection	0.4 m Sea Level Projection		Crest Level (mAHD) 1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A								
NBC_MHEPL_332	339300	6256732	0.98	3.08	0.03	1.87	2.17	3.15	2.66	2.71	2.85	2.87	2.87	2.66	2.70	2.85	2.87	2.87	2.66	2.73	2.98	3.15	3.15	2.17	0.12	0.24	0.37	0.49	0.61	0.73	0.86	0.98
NBC_MHEPL_333	339300	6256782	0.99	3.08	0.03	1.87	2.17	3.16	2.67	2.71	2.86	2.88	2.88	2.67	2.71	2.85	2.87	2.87	2.67	2.74	2.98	3.16	3.16	2.17	0.12	0.25	0.37	0.50	0.62	0.75	0.87	0.99
NBC_MHEPL_334	339301	6256832	0.99	3.08	0.03	1.87	2.17	3.16	2.67	2.72	2.86	2.89	2.89	2.67	2.71	2.85	2.87	2.87	2.67	2.74	2.99	3.16	3.16	2.17	0.12	0.25	0.37	0.50	0.62	0.75	0.87	0.99
NBC_MHEPL_335	339301	6256881	0.97	3.08	0.03	1.87	2.17	3.14	2.66	2.70	2.85	2.87	2.87	2.66	2.70	2.85	2.87	2.87	2.66	2.73	2.97	3.14	3.14	2.17	0.12	0.24	0.36	0.49	0.61	0.73	0.85	0.97
NBC_MHEPL_336	339302	6256931	0.97	3.08	0.03	1.87	2.17	3.14	2.66	2.71	2.85	2.87	2.87	2.66	2.71	2.85	2.87	2.87	2.66	2.73	2.98	3.14	3.14	2.17	0.12	0.24	0.36	0.48	0.61	0.73	0.85	0.97
NBC_MHEPL_337	339302	6256980	1.00	3.08	0.04	1.88	2.18	3.18	2.68	2.72	2.87	2.90	2.90	2.68	2.72	2.86	2.88	2.88	2.68	2.75	2.99	3.18	3.18	2.18	0.12	0.25	0.37	0.50	0.62	0.75	0.87	1.00
NBC_MHEPL_338	339353	6256980	1.03	3.08	0.03	1.87	2.17	3.20	2.69	2.73	2.88	2.91	2.91	2.69	2.73	2.87	2.89	2.89	2.69	2.76	3.00	3.20	3.20	2.17	0.13	0.26	0.39	0.51	0.64	0.77	0.90	1.03
NBC_MHEPL_339	339403	6257029	1.03	3.48	0.04	1.88	2.18	3.21	2.69	2.74	2.88	2.92	2.92	2.69	2.75	2.92	2.99	2.99	2.69	2.76	3.01	3.21	3.21	2.18	0.13	0.26	0.39	0.51	0.64	0.77	0.90	1.03
NBC_MHEPL_340	339404	6257079	1.07	3.48	0.04	1.88	2.18	3.25	2.71	2.76	2.91	2.95	2.95	2.71	2.77	2.94	3.01	3.01	2.71	2.78	3.03	3.25	3.25	2.18	0.13	0.27	0.40	0.53	0.67	0.80	0.93	1.07
NBC_MHEPL_341	339454	6257079	1.05	3.48	0.04	1.88	2.18	3.23	2.70	2.75	2.89	2.93	2.93	2.70	2.76	2.93	3.00	3.00	2.70	2.77	3.02	3.23	3.23	2.18	0.13	0.26	0.39	0.52	0.66	0.79	0.92	1.05
NBC_MHEPL_342	339554	6257129	1.08	3.48	0.03	1.87	2.17	3.25	2.71	2.76	2.91	2.95	2.95	2.71	2.77	2.94	3.01	3.01	2.71	2.78	3.03	3.25	3.25	2.17	0.13	0.27	0.40	0.54	0.67	0.81	0.94	1.08
NBC_MHEPL_343	339654	6257178	1.13	3.48	0.03	1.87	2.17	3.30	2.74	2.79	2.93	2.99	2.99	2.74	2.79	2.95	3.03	3.03	2.74	2.81	3.06	3.30	3.30	2.17	0.14	0.28	0.42	0.56	0.71	0.85	0.99	1.13
NBC_MHEPL_344	339704	6257178	1.17	3.48	0.03	1.87	2.17	3.34	2.76	2.81	2.95	3.01	3.01	2.76	2.81	2.97	3.04	3.04	2.76	2.83	3.08	3.32	3.34	2.17	0.15	0.29	0.44	0.58	0.73	0.88	1.02	1.17
NBC_MHEPL_345	339754	6257228	1.19	3.48	0.04	1.88	2.18	3.36	2.77	2.82	2.96	3.03	3.03	2.77	2.82	2.97	3.05	3.05	2.77	2.84	3.09	3.33	3.36	2.18	0.15	0.30	0.44	0.59	0.74	0.89	1.04	1.19
NBC_MHEPL_346	339804	6257278	1.15	3.48	0.04	1.88	2.18	3.33	2.75	2.80	2.95	3.01	3.01	2.75	2.80	2.96	3.04	3.04	2.75	2.82	3.07	3.31	3.33	2.18	0.14	0.29	0.43	0.58	0.72	0.86	1.01	1.15
NBC_MHEPL_347	339804	6257328	1.14	3.48	0.04	1.88	2.18	3.32	2.75	2.80	2.94	3.00	3.00	2.75	2.80	2.96	3.04	3.04	2.75	2.82	3.07	3.31	3.32	2.18	0.14	0.29	0.43	0.57	0.71	0.86	1.00	1.14
NBC_MHEPL_348	339804	6257378	1.13	3.48	0.05	1.89	2.19	3.32	2.75	2.80	2.94	3.00	3.00	2.75	2.80	2.96	3.04	3.04	2.75	2.82	3.06	3.31	3.32	2.19	0.14	0.28	0.43	0.57	0.71	0.85	0.99	1.13
NBC_MHEPL_349	339854	6257379	1.17	3.48	0.05	1.89	2.19	3.36	2.77	2.82	2.96	3.03	3.03	2.77	2.82	2.98	3.06	3.06	2.77	2.84	3.09	3.33	3.36	2.19	0.15	0.29	0.44	0.59	0.73	0.88	1.03	1.17
NBC_MHEPL_350	339904	6257379	1.17	3.48	0.05	1.89	2.19	3.36	2.77	2.82	2.96	3.03	3.03	2.77	2.82	2.98	3.06	3.06	2.77	2.84	3.09	3.33	3.36	2.19	0.15	0.29	0.44	0.59	0.73	0.88	1.03	1.17
NBC_MHEPL_351	339954	6257379	1.22	3.48	0.04	1.88	2.18	3.40	2.79	2.84	2.98	3.06	3.06	2.79	2.84	2.99	3.07	3.07	2.79	2.86	3.11	3.35	3.40	2.18	0.15	0.30	0.46	0.61	0.76	0.91	1.06	1.22
NBC_MHEPL_352	340004	6257329	1.23	3.95	0.04	1.88	2.18	3.41	2.80	2.84	2.99	3.07	3.07	2.80	2.86	3.05	3.21	3.21	2.80	2.87	3.11	3.36	3.41	2.18	0.15	0.31	0.46	0.62	0.77	0.92	1.08	1.23
NBC_MHEPL_353	340105	6257279	1.20	3.48	0.03	1.87	2.17	3.37	2.77	2.82	2.97	3.03	3.03	2.77	2.82	2.98	3.05	3.05	2.77	2.85	3.09	3.34	3.37	2.17	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20
NBC_MHEPL_354	340155	6257229	1.33	3.95	0.02	1.86	2.16	3.49	2.83	2.88	3.03	3.12	3.12	2.83	2.89	3.07	3.23	3.23	2.83	2.91	3.15	3.40	3.49	2.16	0.17	0.33	0.50	0.67	0.83	1.00	1.17	1.33
NBC_MHEPL_355	340205	6257229	1.37	3.95	0.02	1.86	2.16	3.53	2.85	2.90	3.05	3.15	3.15	2.85	2.91	3.09	3.24	3.24	2.85	2.93	3.17	3.42	3.53	2.16	0.17	0.34	0.52	0.69	0.86	1.03	1.20	1.37
NBC_MHEPL_013	332816	6263730	0.25	1.28	0.29	2.13	2.43	2.68	2.56	2.56	2.61	2.61	2.61	2.56	2.56	2.59	2.59	2.59	2.56	2.56	2.68	2.68	2.68	2.43	0.03	0.06	0.09	0.12	0.16	0.19	0.22	0.25
NBC_MHEPL_356	340255	6257279	1.40	3.95	0.03	1.87	2.17	3.57	2.87	2.92	3.07	3.18	3.18	2.87	2.93	3.10	3.26	3.26	2.87	2.95	3.19	3.44	3.57	2.17	0.18	0.35	0.53	0.70	0.88	1.05	1.23	1.40
NBC_MHEPL_357	340305	6257329	1.46	3.95	0.03	1.87	2.17	3.63	2.90	2.95	3.10	3.22	3.22	2.90	2.96	3.13	3.29	3.29	2.90	2.98	3.22	3.47	3.63	2.17	0.18	0.37	0.55	0.73	0.91	1.10	1.28	1.46
NBC_MHEPL_358	340305	6257380	1.73	12.96	0.03	1.87	2.17	4.30	3.04	3.15	3.54	3.92	4.30	3.04	3.15	3.52	3.88	4.25	3.04	3.12	3.36	3.61	3.85	2.17	0.27	0.53	0.80	1.07	1.33	1.60	1.87	2.13
NBC_MHEPL_359	340355	6257430	1.73	12.96	0.03	1.87	2.17	4.31	3.04	3.15	3.54	3.92	4.31	3.04	3.15	3.52	3.88	4.25	3.04	3.12	3.36	3.61	3.85	2.17	0.27	0.53	0.80	1.07	1.33	1.60	1.87	2.13
NBC_MHEPL_360	340355	6257480	1.73	3.95	0.03	1.87	2.17	3.85	3.04	3.09	3.24	3.39	3.42	3.04	3.09	3.23	3.37	3.39	3.04	3.12	3.36	3.61	3.85	2.17	0.21	0.42	0.63	0.84	1.05	1.26	1.47	1.68
NBC_MHEPL_361	340355	6257530	1.67	3.95	0.04	1.88	2.18	3.82	3.01	3.06	3.21	3.36	3.38	3.01	3.06	3.21	3.35	3.37	3.01	3.09	3.33	3.58	3.82	2.18	0.21	0.41	0.62	0.82	1.03	1.24	1.44	1.65
NBC_MHEPL_362	340406	6257579	1.67	3.95	0.04	1.88	2.18	3.82	3.01	3.06	3.21	3.35	3.38	3.01	3.06	3.21	3.35	3.37	3.01	3.09	3.33	3.58	3.82	2.18	0.21	0.41	0.62	0.82	1.03	1.24	1.44	1.65
NBC_MHEPL_363	340406	6257629	1.63	3.95	0.04	1.88	2.18	3.80	2.99	3.04	3.19	3.34	3.35	2.99	3.05	3.19	3.34	3.36	2.99	3.07	3.31	3.56	3.80	2.18	0.20	0.41	0.61	0.81	1.02	1.22	1.42	1.63
NBC_MHEPL_364	340406	6257679	1.45	3.95	0.04	1.88	2.18	3.63	2.90	2.95	3.10	3.22	3.22	2.90	2.96	3.13	3.29	3.29	2.90	2.98	3.22	3.47	3.63	2.18	0.18	0.36	0.54	0.73	0.91	1.09	1.27	1.45
NBC_MHEPL_365	340406	6257728	1.36	3.95	0.04	1.88	2.18	3.54	2.86	2.91	3.05	3.16	3.16	2.86	2.92	3.09	3.26	3.26	2.86	2.93	3.18	3.42	3.54	2.18	0.17	0.34	0.51	0.68	0.85	1.02	1.19	1.36
NBC_MHEPL_014	332860	6263715	0.29	1.45	0.29	2.13	2.43	2.72	2.58	2.58	2.64	2.64	2.64	2.58	2.58	2.62	2.62	2.62	2.58	2.58	2.72	2.72	2.72	2.43	0.04	0.07	0.11	0.14	0.18	0.21	0.25	0.29
NBC_MHEPL_366	340406	6257778	1.30	3.95	0.04	1.88	2.18	3.48	2.83	2.88	3.02	3.12	3.12	2.83	2.89	3.07	3.23	3.23	2.83	2.90	3.15	3.39	3.48	2.18	0.16	0.33	0.49	0.65	0.81	0.98	1.14	1.30
NBC_MHEPL_367	340406	6257828	1.22	3.95	0.04	1.88	2.18	3.40	2.79	2.84	2.98	3.06	3.06	2.79	2.85	3.05	3.20	3.20	2.79	2.86	3.11	3.35	3.40	2.18	0.15	0.31	0.46	0.61	0.77	0.92	1.07	1.22
NBC_MHEPL_368	340356	6257828	0.94	3.95	0.04	1.88	2.18	3.11	2.64	2.69	2.84	2.85	2.85	2.64	2.71	2.94	3.07	3.07	2.64	2.71	2.96	3.11	3.11	2.18	0.12	0.23	0.35	0.47	0.59	0.70	0.82	0.94
NBC_MHEPL_369	340306	6257878	0.78	3.95	0.04	1.88	2.18	3.00	2.57	2.62	2.79	2.79	2.79	2.57	2.64	2.90	3.00	3.00	2.57	2.64	2.88	2.96	2.96	2.18	0.10	0.20	0.31	0.41	0.51	0.61	0.71	0.82
NBC_MHEPL_370	340256	6257878	0.79	3.95	0.04	1.88	2.18	3.00	2.57	2.62	2.79	2.79	2.79	2.57	2.64	2.90	3.00	3.00	2.57	2.64	2.88	2.97	2.97	2.18	0.10	0.20	0.31	0.41	0.51	0.61	0.72	0.82
NBC_MHEPL_371	340256	6257928	0.84	3.95	0.04	1.88	2.18	3.03	2.60	2.65	2.81	2.82	2.82	2.60	2.67	2.91	3.03	3.03	2.60	2.67	2.91	3.02	3.02	2.18	0.11	0.21	0.32	0.42	0.53	0.63	0.74	0.85
NBC_MHEPL_372	340206	6258029	0.80	3.95	0.04	1.88	2.18	3.01	2.58	2.63	2.80	2.80	2.80	2.58	2.65	2.90	3.01	3.01	2.58	2.65	2.89	2.99	2.99	2.18	0.10	0.21	0.31	0.41	0.52	0.62	0.72	0.83
NBC_MHEPL_373	340156	6258029	0.72	3.95	0.04	1.88	2.18	2.97	2.54	2.59	2.77	2.77	2.77	2.54	2.61	2.88	2.97	2.97	2.54	2.61	2.85	2.90	2.90	2.18	0.10	0.20	0.29	0.39	0.49	0.59	0.69	0.79
NBC_MHEPL_015	332878	6263668	0.31	1.45	0.29	2.13	2.43	2.74	2.58	2.58	2.65	2.65	2.65	2.58	2.58	2.62	2.62	2.62	2.58	2.58	2.74	2.74	2.74	2.43	0.04	0.08	0.12	0.15	0.19	0.23	0.27	0.31
NBC_MHEPL_374	340106	6258129	0.89	15.35	0.04	1.88	2.18	3.97	2.63	2.73	3.14	3.55	3.97	2.63	2.72	3.09	3.46	3.82	2.63	2.69	2.94	3.07	3.07	2.18	0.22	0.45	0.67	0.89	1.11	1.34	1.56	1.78
NBC_MHEPL_375	340056	6258179	1.01	14.36	0.04	1.88	2.18	4.03	2.69	2.80	3.21	3.62	4.03	2.69	2.79	3.15	3.52	3.89	2.69	2.76	3.00	3.20	3.20	2.18	0.23	0.46	0.69	0.92	1.15	1.38	1.61	1.85
NBC_MHEPL_376	340006	6258179	1.08	14.40	0.04	1.88	2.18	4.06	2.72	2.83	3.24	3.65	4.06	2.72	2.82	3.18	3.55	3.92	2.72	2.79	3.03	3.26	3.26	2.18	0.23	0.47	0.70	0.94	1.17	1.41	1.64	1.88
NBC_MHEPL_377	340006	6258229	1.46	14.40	0.05	1.89	2.19	4.24	2.92	3.02	3.43	3.84	4.24	2.92	3.01	3.38	3.75	4.11	2.92	2.99	3.23	3.48	3.64	2.19	0.26	0.51	0.77	1.03	1.28	1.54	1.80	2.05
NBC_MHEPL_378	339956	6258229	1.74	14.40	0.05	1.89	2.19	4.36	3.06	3.17	3.56	3.96	4.36	3.06	3.16	3.53	3.89	4.26	3.06	3.13	3.38	3.62	3.87	2.19	0.27	0.54	0.81	1.09	1.36	1.63	1.90	2.17
NBC_MHEPL_379	339906	6258279	1.74	14.29	0.05	1.89	2.19	4.36	3.06	3.17	3.56	3.96	4.36	3.06	3.16	3.53	3.89	4.26	3.06	3.13	3.38	3.62	3.87	2.19	0.27	0.54	0.81	1.08	1.35	1.63	1.90	2.17
NBC_MHEPL_380	339906	6258329	1.74	13.65	0.05	1.89	2.19	4.34	3.06	3.17	3.56	3.95	4.34	3.06	3.16	3.53	3.89	4.26	3.06	3.13	3.38	3.62	3.87	2.19	0.27	0.54	0.81	1.07	1.34	1.61	1.88	2.15
NBC_MHEPL_381	339906	6258379	1.74	12.19	0.05	1.89	2.19	4.28	3.06	3.16	3.54	3.91	4.28	3.06	3.16	3.53	3.89	4.26	3.06	3.13	3.38	3.62	3.87	2.19	0.26	0.52	0.79	1.05	1.31	1.57	1.83	2.09
NBC_MHEPL_382	339906	6258429	1.75	13.63	0.05	1.89	2.19	4.34	3.06	3.17	3.56	3.95	4.34	3.06	3.16	3.53	3.90	4.26	3.06	3.13	3.38	3.62	3.87	2.19	0.27	0.54	0.80	1.07	1.34	1.61	1.88	2.15

100yr ARI Planning Levels - 0.4m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

Mean Sea Level Rise Allowance **0.40** m sea level rise projection
Freeboard of **0.3** m included in EPLs

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																Reduction Factor. Note: The application of the Reduction Factor should not reduce the EPL below the Local (Still) Water Level							
			Wave			Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)	Max EPL of all Foreshore Types and Crest Levels (mAHD)	Foreshore Type ## 1					2					3					4								
									Crest Level (mAHD)																							
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	0.4 m Sea Level Projection	0.4 m Sea Level Projection		1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_383	339856	6258479	1.75	13.23	0.05	1.89	2.19	4.32	3.07	3.17	3.55	3.94	4.32	3.07	3.16	3.53	3.90	4.26	3.07	3.14	3.38	3.63	3.87	2.19	0.27	0.53	0.80	1.07	1.33	1.60	1.87	2.13
NBC_MHEPL_016	332816	6263647	0.28	1.45	0.29	2.13	2.43	2.71	2.57	2.57	2.63	2.63	2.63	2.57	2.57	2.61	2.61	2.61	2.57	2.57	2.71	2.71	2.71	2.43	0.03	0.07	0.10	0.14	0.17	0.21	0.24	0.28
NBC_MHEPL_384	339856	6258529	1.75	14.89	0.06	1.90	2.20	4.38	3.07	3.17	3.57	3.97	4.38	3.07	3.16	3.53	3.90	4.27	3.07	3.14	3.38	3.63	3.87	2.20	0.27	0.55	0.82	1.09	1.36	1.64	1.91	2.18
NBC_MHEPL_385	339806	6258579	1.75	13.95	0.06	1.90	2.20	4.35	3.08	3.17	3.56	3.96	4.35	3.08	3.17	3.53	3.90	4.27	3.08	3.14	3.39	3.63	3.88	2.20	0.27	0.54	0.81	1.08	1.34	1.61	1.88	2.15
NBC_MHEPL_386	339806	6258629	1.75	14.41	0.06	1.90	2.20	4.37	3.08	3.17	3.57	3.97	4.37	3.08	3.17	3.54	3.90	4.27	3.08	3.14	3.39	3.63	3.88	2.20	0.27	0.54	0.81	1.08	1.35	1.62	1.89	2.16
NBC_MHEPL_387	339756	6258629	1.75	13.13	0.06	1.90	2.20	4.33	3.08	3.17	3.56	3.94	4.33	3.08	3.17	3.54	3.90	4.27	3.08	3.14	3.39	3.63	3.88	2.20	0.27	0.53	0.80	1.06	1.33	1.59	1.86	2.12
NBC_MHEPL_388	339756	6258679	1.76	13.79	0.07	1.91	2.21	4.35	3.08	3.17	3.57	3.96	4.35	3.08	3.17	3.54	3.90	4.27	3.08	3.15	3.39	3.64	3.88	2.21	0.27	0.54	0.80	1.07	1.34	1.61	1.88	2.14
NBC_MHEPL_389	339706	6258729	1.76	13.39	0.07	1.91	2.21	4.34	3.08	3.17	3.56	3.95	4.34	3.08	3.17	3.54	3.90	4.27	3.08	3.15	3.39	3.64	3.88	2.21	0.27	0.53	0.80	1.07	1.33	1.60	1.86	2.13
NBC_MHEPL_390	339656	6258729	1.76	13.13	0.06	1.90	2.20	4.33	3.08	3.17	3.56	3.94	4.33	3.08	3.17	3.54	3.90	4.27	3.08	3.15	3.39	3.64	3.88	2.20	0.27	0.53	0.80	1.06	1.33	1.59	1.86	2.12
NBC_MHEPL_391	339606	6258779	1.76	14.30	0.07	1.91	2.21	4.37	3.09	3.18	3.57	3.97	4.37	3.09	3.17	3.54	3.91	4.27	3.09	3.15	3.40	3.64	3.89	2.21	0.27	0.54	0.81	1.08	1.35	1.62	1.89	2.16
NBC_MHEPL_392	339556	6258779	1.76	13.13	0.07	1.91	2.21	4.33	3.09	3.18	3.56	3.95	4.33	3.09	3.17	3.54	3.91	4.28	3.09	3.15	3.40	3.64	3.89	2.21	0.26	0.53	0.79	1.06	1.32	1.59	1.85	2.12
NBC_MHEPL_393	339506	6258729	1.75	13.13	0.05	1.89	2.19	4.32	3.07	3.17	3.55	3.94	4.32	3.07	3.16	3.53	3.90	4.26	3.07	3.14	3.38	3.63	3.87	2.19	0.27	0.53	0.80	1.06	1.33	1.60	1.86	2.13
NBC_MHEPL_017	332759	6263626	0.19	1.65	0.29	2.13	2.43	2.62	2.52	2.52	2.57	2.57	2.57	2.52	2.52	2.60	2.60	2.60	2.52	2.52	2.62	2.62	2.62	2.43	0.02	0.05	0.07	0.10	0.12	0.15	0.17	0.19
NBC_MHEPL_394	339456	6258779	1.71	13.21	0.00	1.84	2.14	4.30	2.99	3.14	3.52	3.91	4.30	2.99	3.13	3.50	3.86	4.23	2.99	3.09	3.33	3.58	3.82	2.14	0.27	0.54	0.81	1.08	1.35	1.62	1.89	2.16
NBC_MHEPL_395	339506	6258779	1.76	14.28	0.07	1.91	2.21	4.37	3.09	3.18	3.58	3.97	4.37	3.09	3.18	3.54	3.91	4.28	3.09	3.15	3.40	3.64	3.89	2.21	0.27	0.54	0.81	1.08	1.35	1.62	1.89	2.15
NBC_MHEPL_396	339556	6258829	1.77	13.49	0.08	1.92	2.22	4.35	3.10	3.18	3.57	3.96	4.35	3.10	3.18	3.55	3.91	4.28	3.10	3.16	3.40	3.65	3.89	2.22	0.27	0.53	0.80	1.06	1.33	1.60	1.86	2.13
NBC_MHEPL_397	339556	6258829	1.77	12.84	0.08	1.92	2.22	4.32	3.10	3.18	3.56	3.94	4.32	3.10	3.18	3.55	3.91	4.28	3.10	3.16	3.40	3.65	3.89	2.22	0.26	0.53	0.79	1.05	1.32	1.58	1.84	2.11
NBC_MHEPL_398	339606	6258829	1.76	14.02	0.07	1.91	2.21	4.36	3.09	3.18	3.57	3.97	4.36	3.09	3.18	3.54	3.91	4.28	3.09	3.15	3.40	3.64	3.89	2.21	0.27	0.54	0.81	1.07	1.34	1.61	1.88	2.15
NBC_MHEPL_399	339656	6258829	1.76	13.65	0.07	1.91	2.21	4.35	3.09	3.18	3.57	3.96	4.35	3.09	3.17	3.54	3.91	4.27	3.09	3.15	3.40	3.64	3.89	2.21	0.27	0.53	0.80	1.07	1.34	1.60	1.87	2.14
NBC_MHEPL_400	339706	6258879	1.76	14.06	0.07	1.91	2.21	4.36	3.09	3.18	3.57	3.97	4.36	3.09	3.18	3.54	3.91	4.28	3.09	3.15	3.40	3.64	3.89	2.21	0.27	0.54	0.81	1.07	1.34	1.61	1.88	2.15
NBC_MHEPL_401	339706	6258829	1.76	15.28	0.07	1.91	2.21	4.39	3.09	3.18	3.58	3.99	4.39	3.09	3.17	3.54	3.91	4.27	3.09	3.15	3.39	3.64	3.88	2.21	0.27	0.55	0.82	1.09	1.37	1.64	1.91	2.18
NBC_MHEPL_402	339706	6258779	1.76	12.98	0.07	1.91	2.21	4.32	3.08	3.17	3.56	3.94	4.32	3.08	3.17	3.54	3.90	4.27	3.08	3.15	3.39	3.64	3.88	2.21	0.26	0.53	0.79	1.06	1.32	1.59	1.85	2.12
NBC_MHEPL_403	339756	6258779	1.76	15.28	0.07	1.91	2.21	4.39	3.09	3.18	3.58	3.99	4.39	3.09	3.17	3.54	3.91	4.27	3.09	3.15	3.39	3.64	3.88	2.21	0.27	0.55	0.82	1.09	1.37	1.64	1.91	2.18
NBC_MHEPL_018	332723	6263611	0.33	1.65	0.28	2.12	2.42	2.75	2.59	2.59	2.66	2.66	2.66	2.59	2.59	2.65	2.65	2.65	2.59	2.59	2.75	2.75	2.75	2.42	0.04	0.08	0.12	0.16	0.20	0.25	0.29	0.33
NBC_MHEPL_404	339806	6258729	1.76	15.28	0.07	1.91	2.21	4.39	3.08	3.18	3.58	3.99	4.39	3.08	3.17	3.54	3.90	4.27	3.08	3.15	3.39	3.64	3.88	2.21	0.27	0.55	0.82	1.09	1.37	1.64	1.91	2.19
NBC_MHEPL_405	339856	6258729	1.76	15.28	0.06	1.90	2.20	4.39	3.08	3.18	3.58	3.99	4.39	3.08	3.17	3.54	3.90	4.27	3.08	3.15	3.39	3.64	3.88	2.20	0.27	0.55	0.82	1.09	1.37	1.64	1.91	2.19
NBC_MHEPL_406	339906	6258729	1.76	14.88	0.06	1.90	2.20	4.38	3.08	3.18	3.58	3.98	4.38	3.08	3.17	3.54	3.90	4.27	3.08	3.15	3.39	3.64	3.88	2.20	0.27	0.54	0.82	1.09	1.36	1.63	1.90	2.18
NBC_MHEPL_407	339956	6258679	1.75	13.49	0.06	1.90	2.20	4.34	3.08	3.17	3.56	3.95	4.34	3.08	3.17	3.54	3.90	4.27	3.08	3.14	3.39	3.63	3.88	2.20	0.27	0.53	0.80	1.07	1.34	1.60	1.87	2.14
NBC_MHEPL_408	339956	6258629	1.75	14.38	0.06	1.90	2.20	4.36	3.07	3.17	3.57	3.97	4.36	3.07	3.17	3.53	3.90	4.27	3.07	3.14	3.39	3.63	3.88	2.20	0.27	0.54	0.81	1.08	1.35	1.62	1.89	2.16
NBC_MHEPL_409	340006	6258629	1.75	13.61	0.06	1.90	2.20	4.34	3.07	3.17	3.56	3.95	4.34	3.07	3.17	3.53	3.90	4.27	3.07	3.14	3.39	3.63	3.88	2.20	0.27	0.54	0.80	1.07	1.34	1.61	1.87	2.14
NBC_MHEPL_410	340056	6258579	1.75	13.37	0.05	1.89	2.19	4.33	3.07	3.17	3.56	3.94	4.33	3.07	3.16	3.53	3.90	4.26	3.07	3.14	3.38	3.63	3.87	2.19	0.27	0.53	0.80	1.07	1.34	1.60	1.87	2.14
NBC_MHEPL_411	340106	6258529	1.75	13.36	0.05	1.89	2.19	4.33	3.06	3.17	3.55	3.94	4.33	3.06	3.16	3.53	3.90	4.26	3.06	3.14	3.38	3.63	3.87	2.19	0.27	0.53	0.80	1.07	1.34	1.60	1.87	2.14
NBC_MHEPL_412	340156	6258529	1.75	13.36	0.05	1.89	2.19	4.33	3.06	3.17	3.55	3.94	4.33	3.06	3.16	3.53	3.90	4.26	3.06	3.13	3.38	3.62	3.87	2.19	0.27	0.53	0.80	1.07	1.34	1.60	1.87	2.14
NBC_MHEPL_413	340206	6258529	1.75	13.36	0.05	1.89	2.19	4.33	3.06	3.17	3.55	3.94	4.33	3.06	3.16	3.53	3.90	4.26	3.06	3.13	3.38	3.62	3.87	2.19	0.27	0.53	0.80	1.07	1.34	1.60	1.87	2.14
NBC_MHEPL_019	332687	6263597	0.32	1.65	0.28	2.12	2.42	2.75	2.58	2.58	2.66	2.66	2.66	2.58	2.58	2.65	2.65	2.65	2.58	2.58	2.75	2.75	2.75	2.42	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32
NBC_MHEPL_414	340206	6258579	1.75	13.47	0.05	1.89	2.19	4.33	3.07	3.17	3.56	3.94	4.33	3.07	3.16	3.53	3.90	4.26	3.07	3.14	3.38	3.63	3.87	2.19	0.27	0.54	0.80	1.07	1.34	1.61	1.87	2.14
NBC_MHEPL_415	340256	6258579	1.75	13.47	0.05	1.89	2.19	4.33	3.07	3.17	3.56	3.95	4.33	3.07	3.16	3.53	3.90	4.26	3.07	3.14	3.38	3.63	3.87	2.19	0.27	0.53	0.80	1.07	1.34	1.60	1.87	2.14
NBC_MHEPL_416	340306	6258629	1.75	14.21	0.06	1.90	2.20	4.36	3.07	3.17	3.57	3.96	4.36	3.07	3.17	3.53	3.90	4.27	3.07	3.14	3.39	3.63	3.88	2.20	0.27	0.54	0.81	1.08	1.35	1.62	1.89	2.16
NBC_MHEPL_417	340356	6258629	1.75	13.15	0.06	1.90	2.20	4.32	3.07	3.17	3.55	3.94	4.32	3.07	3.17	3.53	3.90	4.27	3.07	3.14	3.39	3.63	3.88	2.20	0.27	0.53	0.80	1.06	1.33	1.59	1.86	2.13
NBC_MHEPL_418	340356	6258579	1.75	14.11	0.05	1.89	2.19	4.35	3.07	3.17	3.56	3.96	4.35	3.07	3.16	3.53	3.90	4.26	3.07	3.14	3.38	3.63	3.87	2.19	0.27	0.54	0.81	1.08	1.35	1.62	1.89	2.16
NBC_MHEPL_419	340406	6258579	1.75	14.42	0.05	1.89	2.19	4.36	3.07	3.17	3.57	3.97	4.36	3.07	3.16	3.53	3.90	4.26	3.07	3.14	3.38	3.63	3.87	2.19	0.27	0.54	0.81	1.08	1.36	1.63	1.90	2.17
NBC_MHEPL_420	340456	6258579	1.75	14.42	0.05	1.89	2.19	4.36	3.07	3.17	3.57	3.97	4.36	3.07	3.16	3.53	3.90	4.27	3.07	3.14	3.38	3.63	3.87	2.19	0.27	0.54	0.81	1.08	1.36	1.63	1.90	2.17
NBC_MHEPL_421	340506	6258579	1.75	14.42	0.05	1.89	2.19	4.36	3.07	3.17	3.57	3.97	4.36	3.07	3.16	3.53	3.90	4.27	3.07	3.14	3.38	3.63	3.87	2.19	0.27	0.54	0.81	1.08	1.36	1.63	1.90	2.17
NBC_MHEPL_422	340506	6258629	1.75	14.42	0.06	1.90	2.20	4.36	3.07	3.17	3.57	3.97	4.36	3.07	3.17	3.53	3.90	4.27	3.07	3.14	3.39	3.63	3.88	2.20	0.27	0.54	0.81	1.08	1.35	1.63	1.90	2.17
NBC_MHEPL_423	340556	6258629	1.75	14.42	0.06	1.90	2.20	4.36	3.07	3.17	3.57	3.97	4.36	3.07	3.17	3.53	3.90	4.27	3.07	3.14	3.39	3.63	3.88	2.20	0.27	0.54	0.81	1.08	1.35	1.63	1.90	2.17
NBC_MHEPL_020	332643	6263554	0.34	1.65	0.28	2.12	2.42	2.76	2.59	2.59	2.66	2.66	2.66	2.59	2.59	2.65	2.65	2.65	2.59	2.59	2.76	2.76	2.76	2.42	0.04	0.09	0.13	0.17	0.21	0.26	0.30	0.34
NBC_MHEPL_424	340606	6258679	1.75	14.02	0.06	1.90	2.20	4.35	3.08	3.17	3.57	3.96	4.35	3.08	3.17	3.53	3.90	4.27	3.08	3.14	3.39	3.63	3.88	2.20	0.27	0.54	0.81	1.08	1.35	1.62	1.88	2.15
NBC_MHEPL_425	340656	6258679	1.75	14.25	0.06	1.90	2.20	4.36	3.08	3.17	3.57	3.96	4.36	3.08	3.17	3.53	3.90	4.27	3.08	3.14	3.39	3.63	3.88	2.20	0.27	0.54	0.81	1.08	1.35	1.62	1.89	2.16
NBC_MHEPL_426	340706	6258679	1.75	14.42	0.06	1.90	2.20	4.36	3.07	3.17	3.57	3.97	4.36	3.07	3.17	3.53	3.90	4.27	3.07	3.14	3.39	3.63	3.88	2.20	0.27	0.54	0.81	1.08	1.35	1.62	1.90	2.17
NBC_MHEPL_427	340756	6258679	1.75	14.41	0.06	1.90	2.20	4.36	3.07	3.17	3.57	3.97	4.36	3.07	3.17	3.53	3.90	4.27	3.07	3.14	3.39	3.63	3.88	2.20	0.27	0.54	0.81	1.08	1.35	1.62	1.90	2.17
NBC_MHEPL_428	340806	6258679	1.75	14.52	0.06	1.90	2.20	4.37	3.07	3.17	3.57	3.97	4.37	3.07	3.16	3.53	3.90	4.27	3.07	3.14	3.38	3.63	3.87	2.20	0.27	0.54	0.81	1.09	1.36	1.63	1.90	2.17
NBC_MHEPL_429	340856	6258679	1.53	3.95	0.06	1.90	2.20	3.73	2.96	3.01	3.16	3.30	3.30	2.96	3.01	3.17	3.33	3.34	2.96	3.03	3.27	3.52	3.73	2.20	0.19	0.38	0.57	0.77	0.96	1.15	1.34	1.53
NBC_MHEPL_430	340906	6258679	1.41	3.95	0.06	1.90	2.20	3.62	2.91	2.95	3.10	3.22	3.22	2.91	2.96	3.13	3.30	3.30	2.91	2.97	3.22	3.46	3.62	2.20	0.18	0.35	0.53	0.71	0.88	1.06	1.24	1.41
NBC_MHEPL_431	340906	6258729	1.33	4.47	0.07	1.91	2.21	3.53	2.87	2.91	3.06	3.16	3.16	2.87	2.93	3.15	3.37	3.43	2.87	2.93	3.17	3.42	3.53	2.21	0.17	0.33	0.50	0.66	0.83	1.00	1.16	1.33

100yr ARI Planning Levels - 0.4m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

Mean Sea Level Rise Allowance **0.40** m sea level rise projection
Freeboard of **0.3** m included in EPLs

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																	Reduction Factor. Note: The application of the Reduction Factor should not reduce the EPL below the Local (Still) Water Level							
			Wave						Foreshore Type ##																							
									1					2					3					4								
						Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)		Crest Level (mAHD)																							
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	0.4 m Sea Level Projection	0.4 m Sea Level Projection	Max EPL of all Foreshore Types and Crest Levels (mAHD)	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_432	340906	6258779	1.30	3.95	0.07	1.91	2.21	3.51	2.86	2.90	3.05	3.15	3.15	2.86	2.91	3.09	3.26	3.26	2.86	2.92	3.16	3.41	3.51	2.21	0.16	0.33	0.49	0.65	0.81	0.98	1.14	1.30
NBC_MHEPL_433	340956	6258779	1.33	3.95	0.07	1.91	2.21	3.55	2.88	2.92	3.06	3.17	3.17	2.88	2.92	3.10	3.28	3.28	2.88	2.94	3.18	3.43	3.55	2.21	0.17	0.33	0.50	0.67	0.83	1.00	1.17	1.33
NBC_MHEPL_021	332602	6263538	0.34	1.65	0.27	2.11	2.41	2.76	2.58	2.58	2.66	2.66	2.66	2.58	2.58	2.64	2.64	2.64	2.58	2.58	2.76	2.76	2.76	2.41	0.04	0.09	0.13	0.17	0.21	0.26	0.30	0.34
NBC_MHEPL_434	341006	6258779	1.38	3.95	0.07	1.91	2.21	3.59	2.90	2.94	3.09	3.20	3.20	2.90	2.95	3.12	3.30	3.30	2.90	2.96	3.20	3.45	3.59	2.21	0.17	0.35	0.52	0.69	0.86	1.04	1.21	1.38
NBC_MHEPL_435	341056	6258729	1.26	3.95	0.07	1.91	2.21	3.47	2.84	2.88	3.02	3.12	3.12	2.84	2.89	3.08	3.25	3.25	2.84	2.90	3.14	3.39	3.47	2.21	0.16	0.32	0.47	0.63	0.79	0.95	1.11	1.26
NBC_MHEPL_436	341106	6258729	1.05	3.95	0.06	1.90	2.20	3.26	2.73	2.77	2.92	2.96	2.96	2.73	2.78	3.00	3.15	3.15	2.73	2.79	3.03	3.26	3.26	2.20	0.13	0.26	0.40	0.53	0.66	0.79	0.92	1.05
NBC_MHEPL_437	341156	6258679	0.56	14.11	0.07	1.91	2.21	3.81	2.49	2.57	2.98	3.39	3.81	2.49	2.56	2.93	3.29	3.29	2.49	2.54	2.77	2.77	2.77	2.21	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60
NBC_MHEPL_438	341206	6258679	0.51	14.41	0.07	1.91	2.21	3.69	2.47	2.55	2.96	3.37	3.69	2.47	2.54	2.91	3.20	3.20	2.47	2.52	2.72	2.72	2.72	2.21	0.19	0.37	0.56	0.74	0.93	1.11	1.30	1.48
NBC_MHEPL_439	341256	6258629	0.94	3.95	0.07	1.91	2.21	3.15	2.68	2.72	2.86	2.89	2.89	2.68	2.73	2.96	3.11	3.11	2.68	2.73	2.98	3.15	3.15	2.21	0.12	0.23	0.35	0.47	0.59	0.70	0.82	0.94
NBC_MHEPL_440	341306	6258579	0.87	3.95	0.07	1.91	2.21	3.08	2.64	2.68	2.84	2.85	2.85	2.64	2.70	2.94	3.07	3.07	2.64	2.70	2.94	3.08	3.08	2.21	0.11	0.22	0.33	0.44	0.54	0.65	0.76	0.87
NBC_MHEPL_441	341356	6258529	0.81	2.71	0.07	1.91	2.21	3.02	2.61	2.65	2.79	2.79	2.79	2.61	2.64	2.77	2.77	2.77	2.61	2.67	2.91	3.02	3.02	2.21	0.10	0.20	0.30	0.40	0.51	0.61	0.71	0.81
NBC_MHEPL_442	341356	6258479	0.73	2.71	0.06	1.90	2.20	2.93	2.56	2.60	2.73	2.73	2.73	2.56	2.60	2.73	2.73	2.73	2.56	2.62	2.87	2.93	2.93	2.20	0.09	0.18	0.28	0.37	0.46	0.55	0.64	0.73
NBC_MHEPL_022	332558	6263498	0.35	1.65	0.27	2.11	2.41	2.76	2.58	2.58	2.66	2.66	2.66	2.58	2.58	2.64	2.64	2.64	2.58	2.58	2.76	2.76	2.76	2.41	0.04	0.09	0.13	0.17	0.22	0.26	0.30	0.35
NBC_MHEPL_443	341306	6258429	0.74	2.71	0.05	1.89	2.19	2.94	2.57	2.60	2.73	2.73	2.73	2.57	2.60	2.73	2.73	2.73	2.57	2.62	2.87	2.94	2.94	2.19	0.09	0.19	0.28	0.37	0.46	0.56	0.65	0.74
NBC_MHEPL_444	341256	6258429	0.69	2.40	0.06	1.90	2.20	2.88	2.54	2.58	2.69	2.69	2.69	2.54	2.57	2.65	2.65	2.65	2.54	2.60	2.84	2.88	2.88	2.20	0.09	0.17	0.26	0.34	0.43	0.51	0.60	0.69
NBC_MHEPL_445	341256	6258379	0.68	3.48	0.05	1.89	2.19	2.87	2.53	2.57	2.69	2.69	2.69	2.53	2.59	2.83	2.86	2.86	2.53	2.59	2.84	2.87	2.87	2.19	0.09	0.17	0.26	0.34	0.43	0.51	0.60	0.68
NBC_MHEPL_446	341156	6258329	0.77	3.48	0.05	1.89	2.19	2.96	2.58	2.62	2.75	2.75	2.75	2.58	2.63	2.85	2.90	2.90	2.58	2.64	2.88	2.96	2.96	2.19	0.10	0.19	0.29	0.39	0.48	0.58	0.68	0.77
NBC_MHEPL_447	341156	6258279	0.80	3.95	0.05	1.89	2.19	3.01	2.59	2.63	2.80	2.81	2.81	2.59	2.65	2.90	3.01	3.01	2.59	2.65	2.89	2.99	2.99	2.19	0.10	0.21	0.31	0.41	0.52	0.62	0.72	0.83
NBC_MHEPL_448	341106	6258229	0.83	3.95	0.04	1.88	2.18	3.03	2.60	2.65	2.81	2.82	2.82	2.60	2.67	2.91	3.03	3.03	2.60	2.66	2.91	3.01	3.01	2.18	0.11	0.21	0.32	0.42	0.53	0.63	0.74	0.84
NBC_MHEPL_449	341106	6258179	0.88	3.95	0.04	1.88	2.18	3.06	2.62	2.67	2.82	2.83	2.83	2.62	2.69	2.93	3.05	3.05	2.62	2.69	2.93	3.06	3.06	2.18	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88
NBC_MHEPL_450	341056	6258129	0.97	3.95	0.04	1.88	2.18	3.15	2.67	2.71	2.86	2.88	2.88	2.67	2.73	2.96	3.09	3.09	2.67	2.73	2.98	3.15	3.15	2.18	0.12	0.24	0.36	0.48	0.61	0.73	0.85	0.97
NBC_MHEPL_451	341056	6258079	1.03	3.95	0.04	1.88	2.18	3.21	2.70	2.74	2.89	2.92	2.92	2.70	2.76	2.98	3.12	3.12	2.70	2.77	3.01	3.21	3.21	2.18	0.13	0.26	0.39	0.51	0.64	0.77	0.90	1.03
NBC_MHEPL_001	331865	6264756	0.10	1.00	0.45	2.29	2.59	2.70	2.65	2.65	2.67	2.67	2.67	2.65	2.65	2.67	2.67	2.67	2.65	2.65	2.70	2.70	2.70	2.59	0.01	0.03	0.04	0.05	0.07	0.08	0.09	0.10
NBC_MHEPL_023	332529	6263487	0.35	1.65	0.27	2.11	2.41	2.76	2.59	2.59	2.66	2.66	2.66	2.59	2.59	2.64	2.64	2.64	2.59	2.59	2.76	2.76	2.76	2.41	0.04	0.09	0.13	0.18	0.22	0.27	0.31	0.35
NBC_MHEPL_452	341056	6258029	1.06	3.95	0.04	1.88	2.18	3.24	2.71	2.76	2.90	2.94	2.94	2.71	2.77	2.99	3.13	3.13	2.71	2.78	3.02	3.24	3.24	2.18	0.13	0.26	0.40	0.53	0.66	0.79	0.92	1.06
NBC_MHEPL_453	341006	6257979	1.09	3.95	0.04	1.88	2.18	3.27	2.73	2.77	2.92	2.97	2.97	2.73	2.79	3.00	3.15	3.15	2.73	2.80	3.04	3.27	3.27	2.18	0.14	0.27	0.41	0.55	0.68	0.82	0.95	1.09
NBC_MHEPL_454	341056	6257979	1.05	3.95	0.04	1.88	2.18	3.23	2.71	2.75	2.90	2.94	2.94	2.71	2.77	2.99	3.13	3.13	2.71	2.77	3.02	3.23	3.23	2.18	0.13	0.26	0.39	0.52	0.65	0.79	0.92	1.05
NBC_MHEPL_455	341056	6257929	0.93	3.95	0.04	1.88	2.18	3.11	2.65	2.69	2.84	2.85	2.85	2.65	2.71	2.95	3.07	3.07	2.65	2.71	2.96	3.11	3.11	2.18	0.12	0.23	0.35	0.47	0.58	0.70	0.81	0.93
NBC_MHEPL_456	341056	6257879	1.09	3.95	0.04	1.88	2.18	3.27	2.72	2.77	2.91	2.96	2.96	2.72	2.78	3.00	3.14	3.14	2.72	2.79	3.04	3.27	3.27	2.18	0.14	0.27	0.41	0.54	0.68	0.81	0.95	1.09
NBC_MHEPL_457	341006	6257828	1.22	3.95	0.04	1.88	2.18	3.40	2.79	2.84	2.98	3.06	3.06	2.79	2.85	3.04	3.20	3.20	2.79	2.86	3.11	3.35	3.40	2.18	0.15	0.30	0.46	0.61	0.76	0.91	1.07	1.22
NBC_MHEPL_458	341006	6257778	1.26	3.95	0.04	1.88	2.18	3.44	2.81	2.85	3.00	3.08	3.08	2.81	2.87	3.06	3.22	3.22	2.81	2.88	3.12	3.37	3.44	2.18	0.16	0.31	0.47	0.63	0.78	0.94	1.10	1.26
NBC_MHEPL_459	341006	6257728	1.27	3.95	0.04	1.88	2.18	3.45	2.81	2.86	3.01	3.09	3.09	2.81	2.87	3.06	3.22	3.22	2.81	2.89	3.13	3.38	3.45	2.18	0.16	0.32	0.48	0.64	0.79	0.95	1.11	1.27
NBC_MHEPL_460	341006	6257679	1.30	3.95	0.04	1.88	2.18	3.48	2.83	2.87	3.02	3.11	3.11	2.83	2.88	3.07	3.23	3.23	2.83	2.90	3.14	3.39	3.48	2.18	0.16	0.32	0.49	0.65	0.81	0.97	1.14	1.30
NBC_MHEPL_461	341006	6257629	1.29	3.95	0.03	1.87	2.17	3.46	2.82	2.87	3.01	3.10	3.10	2.82	2.88	3.07	3.22	3.22	2.82	2.89	3.14	3.38	3.46	2.17	0.16	0.32	0.48	0.64	0.81	0.97	1.13	1.29
NBC_MHEPL_024	332469	6263439	0.37	1.87	0.27	2.11	2.41	2.77	2.59	2.59	2.67	2.67	2.67	2.59	2.59	2.67	2.67	2.67	2.59	2.59	2.77	2.77	2.77	2.41	0.05	0.09	0.14	0.18	0.23	0.28	0.32	0.37
NBC_MHEPL_462	341056	6257629	1.29	3.95	0.03	1.87	2.17	3.46	2.82	2.87	3.01	3.10	3.10	2.82	2.88	3.06	3.22	3.22	2.82	2.89	3.14	3.38	3.46	2.17	0.16	0.32	0.48	0.64	0.80	0.96	1.13	1.29
NBC_MHEPL_463	341106	6257629	1.27	3.95	0.04	1.88	2.18	3.45	2.81	2.86	3.01	3.09	3.09	2.81	2.87	3.06	3.22	3.22	2.81	2.89	3.13	3.38	3.45	2.18	0.16	0.32	0.48	0.64	0.80	0.96	1.12	1.27
NBC_MHEPL_464	341156	6257679	1.20	3.95	0.04	1.88	2.18	3.37	2.77	2.82	2.97	3.04	3.04	2.77	2.84	3.03	3.19	3.19	2.77	2.85	3.09	3.34	3.37	2.18	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20
NBC_MHEPL_465	341206	6257729	1.12	3.95	0.04	1.88	2.18	3.30	2.74	2.79	2.93	2.99	2.99	2.74	2.80	3.01	3.16	3.16	2.74	2.81	3.06	3.30	3.30	2.18	0.14	0.28	0.42	0.56	0.70	0.84	0.98	1.12
NBC_MHEPL_466	341256	6257729	1.15	3.95	0.04	1.88	2.18	3.33	2.76	2.80	2.95	3.01	3.01	2.76	2.82	3.02	3.17	3.17	2.76	2.83	3.07	3.32	3.33	2.18	0.14	0.29	0.43	0.58	0.72	0.86	1.01	1.15
NBC_MHEPL_467	341256	6257779	1.12	3.95	0.04	1.88	2.18	3.30	2.74	2.79	2.93	2.99	2.99	2.74	2.80	3.01	3.16	3.16	2.74	2.81	3.06	3.30	3.30	2.18	0.14	0.28	0.42	0.56	0.70	0.84	0.98	1.12
NBC_MHEPL_468	341306	6257829	1.13	3.95	0.05	1.89	2.19	3.32	2.75	2.80	2.94	3.00	3.00	2.75	2.81	3.02	3.17	3.17	2.75	2.82	3.06	3.31	3.32	2.19	0.14	0.28	0.42	0.57	0.71	0.85	0.99	1.13
NBC_MHEPL_469	341356	6257879	1.61	14.32	0.05	1.89	2.19	4.30	2.99	3.10	3.50	3.90	4.30	2.99	3.09	3.46	3.83	4.19	2.99	3.06	3.31	3.55	3.80	2.19	0.26	0.53	0.79	1.06	1.32	1.58	1.85	2.11
NBC_MHEPL_470	341356	6257929	1.42	14.50	0.05	1.89	2.19	4.23	2.90	3.01	3.41	3.82	4.23	2.90	3.00	3.36	3.73	4.10	2.90	2.97	3.22	3.46	3.61	2.19	0.25	0.51	0.76	1.02	1.27	1.53	1.78	2.04
NBC_MHEPL_025	332451	6263386	0.37	1.65	0.26	2.10	2.40	2.77	2.59	2.59	2.67	2.67	2.67	2.59	2.59	2.64	2.64	2.64	2.59	2.59	2.77	2.77	2.77	2.40	0.05	0.09	0.14	0.19	0.23	0.28	0.32	0.37
NBC_MHEPL_471	341406	6257879	1.51	14.30	0.05	1.89	2.19	4.26	2.94	3.05	3.45	3.86	4.26	2.94	3.04	3.41	3.78	4.14	2.94	3.01	3.26	3.50	3.70	2.19	0.26	0.52	0.78	1.04	1.30	1.55	1.81	2.07
NBC_MHEPL_472	341406	6257829	1.59	14.42	0.04	1.88	2.18	4.29	2.98	3.09	3.49	3.89	4.29	2.98	3.08	3.45	3.81	4.18	2.98	3.05	3.30	3.54	3.77	2.18	0.26	0.53	0.79	1.05	1.32	1.58	1.85	2.11
NBC_MHEPL_473	341406	6257779	1.56	13.99	0.04	1.88	2.18	4.27	2.96	3.07	3.47	3.87	4.27	2.96	3.06	3.43	3.80	4.16	2.96	3.03	3.28	3.52	3.74	2.18	0.26	0.52	0.78	1.04	1.30	1.57	1.83	2.09
NBC_MHEPL_474	341406	6257729	1.59	14.42	0.04	1.88	2.18	4.30	2.98	3.09	3.49	3.89	4.30	2.98	3.08	3.45	3.81	4.18	2.98	3.05	3.30	3.54	3.77	2.18	0.26	0.53	0.79	1.06	1.32	1.59	1.85	2.11
NBC_MHEPL_475	341406	6257679	1.59	14.19	0.04	1.88	2.18	4.29	2.97	3.09	3.49	3.89	4.29	2.97	3.08	3.45	3.81	4.18	2.97	3.05	3.29	3.54	3.77	2.18	0.26	0.53	0.79	1.05	1.32	1.58	1.85	2.11
NBC_MHEPL_476	341406	6257629	1.42	3.95	0.04	1.88	2.18	3.60	2.89	2.94	3.08	3.20	3.20	2.89	2.94	3.12	3.28	3.28	2.89	2.96	3.21	3.45	3.60	2.18	0.18	0.36	0.53	0.71	0.89	1.07	1.24	1.42
NBC_MHEPL_477	341456	6257629	1.26	3.95	0.04	1.88	2.18	3.44	2.81	2.86	3.00	3.09	3.09	2.81	2.87	3.06	3.22	3.22	2.81	2.88	3.13	3.37	3.44	2.18	0.16	0.32	0.47	0.63	0.79	0.95	1.11	1.26
NBC_MHEPL_478	341506	6257629	1.32	3.95	0.04	1.88	2.18	3.50	2.84	2.89	3.03	3.13	3.13	2.84	2.90	3.08	3.24	3.24	2.84	2.91	3.16	3.40	3.50	2.18	0.16	0.33	0.49	0.66	0.82	0.99	1.15	1.32
NBC_MHEPL_479	341556	6257629	1.25	3.95	0.04	1.88	2.18	3.43	2.81	2.85	3.00	3.08	3.08	2.81	2.86	3.06	3.21	3.21	2.81	2.88	3.12	3.37	3.43	2.18	0.16	0.31	0.47	0.63	0.78	0.94	1.10	1.25

100yr ARI Planning Levels - 0.4m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.40** m sea level rise projection
Freeboard of **0.3** m included in EPLs

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																	Reduction Factor. Note: The application of the Reduction Factor should not reduce the EPL below the Local (Still) Water Level							
			Wave			Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)		Foreshore Type ##																							
									1					2					3					4								
									Crest Level (mAHD)																							
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	0.4 m Sea Level Projection	0.4 m Sea Level Projection	Max EPL of all Foreshore Types and Crest Levels (mAHD)	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_480	341556	6257679	1.18	3.95	0.04	1.88	2.18	3.36	2.77	2.81	2.96	3.03	3.03	2.77	2.83	3.03	3.18	3.18	2.77	2.84	3.08	3.33	3.36	2.18	0.15	0.29	0.44	0.59	0.74	0.88	1.03	1.18
NBC_MHEPL_481	341606	6257729	1.21	14.42	0.04	1.88	2.18	4.13	2.79	2.90	3.31	3.72	4.13	2.79	2.88	3.25	3.62	3.99	2.79	2.86	3.10	3.35	3.39	2.18	0.24	0.49	0.73	0.97	1.22	1.46	1.70	1.95
NBC_MHEPL_482	341656	6257779	0.86	14.11	0.04	1.88	2.18	3.95	2.62	2.72	3.13	3.54	3.95	2.62	2.71	3.08	3.44	3.81	2.62	2.68	2.93	3.05	3.05	2.18	0.22	0.44	0.66	0.89	1.11	1.33	1.55	1.77
NBC_MHEPL_483	341656	6257729	1.10	3.95	0.04	1.88	2.18	3.28	2.73	2.78	2.92	2.97	2.97	2.73	2.79	3.00	3.15	3.15	2.73	2.80	3.04	3.28	3.28	2.18	0.14	0.27	0.41	0.55	0.69	0.82	0.96	1.10
NBC_MHEPL_484	341656	6257679	1.06	3.48	0.04	1.88	2.18	3.24	2.71	2.75	2.90	2.94	2.94	2.71	2.76	2.94	3.01	3.01	2.71	2.78	3.02	3.24	3.24	2.18	0.13	0.26	0.40	0.53	0.66	0.79	0.92	1.06
NBC_MHEPL_485	341606	6257629	1.07	3.48	0.04	1.88	2.18	3.25	2.71	2.76	2.90	2.95	2.95	2.71	2.77	2.94	3.01	3.01	2.71	2.78	3.03	3.25	3.25	2.18	0.13	0.27	0.40	0.53	0.67	0.80	0.93	1.07
NBC_MHEPL_486	341606	6257579	0.99	3.48	0.04	1.88	2.18	3.17	2.67	2.72	2.86	2.89	2.89	2.67	2.73	2.91	2.98	2.98	2.67	2.74	2.99	3.17	3.17	2.18	0.12	0.25	0.37	0.50	0.62	0.74	0.87	0.99
NBC_MHEPL_487	341606	6257529	0.93	3.48	0.04	1.88	2.18	3.11	2.64	2.69	2.83	2.85	2.85	2.64	2.70	2.89	2.95	2.95	2.64	2.71	2.96	3.11	3.11	2.18	0.12	0.23	0.35	0.47	0.58	0.70	0.82	0.93
NBC_MHEPL_488	341656	6257479	0.89	3.08	0.03	1.87	2.17	3.07	2.62	2.67	2.81	2.82	2.82	2.62	2.67	2.83	2.84	2.84	2.62	2.69	2.94	3.07	3.07	2.17	0.11	0.22	0.33	0.45	0.56	0.67	0.78	0.89
NBC_MHEPL_489	341656	6257429	0.82	3.08	0.03	1.87	2.17	2.99	2.58	2.63	2.76	2.76	2.76	2.58	2.63	2.81	2.81	2.81	2.58	2.65	2.90	2.99	2.99	2.17	0.10	0.20	0.31	0.41	0.51	0.61	0.72	0.82
NBC_MHEPL_490	341606	6257429	0.90	3.08	0.03	1.87	2.17	3.07	2.62	2.67	2.82	2.82	2.82	2.62	2.67	2.83	2.84	2.84	2.62	2.69	2.94	3.07	3.07	2.17	0.11	0.23	0.34	0.45	0.56	0.68	0.79	0.90
NBC_MHEPL_026	332438	6263327	0.33	1.87	0.25	2.09	2.39	2.73	2.56	2.56	2.63	2.63	2.63	2.56	2.56	2.65	2.65	2.65	2.56	2.56	2.73	2.73	2.73	2.39	0.04	0.08	0.12	0.17	0.21	0.25	0.29	0.33
NBC_MHEPL_491	341606	6257379	0.93	3.08	0.03	1.87	2.17	3.11	2.64	2.69	2.83	2.84	2.84	2.64	2.69	2.84	2.85	2.85	2.64	2.71	2.96	3.11	3.11	2.17	0.12	0.23	0.35	0.47	0.58	0.70	0.82	0.93
NBC_MHEPL_492	341556	6257379	0.99	3.08	0.03	1.87	2.17	3.17	2.67	2.72	2.86	2.89	2.89	2.67	2.72	2.86	2.88	2.88	2.67	2.74	2.99	3.17	3.17	2.17	0.12	0.25	0.37	0.50	0.62	0.75	0.87	0.99
NBC_MHEPL_493	341506	6257379	1.04	3.48	0.03	1.87	2.17	3.22	2.69	2.74	2.89	2.92	2.92	2.69	2.75	2.93	3.00	3.00	2.69	2.77	3.01	3.22	3.22	2.17	0.13	0.26	0.39	0.52	0.65	0.78	0.91	1.04
NBC_MHEPL_494	341456	6257379	1.09	3.48	0.03	1.87	2.17	3.26	2.72	2.77	2.91	2.96	2.96	2.72	2.77	2.94	3.01	3.01	2.72	2.79	3.04	3.26	3.26	2.17	0.14	0.27	0.41	0.55	0.68	0.82	0.95	1.09
NBC_MHEPL_495	341406	6257329	0.94	3.48	0.03	1.87	2.17	3.11	2.64	2.69	2.83	2.85	2.85	2.64	2.70	2.89	2.95	2.95	2.64	2.71	2.96	3.11	3.11	2.17	0.12	0.23	0.35	0.47	0.59	0.70	0.82	0.94
NBC_MHEPL_496	341356	6257279	0.91	3.48	0.03	1.87	2.17	3.08	2.63	2.67	2.82	2.83	2.83	2.63	2.69	2.88	2.94	2.94	2.63	2.70	2.94	3.08	3.08	2.17	0.11	0.23	0.34	0.46	0.57	0.69	0.80	0.91
NBC_MHEPL_497	341356	6257229	0.91	3.08	0.03	1.87	2.17	3.08	2.63	2.67	2.82	2.83	2.83	2.63	2.67	2.83	2.84	2.84	2.63	2.70	2.94	3.08	3.08	2.17	0.11	0.23	0.34	0.46	0.57	0.68	0.80	0.91
NBC_MHEPL_498	341356	6257179	0.93	3.08	0.03	1.87	2.17	3.10	2.63	2.68	2.83	2.84	2.84	2.63	2.68	2.83	2.85	2.85	2.63	2.71	2.95	3.10	3.10	2.17	0.12	0.23	0.35	0.46	0.58	0.69	0.81	0.93
NBC_MHEPL_499	341356	6257129	0.85	3.08	0.03	1.87	2.17	3.02	2.60	2.64	2.78	2.78	2.78	2.60	2.65	2.81	2.82	2.82	2.60	2.67	2.91	3.02	3.02	2.17	0.11	0.21	0.32	0.43	0.53	0.64	0.75	0.85
NBC_MHEPL_500	341356	6257078	0.76	2.71	0.03	1.87	2.17	2.93	2.55	2.59	2.72	2.72	2.72	2.55	2.59	2.71	2.71	2.71	2.55	2.62	2.87	2.93	2.93	2.17	0.10	0.19	0.29	0.38	0.48	0.57	0.67	0.76
NBC_MHEPL_027	332426	6263276	0.29	1.65	0.25	2.09	2.39	2.68	2.53	2.53	2.60	2.60	2.60	2.53	2.53	2.60	2.60	2.60	2.53	2.53	2.68	2.68	2.68	2.39	0.04	0.07	0.11	0.14	0.18	0.22	0.25	0.29
NBC_MHEPL_501	341356	6257028	0.65	2.71	0.03	1.87	2.17	2.82	2.49	2.54	2.64	2.64	2.64	2.49	2.54	2.67	2.67	2.67	2.49	2.56	2.81	2.82	2.82	2.17	0.08	0.16	0.24	0.33	0.41	0.49	0.57	0.65
NBC_MHEPL_502	341306	6257028	0.64	2.71	0.03	1.87	2.17	2.81	2.49	2.53	2.63	2.63	2.63	2.49	2.54	2.66	2.66	2.66	2.49	2.56	2.80	2.81	2.81	2.17	0.08	0.16	0.24	0.32	0.40	0.48	0.56	0.64
NBC_MHEPL_503	341256	6257028	0.63	2.71	0.03	1.87	2.17	2.79	2.48	2.53	2.62	2.62	2.62	2.48	2.53	2.66	2.66	2.66	2.48	2.55	2.79	2.79	2.79	2.17	0.08	0.16	0.24	0.31	0.39	0.47	0.55	0.63
NBC_MHEPL_504	341206	6257079	0.83	3.08	0.03	1.87	2.17	3.00	2.58	2.63	2.77	2.77	2.77	2.58	2.64	2.81	2.81	2.81	2.58	2.66	2.90	3.00	3.00	2.17	0.10	0.21	0.31	0.42	0.52	0.63	0.73	0.83
NBC_MHEPL_505	341156	6257079	1.01	3.95	0.03	1.87	2.17	3.18	2.68	2.72	2.87	2.90	2.90	2.68	2.74	2.97	3.10	3.10	2.68	2.75	2.99	3.18	3.18	2.17	0.13	0.25	0.38	0.51	0.63	0.76	0.89	1.01
NBC_MHEPL_506	341106	6257079	1.28	3.95	0.03	1.87	2.17	3.45	2.81	2.86	3.00	3.09	3.09	2.81	2.87	3.06	3.21	3.21	2.81	2.88	3.13	3.37	3.45	2.17	0.16	0.32	0.48	0.64	0.80	0.96	1.12	1.28
NBC_MHEPL_507	341106	6257029	1.33	3.95	0.03	1.87	2.17	3.49	2.83	2.88	3.03	3.12	3.12	2.83	2.89	3.07	3.23	3.23	2.83	2.91	3.15	3.40	3.49	2.17	0.17	0.33	0.50	0.66	0.83	0.99	1.16	1.33
NBC_MHEPL_508	341106	6256978	1.37	3.95	0.03	1.87	2.17	3.54	2.85	2.90	3.05	3.15	3.15	2.85	2.91	3.09	3.25	3.25	2.85	2.93	3.18	3.42	3.54	2.17	0.17	0.34	0.51	0.68	0.86	1.03	1.20	1.37
NBC_MHEPL_509	341106	6256928	1.37	3.95	0.02	1.86	2.16	3.54	2.85	2.90	3.05	3.15	3.15	2.85	2.91	3.09	3.25	3.25	2.85	2.93	3.18	3.42	3.54	2.16	0.17	0.34	0.51	0.69	0.86	1.03	1.20	1.37
NBC_MHEPL_510	341156	6256878	1.37	3.95	0.02	1.86	2.16	3.54	2.85	2.90	3.05	3.15	3.15	2.85	2.91	3.09	3.25	3.25	2.85	2.93	3.18	3.42	3.54	2.16	0.17	0.34	0.51	0.69	0.86	1.03	1.20	1.37
NBC_MHEPL_511	341256	6256828	1.38	3.95	0.02	1.86	2.16	3.54	2.85	2.90	3.05	3.15	3.15	2.85	2.91	3.09	3.24	3.24	2.85	2.93	3.18	3.42	3.54	2.16	0.17	0.34	0.52	0.69	0.86	1.03	1.20	1.38
NBC_MHEPL_512	341305	6256728	1.32	3.48	0.02	1.86	2.16	3.47	2.82	2.87	3.02	3.11	3.11	2.82	2.87	3.00	3.08	3.08	2.82	2.90	3.14	3.39	3.47	2.16	0.16	0.33	0.49	0.66	0.82	0.99	1.15	1.32
NBC_MHEPL_513	341255	6256679	1.52	3.48	0.02	1.86	2.16	3.68	2.92	2.97	3.12	3.25	3.25	2.92	2.96	3.07	3.15	3.15	2.92	3.00	3.25	3.49	3.68	2.16	0.19	0.38	0.57	0.76	0.95	1.14	1.33	1.52
NBC_MHEPL_514	341255	6256629	1.45	3.48	0.02	1.86	2.16	3.61	2.88	2.94	3.08	3.20	3.20	2.88	2.93	3.05	3.13	3.13	2.88	2.97	3.21	3.46	3.61	2.16	0.18	0.36	0.54	0.72	0.91	1.09	1.27	1.45
NBC_MHEPL_515	341305	6256529	1.55	3.48	0.01	1.85	2.15	3.71	2.93	2.99	3.14	3.27	3.27	2.93	2.98	3.08	3.16	3.16	2.93	3.02	3.26	3.51	3.71	2.15	0.19	0.39	0.58	0.78	0.97	1.17	1.36	1.55
NBC_MHEPL_516	341355	6256479	1.52	3.95	0.01	1.85	2.15	3.68	2.92	2.97	3.12	3.25	3.25	2.92	2.98	3.14	3.30	3.30	2.92	3.00	3.25	3.49	3.68	2.15	0.19	0.38	0.57	0.76	0.95	1.14	1.33	1.52
NBC_MHEPL_517	341355	6256429	1.46	3.95	0.01	1.85	2.15	3.62	2.89	2.94	3.09	3.21	3.21	2.89	2.95	3.12	3.27	3.27	2.89	2.97	3.22	3.46	3.62	2.15	0.18	0.37	0.55	0.73	0.91	1.10	1.28	1.46
NBC_MHEPL_518	341405	6256378	1.44	3.95	0.01	1.85	2.15	3.59	2.87	2.93	3.07	3.19	3.19	2.87	2.94	3.10	3.26	3.26	2.87	2.96	3.20	3.45	3.59	2.15	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44
NBC_MHEPL_519	341455	6256328	1.40	3.95	0.01	1.85	2.15	3.55	2.85	2.91	3.05	3.16	3.16	2.85	2.92	3.09	3.25	3.25	2.85	2.94	3.18	3.43	3.55	2.15	0.18	0.35	0.53	0.70	0.88	1.05	1.23	1.40
NBC_MHEPL_520	341505	6256328	1.37	3.95	0.01	1.85	2.15	3.52	2.83	2.89	3.04	3.14	3.14	2.83	2.90	3.08	3.23	3.23	2.83	2.92	3.17	3.41	3.52	2.15	0.17	0.34	0.51	0.69	0.86	1.03	1.20	1.37
NBC_MHEPL_521	341555	6256328	1.34	3.95	0.00	1.84	2.14	3.48	2.81	2.87	3.02	3.11	3.11	2.81	2.88	3.07	3.22	3.22	2.81	2.90	3.15	3.39	3.48	2.14	0.17	0.33	0.50	0.67	0.84	1.00	1.17	1.34
NBC_MHEPL_522	341605	6256328	1.32	3.95	0.00	1.84	2.14	3.46	2.80	2.86	3.01	3.09	3.09	2.80	2.87	3.06	3.20	3.20	2.80	2.89	3.14	3.38	3.46	2.14	0.16	0.33	0.49	0.66	0.82	0.99	1.15	1.32
NBC_MHEPL_523	341655	6256328	1.26	3.95	0.00	1.84	2.14	3.41	2.78	2.83	2.98	3.05	3.05	2.78	2.85	3.04	3.18	3.18	2.78	2.86	3.11	3.35	3.41	2.14	0.16	0.32	0.47	0.63	0.79	0.95	1.11	1.26
NBC_MHEPL_524	341705	6256328	1.25	3.95	0.00	1.84	2.14	3.39	2.77	2.83	2.97	3.04	3.04	2.77	2.84	3.03	3.18	3.18	2.77	2.86	3.10	3.35	3.39	2.14	0.16	0.31	0.47	0.62	0.78	0.94	1.09	1.25
NBC_MHEPL_525	341755	6256328	1.22	3.95	0.00	1.84	2.14	3.37	2.76	2.81	2.96	3.03	3.03	2.76	2.83	3.02	3.17	3.17	2.76	2.84	3.09	3.33	3.37	2.14	0.15	0.31	0.46	0.61	0.76	0.92	1.07	1.22
NBC_MHEPL_028	332548	6263174	0.37	1.65	0.24	2.08	2.38	2.75	2.56	2.56	2.64	2.64	2.64	2.56	2.56	2.62	2.62	2.62	2.56	2.56	2.75	2.75	2.75	2.38	0.05	0.09	0.14	0.18	0.23	0.27	0.32	0.37
NBC_MHEPL_526	341805	6256328	1.24	3.48	0.00	1.84	2.14	3.38	2.76	2.82	2.97	3.03	3.03	2.76	2.82	2.97	3.04	3.04	2.76	2.85	3.10	3.34	3.38	2.14	0.15	0.31	0.46	0.62	0.77	0.93	1.08	1.24
NBC_MHEPL_527	341855	6256328	1.29	3.48	0.00	1.84	2.14	3.43	2.79	2.85	2.99	3.07	3.07	2.79	2.85	2.99	3.06	3.06	2.79	2.88	3.12	3.37	3.43	2.14	0.16	0.32	0.48	0.64	0.81	0.97	1.13	1.29
NBC_MHEPL_528	341906	6256328	1.30	3.48	0.00	1.84	2.14	3.44	2.79	2.85	3.00	3.08	3.08	2.79	2.85	2.99	3.06	3.06	2.79	2.88	3.13	3.37	3.44	2.14	0.16	0.32	0.49	0.65	0.81	0.97	1.14	1.30
NBC_MHEPL_529	341956	6256328	1.28	3.48	0.00	1.84	2.14	3.43	2.78	2.84	2.99	3.07	3.07	2.78	2.84	2.98	3.06	3.06	2.78	2.87	3.12	3.36	3.43	2.14	0.16	0.32	0.48	0.64	0.80	0.96	1.12	1.28
NBC_MHEPL_029	332600	6263152	0.36	1.65	0.24	2.08	2.38	2.74	2.56	2.56	2.64	2.64	2.64	2.56	2.56	2.62	2.62	2.62	2.56	2.56	2.74	2.74	2.74	2.38	0.05	0.09	0.14	0.18	0.23	0.27	0.32	0.36

100yr ARI Planning Levels - 0.4m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.40** m sea level rise projection
Freeboard of **0.3** m included in EPLs

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																	Reduction Factor Note: The application of the Reduction Factor should not reduce the EPL below the Local (Still) Water Level							
			Wave						Foreshore Type ##																							
									1					2					3					4								
						Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)		Crest Level (mAHD)																							
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	0.4 m Sea Level Projection	0.4 m Sea Level Projection	Max EPL of all Foreshore Types and Crest Levels (mAHD)	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_002	331895	6264742	0.11	1.00	0.40	2.24	2.54	2.65	2.59	2.59	2.62	2.62	2.62	2.59	2.59	2.62	2.62	2.62	2.59	2.59	2.65	2.65	2.65	2.54	0.01	0.03	0.04	0.05	0.07	0.08	0.10	0.11
NBC_MHEPL_030	332632	6263103	0.34	1.65	0.24	2.08	2.38	2.72	2.55	2.55	2.62	2.62	2.62	2.55	2.55	2.60	2.60	2.60	2.55	2.55	2.72	2.72	2.72	2.38	0.04	0.09	0.13	0.17	0.21	0.26	0.30	0.34
NBC_MHEPL_031	332662	6263060	0.32	1.65	0.23	2.07	2.37	2.69	2.53	2.53	2.60	2.60	2.60	2.53	2.53	2.60	2.60	2.60	2.53	2.53	2.69	2.69	2.69	2.37	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32
NBC_MHEPL_032	332696	6263014	0.30	1.65	0.23	2.07	2.37	2.67	2.52	2.52	2.59	2.59	2.59	2.52	2.52	2.59	2.59	2.59	2.52	2.52	2.67	2.67	2.67	2.37	0.04	0.08	0.11	0.15	0.19	0.23	0.27	0.30
NBC_MHEPL_033	332727	6262972	0.29	1.45	0.23	2.07	2.37	2.66	2.51	2.51	2.58	2.58	2.58	2.51	2.51	2.55	2.55	2.55	2.51	2.51	2.66	2.66	2.66	2.37	0.04	0.07	0.11	0.15	0.18	0.22	0.26	0.29
NBC_MHEPL_034	332757	6262932	0.29	1.65	0.22	2.06	2.36	2.65	2.51	2.51	2.57	2.57	2.57	2.51	2.51	2.58	2.58	2.58	2.51	2.51	2.65	2.65	2.65	2.36	0.04	0.07	0.11	0.14	0.18	0.22	0.25	0.29
NBC_MHEPL_035	332788	6262955	0.29	1.65	0.23	2.07	2.37	2.66	2.51	2.51	2.58	2.58	2.58	2.51	2.51	2.58	2.58	2.58	2.51	2.51	2.66	2.66	2.66	2.37	0.04	0.07	0.11	0.15	0.18	0.22	0.26	0.29
NBC_MHEPL_036	332818	6262915	0.30	1.65	0.22	2.06	2.36	2.67	2.52	2.52	2.58	2.58	2.58	2.52	2.52	2.58	2.58	2.58	2.52	2.52	2.67	2.67	2.67	2.36	0.04	0.08	0.11	0.15	0.19	0.23	0.27	0.30
NBC_MHEPL_037	332877	6262900	0.32	1.65	0.22	2.06	2.36	2.68	2.52	2.52	2.59	2.59	2.59	2.52	2.52	2.58	2.58	2.58	2.52	2.52	2.68	2.68	2.68	2.36	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32
NBC_MHEPL_038	332936	6262884	0.32	1.65	0.22	2.06	2.36	2.68	2.52	2.52	2.59	2.59	2.59	2.52	2.52	2.58	2.58	2.58	2.52	2.52	2.68	2.68	2.68	2.36	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32
NBC_MHEPL_039	332996	6262868	0.33	1.65	0.22	2.06	2.36	2.68	2.52	2.52	2.59	2.59	2.59	2.52	2.52	2.58	2.58	2.58	2.52	2.52	2.68	2.68	2.68	2.36	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.33
NBC_MHEPL_003	331926	6264732	0.12	1.13	0.40	2.24	2.54	2.66	2.60	2.60	2.63	2.63	2.63	2.60	2.60	2.63	2.63	2.63	2.60	2.60	2.66	2.66	2.66	2.54	0.02	0.03	0.05	0.06	0.08	0.09	0.11	0.12
NBC_MHEPL_040	333024	6262831	0.40	2.11	0.22	2.06	2.36	2.76	2.56	2.56	2.64	2.64	2.64	2.56	2.56	2.67	2.67	2.67	2.56	2.56	2.76	2.76	2.76	2.36	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40
NBC_MHEPL_041	333084	6262819	0.44	2.11	0.22	2.06	2.36	2.79	2.57	2.57	2.67	2.67	2.67	2.57	2.57	2.68	2.68	2.68	2.57	2.57	2.79	2.79	2.79	2.36	0.05	0.11	0.16	0.22	0.27	0.33	0.38	0.44
NBC_MHEPL_042	333144	6262808	0.47	2.11	0.21	2.05	2.35	2.83	2.59	2.59	2.70	2.70	2.70	2.59	2.59	2.70	2.70	2.70	2.59	2.59	2.81	2.83	2.83	2.35	0.06	0.12	0.18	0.24	0.30	0.35	0.41	0.47
NBC_MHEPL_043	333174	6262772	0.47	2.11	0.21	2.05	2.35	2.82	2.59	2.59	2.69	2.69	2.69	2.59	2.59	2.69	2.69	2.69	2.59	2.59	2.81	2.82	2.82	2.35	0.06	0.12	0.18	0.24	0.30	0.35	0.41	0.47
NBC_MHEPL_044	333171	6262710	0.48	2.11	0.21	2.05	2.35	2.83	2.59	2.59	2.69	2.69	2.69	2.59	2.59	2.69	2.69	2.69	2.59	2.59	2.81	2.83	2.83	2.35	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_045	333167	6262651	0.48	2.11	0.20	2.04	2.34	2.82	2.58	2.58	2.69	2.69	2.69	2.58	2.58	2.69	2.69	2.69	2.58	2.58	2.81	2.82	2.82	2.34	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_046	333194	6262618	0.47	2.11	0.20	2.04	2.34	2.81	2.58	2.58	2.68	2.68	2.68	2.58	2.58	2.68	2.68	2.68	2.58	2.58	2.81	2.81	2.81	2.34	0.06	0.12	0.18	0.24	0.29	0.35	0.41	0.47
NBC_MHEPL_047	333220	6262584	0.47	2.11	0.20	2.04	2.34	2.80	2.57	2.57	2.67	2.67	2.67	2.57	2.57	2.67	2.67	2.67	2.57	2.57	2.80	2.80	2.80	2.34	0.06	0.12	0.17	0.23	0.29	0.35	0.41	0.47
NBC_MHEPL_048	333246	6262550	0.46	2.11	0.19	2.03	2.33	2.79	2.56	2.56	2.66	2.66	2.66	2.56	2.56	2.67	2.67	2.67	2.56	2.56	2.79	2.79	2.79	2.33	0.06	0.11	0.17	0.23	0.29	0.34	0.40	0.46
NBC_MHEPL_049	333272	6262516	0.43	1.87	0.19	2.03	2.33	2.77	2.55	2.55	2.65	2.65	2.65	2.55	2.55	2.62	2.62	2.62	2.55	2.55	2.77	2.77	2.77	2.33	0.05	0.11	0.16	0.22	0.27	0.33	0.38	0.43
NBC_MHEPL_004	331991	6264724	0.14	1.13	0.39	2.23	2.53	2.67	2.60	2.60	2.63	2.63	2.63	2.60	2.60	2.63	2.63	2.63	2.60	2.60	2.67	2.67	2.67	2.53	0.02	0.03	0.05	0.07	0.09	0.10	0.12	0.14
NBC_MHEPL_050	333268	6262456	0.41	1.87	0.19	2.03	2.33	2.74	2.53	2.53	2.63	2.63	2.63	2.53	2.53	2.61	2.61	2.61	2.53	2.53	2.74	2.74	2.74	2.33	0.05	0.10	0.15	0.21	0.26	0.31	0.36	0.41
NBC_MHEPL_051	333236	6262431	0.41	1.87	0.19	2.03	2.33	2.74	2.53	2.53	2.62	2.62	2.62	2.53	2.53	2.61	2.61	2.61	2.53	2.53	2.74	2.74	2.74	2.33	0.05	0.10	0.15	0.21	0.26	0.31	0.36	0.41
NBC_MHEPL_052	333204	6262407	0.41	1.87	0.18	2.02	2.32	2.74	2.53	2.53	2.62	2.62	2.62	2.53	2.53	2.61	2.61	2.61	2.53	2.53	2.74	2.74	2.74	2.32	0.05	0.10	0.15	0.21	0.26	0.31	0.36	0.41
NBC_MHEPL_053	333199	6262347	0.45	2.11	0.18	2.02	2.32	2.77	2.54	2.54	2.64	2.64	2.64	2.54	2.54	2.65	2.65	2.65	2.54	2.54	2.77	2.77	2.77	2.32	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.45
NBC_MHEPL_054	333194	6262286	0.49	2.40	0.18	2.02	2.32	2.81	2.56	2.56	2.67	2.67	2.67	2.56	2.56	2.70	2.70	2.70	2.56	2.56	2.80	2.81	2.81	2.32	0.06	0.12	0.18	0.24	0.31	0.37	0.43	0.49
NBC_MHEPL_055	333222	6262250	0.48	2.11	0.17	2.01	2.31	2.79	2.55	2.55	2.66	2.66	2.66	2.55	2.55	2.66	2.66	2.66	2.55	2.55	2.79	2.79	2.79	2.31	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_056	333219	6262189	0.47	2.11	0.17	2.01	2.31	2.77	2.54	2.54	2.64	2.64	2.64	2.54	2.54	2.65	2.65	2.65	2.54	2.54	2.77	2.77	2.77	2.31	0.06	0.12	0.18	0.23	0.29	0.35	0.41	0.47
NBC_MHEPL_057	333248	6262152	0.45	2.11	0.16	2.00	2.30	2.75	2.53	2.53	2.63	2.63	2.63	2.53	2.53	2.64	2.64	2.64	2.53	2.53	2.75	2.75	2.75	2.30	0.06	0.11	0.17	0.22	0.28	0.34	0.39	0.45
NBC_MHEPL_058	333277	6262115	0.44	2.11	0.16	2.00	2.30	2.74	2.52	2.52	2.62	2.62	2.62	2.52	2.52	2.63	2.63	2.63	2.52	2.52	2.74	2.74	2.74	2.30	0.05	0.11	0.16	0.22	0.27	0.33	0.38	0.44
NBC_MHEPL_059	333307	6262077	0.46	2.11	0.16	2.00	2.30	2.76	2.53	2.53	2.63	2.63	2.63	2.53	2.53	2.64	2.64	2.64	2.53	2.53	2.76	2.76	2.76	2.30	0.06	0.11	0.17	0.23	0.29	0.34	0.40	0.46
NBC_MHEPL_060	333368	6262063	0.48	2.40	0.16	2.00	2.30	2.78	2.54	2.54	2.64	2.64	2.64	2.54	2.54	2.68	2.68	2.68	2.54	2.54	2.78	2.78	2.78	2.30	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_061	333429	6262050	0.50	2.40	0.16	2.00	2.30	2.79	2.55	2.55	2.66	2.66	2.66	2.55	2.55	2.69	2.69	2.69	2.55	2.55	2.79	2.79	2.79	2.30	0.06	0.12	0.19	0.25	0.31	0.37	0.43	0.50
NBC_MHEPL_062	333459	6262013	0.50	2.40	0.16	2.00	2.30	2.80	2.55	2.55	2.66	2.66	2.66	2.55	2.55	2.69	2.69	2.69	2.55	2.55	2.80	2.80	2.80	2.30	0.06	0.13	0.19	0.25	0.31	0.38	0.44	0.50
NBC_MHEPL_063	333490	6262038	0.51	2.40	0.16	2.00	2.30	2.80	2.55	2.56	2.66	2.66	2.66	2.55	2.56	2.69	2.69	2.69	2.55	2.56	2.80	2.80	2.80	2.30	0.06	0.13	0.19	0.25	0.32	0.38	0.44	0.51
NBC_MHEPL_064	333520	6262001	0.51	2.40	0.15	1.99	2.29	2.80	2.55	2.56	2.66	2.66	2.66	2.55	2.56	2.69	2.69	2.69	2.55	2.56	2.80	2.80	2.80	2.29	0.06	0.13	0.19	0.25	0.32	0.38	0.44	0.51
NBC_MHEPL_065	333550	6261964	0.51	2.11	0.15	1.99	2.29	2.80	2.55	2.55	2.66	2.66	2.66	2.55	2.55	2.64	2.64	2.64	2.55	2.55	2.80	2.80	2.80	2.29	0.06	0.13	0.19	0.25	0.32	0.38	0.44	0.51
NBC_MHEPL_066	333609	6261891	0.50	2.11	0.15	1.99	2.29	2.78	2.54	2.54	2.64	2.64	2.64	2.54	2.54	2.64	2.64	2.64	2.54	2.55	2.78	2.78	2.78	2.29	0.06	0.12	0.19	0.25	0.31	0.37	0.43	0.50
NBC_MHEPL_067	333639	6261854	0.48	2.11	0.15	1.99	2.29	2.77	2.53	2.54	2.63	2.63	2.63	2.53	2.54	2.63	2.63	2.63	2.53	2.54	2.77	2.77	2.77	2.29	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_068	333668	6261818	0.46	2.11	0.14	1.98	2.28	2.75	2.52	2.53	2.62	2.62	2.62	2.52	2.53	2.62	2.62	2.62	2.52	2.53	2.75	2.75	2.75	2.28	0.06	0.12	0.17	0.23	0.29	0.35	0.41	0.46
NBC_MHEPL_069	333698	6261781	0.45	1.87	0.14	1.98	2.28	2.73	2.51	2.52	2.60	2.60	2.60	2.51	2.51	2.58	2.58	2.58	2.51	2.52	2.73	2.73	2.73	2.28	0.06	0.11	0.17	0.22	0.28	0.34	0.39	0.45

100yr ARI Planning Levels - 0.9m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

Mean Sea Level Rise Allowance **0.90** m sea level rise projection
Freeboard of **0.3** m included in EPLs

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																	Reduction Factor Note: The application of the Reduction Factor should not reduce the EPL below the Local (Still) Water Level							
			Wave			Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)		Foreshore Type ##																							
									1					2					3					4								
									Crest Level (mAHD)																							
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	0.9 m Sea Level Projection	0.9 m Sea Level Projection	Max EPL of all Foreshore Types and Crest Levels (mAHD)	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_070	333667	6261756	0.48	2.11	0.14	2.48	2.78	3.26	3.02	3.02	3.03	3.13	3.13	3.02	3.02	3.03	3.12	3.12	3.02	3.02	3.03	3.26	3.26	2.78	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_071	333665	6261696	0.50	2.11	0.14	2.48	2.78	3.28	3.03	3.03	3.04	3.14	3.14	3.03	3.03	3.04	3.13	3.13	3.03	3.03	3.04	3.28	3.28	2.78	0.06	0.13	0.19	0.25	0.31	0.38	0.44	0.50
NBC_MHEPL_072	333664	6261636	0.50	2.11	0.13	2.47	2.77	3.27	3.02	3.02	3.04	3.13	3.13	3.02	3.02	3.04	3.12	3.12	3.02	3.02	3.04	3.27	3.27	2.77	0.06	0.12	0.19	0.25	0.31	0.37	0.44	0.50
NBC_MHEPL_073	333692	6261601	0.49	2.11	0.13	2.47	2.77	3.26	3.02	3.02	3.03	3.13	3.13	3.02	3.02	3.03	3.12	3.12	3.02	3.02	3.04	3.26	3.26	2.77	0.06	0.12	0.18	0.25	0.31	0.37	0.43	0.49
NBC_MHEPL_074	333720	6261566	0.48	2.11	0.13	2.47	2.77	3.25	3.01	3.01	3.03	3.12	3.12	3.01	3.01	3.03	3.11	3.11	3.01	3.01	3.03	3.25	3.25	2.77	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_075	333748	6261532	0.48	2.11	0.13	2.47	2.77	3.25	3.01	3.01	3.02	3.11	3.11	3.01	3.01	3.02	3.11	3.11	3.01	3.01	3.03	3.25	3.25	2.77	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_076	333777	6261498	0.47	2.11	0.13	2.47	2.77	3.24	3.00	3.00	3.02	3.11	3.11	3.00	3.00	3.02	3.11	3.11	3.00	3.00	3.02	3.24	3.24	2.77	0.06	0.12	0.18	0.24	0.29	0.35	0.41	0.47
NBC_MHEPL_077	333833	6261431	0.46	2.11	0.12	2.46	2.76	3.23	3.00	3.00	3.01	3.10	3.10	3.00	3.00	3.01	3.10	3.10	3.00	3.00	3.02	3.23	3.23	2.76	0.06	0.12	0.17	0.23	0.29	0.35	0.41	0.46
NBC_MHEPL_078	333860	6261397	0.47	2.11	0.12	2.46	2.76	3.23	2.99	2.99	3.01	3.10	3.10	2.99	2.99	3.01	3.10	3.10	2.99	2.99	3.02	3.23	3.23	2.76	0.06	0.12	0.17	0.23	0.29	0.35	0.41	0.47
NBC_MHEPL_079	333888	6261364	0.47	2.11	0.12	2.46	2.76	3.24	3.00	3.00	3.01	3.10	3.10	3.00	3.00	3.01	3.10	3.10	3.00	3.00	3.02	3.24	3.24	2.76	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.47
NBC_MHEPL_080	333915	6261332	0.48	2.11	0.12	2.46	2.76	3.24	3.00	3.00	3.02	3.11	3.11	3.00	3.00	3.02	3.10	3.10	3.00	3.00	3.02	3.24	3.24	2.76	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_081	333971	6261325	0.49	2.11	0.12	2.46	2.76	3.25	3.00	3.00	3.02	3.11	3.11	3.00	3.00	3.02	3.10	3.10	3.00	3.00	3.03	3.25	3.25	2.76	0.06	0.12	0.18	0.24	0.31	0.37	0.43	0.49
NBC_MHEPL_082	333998	6261294	0.49	1.87	0.12	2.46	2.76	3.25	3.00	3.00	3.02	3.11	3.11	3.00	3.00	3.02	3.07	3.07	3.00	3.00	3.03	3.25	3.25	2.76	0.06	0.12	0.18	0.25	0.31	0.37	0.43	0.49
NBC_MHEPL_083	334054	6261287	0.50	1.87	0.12	2.46	2.76	3.26	3.01	3.01	3.03	3.12	3.12	3.01	3.01	3.02	3.07	3.07	3.01	3.01	3.03	3.26	3.26	2.76	0.06	0.13	0.19	0.25	0.31	0.38	0.44	0.50
NBC_MHEPL_084	334080	6261257	0.51	1.87	0.11	2.45	2.75	3.27	3.01	3.01	3.03	3.12	3.12	3.01	3.01	3.02	3.07	3.07	3.01	3.01	3.04	3.27	3.27	2.75	0.06	0.13	0.19	0.26	0.32	0.38	0.45	0.51
NBC_MHEPL_085	334135	6261252	0.54	2.11	0.11	2.45	2.75	3.30	3.03	3.03	3.04	3.14	3.14	3.03	3.03	3.04	3.12	3.12	3.03	3.03	3.05	3.30	3.30	2.75	0.07	0.14	0.20	0.27	0.34	0.41	0.47	0.54
NBC_MHEPL_086	334197	6261304	0.56	2.11	0.12	2.46	2.76	3.32	3.04	3.04	3.06	3.16	3.16	3.04	3.04	3.05	3.13	3.13	3.04	3.04	3.06	3.31	3.32	2.76	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
NBC_MHEPL_087	334222	6261274	0.56	2.11	0.11	2.45	2.75	3.32	3.04	3.04	3.05	3.16	3.16	3.04	3.04	3.05	3.12	3.12	3.04	3.04	3.06	3.31	3.32	2.75	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
NBC_MHEPL_088	334247	6261245	0.56	2.40	0.11	2.45	2.75	3.31	3.03	3.03	3.05	3.16	3.16	3.03	3.03	3.05	3.17	3.17	3.03	3.03	3.06	3.31	3.31	2.75	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
NBC_MHEPL_089	334297	6261186	0.56	2.40	0.11	2.45	2.75	3.31	3.03	3.03	3.05	3.15	3.15	3.03	3.03	3.05	3.16	3.16	3.03	3.03	3.06	3.30	3.31	2.75	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
NBC_MHEPL_090	334322	6261157	0.56	2.40	0.11	2.45	2.75	3.31	3.03	3.03	3.05	3.15	3.15	3.03	3.03	3.05	3.16	3.16	3.03	3.03	3.06	3.30	3.31	2.75	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
NBC_MHEPL_091	334378	6261155	0.56	2.40	0.11	2.45	2.75	3.31	3.03	3.03	3.05	3.16	3.16	3.03	3.03	3.05	3.17	3.17	3.03	3.03	3.06	3.31	3.31	2.75	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
NBC_MHEPL_092	334403	6261127	0.56	2.40	0.11	2.45	2.75	3.31	3.03	3.03	3.05	3.15	3.15	3.03	3.03	3.05	3.16	3.16	3.03	3.03	3.06	3.31	3.31	2.75	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
NBC_MHEPL_093	334428	6261098	0.55	2.40	0.11	2.45	2.75	3.30	3.03	3.03	3.05	3.15	3.15	3.03	3.03	3.05	3.16	3.16	3.03	3.03	3.06	3.30	3.30	2.75	0.07	0.14	0.21	0.28	0.35	0.42	0.48	0.55
NBC_MHEPL_094	334453	6261069	0.55	2.40	0.11	2.45	2.75	3.30	3.02	3.02	3.04	3.15	3.15	3.02	3.02	3.05	3.16	3.16	3.02	3.02	3.06	3.30	3.30	2.75	0.07	0.14	0.21	0.28	0.34	0.41	0.48	0.55
NBC_MHEPL_095	334480	6261039	0.55	2.40	0.11	2.45	2.75	3.29	3.02	3.02	3.04	3.14	3.14	3.02	3.02	3.04	3.16	3.16	3.02	3.02	3.05	3.29	3.29	2.75	0.07	0.14	0.21	0.27	0.34	0.41	0.48	0.55
NBC_MHEPL_096	334508	6261007	0.54	2.40	0.11	2.45	2.75	3.29	3.02	3.02	3.04	3.14	3.14	3.02	3.02	3.04	3.15	3.15	3.02	3.02	3.05	3.29	3.29	2.75	0.07	0.14	0.20	0.27	0.34	0.41	0.47	0.54
NBC_MHEPL_097	334510	6260943	0.53	2.11	0.10	2.44	2.74	3.28	3.01	3.01	3.03	3.13	3.13	3.01	3.01	3.03	3.10	3.10	3.01	3.01	3.04	3.28	3.28	2.74	0.07	0.13	0.20	0.27	0.33	0.40	0.47	0.53
NBC_MHEPL_098	334549	6260899	0.53	2.11	0.10	2.44	2.74	3.27	3.00	3.00	3.03	3.12	3.12	3.00	3.00	3.02	3.10	3.10	3.00	3.00	3.04	3.27	3.27	2.74	0.07	0.13	0.20	0.26	0.33	0.40	0.46	0.53
NBC_MHEPL_099	334594	6260848	0.52	2.11	0.10	2.44	2.74	3.26	3.00	3.00	3.02	3.12	3.12	3.00	3.00	3.02	3.10	3.10	3.00	3.00	3.04	3.26	3.26	2.74	0.07	0.13	0.20	0.26	0.33	0.39	0.46	0.52
NBC_MHEPL_100	334646	6260790	0.52	2.11	0.10	2.44	2.74	3.26	3.00	3.00	3.02	3.11	3.11	3.00	3.00	3.02	3.09	3.09	3.00	3.00	3.03	3.26	3.26	2.74	0.07	0.13	0.20	0.26	0.33	0.39	0.46	0.52
NBC_MHEPL_101	334615	6260762	0.52	2.11	0.10	2.44	2.74	3.25	2.99	2.99	3.02	3.11	3.11	2.99	2.99	3.02	3.09	3.09	2.99	2.99	3.03	3.25	3.25	2.74	0.06	0.13	0.19	0.26	0.32	0.39	0.45	0.52
NBC_MHEPL_102	334703	6260726	0.50	2.11	0.09	2.43	2.73	3.23	2.98	2.98	3.01	3.09	3.09	2.98	2.98	3.01	3.08	3.08	2.98	2.98	3.02	3.23	3.23	2.73	0.06	0.12	0.19	0.25	0.31	0.37	0.44	0.50
NBC_MHEPL_103	334672	6260698	0.50	1.87	0.09	2.43	2.73	3.24	2.99	2.99	3.01	3.10	3.10	2.99	2.99	3.00	3.05	3.05	2.99	2.99	3.02	3.24	3.24	2.73	0.06	0.13	0.19	0.25	0.31	0.38	0.44	0.50
NBC_MHEPL_104	334641	6260670	0.49	1.87	0.09	2.43	2.73	3.22	2.98	2.98	3.00	3.09	3.09	2.98	2.98	3.00	3.04	3.04	2.98	2.98	3.02	3.22	3.22	2.73	0.06	0.12	0.18	0.24	0.31	0.37	0.43	0.49
NBC_MHEPL_105	334611	6260644	0.47	1.87	0.09	2.43	2.73	3.20	2.97	2.97	2.99	3.07	3.07	2.97	2.97	2.99	3.03	3.03	2.97	2.97	3.00	3.20	3.20	2.73	0.06	0.12	0.18	0.23	0.29	0.35	0.41	0.47
NBC_MHEPL_106	334671	6260577	0.45	1.87	0.09	2.43	2.73	3.18	2.96	2.96	2.98	3.05	3.05	2.96	2.96	2.98	3.03	3.03	2.96	2.96	2.99	3.18	3.18	2.73	0.06	0.11	0.17	0.22	0.28	0.34	0.39	0.45
NBC_MHEPL_107	334729	6260513	0.44	2.11	0.09	2.43	2.73	3.17	2.95	2.95	2.97	3.05	3.05	2.95	2.95	2.98	3.06	3.06	2.95	2.95	2.99	3.17	3.17	2.73	0.05	0.11	0.16	0.22	0.27	0.33	0.38	0.44
NBC_MHEPL_108	334759	6260540	0.45	1.87	0.09	2.43	2.73	3.18	2.96	2.96	2.98	3.05	3.05	2.96	2.96	2.98	3.03	3.03	2.96	2.96	2.99	3.18	3.18	2.73	0.06	0.11	0.17	0.22	0.28	0.34	0.39	0.45
NBC_MHEPL_109	334789	6260568	0.46	1.87	0.09	2.43	2.73	3.20	2.96	2.96	2.99	3.07	3.07	2.96	2.96	2.98	3.03	3.03	2.96	2.96	3.00	3.20	3.20	2.73	0.06	0.12	0.17	0.23	0.29	0.35	0.41	0.46
NBC_MHEPL_005	332243	6264687	0.20	1.28	0.39	2.73	3.03	3.23	3.13	3.13	3.13	3.17	3.17	3.13	3.13	3.13	3.17	3.17	3.13	3.13	3.13	3.23	3.23	3.03	0.02	0.05	0.07	0.10	0.12	0.15	0.17	0.20
NBC_MHEPL_110	334820	6260597	0.48	1.87	0.09	2.43	2.73	3.21	2.97	2.97	3.00	3.08	3.08	2.97	2.97	2.99	3.04	3.04	2.97	2.97	3.01	3.21	3.21	2.73	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_111	334878	6260534	0.48	1.87	0.09	2.43	2.73	3.21	2.97	2.97	2.99	3.07	3.07	2.97	2.97	2.99	3.04	3.04	2.97	2.97	3.01	3.21	3.21	2.73	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_112	334910	6260564	0.47	1.87	0.09	2.43	2.73	3.20	2.97	2.97	2.99	3.07	3.07	2.97	2.97	2.99	3.03	3.03	2.97	2.97	3.01	3.20	3.20	2.73	0.06	0.12	0.18	0.24	0.30	0.36	0.41	0.47
NBC_MHEPL_113	334972	6260498	0.46	1.87	0.09	2.43	2.73	3.19	2.96	2.96	2.99	3.06	3.06	2.96	2.96	2.98	3.03	3.03	2.96	2.96	3.00	3.19	3.19	2.73	0.06	0.12	0.17	0.23	0.29	0.35	0.40	0.46
NBC_MHEPL_114	335004	6260528	0.45	1.87	0.09	2.43	2.73	3.18	2.95	2.95	2.98	3.05	3.05	2.95	2.95	2.97	3.03	3.03	2.95	2.95	2.99	3.18	3.18	2.73	0.06	0.11	0.17	0.22	0.28	0.34	0.39	0.45
NBC_MHEPL_115	335067	6260462	0.44	1.87	0.09	2.43	2.73	3.17	2.95	2.95	2.98	3.05	3.05	2.95	2.95	2.97	3.02	3.02	2.95	2.95	2.99	3.17	3.17	2.73	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44
NBC_MHEPL_116	335099	6260492	0.45	1.87	0.09	2.43	2.73	3.18	2.96	2.96	2.98	3.06	3.06	2.96	2.96	2.98	3.03	3.03	2.96	2.96	3.00	3.18	3.18	2.73	0.06	0.11	0.17	0.23	0.28	0.34	0.40	0.45
NBC_MHEPL_117	335191	6260457	0.47	1.87	0.09	2.43	2.73	3.19	2.96	2.96	2.99	3.06	3.06	2.96	2.96	2.98	3.03	3.03	2.96	2.96	3.00	3.19	3.19	2.73	0.06	0.12	0.17	0.23	0.29	0.35	0.41	0.47
NBC_MHEPL_118	335221	6260486	0.47	1.87	0.09	2.43	2.73	3.20	2.96	2.96	2.99	3.06	3.06	2.96	2.96	2.98	3.03	3.03	2.96	2.96	3.00	3.20	3.20	2.73	0.06	0.12	0.17	0.23	0.29	0.35	0.41	0.47
NBC_MHEPL_119	335278	6260427	0.45	1.87	0.09	2.43	2.73	3.18	2.96	2.96	2.98	3.06	3.06	2.96	2.96	2.98	3.03	3.03	2.96	2.96	2.99	3.18	3.18	2.73	0.06	0.11	0.17	0.23	0.28	0.34	0.40	0.45
NBC_MHEPL_006	332257	6264662	0.18	1.28	0.39	2.73	3.03	3.21	3.12	3.12	3.12	3.16	3.16	3.12	3.12	3.12	3.16	3.16	3.12	3.12	3.12	3.21	3.21	3.03	0.02	0.05	0.07	0.09	0.11	0.14	0.16	0.18
NBC_MHEPL_120	335308	6260457	0.45	1.87	0.09	2.43	2.73	3.18	2.95	2.95	2.98	3.05	3.05	2.95	2.95	2.97	3.03	3.03	2.95	2.95	2.99	3.18	3.18	2.73	0.06	0.11	0.17	0.23	0.28	0.34	0.39	0.45
NBC_MHEPL_121	335363	6260402	0.45	2.11	0.09	2.43	2.73	3.18	2.95	2.95	2.98	3.05	3.05	2.95	2.95	2.98	3.06	3.06	2.95	2.95	2.99	3.18	3.18	2.73	0.06	0.11	0.17	0.23	0.28	0.34	0.40	0.45
NBC_MHEPL_122	335394	6260434	0.46	2.11	0.09	2.43	2.73	3.19	2.96	2.96	2.98	3.06	3.06	2.96	2.96	2.98	3.06	3.06	2.96	2.96	3.00	3.19	3.19	2.73	0.06	0.11	0.17	0.23	0.29	0.34	0.40	0.46
NBC_MHEPL_123	335447	6260381	0.45	2.11	0.09	2.43	2.73	3.18	2.96	2.96	2.98	3.06	3.06	2.96	2.96	2.98	3.06	3.06	2.96	2.96	3.00	3.18	3.18	2.73	0.06	0.11	0.17	0.23	0.28	0.34	0.40	0.45

100yr ARI Planning Levels - 0.9m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.90** m sea level rise projection
Freeboard of **0.3** m included in EPLs

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																	Reduction Factor — Note: The application of the Reduction Factor should not reduce the EPL below the Local (Still) Water Level							
			Wave			Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)		Foreshore Type ## — Crest Level (mAHD)																							
									1					2					3					4								
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	0.9 m Sea Level Projection	0.9 m Sea Level Projection	Max EPL of all Foreshore Types and Crest Levels (mAHD)	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_124	335476	6260411	0.45	1.87	0.09	2.43	2.73	3.18	2.95	2.95	2.98	3.05	3.05	2.95	2.95	2.97	3.02	3.02	2.95	2.95	2.99	3.18	3.18	2.73	0.06	0.11	0.17	0.23	0.28	0.34	0.39	0.45
NBC_MHEPL_125	335526	6260362	0.46	2.11	0.09	2.43	2.73	3.19	2.96	2.96	2.98	3.06	3.06	2.96	2.96	2.98	3.06	3.06	2.96	2.96	3.00	3.19	3.19	2.73	0.06	0.11	0.17	0.23	0.29	0.34	0.40	0.46
NBC_MHEPL_126	335555	6260392	0.47	2.11	0.09	2.43	2.73	3.20	2.96	2.96	2.99	3.07	3.07	2.96	2.96	2.99	3.07	3.07	2.96	2.96	3.00	3.20	3.20	2.73	0.06	0.12	0.18	0.24	0.30	0.36	0.41	0.47
NBC_MHEPL_127	335630	6260379	0.48	2.11	0.09	2.43	2.73	3.21	2.97	2.97	2.99	3.07	3.07	2.97	2.97	2.99	3.07	3.07	2.97	2.97	3.01	3.21	3.21	2.73	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_128	335674	6260338	0.47	2.11	0.09	2.43	2.73	3.20	2.96	2.96	2.99	3.07	3.07	2.96	2.96	2.99	3.07	3.07	2.96	2.96	3.00	3.20	3.20	2.73	0.06	0.12	0.18	0.24	0.29	0.35	0.41	0.47
NBC_MHEPL_129	335702	6260370	0.44	2.11	0.09	2.43	2.73	3.16	2.95	2.95	2.97	3.04	3.04	2.95	2.95	2.97	3.05	3.05	2.95	2.95	2.99	3.16	3.16	2.73	0.05	0.11	0.16	0.22	0.27	0.33	0.38	0.44
NBC_MHEPL_130	335730	6260402	0.46	1.87	0.09	2.43	2.73	3.19	2.96	2.96	2.98	3.06	3.06	2.96	2.96	2.98	3.03	3.03	2.96	2.96	3.00	3.19	3.19	2.73	0.06	0.11	0.17	0.23	0.29	0.34	0.40	0.46
NBC_MHEPL_131	335757	6260433	0.47	1.87	0.09	2.43	2.73	3.20	2.96	2.96	2.99	3.07	3.07	2.96	2.96	2.98	3.03	3.03	2.96	2.96	3.00	3.20	3.20	2.73	0.06	0.12	0.18	0.24	0.30	0.35	0.41	0.47
NBC_MHEPL_132	335714	6260471	0.48	1.87	0.09	2.43	2.73	3.21	2.97	2.97	3.00	3.08	3.08	2.97	2.97	2.99	3.04	3.04	2.97	2.97	3.01	3.21	3.21	2.73	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_133	335783	6260463	0.50	1.87	0.09	2.43	2.73	3.23	2.98	2.98	3.00	3.09	3.09	2.98	2.98	3.00	3.04	3.04	2.98	2.98	3.02	3.23	3.23	2.73	0.06	0.12	0.19	0.25	0.31	0.37	0.43	0.50
NBC_MHEPL_134	335826	6260427	0.48	1.87	0.09	2.43	2.73	3.21	2.97	2.97	2.99	3.07	3.07	2.97	2.97	2.99	3.03	3.03	2.97	2.97	3.01	3.21	3.21	2.73	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_135	335894	6260424	0.50	1.87	0.09	2.43	2.73	3.23	2.98	2.98	3.00	3.09	3.09	2.98	2.98	3.00	3.04	3.04	2.98	2.98	3.02	3.23	3.23	2.73	0.06	0.12	0.19	0.25	0.31	0.37	0.43	0.50
NBC_MHEPL_136	335961	6260425	0.53	1.87	0.09	2.43	2.73	3.26	3.00	3.00	3.02	3.11	3.11	3.00	3.00	3.01	3.05	3.05	3.00	3.00	3.04	3.26	3.26	2.73	0.07	0.13	0.20	0.27	0.33	0.40	0.47	0.53
NBC_MHEPL_137	335988	6260459	0.57	2.11	0.09	2.43	2.73	3.30	3.02	3.02	3.04	3.14	3.14	3.02	3.02	3.04	3.10	3.10	3.02	3.02	3.06	3.30	3.30	2.73	0.07	0.14	0.21	0.29	0.36	0.43	0.50	0.57
NBC_MHEPL_138	336052	6260461	0.61	2.40	0.09	2.43	2.73	3.34	3.03	3.03	3.06	3.17	3.17	3.03	3.03	3.06	3.16	3.16	3.03	3.03	3.07	3.32	3.34	2.73	0.08	0.15	0.23	0.30	0.38	0.46	0.53	0.61
NBC_MHEPL_139	336077	6260494	0.64	2.40	0.09	2.43	2.73	3.37	3.05	3.05	3.08	3.19	3.19	3.05	3.05	3.08	3.17	3.17	3.05	3.05	3.09	3.34	3.37	2.73	0.08	0.16	0.24	0.32	0.40	0.48	0.56	0.64
NBC_MHEPL_007	332305	6264553	0.19	1.13	0.38	2.72	3.02	3.21	3.11	3.11	3.11	3.16	3.16	3.11	3.11	3.11	3.14	3.14	3.11	3.11	3.11	3.21	3.21	3.02	0.02	0.05	0.07	0.10	0.12	0.14	0.17	0.19
NBC_MHEPL_140	336100	6260525	0.68	2.71	0.09	2.43	2.73	3.41	3.07	3.07	3.09	3.22	3.22	3.07	3.07	3.10	3.24	3.24	3.07	3.07	3.11	3.35	3.41	2.73	0.08	0.17	0.25	0.34	0.42	0.51	0.59	0.68
NBC_MHEPL_141	336123	6260557	0.70	2.71	0.09	2.43	2.73	3.43	3.08	3.08	3.11	3.23	3.23	3.08	3.08	3.11	3.25	3.25	3.08	3.08	3.12	3.37	3.43	2.73	0.09	0.18	0.26	0.35	0.44	0.53	0.61	0.70
NBC_MHEPL_142	336110	6260620	0.70	2.71	0.09	2.43	2.73	3.43	3.08	3.08	3.11	3.24	3.24	3.08	3.08	3.11	3.25	3.25	3.08	3.08	3.12	3.37	3.43	2.73	0.09	0.18	0.26	0.35	0.44	0.53	0.61	0.70
NBC_MHEPL_143	336138	6260656	0.71	2.71	0.09	2.43	2.73	3.44	3.09	3.09	3.11	3.24	3.24	3.09	3.09	3.11	3.26	3.26	3.09	3.09	3.13	3.37	3.44	2.73	0.09	0.18	0.27	0.35	0.44	0.53	0.62	0.71
NBC_MHEPL_144	336130	6260722	0.70	2.71	0.09	2.43	2.73	3.43	3.08	3.08	3.11	3.23	3.23	3.08	3.08	3.11	3.25	3.25	3.08	3.08	3.12	3.37	3.43	2.73	0.09	0.17	0.26	0.35	0.44	0.52	0.61	0.70
NBC_MHEPL_145	336158	6260757	0.70	3.08	0.09	2.43	2.73	3.43	3.08	3.08	3.11	3.24	3.24	3.08	3.08	3.12	3.31	3.32	3.08	3.08	3.12	3.37	3.43	2.73	0.09	0.18	0.26	0.35	0.44	0.53	0.61	0.70
NBC_MHEPL_146	336150	6260820	0.68	3.08	0.09	2.43	2.73	3.41	3.07	3.07	3.10	3.22	3.22	3.07	3.07	3.11	3.31	3.31	3.07	3.07	3.11	3.36	3.41	2.73	0.08	0.17	0.25	0.34	0.42	0.51	0.59	0.68
NBC_MHEPL_147	336155	6260897	0.69	3.08	0.10	2.44	2.74	3.43	3.08	3.08	3.11	3.23	3.23	3.08	3.08	3.11	3.31	3.32	3.08	3.08	3.12	3.37	3.43	2.74	0.09	0.17	0.26	0.35	0.43	0.52	0.61	0.69
NBC_MHEPL_148	336119	6260932	0.68	3.08	0.10	2.44	2.74	3.42	3.08	3.08	3.10	3.23	3.23	3.08	3.08	3.11	3.31	3.32	3.08	3.08	3.11	3.36	3.42	2.74	0.09	0.17	0.26	0.34	0.43	0.51	0.60	0.68
NBC_MHEPL_149	336172	6260988	0.67	3.08	0.10	2.44	2.74	3.41	3.07	3.07	3.10	3.22	3.22	3.07	3.07	3.10	3.31	3.31	3.07	3.07	3.11	3.35	3.41	2.74	0.08	0.17	0.25	0.34	0.42	0.50	0.59	0.67
NBC_MHEPL_008	332316	6264523	0.19	1.28	0.38	2.72	3.02	3.20	3.11	3.11	3.11	3.15	3.15	3.11	3.11	3.11	3.15	3.15	3.11	3.11	3.11	3.20	3.20	3.02	0.02	0.05	0.07	0.09	0.12	0.14	0.17	0.19
NBC_MHEPL_150	336134	6261026	0.71	3.08	0.10	2.44	2.74	3.44	3.09	3.09	3.12	3.25	3.25	3.09	3.09	3.12	3.32	3.33	3.09	3.09	3.13	3.37	3.44	2.74	0.09	0.18	0.27	0.35	0.44	0.53	0.62	0.71
NBC_MHEPL_151	336185	6261080	0.74	3.08	0.10	2.44	2.74	3.48	3.11	3.11	3.13	3.27	3.27	3.11	3.11	3.14	3.33	3.34	3.11	3.11	3.14	3.39	3.48	2.74	0.09	0.18	0.28	0.37	0.46	0.55	0.65	0.74
NBC_MHEPL_152	336185	6261080	0.74	3.08	0.10	2.44	2.74	3.48	3.11	3.11	3.13	3.27	3.27	3.11	3.11	3.14	3.33	3.34	3.11	3.11	3.14	3.39	3.48	2.74	0.09	0.18	0.28	0.37	0.46	0.55	0.65	0.74
NBC_MHEPL_153	336234	6261134	0.74	3.08	0.10	2.44	2.74	3.48	3.11	3.11	3.14	3.27	3.27	3.11	3.11	3.14	3.33	3.35	3.11	3.11	3.15	3.39	3.48	2.74	0.09	0.19	0.28	0.37	0.46	0.56	0.65	0.74
NBC_MHEPL_154	336191	6261174	0.72	2.71	0.10	2.44	2.74	3.46	3.10	3.10	3.12	3.26	3.26	3.10	3.10	3.13	3.27	3.27	3.10	3.10	3.14	3.38	3.46	2.74	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72
NBC_MHEPL_155	336145	6261217	0.70	2.71	0.10	2.44	2.74	3.44	3.09	3.09	3.11	3.24	3.24	3.09	3.09	3.12	3.26	3.26	3.09	3.09	3.13	3.37	3.44	2.74	0.09	0.17	0.26	0.35	0.44	0.52	0.61	0.70
NBC_MHEPL_156	336193	6261269	0.66	2.71	0.10	2.44	2.74	3.41	3.07	3.07	3.10	3.22	3.22	3.07	3.07	3.10	3.25	3.25	3.07	3.07	3.11	3.35	3.41	2.74	0.08	0.17	0.25	0.33	0.42	0.50	0.58	0.66
NBC_MHEPL_157	336146	6261313	0.57	2.71	0.10	2.44	2.74	3.31	3.03	3.03	3.05	3.15	3.15	3.03	3.03	3.05	3.21	3.21	3.03	3.03	3.06	3.31	3.31	2.74	0.07	0.14	0.21	0.28	0.35	0.43	0.50	0.57
NBC_MHEPL_158	336094	6261362	0.54	2.71	0.10	2.44	2.74	3.28	3.01	3.01	3.03	3.13	3.13	3.01	3.01	3.04	3.20	3.20	3.01	3.01	3.05	3.28	3.28	2.74	0.07	0.13	0.20	0.27	0.34	0.40	0.47	0.54
NBC_MHEPL_159	336085	6261464	0.52	2.71	0.11	2.45	2.75	3.27	3.01	3.01	3.03	3.12	3.12	3.01	3.01	3.04	3.20	3.20	3.01	3.01	3.04	3.27	3.27	2.75	0.06	0.13	0.19	0.26	0.32	0.39	0.45	0.52
NBC_MHEPL_160	336038	6261414	0.48	2.71	0.11	2.45	2.75	3.23	2.99	2.99	3.01	3.09	3.09	2.99	2.99	3.02	3.18	3.18	2.99	2.99	3.02	3.23	3.23	2.75	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_161	335982	6261468	0.42	2.71	0.12	2.46	2.76	3.17	2.96	2.96	2.98	3.06	3.06	2.96	2.96	2.99	3.16	3.16	2.96	2.96	2.99	3.17	3.17	2.76	0.05	0.10	0.16	0.21	0.26	0.31	0.37	0.42
NBC_MHEPL_162	336102	6261711	0.50	2.40	0.16	2.50	2.80	3.30	3.05	3.05	3.05	3.16	3.16	3.05	3.05	3.05	3.19	3.19	3.05	3.05	3.05	3.30	3.30	2.80	0.06	0.13	0.19	0.25	0.31	0.38	0.44	0.50
NBC_MHEPL_163	336159	6261658	0.50	2.11	0.15	2.49	2.79	3.29	3.04	3.04	3.05	3.15	3.15	3.04	3.04	3.05	3.14	3.14	3.04	3.04	3.05	3.29	3.29	2.79	0.06	0.13	0.19	0.25	0.31	0.38	0.44	0.50
NBC_MHEPL_164	336117	6261612	0.52	2.40	0.14	2.48	2.78	3.30	3.04	3.04	3.05	3.15	3.15	3.04	3.04	3.05	3.18	3.18	3.04	3.04	3.05	3.30	3.30	2.78	0.06	0.13	0.19	0.26	0.32	0.39	0.45	0.52
NBC_MHEPL_165	336174	6261560	0.51	2.40	0.13	2.47	2.77	3.28	3.03	3.03	3.04	3.14	3.14	3.03	3.03	3.04	3.17	3.17	3.03	3.03	3.05	3.28	3.28	2.77	0.06	0.13	0.19	0.26	0.32	0.38	0.45	0.51
NBC_MHEPL_166	336130	6261512	0.55	2.71	0.12	2.46	2.76	3.31	3.04	3.04	3.05	3.16	3.16	3.04	3.04	3.06	3.22	3.22	3.04	3.04	3.06	3.31	3.31	2.76	0.07	0.14	0.21	0.28	0.35	0.42	0.48	0.55
NBC_MHEPL_167	336141	6261412	0.58	2.71	0.11	2.45	2.75	3.33	3.04	3.04	3.06	3.17	3.17	3.04	3.04	3.06	3.22	3.22	3.04	3.04	3.07	3.31	3.33	2.75	0.07	0.15	0.22	0.29	0.36	0.44	0.51	0.58
NBC_MHEPL_168	336192	6261364	0.62	2.71	0.10	2.44	2.74	3.37	3.06	3.06	3.08	3.19	3.19	3.06	3.06	3.08	3.24	3.24	3.06	3.06	3.09	3.33	3.37	2.74	0.08	0.16	0.23	0.31	0.39	0.47	0.55	0.62
NBC_MHEPL_169	336239	6261227	0.72	2.71	0.10	2.44	2.74	3.46	3.10	3.10	3.13	3.26	3.26	3.10	3.10	3.13	3.27	3.27	3.10	3.10	3.14	3.38	3.46	2.74	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72
NBC_MHEPL_170	336283	6261188	0.71	2.71	0.10	2.44	2.74	3.45	3.10	3.10	3.12	3.25	3.25	3.10	3.10	3.12	3.26	3.26	3.10	3.10	3.13	3.38	3.45	2.74	0.09	0.18	0.27	0.36	0.44	0.53	0.62	0.71
NBC_MHEPL_171	336321	6261155	0.65	2.71	0.10	2.44	2.74	3.39	3.07	3.07	3.09	3.21	3.21	3.07	3.07	3.09	3.24	3.24	3.07	3.07	3.10	3.35	3.39	2.74	0.08	0.16	0.25	0.33	0.41	0.49	0.57	0.65
NBC_MHEPL_172	336273	6261099	0.67	2.71	0.10	2.44	2.74	3.41	3.07	3.07	3.10	3.22	3.22	3.07	3.07	3.10	3.25	3.25	3.07	3.07	3.11	3.36	3.41	2.74	0.08	0.17	0.25	0.34	0.42	0.50	0.59	0.67
NBC_MHEPL_173	336309	6261068	0.67	2.71	0.10	2.44	2.74	3.40	3.07	3.07	3.10	3.22	3.22	3.07	3.07	3.10	3.25	3.25	3.07	3.07	3.11	3.35	3.40	2.74	0.08	0.17	0.25	0.33	0.42	0.50	0.58	0.67
NBC_MHEPL_009	332399	6264382	0.17	1.28	0.36	2.70	3.00	3.17	3.09	3.09	3.09	3.13	3.13	3.09	3.09	3.09	3.13	3.13	3.09	3.09	3.09	3.17	3.17	3.00	0.02	0.04	0.06	0.08	0.11	0.13	0.15	0.17
NBC_MHEPL_174	336259	6261012	0.67	2.71	0.10	2.44	2.74	3.40	3.07	3.07	3.09	3.22	3.22	3.07	3.07	3.10	3.25	3.25	3.07	3.07	3.11	3.35	3.40	2.74	0.08	0.17	0.25	0.33	0.42	0.50	0.58	0.67
NBC_MHEPL_175	336294	6260982	0.66	2.71	0.10	2.44	2.74	3.39	3.06	3.06	3.09	3.21	3.21	3.06	3.06	3.09	3.24	3.24	3.06	3.06	3.10	3.35	3.39	2.74	0.08	0.16	0.25	0.33	0.41	0.49	0.57	0.66
NBC_MHEPL_176	336243	6260923	0.67	2.71	0.10	2.44	2.74	3.41	3.07	3.07	3.10	3.22	3.22	3.07	3.07	3.10	3.25	3.25	3.07	3.07	3.11	3.35	3.41	2.74	0.08	0.17	0.25	0.33	0.42	0.50	0.59	0.67

APPENDIX B

20220706_EPL_Database
0.9 m Sea Level Projected WL

100yr ARI Planning Levels - 0.9m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.90** m sea level rise projection
Freeboard of **0.3** m included in EPLs

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																Reduction Factor. Note: The application of the Reduction Factor should not reduce the EPL below the Local (Still) Water Level							
			Wave			Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)		Foreshore Type ## 1					2					3					4								
									Crest Level (mAHD)																							
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	0.9 m Sea Level Projection	0.9 m Sea Level Projection	Max EPL of all Foreshore Types and Crest Levels (mAHD)	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_177	336277	6260894	0.69	2.71	0.10	2.44	2.74	3.42	3.08	3.08	3.10	3.23	3.23	3.08	3.08	3.11	3.25	3.25	3.08	3.08	3.12	3.36	3.42	2.74	0.09	0.17	0.26	0.34	0.43	0.51	0.60	0.69
NBC_MHEPL_178	336259	6260804	0.69	2.71	0.09	2.43	2.73	3.43	3.08	3.08	3.11	3.23	3.23	3.08	3.08	3.11	3.25	3.25	3.08	3.08	3.12	3.37	3.43	2.73	0.09	0.17	0.26	0.35	0.43	0.52	0.61	0.69
NBC_MHEPL_179	336292	6260776	0.66	2.71	0.09	2.43	2.73	3.40	3.07	3.07	3.09	3.21	3.21	3.07	3.07	3.09	3.24	3.24	3.07	3.07	3.10	3.35	3.40	2.73	0.08	0.17	0.25	0.33	0.41	0.50	0.58	0.66
NBC_MHEPL_180	336325	6260750	0.65	2.71	0.09	2.43	2.73	3.38	3.06	3.06	3.08	3.20	3.20	3.06	3.06	3.09	3.23	3.23	3.06	3.06	3.10	3.34	3.38	2.73	0.08	0.16	0.24	0.32	0.40	0.49	0.57	0.65
NBC_MHEPL_181	336263	6260670	0.68	2.71	0.09	2.43	2.73	3.41	3.07	3.07	3.10	3.22	3.22	3.07	3.07	3.10	3.24	3.24	3.07	3.07	3.11	3.35	3.41	2.73	0.08	0.17	0.25	0.34	0.42	0.51	0.59	0.68
NBC_MHEPL_182	336274	6260608	0.69	2.71	0.09	2.43	2.73	3.42	3.07	3.07	3.10	3.23	3.23	3.07	3.07	3.10	3.25	3.25	3.07	3.07	3.11	3.36	3.42	2.73	0.09	0.17	0.26	0.34	0.43	0.51	0.60	0.69
NBC_MHEPL_183	336249	6260573	0.73	3.08	0.09	2.43	2.73	3.46	3.09	3.09	3.12	3.25	3.25	3.09	3.09	3.13	3.32	3.33	3.09	3.09	3.14	3.38	3.46	2.73	0.09	0.18	0.27	0.36	0.45	0.55	0.64	0.73
NBC_MHEPL_184	336288	6260545	0.73	3.08	0.09	2.43	2.73	3.46	3.10	3.10	3.12	3.26	3.26	3.10	3.10	3.13	3.32	3.33	3.10	3.10	3.14	3.38	3.46	2.73	0.09	0.18	0.27	0.37	0.46	0.55	0.64	0.73
NBC_MHEPL_185	336305	6260480	0.75	3.08	0.09	2.43	2.73	3.48	3.10	3.10	3.13	3.27	3.27	3.10	3.10	3.14	3.32	3.34	3.10	3.10	3.14	3.39	3.48	2.73	0.09	0.19	0.28	0.37	0.47	0.56	0.65	0.75
NBC_MHEPL_186	336280	6260445	0.76	3.08	0.09	2.43	2.73	3.49	3.11	3.11	3.14	3.27	3.27	3.11	3.11	3.14	3.33	3.34	3.11	3.11	3.15	3.39	3.49	2.73	0.09	0.19	0.28	0.38	0.47	0.57	0.66	0.76
NBC_MHEPL_187	336323	6260414	0.77	3.08	0.09	2.43	2.73	3.50	3.11	3.11	3.14	3.28	3.28	3.11	3.11	3.15	3.33	3.35	3.11	3.11	3.16	3.40	3.50	2.73	0.10	0.19	0.29	0.38	0.48	0.58	0.67	0.77
NBC_MHEPL_188	336363	6260383	0.77	3.08	0.09	2.43	2.73	3.50	3.11	3.11	3.14	3.28	3.28	3.11	3.11	3.15	3.33	3.35	3.11	3.11	3.16	3.40	3.50	2.73	0.10	0.19	0.29	0.39	0.48	0.58	0.67	0.77
NBC_MHEPL_189	336377	6260320	0.78	3.08	0.09	2.43	2.73	3.51	3.12	3.12	3.15	3.29	3.29	3.12	3.12	3.15	3.33	3.35	3.12	3.12	3.16	3.41	3.51	2.73	0.10	0.20	0.29	0.39	0.49	0.59	0.69	0.78
NBC_MHEPL_190	336416	6260291	0.80	3.48	0.09	2.43	2.73	3.53	3.13	3.13	3.16	3.30	3.30	3.13	3.13	3.17	3.38	3.45	3.13	3.13	3.17	3.42	3.53	2.73	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_191	336478	6260297	0.81	3.48	0.09	2.43	2.73	3.54	3.13	3.13	3.16	3.31	3.31	3.13	3.13	3.17	3.39	3.45	3.13	3.13	3.18	3.42	3.54	2.73	0.10	0.20	0.30	0.41	0.51	0.61	0.71	0.81
NBC_MHEPL_192	336516	6260271	0.81	3.48	0.09	2.43	2.73	3.54	3.13	3.13	3.16	3.31	3.31	3.13	3.13	3.17	3.39	3.45	3.13	3.13	3.18	3.42	3.54	2.73	0.10	0.20	0.31	0.41	0.51	0.61	0.71	0.81
NBC_MHEPL_193	336531	6260211	0.80	3.48	0.09	2.43	2.73	3.53	3.13	3.13	3.16	3.30	3.30	3.13	3.13	3.17	3.38	3.45	3.13	3.13	3.17	3.42	3.53	2.73	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_194	336570	6260186	0.81	3.08	0.09	2.43	2.73	3.53	3.13	3.13	3.16	3.30	3.31	3.13	3.13	3.16	3.34	3.36	3.13	3.13	3.17	3.42	3.53	2.73	0.10	0.20	0.30	0.40	0.50	0.61	0.71	0.81
NBC_MHEPL_195	336591	6260125	0.81	3.08	0.08	2.42	2.72	3.54	3.13	3.13	3.16	3.31	3.31	3.13	3.13	3.16	3.34	3.36	3.13	3.13	3.18	3.42	3.54	2.72	0.10	0.20	0.30	0.41	0.51	0.61	0.71	0.81
NBC_MHEPL_196	336612	6260063	0.81	3.08	0.08	2.42	2.72	3.54	3.13	3.13	3.16	3.31	3.31	3.13	3.13	3.17	3.34	3.36	3.13	3.13	3.18	3.42	3.54	2.72	0.10	0.20	0.30	0.41	0.51	0.61	0.71	0.81
NBC_MHEPL_197	336592	6260029	0.84	3.08	0.08	2.42	2.72	3.56	3.14	3.14	3.17	3.32	3.33	3.14	3.14	3.18	3.35	3.37	3.14	3.14	3.19	3.43	3.56	2.72	0.10	0.21	0.31	0.42	0.52	0.63	0.73	0.84
NBC_MHEPL_198	336636	6260003	0.84	3.08	0.08	2.42	2.72	3.56	3.14	3.14	3.17	3.32	3.33	3.14	3.14	3.18	3.35	3.37	3.14	3.14	3.19	3.43	3.56	2.72	0.10	0.21	0.31	0.42	0.52	0.63	0.73	0.84
NBC_MHEPL_199	336659	6259943	0.84	3.08	0.08	2.42	2.72	3.56	3.14	3.14	3.17	3.32	3.32	3.14	3.14	3.18	3.35	3.37	3.14	3.14	3.19	3.43	3.56	2.72	0.10	0.21	0.31	0.42	0.52	0.63	0.73	0.84
NBC_MHEPL_200	336682	6259883	0.83	3.08	0.08	2.42	2.72	3.55	3.13	3.13	3.17	3.31	3.32	3.13	3.13	3.17	3.34	3.36	3.13	3.13	3.18	3.43	3.55	2.72	0.10	0.21	0.31	0.41	0.52	0.62	0.72	0.83
NBC_MHEPL_201	336725	6259857	0.80	3.08	0.08	2.42	2.72	3.52	3.12	3.12	3.15	3.30	3.30	3.12	3.12	3.16	3.33	3.35	3.12	3.12	3.17	3.41	3.52	2.72	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_202	336689	6259794	0.79	3.08	0.08	2.42	2.72	3.51	3.12	3.12	3.15	3.29	3.29	3.12	3.12	3.15	3.33	3.35	3.12	3.12	3.16	3.41	3.51	2.72	0.10	0.20	0.30	0.40	0.49	0.59	0.69	0.79
NBC_MHEPL_203	336674	6259766	0.77	2.71	0.08	2.42	2.72	3.49	3.11	3.11	3.14	3.27	3.27	3.11	3.11	3.14	3.27	3.27	3.11	3.11	3.15	3.40	3.49	2.72	0.10	0.19	0.29	0.38	0.48	0.58	0.67	0.77
NBC_MHEPL_204	336703	6259716	0.71	2.71	0.08	2.42	2.72	3.43	3.08	3.08	3.11	3.23	3.23	3.08	3.08	3.11	3.25	3.25	3.08	3.08	3.12	3.37	3.43	2.72	0.09	0.18	0.27	0.36	0.44	0.53	0.62	0.71
NBC_MHEPL_205	336690	6259689	0.70	2.71	0.08	2.42	2.72	3.42	3.07	3.07	3.10	3.22	3.22	3.07	3.07	3.10	3.24	3.24	3.07	3.07	3.11	3.36	3.42	2.72	0.09	0.17	0.26	0.35	0.44	0.52	0.61	0.70
NBC_MHEPL_206	336708	6259612	0.66	2.71	0.08	2.42	2.72	3.38	3.05	3.05	3.08	3.20	3.20	3.05	3.05	3.08	3.23	3.23	3.05	3.05	3.10	3.34	3.38	2.72	0.08	0.17	0.25	0.33	0.42	0.50	0.58	0.66
NBC_MHEPL_207	336696	6259584	0.66	2.71	0.08	2.42	2.72	3.38	3.05	3.05	3.08	3.20	3.20	3.05	3.05	3.08	3.23	3.23	3.05	3.05	3.10	3.34	3.38	2.72	0.08	0.17	0.25	0.33	0.42	0.50	0.58	0.66
NBC_MHEPL_208	336670	6259522	0.63	2.71	0.08	2.42	2.72	3.35	3.03	3.03	3.06	3.17	3.17	3.03	3.03	3.07	3.21	3.21	3.03	3.03	3.08	3.32	3.35	2.72	0.08	0.16	0.24	0.31	0.39	0.47	0.55	0.63
NBC_MHEPL_209	336697	6259475	0.60	2.71	0.08	2.42	2.72	3.32	3.02	3.02	3.05	3.15	3.15	3.02	3.02	3.05	3.20	3.20	3.02	3.02	3.06	3.31	3.32	2.72	0.07	0.15	0.22	0.30	0.37	0.45	0.52	0.60
NBC_MHEPL_210	336669	6259409	0.61	3.08	0.08	2.42	2.72	3.32	3.02	3.02	3.05	3.15	3.15	3.02	3.02	3.06	3.27	3.27	3.02	3.02	3.07	3.31	3.32	2.72	0.08	0.15	0.23	0.30	0.38	0.45	0.53	0.61
NBC_MHEPL_211	336615	6259391	0.65	3.08	0.08	2.42	2.72	3.37	3.04	3.04	3.07	3.19	3.19	3.04	3.04	3.08	3.29	3.29	3.04	3.04	3.09	3.33	3.37	2.72	0.08	0.16	0.24	0.32	0.41	0.49	0.57	0.65
NBC_MHEPL_212	336599	6259355	0.73	3.08	0.08	2.42	2.72	3.45	3.08	3.08	3.11	3.24	3.24	3.08	3.08	3.12	3.31	3.32	3.08	3.08	3.13	3.38	3.45	2.72	0.09	0.18	0.27	0.37	0.46	0.55	0.64	0.73
NBC_MHEPL_213	336584	6259321	0.80	3.08	0.08	2.42	2.72	3.51	3.12	3.12	3.15	3.29	3.29	3.12	3.12	3.15	3.33	3.35	3.12	3.12	3.16	3.41	3.51	2.72	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_214	336557	6259265	0.82	3.08	0.07	2.41	2.71	3.54	3.13	3.13	3.16	3.31	3.31	3.13	3.13	3.16	3.34	3.36	3.13	3.13	3.18	3.42	3.54	2.71	0.10	0.21	0.31	0.41	0.51	0.62	0.72	0.82
NBC_MHEPL_215	336587	6259221	0.82	3.08	0.07	2.41	2.71	3.53	3.12	3.12	3.16	3.30	3.30	3.12	3.12	3.16	3.33	3.35	3.12	3.12	3.17	3.42	3.53	2.71	0.10	0.20	0.31	0.41	0.51	0.61	0.72	0.82
NBC_MHEPL_216	336628	6259205	0.81	3.08	0.08	2.42	2.72	3.52	3.12	3.12	3.15	3.30	3.30	3.12	3.12	3.16	3.33	3.35	3.12	3.12	3.17	3.41	3.52	2.72	0.10	0.20	0.30	0.40	0.50	0.61	0.71	0.81
NBC_MHEPL_217	336618	6259177	0.80	3.08	0.07	2.41	2.71	3.52	3.12	3.12	3.15	3.29	3.29	3.12	3.12	3.15	3.33	3.35	3.12	3.12	3.17	3.41	3.52	2.71	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_218	336657	6259126	0.80	3.08	0.07	2.41	2.71	3.51	3.11	3.11	3.14	3.29	3.29	3.11	3.11	3.15	3.33	3.34	3.11	3.11	3.16	3.41	3.51	2.71	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_219	336701	6259068	0.78	3.08	0.07	2.41	2.71	3.49	3.10	3.10	3.14	3.27	3.27	3.10	3.10	3.14	3.32	3.34	3.10	3.10	3.15	3.40	3.49	2.71	0.10	0.19	0.29	0.39	0.49	0.58	0.68	0.78
NBC_MHEPL_220	336771	6259079	0.75	2.71	0.07	2.41	2.71	3.46	3.09	3.09	3.12	3.25	3.25	3.09	3.09	3.12	3.25	3.25	3.09	3.09	3.14	3.38	3.46	2.71	0.09	0.19	0.28	0.38	0.47	0.56	0.66	0.75
NBC_MHEPL_221	336806	6259023	0.71	2.71	0.07	2.41	2.71	3.43	3.07	3.07	3.10	3.23	3.23	3.07	3.07	3.10	3.24	3.24	3.07	3.07	3.12	3.36	3.43	2.71	0.09	0.18	0.27	0.36	0.45	0.54	0.62	0.71
NBC_MHEPL_222	336792	6258989	0.71	2.71	0.07	2.41	2.71	3.42	3.07	3.07	3.10	3.22	3.22	3.07	3.07	3.10	3.24	3.24	3.07	3.07	3.12	3.36	3.42	2.71	0.09	0.18	0.27	0.36	0.44	0.53	0.62	0.71
NBC_MHEPL_223	336779	6258957	0.70	2.71	0.07	2.41	2.71	3.41	3.06	3.06	3.09	3.21	3.21	3.06	3.06	3.10	3.23	3.23	3.06	3.06	3.11	3.36	3.41	2.71	0.09	0.17	0.26	0.35	0.44	0.52	0.61	0.70
NBC_MHEPL_224	336813	6258909	0.66	2.71	0.07	2.41	2.71	3.37	3.04	3.04	3.07	3.19	3.19	3.04	3.04	3.08	3.22	3.22	3.04	3.04	3.09	3.34	3.37	2.71	0.08	0.17	0.25	0.33	0.41	0.50	0.58	0.66
NBC_MHEPL_225	336844	6258864	0.60	2.40	0.07	2.41	2.71	3.31	3.01	3.01	3.04	3.14	3.14	3.01	3.01	3.04	3.14	3.14	3.01	3.01	3.06	3.31	3.31	2.71	0.07	0.15	0.22	0.30	0.37	0.45	0.52	0.60
NBC_MHEPL_226	336888	6258851	0.58	2.40	0.07	2.41	2.71	3.29	3.00	3.00	3.03	3.13	3.13	3.00	3.00	3.03	3.13	3.13	3.00	3.00	3.05	3.29	3.29	2.71	0.07	0.14	0.22	0.29	0.36	0.43	0.50	0.58
NBC_MHEPL_227	336920	6258786	0.57	2.11	0.07	2.41	2.71	3.28	3.00	3.00	3.03	3.12	3.12	3.00	3.00	3.02	3.08	3.08	3.00	3.00	3.05	3.28	3.28	2.71	0.07	0.14	0.21	0.29	0.36	0.43	0.50	0.57
NBC_MHEPL_228	336874	6258799	0.58	2.11	0.07	2.41	2.71	3.29	3.00	3.00	3.03	3.13	3.13	3.00	3.00	3.02	3.09	3.09	3.00	3.00	3.05	3.29	3.29	2.71	0.07	0.14	0.22	0.29	0.36	0.43	0.51	0.58
NBC_MHEPL_229	336854	6258728	0.58	2.11	0.07	2.41	2.71	3.29	3.00	3.00	3.03	3.12	3.12	3.00	3.00	3.02	3.08	3.08	3.00	3.00	3.05	3.29	3.29	2.71	0.07	0.14	0.22	0.29	0.36	0.43	0.50	0.58
NBC_MHEPL_230	336807	6258743	0.57	2.11	0.07	2.41	2.71	3.28	2.99	2.99	3.03	3.12	3.12	2.99	2.99	3.02	3.08	3.08	2.99	2.99	3.04	3.28	3.28	2.71	0.07	0.14	0.21	0.29	0.36	0.43	0.50	0.57
NBC_MHEPL_231	336787	6258677	0.56	2.11	0.07	2.41	2.71	3.27	2.99	2.99	3.02	3.11	3.11	2.99	2.99	3.01	3.08	3.08	2.99	2.99	3.04	3.27	3.27	2.71	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
NBC_MHEPL_232	336766	6258604	0.55	2.11	0.07	2.41	2.71	3.26	2.98	2.98	3.02	3.10	3.10	2.98	2.98	3.01	3.07	3.07	2.98	2.98	3.03	3.26	3.26	2.71	0.07	0.14	0.21	0.27	0.34	0.41	0.48	0.55

100yr ARI Planning Levels - 0.9m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

Mean Sea Level Rise Allowance **0.90** m sea level rise projection
Freeboard of **0.3** m included in EPLs

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																Reduction Factor. Note: The application of the Reduction Factor should not reduce the EPL below the Local (Still) Water Level							
			Wave			Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)		Foreshore Type ## 1 (Crest Level (mAHD))					2					3					4								
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	0.9 m Sea Level Projection	0.9 m Sea Level Projection	Max EPL of all Foreshore Types and Crest Levels (mAHD)	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_233	336715	6258621	0.55	2.40	0.07	2.41	2.71	3.26	2.98	2.98	3.01	3.10	3.10	2.98	2.98	3.02	3.12	3.12	2.98	2.98	3.03	3.26	3.26	2.71	0.07	0.14	0.20	0.27	0.34	0.41	0.48	0.55
NBC_MHEPL_234	336690	6258548	0.56	2.40	0.07	2.41	2.71	3.27	2.99	2.99	3.02	3.12	3.12	2.99	2.99	3.02	3.12	3.12	2.99	2.99	3.04	3.27	3.27	2.71	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56
NBC_MHEPL_235	336671	6258489	0.64	2.71	0.07	2.41	2.71	3.35	3.03	3.03	3.06	3.17	3.17	3.03	3.03	3.07	3.21	3.21	3.03	3.03	3.08	3.32	3.35	2.71	0.08	0.16	0.24	0.32	0.40	0.48	0.56	0.64
NBC_MHEPL_236	336615	6258509	0.71	2.71	0.07	2.41	2.71	3.42	3.06	3.06	3.10	3.22	3.22	3.06	3.06	3.10	3.23	3.23	3.06	3.06	3.11	3.36	3.42	2.71	0.09	0.18	0.27	0.35	0.44	0.53	0.62	0.71
NBC_MHEPL_237	336595	6258449	0.73	2.71	0.07	2.41	2.71	3.44	3.08	3.08	3.11	3.24	3.24	3.08	3.08	3.11	3.24	3.24	3.08	3.08	3.13	3.37	3.44	2.71	0.09	0.18	0.28	0.37	0.46	0.55	0.64	0.73
NBC_MHEPL_238	336515	6258400	0.76	2.71	0.07	2.41	2.71	3.47	3.09	3.09	3.12	3.26	3.26	3.09	3.09	3.12	3.25	3.25	3.09	3.09	3.14	3.39	3.47	2.71	0.10	0.19	0.29	0.38	0.48	0.57	0.67	0.76
NBC_MHEPL_239	336573	6258380	0.76	2.71	0.07	2.41	2.71	3.47	3.09	3.09	3.12	3.25	3.25	3.09	3.09	3.12	3.25	3.25	3.09	3.09	3.14	3.39	3.47	2.71	0.09	0.19	0.28	0.38	0.47	0.57	0.66	0.76
NBC_MHEPL_240	336553	6258320	0.77	2.71	0.07	2.41	2.71	3.48	3.09	3.09	3.13	3.26	3.26	3.09	3.09	3.13	3.26	3.26	3.09	3.09	3.15	3.39	3.48	2.71	0.10	0.19	0.29	0.39	0.48	0.58	0.67	0.77
NBC_MHEPL_241	336597	6258254	0.78	2.71	0.07	2.41	2.71	3.49	3.10	3.10	3.13	3.27	3.27	3.10	3.10	3.13	3.26	3.26	3.10	3.10	3.15	3.40	3.49	2.71	0.10	0.19	0.29	0.39	0.49	0.58	0.68	0.78
NBC_MHEPL_242	336583	6258205	0.78	2.71	0.07	2.41	2.71	3.49	3.10	3.10	3.13	3.27	3.27	3.10	3.10	3.13	3.26	3.26	3.10	3.10	3.15	3.40	3.49	2.71	0.10	0.20	0.29	0.39	0.49	0.59	0.68	0.78
NBC_MHEPL_243	336646	6258187	0.78	2.71	0.07	2.41	2.71	3.49	3.10	3.10	3.13	3.27	3.27	3.10	3.10	3.13	3.26	3.26	3.10	3.10	3.15	3.40	3.49	2.71	0.10	0.20	0.29	0.39	0.49	0.59	0.68	0.78
NBC_MHEPL_010	332541	6264155	0.16	1.28	0.34	2.68	2.98	3.14	3.06	3.06	3.06	3.10	3.10	3.06	3.06	3.06	3.10	3.10	3.06	3.06	3.06	3.14	3.14	2.98	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16
NBC_MHEPL_244	336632	6258136	0.78	2.71	0.07	2.41	2.71	3.49	3.10	3.10	3.13	3.27	3.27	3.10	3.10	3.13	3.26	3.26	3.10	3.10	3.15	3.40	3.49	2.71	0.10	0.20	0.29	0.39	0.49	0.59	0.68	0.78
NBC_MHEPL_245	336701	6258118	0.77	2.71	0.07	2.41	2.71	3.48	3.09	3.09	3.13	3.27	3.27	3.09	3.09	3.13	3.26	3.26	3.09	3.09	3.15	3.39	3.48	2.71	0.10	0.19	0.29	0.39	0.48	0.58	0.68	0.77
NBC_MHEPL_246	336770	6258099	0.77	2.71	0.07	2.41	2.71	3.48	3.09	3.09	3.13	3.26	3.26	3.09	3.09	3.13	3.25	3.25	3.09	3.09	3.14	3.39	3.48	2.71	0.10	0.19	0.29	0.38	0.48	0.58	0.67	0.77
NBC_MHEPL_247	336833	6258082	0.75	2.71	0.07	2.41	2.71	3.46	3.08	3.08	3.12	3.25	3.25	3.08	3.08	3.12	3.25	3.25	3.08	3.08	3.14	3.38	3.46	2.71	0.09	0.19	0.28	0.38	0.47	0.57	0.66	0.75
NBC_MHEPL_248	336901	6258115	0.74	2.71	0.07	2.41	2.71	3.45	3.08	3.08	3.11	3.24	3.24	3.08	3.08	3.11	3.24	3.24	3.08	3.08	3.13	3.38	3.45	2.71	0.09	0.19	0.28	0.37	0.46	0.56	0.65	0.74
NBC_MHEPL_249	336949	6258104	0.74	2.71	0.07	2.41	2.71	3.45	3.08	3.08	3.11	3.24	3.24	3.08	3.08	3.11	3.24	3.24	3.08	3.08	3.13	3.38	3.45	2.71	0.09	0.19	0.28	0.37	0.46	0.56	0.65	0.74
NBC_MHEPL_250	337001	6258143	0.74	2.71	0.07	2.41	2.71	3.45	3.08	3.08	3.11	3.24	3.24	3.08	3.08	3.11	3.24	3.24	3.08	3.08	3.13	3.38	3.45	2.71	0.09	0.19	0.28	0.37	0.46	0.56	0.65	0.74
NBC_MHEPL_251	337045	6258134	0.74	2.71	0.07	2.41	2.71	3.45	3.08	3.08	3.11	3.24	3.24	3.08	3.08	3.11	3.24	3.24	3.08	3.08	3.13	3.37	3.45	2.71	0.09	0.19	0.28	0.37	0.46	0.56	0.65	0.74
NBC_MHEPL_252	337091	6258125	0.74	2.71	0.07	2.41	2.71	3.44	3.07	3.07	3.11	3.24	3.24	3.07	3.07	3.11	3.24	3.24	3.07	3.07	3.13	3.37	3.44	2.71	0.09	0.18	0.28	0.37	0.46	0.55	0.64	0.74
NBC_MHEPL_253	337136	6258117	0.73	2.71	0.07	2.41	2.71	3.44	3.07	3.07	3.11	3.23	3.23	3.07	3.07	3.11	3.24	3.24	3.07	3.07	3.12	3.37	3.44	2.71	0.09	0.18	0.27	0.37	0.46	0.55	0.64	0.73
NBC_MHEPL_254	337178	6258109	0.72	2.40	0.07	2.41	2.71	3.43	3.07	3.07	3.10	3.22	3.22	3.07	3.07	3.09	3.17	3.17	3.07	3.07	3.12	3.36	3.43	2.71	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72
NBC_MHEPL_255	337227	6258153	0.72	2.40	0.07	2.41	2.71	3.42	3.06	3.06	3.10	3.22	3.22	3.06	3.06	3.09	3.17	3.17	3.06	3.06	3.12	3.36	3.42	2.71	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72
NBC_MHEPL_256	337268	6258148	0.71	2.40	0.06	2.40	2.70	3.42	3.06	3.06	3.10	3.22	3.22	3.06	3.06	3.09	3.17	3.17	3.06	3.06	3.12	3.36	3.42	2.70	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.71
NBC_MHEPL_257	337311	6258143	0.72	2.40	0.06	2.40	2.70	3.43	3.07	3.07	3.10	3.22	3.22	3.07	3.07	3.09	3.17	3.17	3.07	3.07	3.12	3.36	3.43	2.70	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72
NBC_MHEPL_258	337359	6258191	0.75	2.40	0.07	2.41	2.71	3.45	3.08	3.08	3.11	3.24	3.24	3.08	3.08	3.11	3.18	3.18	3.08	3.08	3.13	3.38	3.45	2.71	0.09	0.19	0.28	0.37	0.47	0.56	0.65	0.75
NBC_MHEPL_259	337364	6258242	0.75	2.40	0.07	2.41	2.71	3.46	3.09	3.09	3.12	3.25	3.25	3.09	3.09	3.11	3.19	3.19	3.09	3.09	3.14	3.38	3.46	2.71	0.09	0.19	0.28	0.38	0.47	0.56	0.66	0.75
NBC_MHEPL_260	337411	6258289	0.75	2.40	0.07	2.41	2.71	3.46	3.08	3.08	3.12	3.25	3.25	3.08	3.08	3.11	3.19	3.19	3.08	3.08	3.14	3.38	3.46	2.71	0.09	0.19	0.28	0.37	0.47	0.56	0.65	0.75
NBC_MHEPL_261	337414	6258339	0.72	2.40	0.07	2.41	2.71	3.43	3.07	3.07	3.11	3.23	3.23	3.07	3.07	3.10	3.18	3.18	3.07	3.07	3.12	3.37	3.43	2.71	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72
NBC_MHEPL_262	337456	6258337	0.73	2.40	0.07	2.41	2.71	3.44	3.08	3.08	3.11	3.24	3.24	3.08	3.08	3.10	3.18	3.18	3.08	3.08	3.13	3.37	3.44	2.71	0.09	0.18	0.27	0.37	0.46	0.55	0.64	0.73
NBC_MHEPL_263	337500	6258387	0.76	2.40	0.07	2.41	2.71	3.47	3.09	3.09	3.12	3.26	3.26	3.09	3.09	3.12	3.19	3.19	3.09	3.09	3.14	3.39	3.47	2.71	0.09	0.19	0.28	0.38	0.47	0.57	0.66	0.76
NBC_MHEPL_264	337543	6258385	0.80	2.71	0.07	2.41	2.71	3.51	3.11	3.11	3.15	3.29	3.29	3.11	3.11	3.14	3.27	3.27	3.11	3.11	3.16	3.41	3.51	2.71	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_265	337585	6258436	0.84	2.71	0.08	2.42	2.72	3.55	3.13	3.13	3.17	3.31	3.32	3.13	3.13	3.16	3.28	3.28	3.13	3.13	3.18	3.43	3.55	2.72	0.10	0.21	0.31	0.42	0.52	0.63	0.73	0.84
NBC_MHEPL_266	337623	6258383	0.86	2.71	0.07	2.41	2.71	3.58	3.15	3.15	3.18	3.32	3.34	3.15	3.15	3.17	3.29	3.29	3.15	3.15	3.20	3.44	3.58	2.71	0.11	0.22	0.32	0.43	0.54	0.65	0.76	0.86
NBC_MHEPL_267	337664	6258384	0.87	2.71	0.07	2.41	2.71	3.58	3.15	3.15	3.18	3.33	3.34	3.15	3.15	3.18	3.29	3.29	3.15	3.15	3.20	3.45	3.58	2.71	0.11	0.22	0.33	0.44	0.54	0.65	0.76	0.87
NBC_MHEPL_268	337705	6258383	0.87	3.08	0.07	2.41	2.71	3.58	3.15	3.15	3.18	3.33	3.34	3.15	3.15	3.18	3.35	3.37	3.15	3.15	3.20	3.44	3.58	2.71	0.11	0.22	0.33	0.43	0.54	0.65	0.76	0.87
NBC_MHEPL_269	337746	6258383	0.86	3.08	0.07	2.41	2.71	3.57	3.14	3.14	3.18	3.32	3.33	3.14	3.14	3.18	3.35	3.37	3.14	3.14	3.19	3.44	3.57	2.71	0.11	0.22	0.32	0.43	0.54	0.65	0.75	0.86
NBC_MHEPL_270	337785	6258382	0.86	3.08	0.07	2.41	2.71	3.57	3.14	3.14	3.17	3.32	3.33	3.14	3.14	3.18	3.34	3.37	3.14	3.14	3.19	3.44	3.57	2.71	0.11	0.21	0.32	0.43	0.53	0.64	0.75	0.86
NBC_MHEPL_271	337824	6258382	0.85	3.08	0.07	2.41	2.71	3.56	3.14	3.14	3.17	3.32	3.33	3.14	3.14	3.18	3.34	3.36	3.14	3.14	3.19	3.43	3.56	2.71	0.11	0.21	0.32	0.43	0.53	0.64	0.75	0.85
NBC_MHEPL_272	337862	6258433	0.85	3.08	0.07	2.41	2.71	3.57	3.14	3.14	3.17	3.32	3.33	3.14	3.14	3.18	3.34	3.36	3.14	3.14	3.19	3.44	3.57	2.71	0.11	0.21	0.32	0.43	0.53	0.64	0.75	0.85
NBC_MHEPL_273	337899	6258433	0.85	3.08	0.07	2.41	2.71	3.56	3.14	3.14	3.17	3.32	3.33	3.14	3.14	3.18	3.34	3.36	3.14	3.14	3.19	3.43	3.56	2.71	0.11	0.21	0.32	0.43	0.53	0.64	0.74	0.85
NBC_MHEPL_274	337937	6258433	0.84	3.08	0.07	2.41	2.71	3.55	3.13	3.13	3.16	3.31	3.32	3.13	3.13	3.17	3.34	3.36	3.13	3.13	3.18	3.43	3.55	2.71	0.10	0.21	0.31	0.42	0.52	0.63	0.73	0.84
NBC_MHEPL_275	337976	6258433	0.80	2.71	0.07	2.41	2.71	3.52	3.11	3.11	3.15	3.29	3.29	3.11	3.11	3.15	3.27	3.27	3.11	3.11	3.16	3.41	3.52	2.71	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_276	337938	6258381	0.83	2.71	0.07	2.41	2.71	3.54	3.13	3.13	3.16	3.31	3.31	3.13	3.13	3.16	3.28	3.28	3.13	3.13	3.18	3.42	3.54	2.71	0.10	0.21	0.31	0.41	0.52	0.62	0.73	0.83
NBC_MHEPL_277	337938	6258329	0.84	2.71	0.07	2.41	2.71	3.55	3.13	3.13	3.16	3.31	3.31	3.13	3.13	3.16	3.28	3.28	3.13	3.13	3.18	3.43	3.55	2.71	0.10	0.21	0.31	0.42	0.52	0.63	0.73	0.84
NBC_MHEPL_278	337977	6258276	0.84	2.71	0.07	2.41	2.71	3.55	3.13	3.13	3.16	3.31	3.31	3.13	3.13	3.16	3.28	3.28	3.13	3.13	3.18	3.43	3.55	2.71	0.10	0.21	0.31	0.42	0.52	0.63	0.73	0.84
NBC_MHEPL_279	338016	6258276	0.83	2.71	0.07	2.41	2.71	3.54	3.12	3.12	3.16	3.30	3.30	3.12	3.12	3.15	3.28	3.28	3.12	3.12	3.18	3.42	3.54	2.71	0.10	0.21	0.31	0.41	0.52	0.62	0.72	0.83
NBC_MHEPL_280	338055	6258276	0.82	2.71	0.07	2.41	2.71	3.53	3.12	3.12	3.15	3.30	3.30	3.12	3.12	3.15	3.27	3.27	3.12	3.12	3.17	3.41	3.53	2.71	0.10	0.20	0.31	0.41	0.51	0.61	0.71	0.82
NBC_MHEPL_281	338094	6258276	0.80	2.71	0.07	2.41	2.71	3.51	3.11	3.11	3.14	3.28	3.28	3.11	3.11	3.14	3.27	3.27	3.11	3.11	3.16	3.41	3.51	2.71	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_282	338217	6258276	0.69	2.40	0.08	2.42	2.72	3.40	3.06	3.06	3.09	3.21	3.21	3.06	3.06	3.09	3.17	3.17	3.06	3.06	3.11	3.35	3.40	2.72	0.09	0.17	0.26	0.34	0.43	0.51	0.60	0.69
NBC_MHEPL_283	338175	6258222	0.72	2.40	0.07	2.41	2.71	3.43	3.07	3.07	3.10	3.23	3.23	3.07	3.07	3.10	3.18	3.18	3.07	3.07	3.12	3.37	3.43	2.71	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72
NBC_MHEPL_284	338218	6258222	0.71	2.40	0.07	2.41	2.71	3.42	3.07	3.07	3.10	3.23	3.23	3.07	3.07	3.09	3.18	3.18	3.07	3.07	3.12	3.36	3.42	2.71	0.09	0.18	0.27	0.36	0.45	0.54	0.62	0.71
NBC_MHEPL_285	338218	6258167	0.68	2.40	0.07	2.41	2.71	3.39	3.05	3.05	3.08	3.20	3.20	3.05	3.05	3.08	3.17	3.17	3.05	3.05	3.10	3.35	3.39	2.71	0.09	0.17	0.26	0.34	0.43	0.51	0.60	0.68
NBC_MHEPL_286	338218	6258112	0.65	2.40	0.07	2.41	2.71	3.35	3.03	3.03	3.06	3.17	3.17	3.03	3.03	3.06	3.15	3.15	3.03	3.03	3.08	3.33	3.35	2.71	0.08	0.16	0.24	0.32	0.40	0.48	0.56	0.65
NBC_MHEPL_287	338217	6258055	0.62	2.40	0.07	2.41	2.71	3.33	3.02	3.02	3.05	3.16	3.16	3.02	3.02	3.05	3.14	3.14	3.02	3.02	3.07	3.32	3.33	2.71	0.08	0.16	0.23	0.31	0.39	0.47	0.55	0.62

APPENDIX B

20220706_EPL_Database
0.9 m Sea Level Projected WL

100yr ARI Planning Levels - 0.9m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.90** m sea level rise projection
Freeboard of **0.3** m included in EPLs

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																	Reduction Factor. Note: The application of the Reduction Factor should not reduce the EPL below the Local (Still) Water Level							
			Wave						Foreshore Type ##																							
						Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)		1					2					3					4								
									Crest Level (mAHD)																							
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	0.9 m Sea Level Projection	0.9 m Sea Level Projection	Max EPL of all Foreshore Types and Crest Levels (mAHD)	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_288	338174	6258056	0.65	2.40	0.07	2.41	2.71	3.36	3.03	3.03	3.07	3.17	3.17	3.03	3.03	3.06	3.15	3.15	3.03	3.03	3.08	3.33	3.36	2.71	0.08	0.16	0.24	0.33	0.41	0.49	0.57	0.65
NBC_MHEPL_289	338131	6258003	0.69	2.40	0.07	2.41	2.71	3.39	3.05	3.05	3.08	3.20	3.20	3.05	3.05	3.08	3.16	3.16	3.05	3.05	3.10	3.35	3.39	2.71	0.09	0.17	0.26	0.34	0.43	0.52	0.60	0.69
NBC_MHEPL_290	338129	6257949	0.73	2.71	0.06	2.40	2.70	3.43	3.07	3.07	3.10	3.23	3.23	3.07	3.07	3.10	3.24	3.24	3.07	3.07	3.12	3.37	3.43	2.70	0.09	0.18	0.27	0.36	0.45	0.54	0.64	0.73
NBC_MHEPL_291	338090	6257950	0.76	2.71	0.07	2.41	2.71	3.47	3.09	3.09	3.12	3.26	3.26	3.09	3.09	3.12	3.25	3.25	3.09	3.09	3.14	3.39	3.47	2.71	0.10	0.19	0.29	0.38	0.48	0.57	0.67	0.76
NBC_MHEPL_011	332693	6263979	0.22	1.13	0.31	2.65	2.95	3.18	3.07	3.07	3.07	3.12	3.12	3.07	3.07	3.07	3.08	3.08	3.07	3.07	3.07	3.18	3.18	2.95	0.03	0.06	0.08	0.11	0.14	0.17	0.20	0.22
NBC_MHEPL_292	338088	6257896	0.79	3.08	0.07	2.41	2.71	3.50	3.10	3.10	3.14	3.28	3.28	3.10	3.10	3.14	3.32	3.33	3.10	3.10	3.16	3.40	3.50	2.71	0.10	0.20	0.30	0.40	0.50	0.59	0.69	0.79
NBC_MHEPL_293	338087	6257842	0.81	3.08	0.06	2.40	2.70	3.52	3.11	3.11	3.15	3.29	3.29	3.11	3.11	3.15	3.33	3.34	3.11	3.11	3.17	3.41	3.52	2.70	0.10	0.20	0.30	0.41	0.51	0.61	0.71	0.81
NBC_MHEPL_294	338085	6257788	0.82	3.08	0.06	2.40	2.70	3.53	3.12	3.12	3.15	3.30	3.30	3.12	3.12	3.16	3.33	3.34	3.12	3.12	3.17	3.42	3.53	2.70	0.10	0.21	0.31	0.41	0.51	0.62	0.72	0.82
NBC_MHEPL_295	338123	6257732	0.83	3.08	0.06	2.40	2.70	3.53	3.11	3.11	3.15	3.30	3.30	3.11	3.11	3.16	3.33	3.34	3.11	3.11	3.17	3.42	3.53	2.70	0.10	0.21	0.31	0.41	0.52	0.62	0.72	0.83
NBC_MHEPL_296	338165	6257731	0.83	3.08	0.06	2.40	2.70	3.53	3.11	3.11	3.15	3.30	3.30	3.11	3.11	3.16	3.33	3.34	3.11	3.11	3.17	3.42	3.53	2.70	0.10	0.21	0.31	0.42	0.52	0.62	0.73	0.83
NBC_MHEPL_297	338208	6257676	0.83	3.08	0.06	2.40	2.70	3.53	3.11	3.11	3.15	3.30	3.30	3.11	3.11	3.16	3.33	3.34	3.11	3.11	3.17	3.42	3.53	2.70	0.10	0.21	0.31	0.41	0.52	0.62	0.73	0.83
NBC_MHEPL_298	338207	6257623	0.83	3.08	0.06	2.40	2.70	3.53	3.11	3.11	3.15	3.30	3.30	3.11	3.11	3.16	3.33	3.34	3.11	3.11	3.17	3.42	3.53	2.70	0.10	0.21	0.31	0.42	0.52	0.62	0.73	0.83
NBC_MHEPL_299	338257	6257622	0.83	3.08	0.06	2.40	2.70	3.52	3.11	3.11	3.15	3.29	3.29	3.11	3.11	3.15	3.33	3.34	3.11	3.11	3.17	3.41	3.52	2.70	0.10	0.21	0.31	0.41	0.52	0.62	0.72	0.83
NBC_MHEPL_300	338309	6257567	0.82	3.08	0.06	2.40	2.70	3.52	3.11	3.11	3.15	3.29	3.29	3.11	3.11	3.15	3.32	3.34	3.11	3.11	3.17	3.41	3.52	2.70	0.10	0.20	0.31	0.41	0.51	0.61	0.72	0.82
NBC_MHEPL_301	338309	6257513	0.85	3.08	0.05	2.39	2.69	3.54	3.12	3.12	3.16	3.30	3.30	3.12	3.12	3.16	3.33	3.34	3.12	3.12	3.18	3.42	3.54	2.69	0.11	0.21	0.32	0.42	0.53	0.63	0.74	0.85
NBC_MHEPL_302	338310	6257458	0.86	3.08	0.05	2.39	2.69	3.55	3.12	3.12	3.16	3.31	3.31	3.12	3.12	3.17	3.33	3.35	3.12	3.12	3.18	3.43	3.55	2.69	0.11	0.21	0.32	0.43	0.54	0.64	0.75	0.86
NBC_MHEPL_303	338311	6257403	0.88	3.08	0.05	2.39	2.69	3.57	3.13	3.13	3.17	3.32	3.33	3.13	3.13	3.18	3.34	3.36	3.13	3.13	3.19	3.44	3.57	2.69	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88
NBC_MHEPL_304	338365	6257403	0.89	3.08	0.06	2.40	2.70	3.58	3.14	3.14	3.18	3.32	3.33	3.14	3.14	3.18	3.34	3.36	3.14	3.14	3.20	3.44	3.58	2.70	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.89
NBC_MHEPL_305	338421	6257402	0.89	3.08	0.06	2.40	2.70	3.58	3.14	3.14	3.18	3.33	3.34	3.14	3.14	3.18	3.34	3.36	3.14	3.14	3.20	3.44	3.58	2.70	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.89
NBC_MHEPL_306	338478	6257402	0.88	3.08	0.06	2.40	2.70	3.58	3.14	3.14	3.18	3.33	3.34	3.14	3.14	3.18	3.34	3.36	3.14	3.14	3.20	3.44	3.58	2.70	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88
NBC_MHEPL_307	338536	6257402	0.89	3.08	0.06	2.40	2.70	3.59	3.15	3.15	3.18	3.33	3.34	3.15	3.15	3.19	3.35	3.37	3.15	3.15	3.20	3.45	3.59	2.70	0.11	0.22	0.33	0.44	0.55	0.67	0.78	0.89
NBC_MHEPL_308	338536	6257346	0.90	3.08	0.06	2.40	2.70	3.60	3.15	3.15	3.19	3.33	3.35	3.15	3.15	3.19	3.35	3.37	3.15	3.15	3.21	3.45	3.60	2.70	0.11	0.22	0.34	0.45	0.56	0.67	0.78	0.90
NBC_MHEPL_309	338593	6257346	0.89	3.08	0.06	2.40	2.70	3.59	3.15	3.15	3.19	3.33	3.34	3.15	3.15	3.19	3.35	3.37	3.15	3.15	3.20	3.45	3.59	2.70	0.11	0.22	0.33	0.45	0.56	0.67	0.78	0.89
NBC_MHEPL_310	338649	6257345	0.88	3.08	0.06	2.40	2.70	3.59	3.15	3.15	3.18	3.33	3.34	3.15	3.15	3.19	3.35	3.37	3.15	3.15	3.20	3.45	3.59	2.70	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88
NBC_MHEPL_311	338704	6257345	0.88	3.08	0.07	2.41	2.71	3.58	3.15	3.15	3.18	3.33	3.34	3.15	3.15	3.18	3.35	3.37	3.15	3.15	3.20	3.44	3.58	2.71	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88
NBC_MHEPL_312	338757	6257344	0.87	3.08	0.07	2.41	2.71	3.58	3.14	3.14	3.18	3.33	3.34	3.14	3.14	3.18	3.35	3.37	3.14	3.14	3.20	3.44	3.58	2.71	0.11	0.22	0.33	0.43	0.54	0.65	0.76	0.87
NBC_MHEPL_313	338809	6257344	0.85	3.08	0.07	2.41	2.71	3.56	3.14	3.14	3.17	3.32	3.33	3.14	3.14	3.18	3.34	3.36	3.14	3.14	3.19	3.43	3.56	2.71	0.11	0.21	0.32	0.43	0.53	0.64	0.74	0.85
NBC_MHEPL_314	338861	6257289	0.84	3.08	0.07	2.41	2.71	3.55	3.13	3.13	3.16	3.31	3.31	3.13	3.13	3.17	3.34	3.36	3.13	3.13	3.18	3.43	3.55	2.71	0.10	0.21	0.31	0.42	0.52	0.63	0.73	0.84
NBC_MHEPL_315	338862	6257232	0.83	2.71	0.06	2.40	2.70	3.53	3.12	3.12	3.16	3.30	3.30	3.12	3.12	3.15	3.27	3.27	3.12	3.12	3.17	3.42	3.53	2.70	0.10	0.21	0.31	0.42	0.52	0.62	0.73	0.83
NBC_MHEPL_316	338912	6257172	0.83	2.71	0.06	2.40	2.70	3.53	3.11	3.11	3.15	3.29	3.29	3.11	3.11	3.15	3.26	3.26	3.11	3.11	3.17	3.42	3.53	2.70	0.10	0.21	0.31	0.41	0.52	0.62	0.72	0.83
NBC_MHEPL_317	338910	6257109	0.81	2.71	0.05	2.39	2.69	3.51	3.10	3.10	3.14	3.28	3.28	3.10	3.10	3.14	3.26	3.26	3.10	3.10	3.16	3.41	3.51	2.69	0.10	0.20	0.31	0.41	0.51	0.61	0.71	0.81
NBC_MHEPL_318	338958	6257106	0.80	2.71	0.05	2.39	2.69	3.49	3.09	3.09	3.13	3.27	3.27	3.09	3.09	3.13	3.25	3.25	3.09	3.09	3.15	3.40	3.49	2.69	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_319	338955	6257045	0.77	2.71	0.05	2.39	2.69	3.46	3.08	3.08	3.12	3.25	3.25	3.08	3.08	3.11	3.24	3.24	3.08	3.08	3.14	3.38	3.46	2.69	0.10	0.19	0.29	0.39	0.48	0.58	0.68	0.77
NBC_MHEPL_320	338951	6256989	0.77	2.71	0.04	2.38	2.68	3.45	3.07	3.07	3.11	3.24	3.24	3.07	3.07	3.11	3.23	3.23	3.07	3.07	3.13	3.38	3.45	2.68	0.10	0.19	0.29	0.38	0.48	0.58	0.67	0.77
NBC_MHEPL_321	338949	6256938	0.77	2.71	0.04	2.38	2.68	3.45	3.07	3.07	3.11	3.24	3.24	3.07	3.07	3.11	3.23	3.23	3.07	3.07	3.13	3.38	3.45	2.68	0.10	0.19	0.29	0.39	0.48	0.58	0.68	0.77
NBC_MHEPL_322	338947	6256887	0.78	2.71	0.04	2.38	2.68	3.46	3.07	3.07	3.11	3.24	3.24	3.07	3.07	3.11	3.23	3.23	3.07	3.07	3.13	3.38	3.46	2.68	0.10	0.19	0.29	0.39	0.49	0.58	0.68	0.78
NBC_MHEPL_323	338946	6256837	0.78	2.71	0.03	2.37	2.67	3.46	3.06	3.06	3.11	3.24	3.24	3.06	3.06	3.11	3.22	3.22	3.06	3.06	3.13	3.38	3.46	2.67	0.10	0.20	0.29	0.39	0.49	0.59	0.68	0.78
NBC_MHEPL_324	338945	6256787	0.80	2.71	0.04	2.38	2.68	3.48	3.08	3.08	3.12	3.25	3.25	3.08	3.08	3.12	3.23	3.23	3.08	3.08	3.15	3.39	3.48	2.68	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
NBC_MHEPL_325	338945	6256736	0.86	2.71	0.03	2.37	2.67	3.53	3.10	3.10	3.14	3.29	3.29	3.10	3.10	3.14	3.24	3.24	3.10	3.10	3.17	3.42	3.53	2.67	0.11	0.22	0.32	0.43	0.54	0.65	0.76	0.86
NBC_MHEPL_326	339045	6256633	0.89	2.71	0.03	2.37	2.67	3.56	3.12	3.12	3.16	3.31	3.31	3.12	3.12	3.15	3.26	3.26	3.12	3.12	3.19	3.43	3.56	2.67	0.11	0.22	0.33	0.45	0.56	0.67	0.78	0.89
NBC_MHEPL_327	339096	6256633	0.90	2.71	0.03	2.37	2.67	3.57	3.12	3.12	3.17	3.31	3.32	3.12	3.12	3.16	3.26	3.26	3.12	3.12	3.19	3.44	3.57	2.67	0.11	0.22	0.34	0.45	0.56	0.67	0.79	0.90
NBC_MHEPL_328	339147	6256633	0.90	2.71	0.03	2.37	2.67	3.57	3.12	3.12	3.17	3.31	3.32	3.12	3.12	3.16	3.26	3.26	3.12	3.12	3.19	3.44	3.57	2.67	0.11	0.23	0.34	0.45	0.56	0.68	0.79	0.90
NBC_MHEPL_329	339198	6256632	0.92	2.71	0.03	2.37	2.67	3.58	3.12	3.12	3.17	3.32	3.33	3.12	3.12	3.16	3.26	3.26	3.12	3.12	3.20	3.44	3.58	2.67	0.11	0.23	0.34	0.46	0.57	0.69	0.80	0.92
NBC_MHEPL_330	339248	6256632	0.93	2.71	0.03	2.37	2.67	3.60	3.13	3.13	3.18	3.33	3.34	3.13	3.13	3.17	3.27	3.27	3.13	3.13	3.21	3.45	3.60	2.67	0.12	0.23	0.35	0.47	0.58	0.70	0.82	0.93
NBC_MHEPL_012	332679	6263782	0.17	1.45	0.30	2.64	2.94	3.11	3.02	3.02	3.02	3.06	3.06	3.02	3.02	3.02	3.08	3.08	3.02	3.02	3.02	3.11	3.11	2.94	0.02	0.04	0.07	0.09	0.11	0.13	0.15	0.17
NBC_MHEPL_331	339249	6256682	0.96	3.08	0.03	2.37	2.67	3.62	3.15	3.15	3.19	3.34	3.36	3.15	3.15	3.19	3.34	3.36	3.15	3.15	3.22	3.47	3.62	2.67	0.12	0.24	0.36	0.48	0.60	0.72	0.84	0.96
NBC_MHEPL_332	339300	6256732	0.98	3.08	0.03	2.37	2.67	3.65	3.16	3.16	3.21	3.35	3.37	3.16	3.16	3.20	3.35	3.37	3.16	3.16	3.23	3.48	3.65	2.67	0.12	0.24	0.37	0.49	0.61	0.73	0.86	0.98
NBC_MHEPL_333	339300	6256782	0.99	3.08	0.03	2.37	2.67	3.66	3.17	3.17	3.21	3.36	3.38	3.17	3.17	3.21	3.35	3.37	3.17	3.17	3.24	3.48	3.66	2.67	0.12	0.25	0.37	0.50	0.62	0.75	0.87	0.99
NBC_MHEPL_334	339301	6256832	0.99	3.08	0.03	2.37	2.67	3.66	3.17	3.17	3.22	3.36	3.39	3.17	3.17	3.21	3.35	3.37	3.17	3.17	3.24	3.49	3.66	2.67	0.12	0.25	0.37	0.50	0.62	0.75	0.87	0.99
NBC_MHEPL_335	339301	6256881	0.97	3.08	0.03	2.37	2.67	3.64	3.16	3.16	3.20	3.35	3.37	3.16	3.16	3.20	3.35	3.37	3.16	3.16	3.23	3.47	3.64	2.67	0.12	0.24	0.36	0.49	0.61	0.73	0.85	0.97
NBC_MHEPL_336	339302	6256931	0.97	3.08	0.03	2.37	2.67	3.64	3.16	3.16	3.21	3.35	3.37	3.16	3.16	3.21	3.35	3.37	3.16	3.16	3.23	3.48	3.64	2.67	0.12	0.24	0.36	0.48	0.61	0.73	0.85	0.97
NBC_MHEPL_337	339302	6256980	1.00	3.08	0.04	2.38	2.68	3.68	3.18	3.18	3.22	3.37	3.40	3.18	3.18	3.22	3.36	3.38	3.18	3.18	3.25	3.49	3.68	2.68	0.12	0.25	0.37	0.50	0.62	0.75	0.87	1.00
NBC_MHEPL_338	339353	6256980	1.03	3.08	0.03	2.37	2.67	3.70	3.19	3.19	3.23	3.38	3.41	3.19	3.19	3.23	3.37	3.39	3.19	3.19	3.26	3.50	3.70	2.67	0.13	0.26	0.39	0.51	0.64	0.77	0.90	1.03
NBC_MHEPL_339	339403	6257029	1.03	3.48	0.04	2.38	2.68	3.71	3.19	3.19	3.24	3.38	3.42	3.19	3.19	3.25	3.42	3.49	3.19	3.19	3.26	3.51	3.71	2.68	0.13	0.26	0.39	0.51	0.64	0.77	0.90	1.03
NBC_MHEPL_340	339404	6257079	1.07	3.48	0.04	2.38	2.68	3.75	3.21	3.21	3.26	3.41	3.45	3.21	3.21	3.27	3.44	3.51	3.21	3.21	3.28	3.53	3.75	2.68	0.13	0.27	0.40	0.53	0.67	0.80	0.93	1.07
NBC_MHEPL_341	339454	6257079	1.05	3.48	0.04	2.38	2.68	3.73	3.20	3.20	3.25	3.39	3.43	3.20	3.20	3.26	3.43	3.50	3.20	3.20	3.27	3.52	3.73	2.68	0.13	0.26	0.39	0.52	0.66	0.79	0.92	1.05

100yr ARI Planning Levels - 0.9m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

Mean Sea Level Rise Allowance **0.90** m sea level rise projection
Freeboard of **0.3** m included in EPLs

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																	Reduction Factor Note: The application of the Reduction Factor should not reduce the EPL below the Local (Still) Water Level							
			Wave			Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)	Max EPL of all Foreshore Types and Crest Levels (mAHD)	Foreshore Type ##																							
									1					2					3					4								
									Crest Level (mAHD)																							
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	0.9 m Sea Level Projection	0.9 m Sea Level Projection		1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_342	339554	6257129	1.08	3.48	0.03	2.37	2.67	3.75	3.21	3.21	3.26	3.41	3.45	3.21	3.21	3.27	3.44	3.51	3.21	3.21	3.28	3.53	3.75	2.67	0.13	0.27	0.40	0.54	0.67	0.81	0.94	1.08
NBC_MHEPL_343	339654	6257178	1.13	3.48	0.03	2.37	2.67	3.80	3.24	3.24	3.29	3.43	3.49	3.24	3.24	3.29	3.45	3.53	3.24	3.24	3.31	3.56	3.80	2.67	0.14	0.28	0.42	0.56	0.70	0.85	0.99	1.13
NBC_MHEPL_344	339704	6257178	1.17	3.48	0.03	2.37	2.67	3.82	3.26	3.26	3.31	3.45	3.51	3.26	3.26	3.31	3.47	3.54	3.26	3.26	3.33	3.58	3.82	2.67	0.14	0.29	0.43	0.57	0.72	0.86	1.00	1.15
NBC_MHEPL_345	339754	6257228	1.19	3.48	0.04	2.38	2.68	3.83	3.27	3.27	3.32	3.46	3.53	3.27	3.27	3.32	3.47	3.55	3.27	3.27	3.34	3.59	3.83	2.68	0.14	0.29	0.43	0.58	0.72	0.87	1.01	1.16
NBC_MHEPL_346	339804	6257278	1.15	3.48	0.04	2.38	2.68	3.81	3.25	3.25	3.30	3.45	3.51	3.25	3.25	3.30	3.46	3.54	3.25	3.25	3.32	3.57	3.81	2.68	0.14	0.28	0.43	0.57	0.71	0.85	1.00	1.14
NBC_MHEPL_347	339804	6257328	1.14	3.48	0.04	2.38	2.68	3.81	3.25	3.25	3.30	3.44	3.50	3.25	3.25	3.30	3.46	3.54	3.25	3.25	3.32	3.57	3.81	2.68	0.14	0.28	0.42	0.57	0.71	0.85	0.99	1.13
NBC_MHEPL_348	339804	6257378	1.13	3.48	0.05	2.39	2.69	3.81	3.25	3.25	3.30	3.44	3.50	3.25	3.25	3.30	3.46	3.54	3.25	3.25	3.32	3.56	3.81	2.69	0.14	0.28	0.42	0.56	0.70	0.84	0.98	1.12
NBC_MHEPL_349	339854	6257379	1.17	3.48	0.05	2.39	2.69	3.83	3.27	3.27	3.32	3.46	3.53	3.27	3.27	3.32	3.48	3.56	3.27	3.27	3.34	3.59	3.83	2.69	0.14	0.29	0.43	0.57	0.72	0.86	1.00	1.14
NBC_MHEPL_350	339904	6257379	1.17	3.48	0.05	2.39	2.69	3.83	3.27	3.27	3.32	3.46	3.53	3.27	3.27	3.32	3.48	3.56	3.27	3.27	3.34	3.59	3.83	2.69	0.14	0.29	0.43	0.57	0.72	0.86	1.00	1.15
NBC_MHEPL_351	339954	6257379	1.22	3.48	0.04	2.38	2.68	3.85	3.29	3.29	3.34	3.48	3.56	3.29	3.29	3.34	3.49	3.57	3.29	3.29	3.36	3.61	3.85	2.68	0.15	0.29	0.44	0.58	0.73	0.87	1.02	1.17
NBC_MHEPL_352	340004	6257329	1.23	3.95	0.04	2.38	2.68	3.86	3.30	3.30	3.34	3.49	3.57	3.30	3.30	3.36	3.55	3.71	3.30	3.30	3.37	3.61	3.86	2.68	0.15	0.29	0.44	0.59	0.74	0.88	1.03	1.18
NBC_MHEPL_353	340105	6257279	1.20	3.48	0.03	2.37	2.67	3.84	3.27	3.27	3.32	3.47	3.53	3.27	3.27	3.32	3.48	3.55	3.27	3.27	3.35	3.59	3.84	2.67	0.15	0.29	0.44	0.58	0.73	0.88	1.02	1.17
NBC_MHEPL_354	340155	6257229	1.33	3.95	0.02	2.36	2.66	3.90	3.33	3.33	3.38	3.53	3.62	3.33	3.33	3.39	3.57	3.73	3.33	3.33	3.41	3.65	3.90	2.66	0.15	0.31	0.46	0.62	0.77	0.93	1.08	1.24
NBC_MHEPL_355	340205	6257229	1.37	3.95	0.02	2.36	2.66	3.92	3.35	3.35	3.40	3.55	3.65	3.35	3.35	3.41	3.59	3.74	3.35	3.35	3.43	3.67	3.92	2.66	0.16	0.31	0.47	0.63	0.79	0.94	1.10	1.26
NBC_MHEPL_013	332816	6263730	0.25	1.28	0.29	2.63	2.93	3.18	3.06	3.06	3.06	3.11	3.11	3.06	3.06	3.06	3.09	3.09	3.06	3.06	3.06	3.18	3.18	2.93	0.03	0.06	0.09	0.12	0.16	0.19	0.22	0.25
NBC_MHEPL_356	340255	6257279	1.40	3.95	0.03	2.37	2.67	3.94	3.37	3.37	3.42	3.57	3.68	3.37	3.37	3.43	3.60	3.76	3.37	3.37	3.45	3.69	3.94	2.67	0.16	0.32	0.48	0.64	0.79	0.95	1.11	1.27
NBC_MHEPL_357	340305	6257329	1.46	3.95	0.03	2.37	2.67	3.97	3.40	3.40	3.45	3.60	3.72	3.40	3.40	3.46	3.63	3.79	3.40	3.40	3.48	3.72	3.97	2.67	0.16	0.32	0.49	0.65	0.81	0.97	1.14	1.30
NBC_MHEPL_358	340305	6257380	2.10	12.96	0.03	2.37	2.67	4.58	3.72	3.72	3.84	4.21	4.58	3.72	3.72	3.84	4.20	4.57	3.72	3.72	3.80	4.05	4.29	2.67	0.24	0.48	0.72	0.95	1.19	1.43	1.67	1.91
NBC_MHEPL_359	340355	6257430	2.10	12.96	0.03	2.37	2.67	4.58	3.72	3.72	3.84	4.21	4.58	3.72	3.72	3.84	4.20	4.57	3.72	3.72	3.81	4.05	4.30	2.67	0.24	0.48	0.72	0.95	1.19	1.43	1.67	1.91
NBC_MHEPL_360	340355	6257480	1.77	3.95	0.03	2.37	2.67	4.13	3.56	3.56	3.61	3.76	3.90	3.56	3.56	3.61	3.74	3.88	3.56	3.56	3.64	3.88	4.13	2.67	0.18	0.36	0.55	0.73	0.91	1.09	1.27	1.45
NBC_MHEPL_361	340355	6257530	1.67	3.95	0.04	2.38	2.68	4.08	3.51	3.51	3.56	3.71	3.86	3.51	3.51	3.56	3.71	3.85	3.51	3.51	3.59	3.83	4.08	2.68	0.18	0.35	0.53	0.70	0.88	1.05	1.23	1.40
NBC_MHEPL_362	340406	6257579	1.67	3.95	0.04	2.38	2.68	4.08	3.51	3.51	3.56	3.71	3.85	3.51	3.51	3.56	3.71	3.85	3.51	3.51	3.59	3.83	4.08	2.68	0.18	0.35	0.53	0.70	0.88	1.05	1.23	1.40
NBC_MHEPL_363	340406	6257629	1.63	3.95	0.04	2.38	2.68	4.06	3.49	3.49	3.54	3.69	3.84	3.49	3.49	3.55	3.69	3.84	3.49	3.49	3.57	3.81	4.06	2.68	0.17	0.35	0.52	0.69	0.86	1.04	1.21	1.38
NBC_MHEPL_364	340406	6257679	1.45	3.95	0.04	2.38	2.68	3.97	3.40	3.40	3.45	3.60	3.72	3.40	3.40	3.46	3.63	3.79	3.40	3.40	3.48	3.72	3.97	2.68	0.16	0.32	0.48	0.65	0.81	0.97	1.13	1.29
NBC_MHEPL_365	340406	6257728	1.36	3.95	0.04	2.38	2.68	3.92	3.36	3.36	3.41	3.55	3.66	3.36	3.36	3.42	3.59	3.76	3.36	3.36	3.43	3.68	3.92	2.68	0.16	0.31	0.47	0.62	0.78	0.93	1.09	1.25
NBC_MHEPL_014	332860	6263715	0.29	1.45	0.29	2.63	2.93	3.22	3.08	3.08	3.08	3.14	3.14	3.08	3.08	3.08	3.12	3.12	3.08	3.08	3.08	3.22	3.22	2.93	0.04	0.07	0.11	0.14	0.18	0.21	0.25	0.29
NBC_MHEPL_366	340406	6257778	1.30	3.95	0.04	2.38	2.68	3.89	3.33	3.33	3.38	3.52	3.62	3.33	3.33	3.39	3.57	3.73	3.33	3.33	3.40	3.65	3.89	2.68	0.15	0.30	0.45	0.61	0.76	0.91	1.06	1.21
NBC_MHEPL_367	340406	6257828	1.22	3.95	0.04	2.38	2.68	3.85	3.29	3.29	3.34	3.48	3.56	3.29	3.29	3.35	3.55	3.70	3.29	3.29	3.36	3.61	3.85	2.68	0.15	0.29	0.44	0.59	0.73	0.88	1.03	1.17
NBC_MHEPL_368	340356	6257828	0.94	3.95	0.04	2.38	2.68	3.61	3.14	3.14	3.19	3.34	3.35	3.14	3.14	3.21	3.44	3.57	3.14	3.14	3.21	3.46	3.61	2.68	0.12	0.23	0.35	0.47	0.59	0.70	0.82	0.94
NBC_MHEPL_369	340306	6257878	0.78	3.95	0.04	2.38	2.68	3.50	3.07	3.07	3.12	3.29	3.29	3.07	3.07	3.14	3.40	3.50	3.07	3.07	3.14	3.38	3.46	2.68	0.10	0.20	0.31	0.41	0.51	0.61	0.71	0.82
NBC_MHEPL_370	340256	6257878	0.79	3.95	0.04	2.38	2.68	3.50	3.07	3.07	3.12	3.29	3.29	3.07	3.07	3.14	3.40	3.50	3.07	3.07	3.14	3.38	3.47	2.68	0.10	0.20	0.31	0.41	0.51	0.61	0.72	0.82
NBC_MHEPL_371	340256	6257928	0.84	3.95	0.04	2.38	2.68	3.53	3.10	3.10	3.15	3.31	3.32	3.10	3.10	3.17	3.41	3.53	3.10	3.10	3.17	3.41	3.52	2.68	0.11	0.21	0.32	0.42	0.53	0.63	0.74	0.85
NBC_MHEPL_372	340206	6258029	0.80	3.95	0.04	2.38	2.68	3.51	3.08	3.08	3.13	3.30	3.30	3.08	3.08	3.15	3.40	3.51	3.08	3.08	3.15	3.39	3.49	2.68	0.10	0.21	0.31	0.41	0.52	0.62	0.72	0.83
NBC_MHEPL_373	340156	6258029	0.72	3.95	0.04	2.38	2.68	3.47	3.04	3.04	3.09	3.27	3.27	3.04	3.04	3.11	3.38	3.47	3.04	3.04	3.11	3.35	3.40	2.68	0.10	0.20	0.29	0.39	0.49	0.59	0.69	0.79
NBC_MHEPL_015	332878	6263668	0.31	1.45	0.29	2.63	2.93	3.24	3.08	3.08	3.08	3.15	3.15	3.08	3.08	3.08	3.12	3.12	3.08	3.08	3.08	3.24	3.24	2.93	0.04	0.08	0.12	0.15	0.19	0.23	0.27	0.31
NBC_MHEPL_374	340106	6258129	0.89	15.35	0.04	2.38	2.68	4.05	3.13	3.13	3.23	3.64	4.05	3.13	3.13	3.22	3.59	3.96	3.13	3.13	3.19	3.44	3.57	2.68	0.17	0.34	0.51	0.69	0.86	1.03	1.20	1.37
NBC_MHEPL_375	340056	6258179	1.01	14.36	0.04	2.38	2.68	4.12	3.19	3.19	3.30	3.71	4.12	3.19	3.19	3.29	3.65	4.02	3.19	3.19	3.26	3.50	3.70	2.68	0.18	0.36	0.54	0.72	0.90	1.08	1.25	1.43
NBC_MHEPL_376	340006	6258179	1.08	14.40	0.04	2.38	2.68	4.15	3.22	3.22	3.33	3.74	4.15	3.22	3.22	3.32	3.68	4.05	3.22	3.22	3.29	3.53	3.76	2.68	0.18	0.37	0.55	0.73	0.92	1.10	1.28	1.47
NBC_MHEPL_377	340006	6258229	1.46	14.40	0.05	2.39	2.69	4.34	3.42	3.42	3.52	3.93	4.34	3.42	3.42	3.51	3.88	4.25	3.42	3.42	3.49	3.73	3.98	2.69	0.21	0.41	0.62	0.82	1.03	1.24	1.44	1.65
NBC_MHEPL_378	339956	6258229	2.11	14.40	0.05	2.39	2.69	4.62	3.74	3.74	3.85	4.24	4.62	3.74	3.74	3.85	4.21	4.58	3.74	3.74	3.82	4.06	4.31	2.69	0.24	0.48	0.73	0.97	1.21	1.45	1.69	1.94
NBC_MHEPL_379	339906	6258279	2.11	14.29	0.05	2.39	2.69	4.62	3.74	3.74	3.85	4.24	4.62	3.74	3.74	3.85	4.21	4.58	3.74	3.74	3.82	4.06	4.31	2.69	0.24	0.48	0.73	0.97	1.21	1.45	1.69	1.93
NBC_MHEPL_380	339906	6258329	2.11	13.65	0.05	2.39	2.69	4.61	3.74	3.74	3.85	4.23	4.61	3.74	3.74	3.85	4.21	4.58	3.74	3.74	3.82	4.06	4.31	2.69	0.24	0.48	0.72	0.96	1.20	1.44	1.68	1.92
NBC_MHEPL_381	339906	6258379	2.11	12.19	0.05	2.39	2.69	4.58	3.74	3.74	3.85	4.21	4.57	3.74	3.74	3.85	4.21	4.58	3.74	3.74	3.82	4.06	4.31	2.69	0.24	0.47	0.71	0.95	1.18	1.42	1.65	1.89
NBC_MHEPL_382	339906	6258429	2.11	13.63	0.05	2.39	2.69	4.61	3.75	3.75	3.85	4.23	4.61	3.75	3.75	3.85	4.21	4.58	3.75	3.75	3.82	4.07	4.31	2.69	0.24	0.48	0.72	0.96	1.20	1.44	1.68	1.92
NBC_MHEPL_383	339856	6258479	2.11	13.23	0.05	2.39	2.69	4.60	3.75	3.75	3.85	4.23	4.60	3.75	3.75	3.85	4.22	4.58	3.75	3.75	3.82	4.07	4.31	2.69	0.24	0.48	0.72	0.95	1.19	1.43	1.67	1.91
NBC_MHEPL_016	332816	6263647	0.28	1.45	0.29	2.63	2.93	3.21	3.07	3.07	3.07	3.13	3.13	3.07	3.07	3.07	3.11	3.11	3.07	3.07	3.07	3.21	3.21	2.93	0.03	0.07	0.10	0.14	0.17	0.21	0.24	0.28
NBC_MHEPL_384	339856	6258529	2.11	14.89	0.06	2.40	2.70	4.64	3.75	3.75	3.86	4.25	4.64	3.75	3.75	3.85	4.22	4.58	3.75	3.75	3.82	4.07	4.31	2.70	0.24	0.49	0.73	0.97	1.21	1.46	1.70	1.94
NBC_MHEPL_385	339806	6258579	2.12	13.95	0.06	2.40	2.70	4.62	3.76	3.76	3.86	4.24	4.62	3.76	3.76	3.85	4.22	4.59	3.76	3.76	3.83	4.07	4.32	2.70	0.24	0.48	0.72	0.96	1.20	1.44	1.68	1.92
NBC_MHEPL_386	339806	6258629	2.12	14.41	0.06	2.40	2.70	4.63	3.76	3.76	3.86	4.25	4.63	3.76	3.76	3.85	4.22	4.59	3.76	3.76	3.83	4.08	4.32	2.70	0.24	0.48	0.72	0.97	1.21	1.45	1.69	1.93
NBC_MHEPL_387	339756	6258629	2.12	13.13	0.06	2.40	2.70	4.60	3.76	3.76	3.86	4.23	4.60	3.76	3.76	3.85	4.22	4.59	3.76	3.76	3.83	4.08	4.32	2.70	0.24	0.48	0.71	0.95	1.19	1.43	1.66	1.90
NBC_MHEPL_388	339756	6258679	2.12	13.79	0.07	2.41	2.71	4.62	3.77	3.77	3.86	4.24	4.62	3.77	3.77	3.86	4.22	4.59	3.77	3.77	3.83	4.08	4.32	2.71	0.24	0.48	0.72	0.96	1.20	1.44	1.68	1.92
NBC_MHEPL_389	339706	6258729	2.12	13.39	0.07	2.41	2.71	4.61	3.77	3.77	3.86	4.23	4.61	3.77	3.77	3.86	4.22	4.59	3.77	3.77	3.83	4.08	4.32	2.71	0.24	0.48	0.71	0.95	1.19	1.43	1.67	1.91
NBC_MHEPL_390	339656	6258729	2.12	13.13	0.06	2.40	2.70	4.60	3.76	3.76	3.86	4.23	4.60	3.76	3.76	3.86	4.22	4.59	3.76	3.76	3.83	4.08	4.32	2.70	0.24	0.47	0.71	0.95	1.19	1.42	1.66	1.90
NBC_MHEPL_391	339606	6258779	2.12	14.30	0.07	2.41	2.71	4.63	3.77	3.77	3.86	4.25	4.63	3.77	3.77	3.86	4.23	4.59	3.77	3.77	3.84	4.08	4.33	2.71	0.24	0.48	0.72	0.96	1.20	1.44	1.68	1.92
NBC_MHEPL_392	339556	6258779	2.13	13.13	0.07	2.41	2.71	4.61	3.77	3.77	3.86	4.23	4.61	3.77	3.77	3.86	4.23	4.59	3.77	3.77	3.84	4.08	4.33	2.71	0.24	0.47	0.71	0.95	1.19	1.42	1.66	1.90
NBC_MHEPL_393	339506	6258729	2.11	13.13	0.05	2.39	2.69	4.60	3.75	3.75	3.85	4.22	4.60	3.75	3.75	3.85	4.22	4.58	3.75	3.75	3.82	4.07	4.31	2.69	0.24	0.48	0.71	0.95	1.19	1.43	1.67	1.90

APPENDIX B

20220706_EPL_Database
0.9 m Sea Level Projected WL

100yr ARI Planning Levels - 0.9m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.90** m sea level rise projection
Freeboard of **0.3** m included in EPLs

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)					
			Wave			Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)		Foreshore Type ## - Crest Level (mAHD)				
									1				
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	0.9 m Sea Level Projection	0.9 m Sea Level Projection	Max EPL of all Foreshore Types and Crest Levels (mAHD)	1.5	2	2.5	3	3.5
NBC_MHEPL_017	332759	6263626	0.19	1.65	0.29	2.63	2.93	3.12	3.02	3.02	3.02	3.07	3.07
NBC_MHEPL_394	339456	6258779	2.07	13.21	0.00	2.34	2.64	4.57	3.68	3.68	3.82	4.19	4.57
NBC_MHEPL_395	339506	6258779	2.13	14.28	0.07	2.41	2.71	4.64	3.78	3.78	3.86	4.25	4.64
NBC_MHEPL_396	339556	6258829	2.13	13.49	0.08	2.42	2.72	4.62	3.78	3.78	3.87	4.24	4.62
NBC_MHEPL_397	339556	6258829	2.13	12.84	0.08	2.42	2.72	4.60	3.78	3.78	3.87	4.23	4.60
NBC_MHEPL_398	339606	6258829	2.13	14.02	0.07	2.41	2.71	4.63	3.78	3.78	3.86	4.25	4.63
NBC_MHEPL_399	339656	6258829	2.12	13.65	0.07	2.41	2.71	4.62	3.77	3.77	3.86	4.24	4.62
NBC_MHEPL_400	339706	6258879	2.13	14.06	0.07	2.41	2.71	4.63	3.78	3.78	3.86	4.25	4.63
NBC_MHEPL_401	339706	6258829	2.12	15.28	0.07	2.41	2.71	4.65	3.77	3.77	3.86	4.26	4.65
NBC_MHEPL_402	339706	6258779	2.12	12.98	0.07	2.41	2.71	4.60	3.77	3.77	3.86	4.23	4.60
NBC_MHEPL_403	339756	6258779	2.12	15.28	0.07	2.41	2.71	4.65	3.77	3.77	3.86	4.26	4.65
NBC_MHEPL_018	332723	6263611	0.33	1.65	0.28	2.62	2.92	3.25	3.09	3.09	3.09	3.16	3.16
NBC_MHEPL_404	339806	6258729	1.94	15.28	0.07	2.41	2.71	4.57	3.67	3.67	3.77	4.17	4.57
NBC_MHEPL_405	339856	6258729	1.88	15.28	0.06	2.40	2.70	4.54	3.64	3.64	3.74	4.14	4.54
NBC_MHEPL_406	339906	6258729	2.12	14.88	0.06	2.40	2.70	4.64	3.76	3.76	3.86	4.25	4.64
NBC_MHEPL_407	339956	6258679	2.12	13.49	0.06	2.40	2.70	4.61	3.76	3.76	3.86	4.23	4.61
NBC_MHEPL_408	339956	6258629	2.12	14.38	0.06	2.40	2.70	4.63	3.76	3.76	3.86	4.24	4.63
NBC_MHEPL_409	340006	6258629	2.12	13.61	0.06	2.40	2.70	4.61	3.76	3.76	3.85	4.23	4.61
NBC_MHEPL_410	340056	6258579	2.11	13.37	0.05	2.39	2.69	4.60	3.75	3.75	3.85	4.23	4.60
NBC_MHEPL_411	340106	6258529	2.11	13.36	0.05	2.39	2.69	4.60	3.75	3.75	3.85	4.23	4.60
NBC_MHEPL_412	340156	6258529	2.11	13.36	0.05	2.39	2.69	4.60	3.75	3.75	3.85	4.23	4.60
NBC_MHEPL_413	340206	6258529	2.11	13.36	0.05	2.39	2.69	4.60	3.75	3.75	3.85	4.23	4.60
NBC_MHEPL_019	332687	6263597	0.32	1.65	0.28	2.62	2.92	3.25	3.08	3.08	3.08	3.16	3.16
NBC_MHEPL_414	340206	6258579	2.11	13.47	0.05	2.39	2.69	4.61	3.75	3.75	3.85	4.23	4.61
NBC_MHEPL_415	340256	6258579	2.11	13.47	0.05	2.39	2.69	4.61	3.75	3.75	3.85	4.23	4.61
NBC_MHEPL_416	340306	6258629	2.12	14.21	0.06	2.40	2.70	4.63	3.76	3.76	3.86	4.24	4.63
NBC_MHEPL_417	340356	6258629	2.12	13.15	0.06	2.40	2.70	4.60	3.76	3.76	3.85	4.23	4.60
NBC_MHEPL_418	340356	6258579	2.11	14.11	0.05	2.39	2.69	4.62	3.75	3.75	3.85	4.24	4.62
NBC_MHEPL_419	340406	6258579	2.11	14.42	0.05	2.39	2.69	4.63	3.75	3.75	3.85	4.24	4.63
NBC_MHEPL_420	340456	6258579	2.11	14.42	0.05	2.39	2.69	4.63	3.75	3.75	3.85	4.24	4.63
NBC_MHEPL_421	340506	6258579	2.11	14.42	0.05	2.39	2.69	4.63	3.75	3.75	3.85	4.24	4.63
NBC_MHEPL_422	340506	6258629	2.11	14.42	0.06	2.40	2.70	4.63	3.75	3.75	3.85	4.24	4.63
NBC_MHEPL_423	340556	6258629	2.12	14.42	0.06	2.40	2.70	4.63	3.75	3.75	3.86	4.24	4.63
NBC_MHEPL_020	332643	6263554	0.34	1.65	0.28	2.62	2.92	3.26	3.09	3.09	3.09	3.16	3.16
NBC_MHEPL_424	340606	6258679	1.93	14.02	0.06	2.40	2.70	4.54	3.66	3.66	3.76	4.15	4.54
NBC_MHEPL_425	340656	6258679	1.93	14.25	0.06	2.40	2.70	4.54	3.67	3.67	3.76	4.15	4.54
NBC_MHEPL_426	340706	6258679	1.81	14.42	0.06	2.40	2.70	4.49	3.60	3.60	3.70	4.10	4.49
NBC_MHEPL_427	340756	6258679	1.83	14.41	0.06	2.40	2.70	4.50	3.61	3.61	3.71	4.11	4.50
NBC_MHEPL_428	340806	6258679	1.77	14.52	0.06	2.40	2.70	4.48	3.58	3.58	3.68	4.08	4.48
NBC_MHEPL_429	340856	6258679	1.53	3.95	0.06	2.40	2.70	4.02	3.46	3.46	3.51	3.66	3.80
NBC_MHEPL_430	340906	6258679	1.41	3.95	0.06	2.40	2.70	3.96	3.41	3.41	3.45	3.60	3.72
NBC_MHEPL_431	340906	6258729	1.33	4.47	0.07	2.41	2.71	3.92	3.37	3.37	3.41	3.56	3.66
NBC_MHEPL_432	340906	6258779	1.30	3.95	0.07	2.41	2.71	3.91	3.36	3.36	3.40	3.55	3.65
NBC_MHEPL_433	340956	6258779	1.33	3.95	0.07	2.41	2.71	3.93	3.38	3.38	3.42	3.56	3.67
NBC_MHEPL_021	332602	6263538	0.34	1.65	0.27	2.61	2.91	3.26	3.08	3.08	3.08	3.16	3.16
NBC_MHEPL_434	341006	6258779	1.38	3.95	0.07	2.41	2.71	3.95	3.40	3.40	3.44	3.59	3.70
NBC_MHEPL_435	341056	6258729	1.26	3.95	0.07	2.41	2.71	3.89	3.34	3.34	3.38	3.52	3.62
NBC_MHEPL_436	341106	6258729	1.05	3.95	0.06	2.40	2.70	3.76	3.23	3.23	3.27	3.42	3.46
NBC_MHEPL_437	341156	6258679	0.56	14.11	0.07	2.41	2.71	3.89	2.99	2.99	3.07	3.48	3.89
NBC_MHEPL_438	341206	6258679	0.51	14.41	0.07	2.41	2.71	3.87	2.97	2.97	3.05	3.46	3.87
NBC_MHEPL_439	341256	6258629	0.94	3.95	0.07	2.41	2.71	3.65	3.18	3.18	3.22	3.36	3.39
NBC_MHEPL_440	341306	6258579	0.87	3.95	0.07	2.41	2.71	3.58	3.14	3.14	3.18	3.34	3.35
NBC_MHEPL_441	341356	6258529	0.81	2.71	0.07	2.41	2.71	3.52	3.11	3.11	3.15	3.29	3.29
NBC_MHEPL_442	341356	6258479	0.73	2.71	0.06	2.40	2.70	3.43	3.06	3.06	3.10	3.23	3.23
NBC_MHEPL_022	332558	6263498	0.35	1.65	0.27	2.61	2.91	3.26	3.08	3.08	3.08	3.16	3.16
NBC_MHEPL_443	341306	6258429	0.74	2.71	0.05	2.39	2.69	3.44	3.07	3.07	3.10	3.23	3.23

Estuarine Planning Level (m)												Reduction Factor (Note: The application of the Reduction Factor should not reduce the EPL below the Local (Still) Water Level)							
	Foreshore Type ## - Crest Level (mAHD)																		
	2					3					4								
Name	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_017	3.02	3.02	3.02	3.10	3.10	3.02	3.02	3.02	3.12	3.12	2.93	0.02	0.05	0.07	0.10	0.12	0.15	0.17	0.19
NBC_MHEPL_394	3.68	3.68	3.81	4.18	4.55	3.68	3.68	3.78	4.02	4.27	2.64	0.24	0.48	0.72	0.96	1.21	1.45	1.69	1.93
NBC_MHEPL_395	3.78	3.78	3.86	4.23	4.60	3.78	3.78	3.84	4.09	4.33	2.71	0.24	0.48	0.72	0.96	1.20	1.44	1.68	1.92
NBC_MHEPL_396	3.78	3.78	3.87	4.23	4.60	3.78	3.78	3.85	4.09	4.34	2.72	0.24	0.48	0.71	0.95	1.19	1.43	1.66	1.90
NBC_MHEPL_397	3.78	3.78	3.87	4.23	4.60	3.78	3.78	3.85	4.09	4.34	2.72	0.24	0.47	0.71	0.94	1.18	1.41	1.65	1.89
NBC_MHEPL_398	3.78	3.78	3.86	4.23	4.60	3.78	3.78	3.84	4.09	4.33	2.71	0.24	0.48	0.72	0.96	1.20	1.44	1.68	1.92
NBC_MHEPL_399	3.77	3.77	3.86	4.23	4.59	3.77	3.77	3.84	4.08	4.33	2.71	0.24	0.48	0.72	0.96	1.19	1.43	1.67	1.91
NBC_MHEPL_400	3.78	3.78	3.86	4.23	4.60	3.78	3.78	3.84	4.09	4.33	2.71	0.24	0.48	0.72	0.96	1.20	1.44	1.68	1.92
NBC_MHEPL_401	3.77	3.77	3.86	4.22	4.59	3.77	3.77	3.83	4.08	4.32	2.71	0.24	0.49	0.73	0.97	1.22	1.46	1.70	1.95
NBC_MHEPL_402	3.77	3.77	3.86	4.22	4.59	3.77	3.77	3.83	4.08	4.32	2.71	0.24	0.47	0.71	0.95	1.18	1.42	1.66	1.89
NBC_MHEPL_403	3.77	3.77	3.86	4.22	4.59	3.77	3.77	3.83	4.08	4.32	2.71	0.24	0.49	0.73	0.97	1.22	1.46	1.70	1.95
NBC_MHEPL_018	3.09	3.09	3.09	3.15	3.15	3.09	3.09	3.09	3.25	3.25	2.92	0.04	0.08	0.12	0.16	0.20	0.25	0.29	0.33
NBC_MHEPL_404	3.67	3.67	3.76	4.13	4.50	3.67	3.67	3.74	3.99	4.23	2.71	0.23	0.47	0.70	0.93	1.16	1.40	1.63	1.86
NBC_MHEPL_405	3.64	3.64	3.73	4.10	4.47	3.64	3.64	3.71	3.95	4.20	2.70	0.23	0.46	0.69	0.92	1.15	1.38	1.61	1.84
NBC_MHEPL_406	3.76	3.76	3.86	4.22	4.59	3.76	3.76	3.83	4.08	4.32	2.70	0.24	0.48	0.73	0.97	1.21	1.45	1.70	1.94
NBC_MHEPL_407	3.76	3.76	3.85	4.22	4.59	3.76	3.76	3.83	4.08	4.32	2.70	0.24	0.48	0.72	0.95	1.19	1.43	1.67	1.91
NBC_MHEPL_408	3.76	3.76	3.85	4.22	4.59	3.76	3.76	3.83	4.07	4.32	2.70	0.24	0.48	0.72	0.97	1.21	1.45	1.69	1.93
NBC_MHEPL_409	3.76	3.76	3.85	4.22	4.59	3.76	3.76	3.83	4.07	4.32	2.70	0.24	0.48	0.72	0.96	1.20	1.44	1.67	1.91
NBC_MHEPL_410	3.75	3.75	3.85	4.22	4.58	3.75	3.75	3.82	4.07	4.31	2.69	0.24	0.48	0.72	0.95	1.19	1.43	1.67	1.91
NBC_MHEPL_411	3.75	3.75	3.85	4.22	4.58	3.75	3.75	3.82	4.07	4.31	2.69	0.24	0.48	0.72	0.96	1.19	1.43	1.67	1.91
NBC_MHEPL_412	3.75	3.75	3.85	4.21	4.58	3.75	3.75	3.82	4.07	4.31	2.69	0.24	0.48	0.72	0.96	1.19	1.43	1.67	1.91
NBC_MHEPL_413	3.75	3.75	3.85	4.21	4.58	3.75	3.75	3.82	4.07	4.31	2.69	0.24	0.48	0.72	0.96	1.19	1.43	1.67	1.91
NBC_MHEPL_019	3.08	3.08	3.08	3.15	3.15	3.08	3.08	3.08	3.25	3.25	2.92	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32
NBC_MHEPL_414	3.75	3.75	3.85	4.22	4.58	3.75	3.75	3.82	4.07	4.31	2.69	0.24	0.48	0.72	0.96	1.20	1.44	1.67	1.91
NBC_MHEPL_415	3.75	3.75	3.85	4.22	4.58	3.75	3.75	3.82	4.07	4.31	2.69	0.24	0.48	0.72	0.96	1.20	1.43	1.67	1.91
NBC_MHEPL_416	3.76	3.76	3.85	4.22	4.59	3.76	3.76	3.83	4.07	4.32	2.70	0.24	0.48	0.72	0.96	1.20	1.45	1.69	1.93
NBC_MHEPL_417	3.76	3.76	3.85	4.22	4.59	3.76	3.76	3.83	4.07	4.32	2.70	0.24	0.48	0.71	0.95	1.19	1.43	1.66	1.90
NBC_MHEPL_418	3.75	3.75	3.85	4.22	4.58	3.75	3.75	3.82	4.07	4.31	2.69	0.24	0.48	0.72	0.96	1.20	1.45	1.69	1.93
NBC_MHEPL_419	3.75	3.75	3.85	4.22	4.58	3.75	3.75	3.82	4.07	4.31	2.69	0.24	0.48	0.73	0.97	1.21	1.45	1.69	1.93
NBC_MHEPL_420	3.75	3.75	3.85	4.22	4.58	3.75	3.75	3.82	4.07	4.31	2.69	0.24	0.48	0.73	0.97	1.21	1.45	1.69	1.93
NBC_MHEPL_421	3.75	3.75	3.85	4.22	4.58	3.75	3.75	3.82	4.07	4.31	2.69	0.24	0.48	0.73	0.97	1.21	1.45	1.69	1.93
NBC_MHEPL_422	3.75	3.75	3.85	4.22	4.58	3.75	3.75	3.82	4.07	4.31	2.70	0.24	0.48	0.72	0.97	1.21	1.45	1.69	1.93
NBC_MHEPL_423	3.75	3.75	3.85	4.22	4.59	3.75	3.75	3.83	4.07	4.32	2.70	0.24	0.48	0.72	0.97	1.21	1.45	1.69	1.93
NBC_MHEPL_020	3.09	3.09	3.09	3.15	3.15	3.09	3.09	3.09	3.26	3.26	2.92	0.04	0.09	0.13	0.17	0.21	0.26	0.30	0.34
NBC_MHEPL_424	3.66	3.66	3.76	4.12	4.49	3.66	3.66	3.73	3.98	4.22	2.70	0.23	0.46	0.69	0.92	1.15	1.38	1.61	1.84
NBC_MHEPL_425	3.67	3.67	3.76	4.13	4.49	3.67	3.67	3.73	3.98	4.22	2.70	0.23	0.46	0.69	0.92	1.15	1.38	1.61	1.84
NBC_MHEPL_426	3.60	3.60	3.70	4.06	4.43	3.60	3.60	3.67	3.92	4.16	2.70	0.22	0.45	0.67	0.90	1.12	1.35	1.57	1.80
NBC_MHEPL_427	3.61	3.61	3.71	4.08	4.44	3.61	3.61	3.68	3.93	4.17	2.70	0.23	0.45	0.68	0.90	1.13	1.35	1.58	1.81
NBC_MHEPL_428	3.58	3.58	3.68	4.04	4.41	3.58	3.58	3.65	3.90	4.14	2.70	0.22	0.45	0.67	0.89	1.11	1.34	1.56	1.78
NBC_MHEPL_429	3.46	3.46	3.51	3.67	3.83	3.46	3.46	3.53	3.77	4.02	2.70	0.17	0.33	0.50	0.66	0.83	0.99	1.16	1.32
NBC_MHEPL_430	3.41	3.41	3.46	3.63	3.80	3.41	3.41	3.47	3.72	3.96	2.70	0.16	0.31	0.47	0.63	0.79	0.94	1.10	1.26
NBC_MHEPL_431	3.37	3.37	3.43	3.65	3.87	3.37	3.37	3.43	3.67	3.92	2.71	0.15	0.30	0.46	0.61	0.76	0.91	1.06	1.21
NBC_MHEPL_432	3.36	3.36	3.41	3.59	3.76	3.36	3.36	3.42	3.66	3.91	2.71	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20
NBC_MHEPL_433	3.38	3.38	3.42	3.60	3.78	3.38	3.38	3.44	3.68	3.93	2.71	0.15	0.30	0.46	0.61	0.76	0.91	1.06	1.21
NBC_MHEPL_021	3.08	3.08	3.08	3.14	3.14	3.08	3.08	3.08	3.26	3.26	2.91	0.04	0.09	0.13	0.17	0.21	0.26	0.30	0.34
NBC_MHEPL_434	3.40	3.40	3.45	3.62	3.80	3.40	3.40	3.46	3.70	3.95	2.71	0.15	0.31	0.46	0.62	0.77	0.93	1.08	1.24
NBC_MHEPL_435	3.34	3.34	3.39	3.58	3.75	3.34	3.34	3.40	3.64	3.89	2.71	0.15	0.30	0.44	0.59	0.74	0.89	1.03	1.18
NBC_MHEPL_436	3.23	3.23	3.28	3.50	3.65	3.23	3.23	3.29	3.53	3.76	2.70	0.13	0.26	0.40	0.53	0.66	0.79	0.92	1.05
NBC_MHEPL_437	2.99	2.99	3.06	3.43	3.79	2.99	2.99	3.04	3.27	3.27	2.71	0.15	0.30	0.44	0.59	0.74	0.89	1.04	1.19
NBC_MHEPL_438	2.97	2.97	3.04	3.41	3.70	2.97	2.97	3.02	3.22	3.22	2.71	0.15	0.29	0.44	0.58	0.73	0.87	1.02	1.16
NBC_MHEPL_439	3.18	3.18	3.23	3.46	3.61	3.18	3.18	3.23	3.48	3.65	2.71	0.12	0.23	0.35	0.47	0.59	0.70	0.82	0.94
NBC_MHEPL_440	3.14	3.14	3.20	3.44	3.57	3.14	3.14	3.20	3.44	3.58	2.71	0.11	0.22	0.33	0.44	0.54	0.65	0.76	0.87
NBC_MHEPL_441	3.11	3.11	3.14	3.27	3.27	3.11	3.11	3.17	3.41	3.52	2.71	0.10	0.20	0.30	0.40	0.51	0.61	0.71	0.81
NBC_MHEPL_442	3.06	3.06	3.10	3.23	3.23	3.06	3.06	3.12	3.37	3.43	2.70	0.09	0.18	0.28	0.37	0.46	0.55	0.64	0.73
NBC_MHEPL_022	3.08	3.08	3.08	3.14	3.14	3.08	3.08	3.08	3.26	3.26	2.91	0.04	0.09	0.13	0.17	0.22	0.26	0.30	0.35
NBC_MHEPL_443	3.07	3.07	3.10	3.23	3.23	3.07	3.07	3.12	3.37	3.44	2.69	0.09	0.19	0.28	0.37	0.46	0.56	0.65	0.74

100yr ARI Planning Levels - 0.9m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.90** m sea level rise projection
Freeboard of **0.3** m included in EPLs

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																	Reduction Factor Note: The application of the Reduction Factor should not reduce the EPL below the Local (Still) Water Level							
			Wave			Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)		Foreshore Type ##																							
									1					2					3					4								
									Crest Level (mAHD)																							
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	0.9 m Sea Level Projection	0.9 m Sea Level Projection	Max EPL of all Foreshore Types and Crest Levels (mAHD)	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_444	341256	6258429	0.69	2.40	0.06	2.40	2.70	3.38	3.04	3.04	3.08	3.19	3.19	3.04	3.04	3.07	3.15	3.15	3.04	3.04	3.10	3.34	3.38	2.70	0.09	0.17	0.26	0.34	0.43	0.51	0.60	0.69
NBC_MHEPL_445	341256	6258379	0.68	3.48	0.05	2.39	2.69	3.37	3.03	3.03	3.07	3.19	3.19	3.03	3.03	3.09	3.33	3.36	3.03	3.03	3.09	3.34	3.37	2.69	0.09	0.17	0.26	0.34	0.43	0.51	0.60	0.68
NBC_MHEPL_446	341156	6258329	0.77	3.48	0.05	2.39	2.69	3.46	3.08	3.08	3.12	3.25	3.25	3.08	3.08	3.13	3.35	3.40	3.08	3.08	3.14	3.38	3.46	2.69	0.10	0.19	0.29	0.39	0.48	0.58	0.68	0.77
NBC_MHEPL_447	341156	6258279	0.80	3.95	0.05	2.39	2.69	3.51	3.09	3.09	3.13	3.30	3.31	3.09	3.09	3.15	3.40	3.51	3.09	3.09	3.15	3.39	3.49	2.69	0.10	0.21	0.31	0.41	0.52	0.62	0.72	0.83
NBC_MHEPL_448	341106	6258229	0.83	3.95	0.04	2.38	2.68	3.53	3.10	3.10	3.15	3.31	3.32	3.10	3.10	3.17	3.41	3.53	3.10	3.10	3.16	3.41	3.51	2.68	0.11	0.21	0.32	0.42	0.53	0.63	0.74	0.84
NBC_MHEPL_449	341106	6258179	0.88	3.95	0.04	2.38	2.68	3.56	3.12	3.12	3.17	3.32	3.33	3.12	3.12	3.19	3.43	3.55	3.12	3.12	3.19	3.43	3.56	2.68	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88
NBC_MHEPL_450	341056	6258129	0.97	3.95	0.04	2.38	2.68	3.65	3.17	3.17	3.21	3.36	3.38	3.17	3.17	3.23	3.46	3.59	3.17	3.17	3.23	3.48	3.65	2.68	0.12	0.24	0.36	0.48	0.61	0.73	0.85	0.97
NBC_MHEPL_451	341056	6258079	1.03	3.95	0.04	2.38	2.68	3.71	3.20	3.20	3.24	3.39	3.42	3.20	3.20	3.26	3.48	3.62	3.20	3.20	3.27	3.51	3.71	2.68	0.13	0.26	0.39	0.51	0.64	0.77	0.90	1.03
NBC_MHEPL_001	331865	6264756	0.10	1.00	0.45	2.79	3.09	3.20	3.15	3.15	3.15	3.17	3.17	3.15	3.15	3.15	3.17	3.17	3.15	3.15	3.15	3.20	3.20	3.09	0.01	0.03	0.04	0.05	0.07	0.08	0.09	0.10
NBC_MHEPL_023	332529	6263487	0.35	1.65	0.27	2.61	2.91	3.26	3.09	3.09	3.09	3.16	3.16	3.09	3.09	3.09	3.14	3.14	3.09	3.09	3.09	3.26	3.26	2.91	0.04	0.09	0.13	0.18	0.22	0.27	0.31	0.35
NBC_MHEPL_452	341056	6258029	1.06	3.95	0.04	2.38	2.68	3.74	3.21	3.21	3.26	3.40	3.44	3.21	3.21	3.27	3.49	3.63	3.21	3.21	3.28	3.52	3.74	2.68	0.13	0.26	0.40	0.53	0.66	0.79	0.92	1.06
NBC_MHEPL_453	341006	6257979	1.09	3.95	0.04	2.38	2.68	3.77	3.23	3.23	3.27	3.42	3.47	3.23	3.23	3.29	3.50	3.65	3.23	3.23	3.30	3.54	3.77	2.68	0.14	0.27	0.41	0.55	0.68	0.82	0.95	1.09
NBC_MHEPL_454	341056	6257979	1.05	3.95	0.04	2.38	2.68	3.73	3.21	3.21	3.25	3.40	3.44	3.21	3.21	3.27	3.49	3.63	3.21	3.21	3.27	3.52	3.73	2.68	0.13	0.26	0.39	0.52	0.65	0.79	0.92	1.05
NBC_MHEPL_455	341056	6257929	0.93	3.95	0.04	2.38	2.68	3.61	3.15	3.15	3.19	3.34	3.35	3.15	3.15	3.21	3.45	3.57	3.15	3.15	3.21	3.46	3.61	2.68	0.12	0.23	0.35	0.47	0.58	0.70	0.81	0.93
NBC_MHEPL_456	341056	6257879	1.09	3.95	0.04	2.38	2.68	3.77	3.22	3.22	3.27	3.41	3.46	3.22	3.22	3.28	3.50	3.64	3.22	3.22	3.29	3.54	3.77	2.68	0.14	0.27	0.41	0.54	0.68	0.81	0.95	1.09
NBC_MHEPL_457	341006	6257828	1.22	3.95	0.04	2.38	2.68	3.85	3.29	3.29	3.34	3.48	3.56	3.29	3.29	3.35	3.54	3.70	3.29	3.29	3.36	3.61	3.85	2.68	0.15	0.29	0.44	0.59	0.73	0.88	1.02	1.17
NBC_MHEPL_458	341006	6257778	1.26	3.95	0.04	2.38	2.68	3.87	3.31	3.31	3.35	3.50	3.58	3.31	3.31	3.37	3.56	3.72	3.31	3.31	3.38	3.62	3.87	2.68	0.15	0.30	0.45	0.59	0.74	0.89	1.04	1.19
NBC_MHEPL_459	341006	6257728	1.27	3.95	0.04	2.38	2.68	3.88	3.31	3.31	3.36	3.51	3.59	3.31	3.31	3.37	3.56	3.72	3.31	3.31	3.39	3.63	3.88	2.68	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20
NBC_MHEPL_460	341006	6257679	1.30	3.95	0.04	2.38	2.68	3.89	3.33	3.33	3.37	3.52	3.61	3.33	3.33	3.38	3.57	3.73	3.33	3.33	3.40	3.64	3.89	2.68	0.15	0.30	0.46	0.61	0.76	0.91	1.06	1.21
NBC_MHEPL_461	341006	6257629	1.29	3.95	0.03	2.37	2.67	3.88	3.32	3.32	3.37	3.51	3.60	3.32	3.32	3.38	3.57	3.72	3.32	3.32	3.39	3.64	3.88	2.67	0.15	0.30	0.45	0.60	0.76	0.91	1.06	1.21
NBC_MHEPL_024	332469	6263439	0.37	1.87	0.27	2.61	2.91	3.27	3.09	3.09	3.09	3.17	3.17	3.09	3.09	3.09	3.17	3.17	3.09	3.09	3.09	3.27	3.27	2.91	0.05	0.09	0.14	0.18	0.23	0.28	0.32	0.37
NBC_MHEPL_462	341056	6257629	1.29	3.95	0.03	2.37	2.67	3.88	3.32	3.32	3.37	3.51	3.60	3.32	3.32	3.38	3.56	3.72	3.32	3.32	3.39	3.64	3.88	2.67	0.15	0.30	0.45	0.60	0.75	0.91	1.06	1.21
NBC_MHEPL_463	341106	6257629	1.27	3.95	0.04	2.38	2.68	3.88	3.31	3.31	3.36	3.51	3.59	3.31	3.31	3.37	3.56	3.72	3.31	3.31	3.39	3.63	3.88	2.68	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20
NBC_MHEPL_464	341156	6257679	1.20	3.95	0.04	2.38	2.68	3.84	3.27	3.27	3.32	3.47	3.54	3.27	3.27	3.34	3.53	3.69	3.27	3.27	3.35	3.59	3.84	2.68	0.15	0.29	0.44	0.58	0.73	0.87	1.02	1.16
NBC_MHEPL_465	341206	6257729	1.12	3.95	0.04	2.38	2.68	3.80	3.24	3.24	3.29	3.43	3.49	3.24	3.24	3.30	3.51	3.66	3.24	3.24	3.31	3.56	3.80	2.68	0.14	0.28	0.42	0.56	0.70	0.84	0.98	1.12
NBC_MHEPL_466	341256	6257729	1.15	3.95	0.04	2.38	2.68	3.82	3.26	3.26	3.30	3.45	3.51	3.26	3.26	3.32	3.52	3.67	3.26	3.26	3.33	3.57	3.82	2.68	0.14	0.28	0.43	0.57	0.71	0.85	0.99	1.14
NBC_MHEPL_467	341256	6257779	1.12	3.95	0.04	2.38	2.68	3.80	3.24	3.24	3.29	3.43	3.49	3.24	3.24	3.30	3.51	3.66	3.24	3.24	3.31	3.56	3.80	2.68	0.14	0.28	0.42	0.56	0.70	0.84	0.98	1.12
NBC_MHEPL_468	341306	6257829	1.13	3.95	0.05	2.39	2.69	3.81	3.25	3.25	3.30	3.44	3.50	3.25	3.25	3.31	3.52	3.67	3.25	3.25	3.32	3.56	3.81	2.69	0.14	0.28	0.42	0.56	0.70	0.84	0.98	1.12
NBC_MHEPL_469	341356	6257879	1.61	14.32	0.05	2.39	2.69	4.40	3.49	3.49	3.60	4.00	4.40	3.49	3.49	3.59	3.96	4.33	3.49	3.49	3.56	3.81	4.05	2.69	0.21	0.43	0.64	0.86	1.07	1.28	1.50	1.71
NBC_MHEPL_470	341356	6257929	1.42	14.50	0.05	2.39	2.69	4.32	3.40	3.40	3.51	3.91	4.32	3.40	3.40	3.50	3.86	4.23	3.40	3.40	3.47	3.72	3.96	2.69	0.20	0.41	0.61	0.82	1.02	1.22	1.43	1.63
NBC_MHEPL_025	332451	6263386	0.37	1.65	0.26	2.60	2.90	3.27	3.09	3.09	3.09	3.17	3.17	3.09	3.09	3.09	3.14	3.14	3.09	3.09	3.09	3.27	3.27	2.90	0.05	0.09	0.14	0.19	0.23	0.28	0.32	0.37
NBC_MHEPL_471	341406	6257879	1.51	14.30	0.05	2.39	2.69	4.36	3.44	3.44	3.55	3.95	4.36	3.44	3.44	3.54	3.91	4.28	3.44	3.44	3.51	3.76	4.00	2.69	0.21	0.42	0.63	0.83	1.04	1.25	1.46	1.67
NBC_MHEPL_472	341406	6257829	1.59	14.42	0.04	2.38	2.68	4.39	3.48	3.48	3.59	3.99	4.39	3.48	3.48	3.58	3.95	4.31	3.48	3.48	3.55	3.80	4.04	2.68	0.21	0.43	0.64	0.85	1.07	1.28	1.49	1.71
NBC_MHEPL_473	341406	6257779	1.56	13.99	0.04	2.38	2.68	4.37	3.46	3.46	3.57	3.97	4.37	3.46	3.46	3.56	3.93	4.30	3.46	3.46	3.53	3.78	4.02	2.68	0.21	0.42	0.63	0.84	1.05	1.27	1.48	1.69
NBC_MHEPL_474	341406	6257729	1.59	14.42	0.04	2.38	2.68	4.39	3.48	3.48	3.59	3.99	4.39	3.48	3.48	3.58	3.95	4.31	3.48	3.48	3.55	3.80	4.04	2.68	0.21	0.43	0.64	0.86	1.07	1.28	1.50	1.71
NBC_MHEPL_475	341406	6257679	1.59	14.19	0.04	2.38	2.68	4.39	3.47	3.47	3.59	3.99	4.39	3.47	3.47	3.58	3.95	4.31	3.47	3.47	3.55	3.79	4.04	2.68	0.21	0.43	0.64	0.85	1.07	1.28	1.50	1.71
NBC_MHEPL_476	341406	6257629	1.42	3.95	0.04	2.38	2.68	3.95	3.39	3.39	3.44	3.58	3.70	3.39	3.39	3.44	3.62	3.78	3.39	3.39	3.46	3.71	3.95	2.68	0.16	0.32	0.48	0.64	0.80	0.96	1.12	1.28
NBC_MHEPL_477	341456	6257629	1.26	3.95	0.04	2.38	2.68	3.87	3.31	3.31	3.36	3.50	3.59	3.31	3.31	3.37	3.56	3.72	3.31	3.31	3.38	3.63	3.87	2.68	0.15	0.30	0.45	0.60	0.75	0.90	1.04	1.19
NBC_MHEPL_478	341506	6257629	1.32	3.95	0.04	2.38	2.68	3.90	3.34	3.34	3.39	3.53	3.63	3.34	3.34	3.40	3.58	3.74	3.34	3.34	3.41	3.66	3.90	2.68	0.15	0.31	0.46	0.61	0.76	0.92	1.07	1.22
NBC_MHEPL_479	341556	6257629	1.25	3.95	0.04	2.38	2.68	3.87	3.31	3.31	3.35	3.50	3.58	3.31	3.31	3.36	3.56	3.71	3.31	3.31	3.38	3.62	3.87	2.68	0.15	0.30	0.45	0.59	0.74	0.89	1.04	1.19
NBC_MHEPL_480	341556	6257679	1.18	3.95	0.04	2.38	2.68	3.83	3.27	3.27	3.31	3.46	3.53	3.27	3.27	3.33	3.53	3.68	3.27	3.27	3.34	3.58	3.83	2.68	0.14	0.29	0.43	0.57	0.72	0.86	1.01	1.15
NBC_MHEPL_481	341606	6257729	1.21	14.42	0.04	2.38	2.68	4.22	3.29	3.29	3.40	3.81	4.22	3.29	3.29	3.38	3.75	4.12	3.29	3.29	3.36	3.60	3.85	2.68	0.19	0.38	0.58	0.77	0.96	1.15	1.34	1.54
NBC_MHEPL_482	341656	6257779	0.86	14.11	0.04	2.38	2.68	4.04	3.12	3.12	3.22	3.63	4.04	3.12	3.12	3.21	3.58	3.94	3.12	3.12	3.18	3.43	3.55	2.68	0.17	0.34	0.51	0.68	0.85	1.02	1.19	1.36
NBC_MHEPL_483	341656	6257729	1.10	3.95	0.04	2.38	2.68	3.78	3.23	3.23	3.28	3.42	3.47	3.23	3.23	3.29	3.50	3.65	3.23	3.23	3.30	3.54	3.78	2.68	0.14	0.27	0.41	0.55	0.69	0.82	0.96	1.10
NBC_MHEPL_484	341656	6257679	1.06	3.48	0.04	2.38	2.68	3.74	3.21	3.21	3.25	3.40	3.44	3.21	3.21	3.26	3.44	3.51	3.21	3.21	3.28	3.52	3.74	2.68	0.13	0.26	0.40	0.53	0.66	0.79	0.92	1.06
NBC_MHEPL_485	341606	6257629	1.07	3.48	0.04	2.38	2.68	3.75	3.21	3.21	3.26	3.40	3.45	3.21	3.21	3.27	3.44	3.51	3.21	3.21	3.28	3.53	3.75	2.68	0.13	0.27	0.40	0.53	0.67	0.80	0.93	1.07
NBC_MHEPL_486	341606	6257579	0.99	3.48	0.04	2.38	2.68	3.67	3.17	3.17	3.22	3.36	3.39	3.17	3.17	3.23	3.41	3.48	3.17	3.17	3.24	3.49	3.67	2.68	0.12	0.25	0.37	0.50	0.62	0.74	0.87	0.99
NBC_MHEPL_487	341606	6257529	0.93	3.48	0.04	2.38	2.68	3.61	3.14	3.14	3.19	3.33	3.35	3.14	3.14	3.20	3.39	3.45	3.14	3.14	3.21	3.46	3.61	2.68	0.12	0.23	0.35	0.47	0.58	0.70	0.82	0.93
NBC_MHEPL_488	341656	6257479	0.89	3.08	0.03	2.37	2.67	3.57	3.12	3.12	3.17	3.31	3.32	3.12	3.12	3.17	3.33	3.34	3.12	3.12	3.19	3.44	3.57	2.67	0.11	0.22	0.33	0.45	0.56	0.67	0.78	0.89
NBC_MHEPL_489	341656	6257429	0.82	3.08	0.03	2.37	2.67	3.49	3.08	3.08	3.13	3.26	3.26	3.08	3.08	3.13	3.31	3.31	3.08	3.08	3.15	3.40	3.49	2.67	0.10	0.20	0.31	0.41	0.51	0.61	0.72	0.82
NBC_MHEPL_490	341606	6257429	0.90	3.08	0.03	2.37	2.67	3.57	3.12	3.12	3.17	3.32	3.32	3.12	3.12	3.17	3.33	3.34	3.12	3.12	3.19	3.44	3.57	2.67	0.11	0.23	0.34	0.45	0.56	0.68	0.79	0.90
NBC_MHEPL_026	332438	6263327	0.33	1.87	0.25	2.59	2.89	3.23	3.06	3.06	3.06	3.13	3.13	3.06	3.06	3.06	3.15	3.15	3.06	3.06	3.06	3.23	3.23	2.89	0.04	0.08	0.12	0.17	0.21	0.25	0.29	0.33
NBC_MHEPL_491	341606	6257379	0.93	3.08	0.03	2.37	2.67	3.61	3.14	3.14	3.19	3.33	3.34	3.14	3.14	3.19	3.34	3.35	3.14	3.14	3.21	3.46	3.61	2.67	0.12	0.23	0.35	0.47	0.58	0.70	0.82	0.93
NBC_MHEPL_492	341556	6257379	0.99	3.08	0.03	2.37	2.67	3.67	3.17	3.17	3.22	3.36	3.39	3.17	3.17	3.22	3.36	3.38	3.17	3.17	3.24	3.49	3.67	2.67	0.12	0.25	0.37	0.50	0.62	0.75	0.87	0.99
NBC_MHEPL_493	341506	6257379	1.04	3.48	0.03	2.37	2.67	3.72	3.19	3.19	3.24	3.39	3.42	3.19	3.19	3.25	3.43	3.50	3.19	3.19	3.27	3.51	3.72	2.67	0.13	0.26	0.39	0.52	0.65	0.78	0.91	1.04
NBC_MHEPL_494	341456	6257379	1.09	3.48	0.03	2.37	2.67	3.76	3.22	3.22	3.27	3.41	3.46	3.22	3.22	3.27	3.44	3.51	3.22	3.22	3.29	3.54	3.76	2.67	0.14	0.27	0.41	0.55	0.68	0.82	0.95	1.09

100yr ARI Planning Levels - 0.9m Sea Level Rise

Foreshore Types:

1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)

EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.90** m sea level rise projection

Freeboard of **0.3** m included in EPLs

Name	X MGAz56	Y MGAz56	Wave Hs (m)	Wave Tp (sec)	Local Wind Setup* (m)	Local (Still) Water Level (mAHD) 0.9 m Sea Level Projection	Local (Still) Water Level with 0.3m Freeboard (mAHD) 0.9 m Sea Level Projection	Max EPL of all Foreshore Types and Crest Levels (mAHD)	Foreshore Type ## 1, Crest Level (mAHD) 1.5	1 – 2	1 – 2.5	1 – 3	1 – 3.5	2 – 1.5	2 – 2	2 – 2.5	2 – 3	2 – 3.5	3 – 1.5	3 – 2	3 – 2.5	3 – 3	3 – 3.5	4 – N/A	Reduction Factor 5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_495	341406	6257329	0.94	3.48	0.03	2.37	2.67	3.61	3.14	3.14	3.19	3.33	3.35	3.14	3.14	3.20	3.39	3.45	3.14	3.14	3.21	3.46	3.61	2.67	0.12	0.23	0.35	0.47	0.59	0.70	0.82	0.94
NBC_MHEPL_496	341356	6257279	0.91	3.48	0.03	2.37	2.67	3.58	3.13	3.13	3.17	3.32	3.33	3.13	3.13	3.19	3.38	3.44	3.13	3.13	3.20	3.44	3.58	2.67	0.11	0.23	0.34	0.46	0.57	0.69	0.80	0.91
NBC_MHEPL_497	341356	6257229	0.91	3.08	0.03	2.37	2.67	3.58	3.13	3.13	3.17	3.32	3.33	3.13	3.13	3.17	3.33	3.34	3.13	3.13	3.20	3.44	3.58	2.67	0.11	0.23	0.34	0.46	0.57	0.68	0.80	0.91
NBC_MHEPL_498	341356	6257179	0.93	3.08	0.03	2.37	2.67	3.60	3.13	3.13	3.18	3.33	3.34	3.13	3.13	3.18	3.33	3.35	3.13	3.13	3.21	3.45	3.60	2.67	0.12	0.23	0.35	0.46	0.58	0.69	0.81	0.93
NBC_MHEPL_499	341356	6257129	0.85	3.08	0.03	2.37	2.67	3.52	3.10	3.10	3.14	3.28	3.28	3.10	3.10	3.15	3.31	3.32	3.10	3.10	3.17	3.41	3.52	2.67	0.11	0.21	0.32	0.43	0.53	0.64	0.75	0.85
NBC_MHEPL_500	341356	6257078	0.76	2.71	0.03	2.37	2.67	3.43	3.05	3.05	3.09	3.22	3.22	3.05	3.05	3.09	3.21	3.21	3.05	3.05	3.12	3.37	3.43	2.67	0.10	0.19	0.29	0.38	0.48	0.57	0.67	0.76
NBC_MHEPL_027	332426	6263276	0.29	1.65	0.25	2.59	2.89	3.18	3.03	3.03	3.03	3.10	3.10	3.03	3.03	3.03	3.10	3.10	3.03	3.03	3.03	3.18	3.18	2.89	0.04	0.07	0.11	0.14	0.18	0.22	0.25	0.29
NBC_MHEPL_501	341356	6257028	0.65	2.71	0.03	2.37	2.67	3.32	2.99	2.99	3.04	3.14	3.14	2.99	2.99	3.04	3.17	3.17	2.99	2.99	3.06	3.31	3.32	2.67	0.08	0.16	0.24	0.33	0.41	0.49	0.57	0.65
NBC_MHEPL_502	341306	6257028	0.64	2.71	0.03	2.37	2.67	3.31	2.99	2.99	3.03	3.13	3.13	2.99	2.99	3.04	3.16	3.16	2.99	2.99	3.06	3.30	3.31	2.67	0.08	0.16	0.24	0.32	0.40	0.48	0.56	0.64
NBC_MHEPL_503	341256	6257028	0.63	2.71	0.03	2.37	2.67	3.29	2.98	2.98	3.03	3.12	3.12	2.98	2.98	3.03	3.16	3.16	2.98	2.98	3.05	3.29	3.29	2.67	0.08	0.16	0.24	0.31	0.39	0.47	0.55	0.63
NBC_MHEPL_504	341206	6257079	0.83	3.08	0.03	2.37	2.67	3.50	3.08	3.08	3.13	3.27	3.27	3.08	3.08	3.14	3.31	3.31	3.08	3.08	3.16	3.40	3.50	2.67	0.10	0.21	0.31	0.42	0.52	0.63	0.73	0.83
NBC_MHEPL_505	341156	6257079	1.01	3.95	0.03	2.37	2.67	3.68	3.18	3.18	3.22	3.37	3.40	3.18	3.18	3.24	3.47	3.60	3.18	3.18	3.25	3.49	3.68	2.67	0.13	0.25	0.38	0.51	0.63	0.76	0.89	1.01
NBC_MHEPL_506	341106	6257079	1.28	3.95	0.03	2.37	2.67	3.87	3.31	3.31	3.36	3.50	3.59	3.31	3.31	3.37	3.56	3.71	3.31	3.31	3.38	3.63	3.87	2.67	0.15	0.30	0.45	0.60	0.75	0.90	1.06	1.21
NBC_MHEPL_507	341106	6257029	1.33	3.95	0.03	2.37	2.67	3.90	3.33	3.33	3.38	3.53	3.62	3.33	3.33	3.39	3.57	3.73	3.33	3.33	3.41	3.65	3.90	2.67	0.15	0.31	0.46	0.62	0.77	0.92	1.08	1.23
NBC_MHEPL_508	341106	6256978	1.37	3.95	0.03	2.37	2.67	3.92	3.35	3.35	3.40	3.55	3.65	3.35	3.35	3.41	3.59	3.75	3.35	3.35	3.43	3.68	3.92	2.67	0.16	0.31	0.47	0.63	0.78	0.94	1.10	1.25
NBC_MHEPL_509	341106	6256928	1.37	3.95	0.02	2.36	2.66	3.92	3.35	3.35	3.40	3.55	3.65	3.35	3.35	3.41	3.59	3.75	3.35	3.35	3.43	3.68	3.92	2.66	0.16	0.31	0.47	0.63	0.78	0.94	1.10	1.26
NBC_MHEPL_510	341156	6256878	1.37	3.95	0.02	2.36	2.66	3.92	3.35	3.35	3.40	3.55	3.65	3.35	3.35	3.41	3.59	3.75	3.35	3.35	3.43	3.68	3.92	2.66	0.16	0.31	0.47	0.63	0.79	0.94	1.10	1.26
NBC_MHEPL_511	341256	6256828	1.38	3.95	0.02	2.36	2.66	3.92	3.35	3.35	3.40	3.55	3.65	3.35	3.35	3.41	3.59	3.74	3.35	3.35	3.43	3.68	3.92	2.66	0.16	0.32	0.47	0.63	0.79	0.95	1.10	1.26
NBC_MHEPL_512	341305	6256728	1.32	3.48	0.02	2.36	2.66	3.89	3.32	3.32	3.37	3.52	3.61	3.32	3.32	3.37	3.50	3.58	3.32	3.32	3.40	3.64	3.89	2.66	0.15	0.31	0.46	0.62	0.77	0.92	1.08	1.23
NBC_MHEPL_513	341255	6256679	1.52	3.48	0.02	2.36	2.66	3.99	3.42	3.42	3.47	3.62	3.75	3.42	3.42	3.46	3.57	3.65	3.42	3.42	3.50	3.75	3.99	2.66	0.17	0.33	0.50	0.67	0.83	1.00	1.17	1.34
NBC_MHEPL_514	341255	6256629	1.45	3.48	0.02	2.36	2.66	3.96	3.38	3.38	3.44	3.58	3.70	3.38	3.38	3.43	3.55	3.63	3.38	3.38	3.47	3.71	3.96	2.66	0.16	0.32	0.49	0.65	0.81	0.97	1.14	1.30
NBC_MHEPL_515	341305	6256529	1.55	3.48	0.01	2.35	2.65	4.01	3.43	3.43	3.49	3.64	3.77	3.43	3.43	3.48	3.58	3.66	3.43	3.43	3.52	3.76	4.01	2.65	0.17	0.34	0.51	0.68	0.85	1.02	1.19	1.35
NBC_MHEPL_516	341355	6256479	1.52	3.95	0.01	2.35	2.65	3.99	3.42	3.42	3.47	3.62	3.75	3.42	3.42	3.48	3.64	3.80	3.42	3.42	3.50	3.75	3.99	2.65	0.17	0.33	0.50	0.67	0.84	1.00	1.17	1.34
NBC_MHEPL_517	341355	6256429	1.46	3.95	0.01	2.35	2.65	3.96	3.39	3.39	3.44	3.59	3.71	3.39	3.39	3.45	3.62	3.77	3.39	3.39	3.47	3.72	3.96	2.65	0.16	0.33	0.49	0.65	0.82	0.98	1.14	1.31
NBC_MHEPL_518	341405	6256378	1.44	3.95	0.01	2.35	2.65	3.95	3.37	3.37	3.43	3.57	3.69	3.37	3.37	3.44	3.60	3.76	3.37	3.37	3.46	3.70	3.95	2.65	0.16	0.33	0.49	0.65	0.81	0.98	1.14	1.30
NBC_MHEPL_519	341455	6256328	1.40	3.95	0.01	2.35	2.65	3.93	3.35	3.35	3.41	3.55	3.66	3.35	3.35	3.42	3.59	3.75	3.35	3.35	3.44	3.68	3.93	2.65	0.16	0.32	0.48	0.64	0.80	0.96	1.12	1.28
NBC_MHEPL_520	341505	6256328	1.37	3.95	0.01	2.35	2.65	3.91	3.33	3.33	3.39	3.54	3.64	3.33	3.33	3.40	3.58	3.73	3.33	3.33	3.42	3.67	3.91	2.65	0.16	0.32	0.47	0.63	0.79	0.95	1.11	1.26
NBC_MHEPL_521	341555	6256328	1.34	3.95	0.00	2.34	2.64	3.89	3.31	3.31	3.37	3.52	3.61	3.31	3.31	3.38	3.57	3.72	3.31	3.31	3.40	3.65	3.89	2.64	0.16	0.31	0.47	0.62	0.78	0.94	1.09	1.25
NBC_MHEPL_522	341605	6256328	1.32	3.95	0.00	2.34	2.64	3.88	3.30	3.30	3.36	3.51	3.59	3.30	3.30	3.37	3.56	3.70	3.30	3.30	3.39	3.64	3.88	2.64	0.15	0.31	0.46	0.62	0.77	0.93	1.08	1.24
NBC_MHEPL_523	341655	6256328	1.26	3.95	0.00	2.34	2.64	3.85	3.28	3.28	3.33	3.48	3.55	3.28	3.28	3.35	3.54	3.68	3.28	3.28	3.36	3.61	3.85	2.64	0.15	0.30	0.45	0.61	0.76	0.91	1.06	1.21
NBC_MHEPL_524	341705	6256328	1.25	3.95	0.00	2.34	2.64	3.85	3.27	3.27	3.33	3.47	3.54	3.27	3.27	3.34	3.53	3.68	3.27	3.27	3.36	3.60	3.85	2.64	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20
NBC_MHEPL_525	341755	6256328	1.22	3.95	0.00	2.34	2.64	3.83	3.26	3.26	3.31	3.46	3.53	3.26	3.26	3.33	3.52	3.67	3.26	3.26	3.34	3.59	3.83	2.64	0.15	0.30	0.45	0.59	0.74	0.89	1.04	1.19
NBC_MHEPL_028	332548	6263174	0.37	1.65	0.24	2.58	2.88	3.25	3.06	3.06	3.06	3.14	3.14	3.06	3.06	3.06	3.12	3.12	3.06	3.06	3.06	3.25	3.25	2.88	0.05	0.09	0.14	0.18	0.23	0.27	0.32	0.37
NBC_MHEPL_526	341805	6256328	1.24	3.48	0.00	2.34	2.64	3.84	3.26	3.26	3.32	3.47	3.53	3.26	3.26	3.32	3.47	3.54	3.26	3.26	3.35	3.60	3.84	2.64	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20
NBC_MHEPL_527	341855	6256328	1.29	3.48	0.00	2.34	2.64	3.87	3.29	3.29	3.35	3.49	3.57	3.29	3.29	3.35	3.49	3.56	3.29	3.29	3.38	3.62	3.87	2.64	0.15	0.31	0.46	0.61	0.77	0.92	1.07	1.22
NBC_MHEPL_528	341906	6256328	1.30	3.48	0.00	2.34	2.64	3.87	3.29	3.29	3.35	3.50	3.58	3.29	3.29	3.35	3.49	3.56	3.29	3.29	3.38	3.63	3.87	2.64	0.15	0.31	0.46	0.61	0.77	0.92	1.08	1.23
NBC_MHEPL_529	341956	6256328	1.28	3.48	0.00	2.34	2.64	3.86	3.28	3.28	3.34	3.49	3.57	3.28	3.28	3.34	3.48	3.56	3.28	3.28	3.37	3.62	3.86	2.64	0.15	0.31	0.46	0.61	0.76	0.92	1.07	1.22
NBC_MHEPL_029	332600	6263152	0.36	1.65	0.24	2.58	2.88	3.24	3.06	3.06	3.06	3.14	3.14	3.06	3.06	3.06	3.12	3.12	3.06	3.06	3.06	3.24	3.24	2.88	0.05	0.09	0.14	0.18	0.23	0.27	0.32	0.36
NBC_MHEPL_002	331895	6264742	0.11	1.00	0.40	2.74	3.04	3.15	3.09	3.09	3.09	3.12	3.12	3.09	3.09	3.09	3.12	3.12	3.09	3.09	3.09	3.15	3.15	3.04	0.01	0.03	0.04	0.05	0.07	0.08	0.10	0.11
NBC_MHEPL_030	332632	6263103	0.34	1.65	0.24	2.58	2.88	3.22	3.05	3.05	3.05	3.12	3.12	3.05	3.05	3.05	3.10	3.10	3.05	3.05	3.05	3.22	3.22	2.88	0.04	0.09	0.13	0.17	0.21	0.26	0.30	0.34
NBC_MHEPL_031	332662	6263060	0.32	1.65	0.23	2.57	2.87	3.19	3.03	3.03	3.03	3.10	3.10	3.03	3.03	3.03	3.10	3.10	3.03	3.03	3.03	3.19	3.19	2.87	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32
NBC_MHEPL_032	332696	6263014	0.30	1.65	0.23	2.57	2.87	3.17	3.02	3.02	3.02	3.09	3.09	3.02	3.02	3.02	3.09	3.09	3.02	3.02	3.02	3.17	3.17	2.87	0.04	0.08	0.11	0.15	0.19	0.23	0.27	0.30
NBC_MHEPL_033	332727	6262972	0.29	1.45	0.23	2.57	2.87	3.16	3.01	3.01	3.01	3.08	3.08	3.01	3.01	3.01	3.05	3.05	3.01	3.01	3.01	3.16	3.16	2.87	0.04	0.07	0.11	0.15	0.18	0.22	0.26	0.29
NBC_MHEPL_034	332757	6262932	0.29	1.65	0.22	2.56	2.86	3.15	3.01	3.01	3.01	3.07	3.07	3.01	3.01	3.01	3.08	3.08	3.01	3.01	3.01	3.15	3.15	2.86	0.04	0.07	0.11	0.14	0.18	0.22	0.25	0.29
NBC_MHEPL_035	332788	6262955	0.29	1.65	0.23	2.57	2.87	3.16	3.01	3.01	3.01	3.08	3.08	3.01	3.01	3.01	3.08	3.08	3.01	3.01	3.01	3.16	3.16	2.87	0.04	0.07	0.11	0.15	0.18	0.22	0.26	0.29
NBC_MHEPL_036	332818	6262915	0.30	1.65	0.22	2.56	2.86	3.17	3.02	3.02	3.02	3.08	3.08	3.02	3.02	3.02	3.08	3.08	3.02	3.02	3.02	3.17	3.17	2.86	0.04	0.08	0.11	0.15	0.19	0.23	0.27	0.30
NBC_MHEPL_037	332877	6262900	0.32	1.65	0.22	2.56	2.86	3.18	3.02	3.02	3.02	3.09	3.09	3.02	3.02	3.02	3.08	3.08	3.02	3.02	3.02	3.18	3.18	2.86	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32
NBC_MHEPL_038	332936	6262884	0.32	1.65	0.22	2.56	2.86	3.18	3.02	3.02	3.02	3.09	3.09	3.02	3.02	3.02	3.08	3.08	3.02	3.02	3.02	3.18	3.18	2.86	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32
NBC_MHEPL_039	332996	6262868	0.33	1.65	0.22	2.56	2.86	3.18	3.02	3.02	3.02	3.09	3.09	3.02	3.02	3.02	3.08	3.08	3.02	3.02	3.02	3.18	3.18	2.86	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.33
NBC_MHEPL_003	331926	6264732	0.12	1.13	0.40	2.74	3.04	3.16	3.10	3.10	3.10	3.13	3.13	3.10	3.10	3.10	3.13	3.13	3.10	3.10	3.10	3.16	3.16	3.04	0.02	0.03	0.05	0.06	0.08	0.09	0.11	0.12
NBC_MHEPL_040	333024	6262831	0.40	2.11	0.22	2.56	2.86	3.26	3.06	3.06	3.06	3.14	3.14	3.06	3.06	3.06	3.17	3.17	3.06	3.06	3.06	3.26	3.26	2.86	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40
NBC_MHEPL_041	333084	6262819	0.44	2.11	0.22	2.56	2.86	3.29	3.07	3.07	3.07	3.17	3.17	3.07	3.07	3.07	3.18	3.18	3.07	3.07	3.07	3.29	3.29	2.86	0.05	0.11	0.16	0.22	0.27	0.33	0.38	0.44
NBC_MHEPL_042	333144	6262808	0.47	2.11	0.21	2.55	2.85	3.33	3.09	3.09	3.09	3.20	3.20	3.09	3.09	3.09	3.20	3.20	3.09	3.09	3.09	3.31	3.33	2.85	0.06	0.12	0.18	0.24	0.30	0.35	0.41	0.47
NBC_MHEPL_043	333174	6262772	0.47	2.11	0.21	2.55	2.85	3.32	3.09	3.09	3.09	3.19	3.19	3.09	3.09	3.09	3.19	3.19	3.09	3.09	3.09	3.31	3.32	2.85	0.06	0.12	0.18	0.24	0.30	0.35	0.41	0.47
NBC_MHEPL_044	333171	6262710	0.48	2.11	0.21	2.55	2.85	3.33	3.09	3.09	3.09	3.19	3.19	3.09	3.09	3.09	3.19	3.19	3.09	3.09	3.09	3.31	3.33	2.85	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_045	333167	6262651	0.48	2.11	0.20	2.54	2.84	3.32	3.08	3.08	3.08	3.19	3.19	3.08	3.08	3.08	3.19	3.19	3.08	3.08	3.08	3.31	3.32	2.84	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48

Table group headings: Foreshore Location (X,Y Coordinates @ Wave Output Location); 100yrARI; Estuarine Planning Level (m); Reduction Factor — Note: The application of the Reduction Factor should not reduce the EPL below the Local (Still) Water Level

APPENDIX B

20220706_EPL_Database
0.9 m Sea Level Projected WL

100yr ARI Planning Levels - 0.9m Sea Level Rise
Foreshore Types:
1. Grassed or Sandy Slope (1 in 10 slope)
2. Rocky Shoreline (1 in 5 slope)
3. Sea Wall
4. Mangroves

100-year ARI Storm Tide at Fort Denison is **1.44** mAHD (excluding Sea Level Rise)
EPLs for all sea wall heights less than 1.5 m AHD will be the equivalent.

Mean Sea Level Rise Allowance **0.90** m sea level rise projection
Freeboard of **0.3** m included in EPLs

Foreshore Location (X,Y Coordinates @ Wave Output Location)			100yrARI					Estuarine Planning Level (m)																		Reduction Factor. Note: The application of the Reduction Factor should not reduce the EPL below the Local (Still) Water Level							
			Wave						Foreshore Type ##																							
									1					2					3					4							
						Local (Still) Water Level (mAHD)	Local (Still) Water Level with 0.3m Freeboard (mAHD)	Max EPL of all Foreshore Types and Crest Levels (mAHD)	Crest Level (mAHD)																						
Name	X MGAz56	Y MGAz56	Hs (m)	Tp (sec)	Local Wind Setup* (m)	0.9 m Sea Level Projection	0.9 m Sea Level Projection		1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	1.5	2	2.5	3	3.5	N/A	5m	10m	15m	20m	25m	30m	35m	40m
NBC_MHEPL_046	333194	6262618	0.47	2.11	0.20	2.54	2.84	3.31	3.08	3.08	3.08	3.18	3.18	3.08	3.08	3.08	3.18	3.18	3.08	3.08	3.08	3.31	3.31	2.84	0.06	0.12	0.18	0.24	0.29	0.35	0.41	0.47
NBC_MHEPL_047	333220	6262584	0.47	2.11	0.20	2.54	2.84	3.30	3.07	3.07	3.07	3.17	3.17	3.07	3.07	3.07	3.17	3.17	3.07	3.07	3.07	3.30	3.30	2.84	0.06	0.12	0.17	0.23	0.29	0.35	0.41	0.47
NBC_MHEPL_048	333246	6262550	0.46	2.11	0.19	2.53	2.83	3.29	3.06	3.06	3.06	3.16	3.16	3.06	3.06	3.06	3.17	3.17	3.06	3.06	3.06	3.29	3.29	2.83	0.06	0.11	0.17	0.23	0.29	0.34	0.40	0.46
NBC_MHEPL_049	333272	6262516	0.43	1.87	0.19	2.53	2.83	3.27	3.05	3.05	3.05	3.15	3.15	3.05	3.05	3.05	3.12	3.12	3.05	3.05	3.05	3.27	3.27	2.83	0.05	0.11	0.16	0.22	0.27	0.33	0.38	0.43
NBC_MHEPL_004	331991	6264724	0.14	1.13	0.39	2.73	3.03	3.17	3.10	3.10	3.10	3.13	3.13	3.10	3.10	3.10	3.13	3.13	3.10	3.10	3.10	3.17	3.17	3.03	0.02	0.03	0.05	0.07	0.09	0.10	0.12	0.14
NBC_MHEPL_050	333268	6262456	0.41	1.87	0.19	2.53	2.83	3.24	3.03	3.03	3.03	3.13	3.13	3.03	3.03	3.03	3.11	3.11	3.03	3.03	3.03	3.24	3.24	2.83	0.05	0.10	0.15	0.21	0.26	0.31	0.36	0.41
NBC_MHEPL_051	333236	6262431	0.41	1.87	0.19	2.53	2.83	3.24	3.03	3.03	3.03	3.12	3.12	3.03	3.03	3.03	3.11	3.11	3.03	3.03	3.03	3.24	3.24	2.83	0.05	0.10	0.15	0.21	0.26	0.31	0.36	0.41
NBC_MHEPL_052	333204	6262407	0.41	1.87	0.18	2.52	2.82	3.24	3.03	3.03	3.03	3.12	3.12	3.03	3.03	3.03	3.11	3.11	3.03	3.03	3.03	3.24	3.24	2.82	0.05	0.10	0.15	0.21	0.26	0.31	0.36	0.41
NBC_MHEPL_053	333199	6262347	0.45	2.11	0.18	2.52	2.82	3.27	3.04	3.04	3.04	3.14	3.14	3.04	3.04	3.04	3.15	3.15	3.04	3.04	3.04	3.27	3.27	2.82	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.45
NBC_MHEPL_054	333194	6262286	0.49	2.40	0.18	2.52	2.82	3.31	3.06	3.06	3.06	3.17	3.17	3.06	3.06	3.06	3.20	3.20	3.06	3.06	3.06	3.30	3.31	2.82	0.06	0.12	0.18	0.24	0.31	0.37	0.43	0.49
NBC_MHEPL_055	333222	6262250	0.48	2.11	0.17	2.51	2.81	3.29	3.05	3.05	3.05	3.16	3.16	3.05	3.05	3.05	3.16	3.16	3.05	3.05	3.05	3.29	3.29	2.81	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_056	333219	6262189	0.47	2.11	0.17	2.51	2.81	3.27	3.04	3.04	3.04	3.14	3.14	3.04	3.04	3.04	3.15	3.15	3.04	3.04	3.04	3.27	3.27	2.81	0.06	0.12	0.18	0.23	0.29	0.35	0.41	0.47
NBC_MHEPL_057	333248	6262152	0.45	2.11	0.16	2.50	2.80	3.25	3.03	3.03	3.03	3.13	3.13	3.03	3.03	3.03	3.14	3.14	3.03	3.03	3.03	3.25	3.25	2.80	0.06	0.11	0.17	0.22	0.28	0.34	0.39	0.45
NBC_MHEPL_058	333277	6262115	0.44	2.11	0.16	2.50	2.80	3.24	3.02	3.02	3.02	3.12	3.12	3.02	3.02	3.02	3.13	3.13	3.02	3.02	3.02	3.24	3.24	2.80	0.05	0.11	0.16	0.22	0.27	0.33	0.38	0.44
NBC_MHEPL_059	333307	6262077	0.46	2.11	0.16	2.50	2.80	3.26	3.03	3.03	3.03	3.13	3.13	3.03	3.03	3.03	3.14	3.14	3.03	3.03	3.03	3.26	3.26	2.80	0.06	0.11	0.17	0.23	0.29	0.34	0.40	0.46
NBC_MHEPL_060	333368	6262063	0.48	2.40	0.16	2.50	2.80	3.28	3.04	3.04	3.04	3.14	3.14	3.04	3.04	3.04	3.18	3.18	3.04	3.04	3.04	3.28	3.28	2.80	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_061	333429	6262050	0.50	2.40	0.16	2.50	2.80	3.29	3.05	3.05	3.05	3.16	3.16	3.05	3.05	3.05	3.19	3.19	3.05	3.05	3.05	3.29	3.29	2.80	0.06	0.12	0.19	0.25	0.31	0.37	0.43	0.50
NBC_MHEPL_062	333459	6262013	0.50	2.40	0.16	2.50	2.80	3.30	3.05	3.05	3.05	3.16	3.16	3.05	3.05	3.05	3.19	3.19	3.05	3.05	3.05	3.30	3.30	2.80	0.06	0.13	0.19	0.25	0.31	0.38	0.44	0.50
NBC_MHEPL_063	333490	6262038	0.51	2.40	0.16	2.50	2.80	3.30	3.05	3.05	3.06	3.16	3.16	3.05	3.05	3.06	3.19	3.19	3.05	3.05	3.06	3.30	3.30	2.80	0.06	0.13	0.19	0.25	0.32	0.38	0.44	0.51
NBC_MHEPL_064	333520	6262001	0.51	2.40	0.15	2.49	2.79	3.30	3.05	3.05	3.06	3.16	3.16	3.05	3.05	3.06	3.19	3.19	3.05	3.05	3.06	3.30	3.30	2.79	0.06	0.13	0.19	0.25	0.32	0.38	0.44	0.51
NBC_MHEPL_065	333550	6261964	0.51	2.11	0.15	2.49	2.79	3.30	3.05	3.05	3.05	3.16	3.16	3.05	3.05	3.05	3.14	3.14	3.05	3.05	3.05	3.30	3.30	2.79	0.06	0.13	0.19	0.25	0.32	0.38	0.44	0.51
NBC_MHEPL_066	333609	6261891	0.50	2.11	0.15	2.49	2.79	3.28	3.04	3.04	3.04	3.14	3.14	3.04	3.04	3.04	3.14	3.14	3.04	3.04	3.05	3.28	3.28	2.79	0.06	0.12	0.19	0.25	0.31	0.37	0.43	0.50
NBC_MHEPL_067	333639	6261854	0.48	2.11	0.15	2.49	2.79	3.27	3.03	3.03	3.04	3.13	3.13	3.03	3.03	3.04	3.13	3.13	3.03	3.03	3.04	3.27	3.27	2.79	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48
NBC_MHEPL_068	333668	6261818	0.46	2.11	0.14	2.48	2.78	3.25	3.02	3.02	3.03	3.12	3.12	3.02	3.02	3.03	3.12	3.12	3.02	3.02	3.03	3.25	3.25	2.78	0.06	0.12	0.17	0.23	0.29	0.35	0.41	0.46
NBC_MHEPL_069	333698	6261781	0.45	1.87	0.14	2.48	2.78	3.23	3.01	3.01	3.02	3.10	3.10	3.01	3.01	3.01	3.08	3.08	3.01	3.01	3.02	3.23	3.23	2.78	0.06	0.11	0.17	0.22	0.28	0.34	0.39	0.45

APPENDIX B

20220706_EPL_Database
0.9 m Sea Level Projected WL

Rhelm
engineering | environmental | economics | engagement

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Project 200876.00
21 June 2022
Rev2
FM

Attention: Mr Simon Gray

Email: Simon.Gray@northernbeaches.nsw.gov.au

Geotechnical Review
Geotechnical Planning Controls
Northern Beaches

1. Introduction

This report presents the results of a review undertaken by Douglas Partners Pty Ltd (DP) on the geotechnical planning controls for the Northern Beaches Local Government Area.

The review was undertaken at the request of Northern Beaches Council and was aimed at providing recommendations for a revised unified system of geotechnical planning controls to replace the existing planning controls and to inform the planning framework for the three former council areas of Pittwater, Manly and Warringah which have been amalgamated to form the Northern Beaches Local Government Area.

The scope of work for the review comprised the following:

- Analysis of the existing planning controls from the three former councils;
- Review of the known geotechnical constraints in the Northern Beaches area;
- Consideration of the potential impacts of climate change; and
- Development of recommendations for revised planning controls and assessment processes.

2. Analysis of Existing Controls

The system for controlling planning and development in NSW comprises the following:

- The Environmental Planning and Assessment Act 1979 (EPA Act) – prepared by the State Government;
- State Environmental Planning Policies (SEPP) - prepared by the State Government;
- Local Environmental Plans (LEPs) – prepared by local Councils; and
- Development Control Plans (DCPs) – prepared by local Councils.

The LEPs and DCPs are used by Councils to regulate development and land use. The LEPs are legally binding documents published as part of the NSW legislation, while the DCPs are documents prepared and controlled by Council to give guidance on achieving the aims and objectives of the whole planning system. The DCPs may be modified relatively easily by Council while the LEPs are laws which are more difficult to change.

For each of the three former council areas of Pittwater, Manly and Warringah, the main clauses in the LEPs and DCPs relating to geotechnical planning are listed in Table 1.

Table 1: Summary of Existing Geotechnical Related Planning Clauses

Pittwater	**Manly**	**Warringah #**
LEP 2014	LEP 2013	LEP 2011
7.1 Acid sulfate soils	6.1 Acid sulfate soils	6.1 Acid sulfate soils
7.2 Earthworks	6.2 Earthworks	6.2 Earthworks
7.5 Coastal risk planning		6.5 Coastal hazards
7.7 Geotechnical hazards	6.8 Landslide Risk	6.4 Development on sloping land
Maps – Geotechnical Hazard maps *(showing H1 and H2 areas)* Separate ASS maps Coastline Hazard maps *(showing wave inundation, coastal erosion and bluff/cliff instability areas)*	Maps – Combined ASS and Landslide Risk maps	Maps – Landslide Risk maps *(showing Areas A to E)* Separate ASS maps Coastline Hazard map *(showing reduced foundation capacity and wave impact areas)*
21 DCP	DCP 2013	DCP 2011
B3.1 Landslip Hazard	4.1.8 Sloping Sites	E10 Landslip Risk
B3.4 Coastline (Bluff) Hazard		E9 Coastline Hazard
B3.12 Climate Change		
B8.1 Construction and Demolition – Excavation and Landfill	4.4.5 Earthworks	C7 Excavation and Landfill
Appendix 5 Geotechnical Risk Management Policy	Schedule 1 Map C Potential Landslip *Hazards (showing Areas G1 to G4)*	
Appendix 6 Coastal Risk Management Policy	Schedule 11 Checklist for Preliminary Assessment of Site Conditions	

Note: # Warringah LEP 2000 applies to areas shown on the 2011 Land Application Maps as 'Deferred Matter', reference Clause 57 Development on Sloping Land and Hazard Map 2 – Land Slip

One key feature of all the existing systems is that the maps used to identify areas of geotechnical hazards, acid sulfate soils (ASS) and coastline hazard areas have been included within the LEP documents, which means that it is not easy to modify the maps if any errors are identified or changes are required. DP proposes that, under the revised unified system, the geotechnical planning maps would be included within the DCP documents to allow changes to be made more readily if any additional information (such as from detailed geotechnical investigations) becomes available, whilst maintaining the objectives of the clauses in the LEP.

DP recognises that the DCP will also incorporate controls for sloping sites with respect to urban design outcomes, visual impact and view sharing etc. however, these matters are being addressed by a separate Urban Design Study and Council staff and are outside the scope of this report.

A detailed comparison of the words in each of the LEP and DCP clauses from the former councils is provided in the tables in Appendices A and B, together with suggested revised wording of new clauses.

The detailed comparison is summarised in Table 2.

Table 2: Summary of Comparison of Existing Geotechnical Related Planning Clauses

Clauses	**Comments**	**Suggested Changes**
LEPs		
Acid Sulfate Soils	All existing clauses are identical. All refer to ASS maps contained within the LEPs. The Manly maps combined ASS with landslide risk. The other two councils had separate ASS maps	No changes to words proposed. The ASS maps to remain in the LEP.
Earthworks	All the existing clauses are similar. The Manly clause includes groundwater dewatering associated with the earthworks. The objectives of both Manly and Warringah include allowing earthworks of a minor nature without requiring a separate development consent. Pittwater does not include this clause. Pittwater does not require the applicant to consider potential adverse impacts on watercourses or environmentally sensitive areas, whereas the other two do. All three refer to the "quality" of the fill or soil to be excavated. The term "quality" is undefined and open to multiple interpretations. The aim of this clause is unclear.	Revised composite clause which: Includes reference to groundwater dewatering. Aims to allow earthworks of a minor nature without requiring a separate development consent. Removes separate reference to disturbing relics as this is included under considering adverse impacts on any heritage item or archaeological site. Includes reference to potential for adverse impacts on watercourses or environmentally sensitive areas. Rewords the clause on "quality" of fill to refer to potential for contamination.
Coastal Hazards	Manly does not have a separate LEP clause on coastal hazards or coastal risk planning. The Pittwater and Warringah clauses have quite different wording and different emphases.	New clause to be drafted by Council's coastal management team, with reference to the geotechnical clauses applicable to Coastal Cliff Zones.

Clauses	Comments	Suggested Changes
Geotechnical Hazards	The Pittwater and Manly clauses are very similar except that Manly refers to "landslide" while Pittwater refers more generally to "geotechnical hazards". The Warringah clause concentrates specifically on developments on sloping land and the objectives and conditions are more specific, including avoiding adverse impacts on properties near the development due to slope instability caused by landslides or changes in stormwater runoff or subsurface (groundwater) flows which adversely affect the stability of the ground. All three clauses refer to the associated Landslide Risk or Geotechnical Hazard Maps	Change title of clause to Geotechnical Planning. Revised wording based on the more general wording used in the Pittwater and Manly clauses, but including a specific reference to the impact of changes to the subsurface flows. Remove reference to maps and change wording to state that the clause applies to "all land in the LGA".
Geotechnical Maps	The Pittwater maps show Hazard H1 and H2 Zones which are not defined on the plans. The Manly maps are combined ASS and Landslide Risk maps with only one zone indicating Landslide Risk and the zone boundaries running along lot boundaries rather than geotechnical features. The Warringah Maps show Landslide Risk Areas A to E, based on slopes with some special areas around Collaroy Plateau.	Prepare new combined maps for whole Northern Beaches LGA but include in the DCP rather than in the LEP so that changes can be made, if required, as more information becomes available from future geotechnical investigations.
Geotechnical Classes or Zones	Pittwater has two zones H1 and H2 which are not defined in either the LEP or the DCP. H1 appears to cover the steeper areas and H2 appears to be related to road cuts and fills. Manly has only one zone shown on the LEP maps showing lots which are affected by landslip, but in the DCP there is a more detailed map which includes four zones (G1 to G4) based mainly on topography. Warringah has five zones (A to E) based on topography, with special zones around the Collaroy Plateau area.	Divide whole area into seven zones based on a combination of topography and the underlying geology.
DCPs		
Slope Stability	Pittwater has minimal information contained within the DCP clause – all specific details, relating mainly to slope instability, are included in Appendix 5. which is very extensive. Appendix includes Forms 1 to 4 which are to be completed and submitted at different stages of development.	Base new clause on Pittwater general DCP clause Change reference to which land it applies to "All land" Revise Appendix to refer to new Geotechnical Planning Classes.

Clauses	Comments	Suggested Changes
	Manly refers to both landslip and subsidence and contains specific considerations for each of zones G1 to G4. Also includes some opinions on what stabilisation may be required. Specific requirements relate to the visual impact of the development and avoiding the loss of views. Schedule 11 provides a checklist for preliminary assessment and a flow chart which is based on the Warringah flowchart. Warringah objectives include geotechnical stability, minimising impact from stormwater discharge and on existing subsurface flows. Provides requirements for geotechnical and hydrological assessments in Areas A to E. Checklist for Council's assessment of site conditions includes flowchart.	Add reference to other geotechnical hazards relevant to the whole LGA to incorporate requirements relating to stormwater, groundwater and settlement. Include clear matrix in Appendix to determine when geotechnical or hydrogeological assessments or reports are required.
Earthworks	Pittwater clause is aimed solely at avoiding adverse stability impacts due to excavation and filling. Specifies extent of cut or fill for which Geotechnical Report is required at CC stage. Refers to Appendix 5. Manly clause has an emphasis on retaining the landscape character and limiting the change to topography and vegetation. Includes requirements on controlling sediment going into water courses and avoiding changes to natural groundwater and surface water flows. Excavation and filling limited to <1m and retaining walls within 1m of the front boundary must not exceed 1m. Warringah also has an emphasis on visual impact and requires that works do not generate airborne pollution or siltation of watercourses, that all filling is clean and revegetation of filling is undertaken.	Base clause on Pittwater clause General clauses added on: • any landfill must not be contaminated • avoiding air pollution, siltation or pollution of waterways • siltation and stormwater control devices must be in place during construction

The process for determining whether a preliminary geotechnical assessment, detailed geotechnical report or hydrogeological report is required for a development varies significantly between former council areas. A comparison of the different specific requirements is given in Table 3.

In all cases there are difficulties in defining minor works which do not require geotechnical assessments.

The Pittwater recommendations included in Appendix 5 are very comprehensive and based primarily on risk assessment of slope instability, but they are very wordy and more difficult to comprehend than the simpler Manly and Warringah documents. Only the Warringah clauses refer to the possible requirement for hydrological and hydrogeological reports to assess impacts on stormwater and groundwater.

Table 3: Comparison of Existing Requirements for Geotechnical Reports

Requirements for Geotechnical Reports	**Preliminary Geotechnical Assessment Required**	**Detailed Geotechnical Report Required**	**Hydrological or Hydrogeological Report Required**
Pittwater			
Required at DA stage for any land identified on maps as H1 or H2 or Coastal bluff areas		Yes	
Required at CC stage - for any development on any site that includes: • Any excavation >1m which is closer to the site boundary than the depth of excavation • Any excavation >1.5m below existing surface level • Any excavation that has potential to destabilise a tree • Any fill >1m • Any works that may affect or be affected by geotechnical processes (including low bearing capacity soils).		Yes	
If only "Minor development, minor alterations and/or development separate from geotechnical hazards" – Geotechnical engineer may assess that geotechnical report is not required	Yes	Possibly	
For "structures separated from the primary development, eg swimming pools, retaining walls" – Geotechnical engineer to determine level of investigation required.	Yes	Probably	
Warringah			
Not required if development does not include "any site, building or structural works".			
Class A – Plateau areas, footslopes and alluvial flats Not normally required. Council may require preliminary assessment	Not usually		
Class B – Flanking slopes Preliminary assessment required to see if geotechnical and hydrological report is required – Flowchart provided for assessment	Yes	Possibly	Possibly
Class C – Steeper slopes Geotechnical Report and Hydrological Assessment of stormwater discharge and subsurface flows required, unless preliminary geotechnical assessment indicates either is not required	Yes	Probably	Probably
Class D – Flanking slopes Collaroy Plateau	Yes	Possibly	Possibly

Requirements for Geotechnical Reports	**Preliminary Geotechnical Assessment Required**	**Detailed Geotechnical Report Required**	**Hydrological or Hydrogeological Report Required**
Preliminary assessment required to see if geotechnical and hydrological report is required – Flowchart provided for assessment			
Class E – Steeper slopes Collaroy plateau Geotechnical Report and Hydrological Assessment of stormwater discharge and subsurface flows required, unless preliminary geotechnical assessment indicates either is not required	Yes	Probably	Probably
Flowchart for Areas in Classes B and D - Geotechnical Report is required if: Site or adjacent sites have history of instability Proposed cuts or fills >2m depth On existing developed sites - Fill >1m or Cuts >2m On undeveloped sites - Slopes steeper than 1V:4H Natural cliffs higher than 3m		Yes	
Manly			
Required for any property identified on maps as being in a Landslip area		Yes	
Required for any excavation greater than 1m below natural ground level for a basement or basement car parking area		Yes	
Area G1 – Steeper slopes For load bearing building works – geotechnical report required (except for “minor works”)		Yes	
Areas G2, G3 and G4 – all other areas For load bearing building works – preliminary assessment required to determine whether geotechnical report is required using Schedule 11 checklist & flowchart	Yes	Possibly	
Schedule 11 – Includes checklist & flowchart (from Warringah DCP) Site or adjacent sites have history of instability Proposed cuts or fills >2m depth On existing developed sites - Fill >1m or Cuts >2m On undeveloped sites - Slopes steeper than 1V:4H Natural cliffs higher than 3m		Yes	

3. Review of Known Geotechnical Constraints

The historical differences in geotechnical planning for the Northern Beaches area have been based on the slightly differing geotechnical issues in each of the former council areas.

As indicated on Figure 1, while the bulk of the southern and western part of the Northern Beaches LGA is underlain by Hawkesbury Sandstone (light green), the northern peninsula and Collaroy plateau area are underlain by rocks of the Narrabeen Group (mid green), with numerous areas of typically low lying alluvial, estuarine or aeolian soils (light yellow).

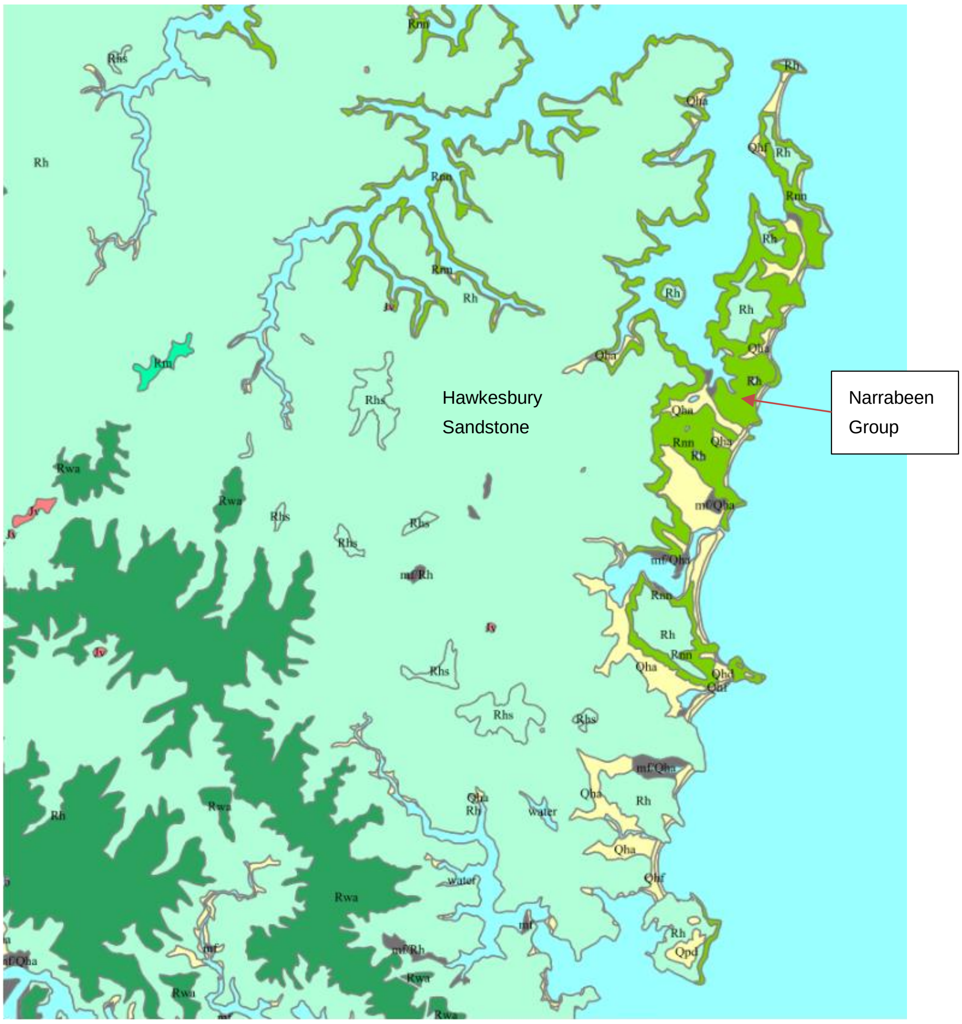

Figure 1: Regional Geology

Hawkesbury Sandstone is typically a series of thick horizontal beds of medium to coarse grained quartz sandstone. The soils forming on these rocks tend to be relatively shallow sandy soils and the landforms on areas of Hawkesbury Sandstone are usually relatively flat ridge crests or plateaus and slopes formed by a series of steps or cliffs, with or without large, potentially unstable joint blocks or boulders. Slopes developed on Hawkesbury Sandstone are usually relatively stable, the key hazards are the potential for collapse of cliff lines, boulders falling from cliffs caused by weathering of softer layers, root jacking by trees, water pressure along open joints or undermining of large boulders.

In contrast the rocks of the Narrabeen Group are known to be less stable. The rocks comprise a series of interbedded siltstones, claystones and fine grained lithic sandstones. These rocks weather more rapidly than the Hawkesbury Sandstone. Many of the slopes in the peninsula area and those around the Collaroy plateau area are underlain by thick colluvial deposits of soil and boulders which are derived from weathering of these rocks and have moved downslope under the forces of gravity, water and ancient landslides. Landslides are relatively common on slopes underlain by the Narrabeen Group rocks, particularly in areas where there have been excavations into the natural slopes or concentrations of stormwater.

The low lying areas underlain by alluvial, estuarine or aeolian soils are not usually affected by slope instability but may be affected by issues associated with low bearing capacity for foundations, settlement of soft soils, high groundwater tables, acid sulfate soils and coastal erosion or flooding.

The coastline of the Northern Beaches area is typified by a series of beaches and headland areas. The headlands are mostly near vertical cliff faces (coastal bluffs) formed within rocks of the Narrabeen Group. Studies have indicated that the overall erosion of the cliff faces is relatively slow (in human terms rather than geological time) but there is the potential at any stage for large sections of the cliff faces to collapse due to erosion and undercutting.

4. Consideration of Potential Impacts of Climate Change

Predicted effects of climate change over the next 50 years in the Sydney area include:

- possible sea level rises by about 0.4 m,
- the maximum summer temperatures may increase by 2-2.5 degrees;
- the average rainfall in the summer and autumn may increase by 10-20%; and
- there may be more extreme East Coast Low storms in the warmer months.

The predicted sea level rises will primarily increase the potential for flooding of low lying and coastal areas as well as coastal erosion, but will also increase the groundwater levels in low lying areas close to the coast. This could increase the risk of flooding of basement structures in these areas.

The predicted increase in maximum summer temperatures is not likely to have a direct impact on geotechnical hazards but could cause more cracking of exposed clay soil surfaces which could enable water to more readily penetrate into the clays.

The key impact of climate change on geotechnical hazards is likely to be the increased potential for periods of concentrated heavy rainfall which may overwhelm the existing stormwater systems and result in saturation of soils. This is one of the key triggers for many landslides.

5. Recommendations for Planning Controls and Assessment relating to Geotechnical Hazards

DP has reviewed the existing planning controls and has provided suggestions for proposed new clauses and controls that seek to combine the content of the previous planning controls and develop one standard system that can be applied to all areas of the Northern Beaches LGA.

The maps for the LGA have been revised to develop seven new geotechnical planning classes which cover all of the LGA based on underlying geology, existing slopes and proximity to the coastal cliff line. It is proposed that these maps be included within the new DCP rather than the LEP, to allow for changes and modifications to be made if more information becomes available from detailed site investigations. The system used for the suggested new Classes is given in Appendix C, together with a matrix indicating the proposed requirements for geotechnical reports at development application stage.

The proposed Classes 1 to 6 are based simply on combinations of the underlying geology and the ground slopes. Class 7 (Coastal Cliff Zone) has been developed by identifying all slopes along the coastline between Barrenjoey Head and the Spit Bridge which are steeper than 45 degrees, and then plotting an area which starts 20 m upslope of the crest of the slope (refer Figure 2). While the zone shown on the maps is a uniform width of 40 m for plotting purposes only, in all cases the Coastal Cliff Zone extends to water level in the downslope direction.

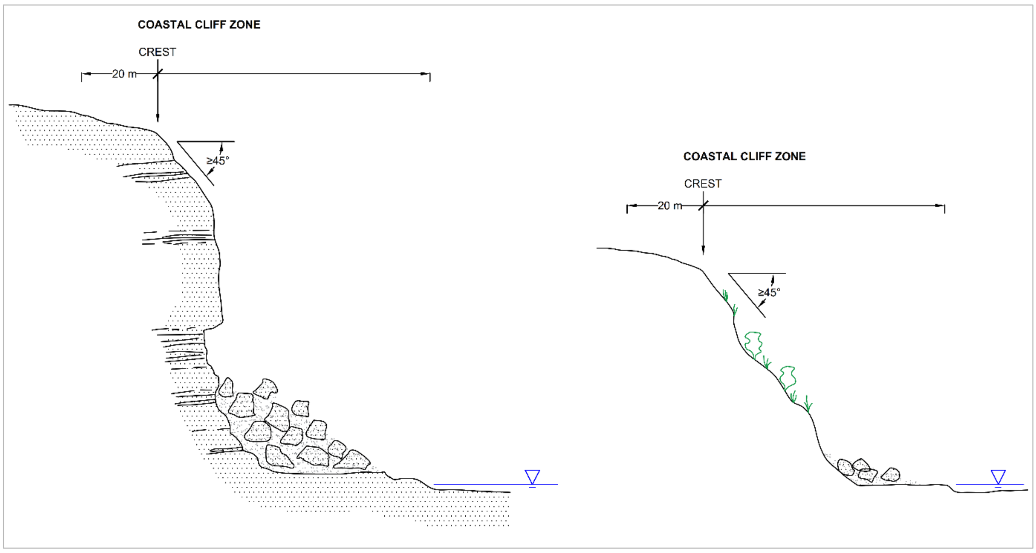

Figure 2: Definition of Coastal Cliff Zone used on maps

The new LEP and DCP clauses are based primarily on the existing Pittwater clauses but modifications have been suggested to incorporate some of the measures previously included in the Warringah and Manly clauses relating to other geotechnical issues. The majority of the geotechnical requirements are contained within an Appendix to the DCP (similar to the previous Pittwater Appendix 5) but the appendix has been revised to incorporate geotechnical hazards other than slope instability and to simplify the requirements.

The revised new appendix includes revised Forms 1 to 4, which contain references to a range of geotechnical issues (see Appendix C). DP suggests that the current Pittwater references to coastal engineers be removed from the geotechnical planning controls for coastal cliff areas as coastal engineers are usually experienced in erosion of sediments and flooding of low areas, rather than stability of rock faces. DP suggests that the coastal engineers' input will be included within revised clauses on coastal hazards, rather than with the geotechnical controls, and that the revised coastal hazard clauses will reference the geotechnical clauses for issues relating to stability of coastal cliff areas.

6. Limitations

Douglas Partners (DP) has prepared this report for Northern Beaches Council. This report is provided for the exclusive use of Northern Beaches Council for the purposes as described in the report. It should not be used by or be relied upon for other projects or purposes. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client.

DP has prepared maps of the area based upon published mapping of geology and slopes within the Northern Beaches Local Government area. The accuracy of the mapping has not been verified by DP and the advice provided by DP in this report may be affected by variations in ground conditions across the area.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

Please contact the undersigned if you have any questions on this matter.

Yours faithfully
Douglas Partners Pty Ltd Reviewed by

Fiona MacGregor
Principal

John Braybrooke
Principal

Appendices A: Comparison of detailed LEP Clauses
Table A1 LEP Acid Sulfate Soil Clauses
Table A2 LEP Earthworks Clauses
Table A3 LEP Coastal Hazard Clauses
Table A4 LEP Geotechnical Hazard Clauses
Table A5 Comparison of Landslide Risk Classes used on Existing Maps

B: Comparison of detailed DCP Clauses
Table B1 DCP Landslide Clauses
Table B2 DCP Earthworks Clauses

C: Suggested New Planning Controls
Table C1 Suggested New Geotechnical Planning Classes
Table C2 Suggested Requirements for Geotechnical Reports
C3: Proposed New Appendix to DCP Geotechnical Planning Clause

Appendix A

Comparison of Detailed LEP Clauses

Table A1 - Existing LEP Acid Sulfate Soil Clauses

<table>
<tr><th>Pittwater Local Environmental Plan 2014</th><th>Manly Local Environmental Plan 2013</th><th>Warringah Local Environmental Plan 2011</th><th>Suggested New Clause</th></tr>
<tr>
<td>7.1 Acid sulfate soils
1) The objective of this clause is to ensure that development does not disturb, expose or drain acid sulfate soils and cause environmental damage.

2) Development consent is required for the carrying out of works described in the table to this subclause on land shown on the Acid Sulfate Soils Map as being of the class specified for those works.
<table>
<tr><th>Class of Land</th><th>Works</th></tr>
<tr><td>1</td><td>Any works</td></tr>
<tr><td>2</td><td>Works below the natural ground surface.
Works by which the watertable is likely to be lowered</td></tr>
<tr><td>3</td><td>Works more than 1 metre below the natural ground surface.
Works by which the watertable is likely to be lowered more than 1 metre below the natural ground surface.</td></tr>
<tr><td>4</td><td>Works more than 2 metres below the natural ground surface.
Works by which the watertable is likely to be lowered more than 2 metres below the natural ground surface.</td></tr>
<tr><td>5</td><td>Works within 500 metres of adjacent Class 1, 2, 3 or 4 land that is below 5 metres Australian Height Datum and by which the water table is likely to be lowered below 1 metre Australian Height Datum on adjacent Class 1, 2, 3 or 4 land.</td></tr>
</table>
3) Development consent must not be granted under this clause for the carrying out of works unless an acid sulfate soils management plan has been prepared for the proposed works in accordance with the Acid Sulfate Soils Manual and has been provided to the consent authority.

4) Despite subclause (2), development consent is not required under this clause for the carrying out of works if –
a) a preliminary assessment of the proposed works prepared in accordance with the Acid Sulfate Soils Manual indicates that an acid sulfate soils management plan is not required for the works, and

b) the preliminary assessment has been provided to the consent authority and the consent authority has confirmed the assessment by notice in writing to the person proposing to carry out the works.

5) Despite subclause (2), development consent is not required under this clause for the carrying out of any of the following works by a public authority (including ancillary work such as excavation, construction</td>
<td>6.1 Acid sulfate soils
1) The objective of this clause is to ensure that development does not disturb, expose or drain acid sulfate soils and cause environmental damage.

2) Development consent is required for the carrying out of works described in the Table to this subclause on land shown on the Acid Sulfate Soils Map as being of the class specified for those works.
<table>
<tr><th>Class of Land</th><th>Works</th></tr>
<tr><td>1</td><td>Any works</td></tr>
<tr><td>2</td><td>Works below the natural ground surface.
Works by which the watertable is likely to be lowered</td></tr>
<tr><td>3</td><td>Works more than 1 metre below the natural ground surface.
Works by which the watertable is likely to be lowered more than 1 metre below the natural ground surface.</td></tr>
<tr><td>4</td><td>Works more than 2 metres below the natural ground surface.
Works by which the watertable is likely to be lowered more than 2 metres below the natural ground surface.</td></tr>
<tr><td>5</td><td>Works within 500 metres of adjacent Class 1, 2, 3 or 4 land that is below 5 metres Australian Height Datum and by which the water table is likely to be lowered below 1 metre Australian Height Datum on adjacent Class 1, 2, 3 or 4 land.</td></tr>
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3) Development consent must not be granted under this clause for the carrying out of works unless an acid sulfate soils management plan has been prepared for the proposed works in accordance with the Acid Sulfate Soils Manual and has been provided to the consent authority.

4) Despite subclause (2), development consent is not required under this clause for the carrying out of works if –
a) a preliminary assessment of the proposed works prepared in accordance with the Acid Sulfate Soils Manual indicates that an acid sulfate soils management plan is not required for the works, and

b) the preliminary assessment has been provided to the consent authority and the consent authority has confirmed the assessment by notice in writing to the person proposing to carry out the works.

5) Despite subclause (2), development consent is not required under this clause for the carrying out of any of the following works by a public authority (including ancillary work such as excavation, construction</td>
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Works by which the watertable is likely to be lowered</td></tr>
<tr><td>3</td><td>Works more than 1 metre below the natural ground surface.
Works by which the watertable is likely to be lowered more than 1 metre below the natural ground surface.</td></tr>
<tr><td>4</td><td>Works more than 2 metres below the natural ground surface.
Works by which the watertable is likely to be lowered more than 2 metres below the natural ground surface.</td></tr>
<tr><td>5</td><td>Works within 500 metres of adjacent Class 1, 2, 3 or 4 land that is below 5 metres Australian Height Datum and by which the water table is likely to be lowered below 1 metre Australian Height Datum on adjacent Class 1, 2, 3 or 4 land.</td></tr>
</table>
3) Development consent must not be granted under this clause for the carrying out of works unless an acid sulfate soils management plan has been prepared for the proposed works in accordance with the Acid Sulfate Soils Manual and has been provided to the consent authority.

4) Despite subclause (2), development consent is not required under this clause for the carrying out of works if –
a) a preliminary assessment of the proposed works prepared in accordance with the Acid Sulfate Soils Manual indicates that an acid sulfate soils management plan is not required for the works, and

b) the preliminary assessment has been provided to the consent authority and the consent authority has confirmed the assessment by notice in writing to the person proposing to carry out the works.

5) Despite subclause (2), development consent is not required under this clause for the carrying out of any of the following works by a public authority (including ancillary work such as excavation, construction</td>
<td>Existing clauses are all the same – and all refer to Acid Sulfate Soils Maps within LEP

Recommend retain existing clause and ASS maps within LEP</td>
</tr>
</table>

of access ways or the supply of power) – a) emergency works, being the repair or replacement of the works of the public authority, required to be carried out urgently because the works have been damaged, have ceased to function or pose a risk to the environment or to public health and safety, b) routine maintenance work, being the periodic inspection, cleaning, repair or replacement of the works of the public authority (other than work that involves the disturbance of more than 1 tonne of soil), c) minor work, being work that costs less than $20,000 (other than drainage work). 6) Despite subclause (2), development consent is not required under this clause to carry out works if – a) the works involve the disturbance of less than 1 tonne of soil, and b) the works are not likely to lower the watertable.	of access ways or the supply of power) – a) emergency works, being the repair or replacement of the works of the public authority, required to be carried out urgently because the works have been damaged, have ceased to function or pose a risk to the environment or to public health and safety, b) routine maintenance work, being the periodic inspection, cleaning, repair or replacement of the works of the public authority (other than work that involves the disturbance of more than 1 tonne of soil), c) minor work, being work that costs less than $20,000 (other than drainage work). 6) Despite subclause (2), development consent is not required under this clause to carry out works if – a) the works involve the disturbance of less than 1 tonne of soil, and b) the works are not likely to lower the watertable.	of access ways or the supply of power) – a) emergency works, being the repair or replacement of the works of the public authority, required to be carried out urgently because the works have been damaged, have ceased to function or pose a risk to the environment or to public health and safety, b) routine maintenance work, being the periodic inspection, cleaning, repair or replacement of the works of the public authority (other than work that involves the disturbance of more than 1 tonne of soil), c) minor work, being work that costs less than $20,000 (other than drainage work). 6) Despite subclause (2), development consent is not required under this clause to carry out works if – a) the works involve the disturbance of less than 1 tonne of soil, and b) the works are not likely to lower the watertable.	
Separate ASS and Geotechnical Hazard Plans	Combined ASS and Landslide Risk Plans	Separate ASS and Geotechnical Hazard Plans	ASS Plans to be included with LEP

Table A2 - Existing LEP Earthworks Clauses

Pittwater Local Environmental Plan 2014	Manly Local Environmental Plan 2013	Warringah Local Environmental Plan 2011	Suggested New Clause
7.2 Earthworks	**6.2 Earthworks**	**6.2 Earthworks**	**Earthworks**
1) The objective of this clause is to ensure that earthworks for which development consent is required will not have a detrimental impact on environmental functions and processes, neighbouring uses, cultural or heritage items or features of the surrounding land.	1) The objectives of this clause are as follows –	1) The objectives of this clause are as follows –	1) The objectives of this clause are as follows –
	a) to ensure that earthworks and associated groundwater dewatering for which development consent is required will not have a detrimental impact on environmental functions and processes, neighbouring uses, cultural or heritage items or features of the surrounding land,	a) to ensure that earthworks for which development consent is required will not have a detrimental impact on environmental functions and processes, neighbouring uses, cultural or heritage items or features of the surrounding land,	a) to ensure that earthworks and associated groundwater dewatering for which development consent is required will not have a detrimental impact on environmental functions and processes, neighbouring uses, cultural or heritage items or features of the surrounding land,
	b) to allow earthworks of a minor nature without requiring a separate development consent.	b) to allow earthworks of a minor nature without requiring a separate development consent.	b) to allow earthworks of a minor nature without requiring a separate development consent.
2) Development consent is required for earthworks unless –	2) Development consent is required for earthworks unless –	2) Development consent is required for earthworks unless –	2) Development consent is required for earthworks unless –
a) the earthworks are exempt development under this Plan or another applicable environmental planning instrument, or	a) the earthworks are exempt development under this Plan or another applicable environmental planning instrument, or	a) the work is exempt development under this Plan or another applicable environmental planning instrument, or	a) the earthworks are exempt development under this Plan or another applicable environmental planning instrument, or
b) the earthworks are ancillary to development that is permitted without consent under this Plan or to development for which development consent has been given.	b) the earthworks are ancillary to development that is permitted without consent under this Plan or to development for which development consent has been given.	b) the work is ancillary to other development for which development consent has been given.	b) the earthworks are ancillary to development that is permitted without consent under this Plan or to development for which development consent has been given.
3) In deciding whether to grant development consent for earthworks (or for development involving ancillary earthworks), the consent authority must consider the following matters –	3) Before granting development consent for earthworks (or for development involving ancillary earthworks), the consent authority must consider the following matters –	3) Before granting development consent for earthworks, the consent authority must consider the following matters –	3) In deciding whether to grant development consent for earthworks (or for development involving ancillary earthworks), the consent authority must consider the following matters –
a) the likely disruption of, or any detrimental effect on, drainage patterns and soil stability in the locality of the development,	a) the likely disruption of, or any detrimental effect on, drainage patterns and soil stability in the locality of the development,	a) the likely disruption of, or any detrimental effect on, existing drainage patterns and soil stability in the locality,	a) the likely disruption of, or any detrimental effect on, existing drainage patterns and soil stability in the locality of the development,
b) the effect of the development on the likely future use or redevelopment of the land,	b) the effect of the development on the likely future use or redevelopment of the land,	b) the effect of the proposed development on the likely future use or redevelopment of the land,	b) the effect of the proposed development on the likely future use or redevelopment of the land,
c) the quality of the fill or the soil to be excavated, or both,	c) the quality of the fill or the soil to be excavated or both,	c) the quality of the fill or the soil to be excavated, or both,	c) the possibility that the fill or the soils to be excavated are contaminated,
d) the effect of the development on the existing and likely amenity of adjoining properties,	d) the effect of the development on the existing and likely amenity of adjoining properties,	d) the effect of the proposed development on the existing and likely amenity of adjoining properties,	d) the effect of the proposed development on the existing and likely amenity of adjoining properties,
e) the source of any fill material and the destination of any excavated material,	e) the source of any fill material and the destination of any excavated material,	e) the source of any fill material and the destination of any excavated material,	e) the source of any fill material and the destination of any excavated material,
f) the likelihood of disturbing relics,	f) the likelihood of disturbing relics,	f) the likelihood of disturbing relics,	f) the proximity to and potential for adverse impacts on any heritage item, archaeological site or heritage conservation area,
g) the proximity to and potential for adverse impacts on any heritage item, archaeological site or heritage conservation area.	g) the proximity to, and potential for adverse impacts on, any waterway, drinking water catchment or environmentally sensitive area,	g) the proximity to and potential for adverse impacts on any watercourse, drinking water catchment or environmentally sensitive area,	g) the proximity to and potential for adverse impacts on any watercourse, drinking water catchment or environmentally sensitive area.
4) In this clause – ***environmentally sensitive area*** has the same meaning as environmentally sensitive area for exempt or complying development in clause 3.3	h) any appropriate measures proposed to avoid, minimize or mitigate the impacts of the development		

Table A3 - Existing LEP Coastal Hazard Clauses

Pittwater Local Environmental Plan 2014	Manly Local Environmental Plan 2013	Warringah Local Environmental Plan 2011	Suggested New Clause
7.5 Coastal risk planning 1) The objectives of this clause are as follows – a) to avoid significant adverse impacts from coastal hazards, b) to ensure uses of land identified as coastal risk are compatible with the risks presented by coastal hazards, c) to enable the evacuation of land identified as coastal risk in an emergency, d) to avoid development that increases the severity of coastal hazards. 2) This clause applies to land identified on the Coastal Risk Planning Map as - a) Wave Inundation, or b) Coastal Erosion/Wave Inundation, or c) Bluff/Cliff Instability. 3) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development - a) is not likely to cause detrimental increases in coastal risks to other development or properties, and b) is not likely to alter coastal processes and the impacts of coastal hazards to the detriment of the environment, and c) incorporates appropriate measures to manage risk to life from coastal risks, and d) is likely to avoid or minimise adverse effects from the impact of coastal processes and the exposure to coastal hazards, particularly if the development is located seaward of the immediate hazard line, and e) provides for the relocation, modification or removal of the development to adapt to the impact of coastal processes and coastal hazards, and f) has regard to the impacts of sea level rise, and will have an acceptable level of risk to both property and life, in relation to all identifiable coastline hazards. 4) A word or expression used in this clause has the same meaning as it has in the *NSW Coastal Planning Guideline: Adapting to Sea Level Rise* (ISBN 978-1-74263-035-9) published by the NSW Government in August 2010, unless it is otherwise defined in this clause. 5) In this clause – ***coastal hazard*** has the same meaning as in the Coastal Management Act 2016.	*No specific clauses on coastal risk - maps show most coastal areas are included as landslip risk.*	**6.5 Coastal hazards** 1) The objectives of this clause are as follows – a) to avoid significant adverse impacts from coastal hazards, b) to enable evacuation of coastal risk areas in an emergency, c) to ensure uses are compatible with coastal risks, d) to preserve and protect Collaroy Beach, Narrabeen Beach and Fishermans Beach as national assets for public recreation and amenity. 2) This clause applies to the land identified on the Coastal Hazard Map as - a) Area of Wave Impact and Slope Adjustment, and b) Area of Reduced Foundation Capacity. 3) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development - a) will not significantly adversely affect coastal hazards, and b) will not result in significant detrimental increases in coastal risks to other development or properties, and c) will not significantly alter coastal hazards to the detriment of the environment, and d) incorporates appropriate measures to manage risk to life from coastal risks, and e) avoids or minimises exposure to coastal hazards, and f) makes provision for the relocation, modification or removal of the development to adapt to coastal hazards and NSW sea level rise planning benchmarks. 4) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the foundations of the development have been designed to be constructed having regard to coastal risk. 5) A word or expression used in this clause has the same meaning as it has in the *NSW Coastal Planning Guideline: Adapting to Sea Level Rise* (ISBN 978-1-74263-035-9) published by the NSW Government in August 2010, unless it is otherwise defined in this Plan.	New clause to be drafted by Council's coastal management team, with reference to the geotechnical planning clauses applicable to Coastal Cliff Zones

Table A4 - Existing LEP Geotechnical Clauses

Pittwater Local Environmental Plan 2014	Manly Local Environmental Plan 2013	Warringah Local Environmental Plan 2011	Suggested New Clause
7.7 Geotechnical hazards 1) The objectives of this clause are to ensure that development on land susceptible to geotechnical hazards - a) matches the underlying geotechnical conditions of the land, and b) is restricted on unsuitable land, and c) does not endanger life or property.	**6.8 Landslide Risk** 1) The objectives of this clause are to ensure that development on land susceptible to landslide - a) matches the underlying geotechnical conditions of the land, and b) is restricted on unsuitable land, and c) does not endanger life or property.	**6.4 Development on sloping land** 1) The objectives of this clause are as follows – a) to avoid significant adverse impacts on development and on properties in the vicinity of development sites resulting from landslides originating either on or near sloping land, b) to ensure the impacts of storm water runoff from development on or near sloping land are minimised so as to not adversely affect the stability of the subject and surrounding land, c) to ensure subsurface flows are not adversely affected by development so as to not impact on the stability of existing or adjoining land.	**Geotechnical Planning** 1) The objectives of this clause are to ensure that development on land susceptible to geotechnical hazards - a) matches the underlying geotechnical conditions of the land, and b) is restricted on unsuitable land, and c) does not endanger life or property.
2) This clause applies to land identified as "Geotechnical Hazard H1" and "Geotechnical Hazard H2" on the Geotechnical Hazard Map.	2) This clause applies to land identified as "Landslide risk" on the Landslide Risk Map.	2) This clause applies to land shown as Area A, Area B, Area C, Area D and Area E on the Landslip Risk Map.	2) This clause applies to all land in the LGA.
3) Before determining a development application for development on land to which this clause applies, the consent authority must consider the following matters to decide whether or not the development takes into account all geotechnical risks - a) site layout, including access, b) the development's design and construction methods, c) the amount of cut and fill that will be required for the development, d) waste water management, stormwater and drainage across the land, e) the geotechnical constraints of the site, f) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development 4) Development consent must not be granted to development on land to which this clause applies unless – a) the consent authority is satisfied that the development will appropriately manage waste water, stormwater and drainage across the land so as not to affect the rate, volume and quality of water leaving the land, and b) the consent authority is satisfied that – i) the development is designed, sited and will be managed to avoid any geotechnical risk or significant adverse impact on the development and the land surrounding the development, or ii) if that risk or impact cannot be reasonably avoided – the development is designed, sited and will be managed to minimise that risk or impact, or iii) if that risk or impact cannot be minimised – the development will	3) Before determining a development application for development on land to which this clause applies, the consent authority must consider the following matters to decide whether or not the development takes into account the risk of landslide - a) site layout, including access, b) the development's design and construction methods, c) the amount of cut and fill that will be required for the development, d) waste water management, stormwater and drainage across the land, e) the geotechnical constraints of the site, f) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development 4) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development will appropriately manage waste water, stormwater and drainage across the land so as not to affect the rate, volume and quality of water leaving the land, and that – a) the development is designed, sited and will be managed to avoid any landslide risk or significant adverse impact on the development and the land surrounding the development, or b) if that risk or impact cannot be reasonably avoided – the development is designed, sited and will be managed to minimise that risk or impact, or c) if that risk or impact cannot be minimised – the development will be managed to mitigate that risk or impact.	3) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that - a) the application for development has been assessed for the risk associated with landslides in relation to both property and life, and b) the development will not cause significant detrimental impacts because of stormwater discharge from the development site, and c) the development will not impact on or affect the existing subsurface flow conditions. d) waste water management, stormwater and drainage across the land, e) the geotechnical constraints of the site, f) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development	3) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that – a) the development will appropriately manage waste water, stormwater and drainage across the land so as not to adversely affect the rate, volume and quality of water leaving the land, or adversely impact the stability of the land or adjoining land, b) the development is designed to ensure that any changes to existing subsurface flow conditions do not adversely impact on the land or adjoining land, and c) the development is designed, sited and will be managed to avoid any geotechnical risk or significant adverse impact on the development and the land surrounding the development. If that risk or impact cannot be reasonably avoided – the development is designed, sited and will be managed to minimise that risk or impact.

be managed to mitigate that risk or impact.			
		Warringah LEP 2000 – Deferred Land	
		57 Development on sloping land On sloping land, the height and bulk of development, particularly on the downhill side, is to be minimised and the need for cut and fill reduced by designs which minimise the building footprint and allow the building mass to step down the slope. In particular – • the amount of fill is not to exceed more than 1 metre in depth, and • fill is not to spread beyond the footprint of the building, and • excavation of the landform is to be minimised. The geotechnical stability of sloping land to support development is to be demonstrated. Consent must not be granted for development involving the erection of a structure, including additions to an existing structure, on land identified as being potentially subject to landslip on the Landslip Hazard Map unless the consent authority has considered a report from a suitably qualified engineer as to the geotechnical stability of the land to support such a development and an assessment of stormwater prepared by a suitably qualified hydraulic engineer.	

Table A5 – Comparison of Landslide Risk Classes used on Existing Maps

Pittwater Landslide Risk Classes

Class	Description		Council Require
H1	Coloured red with "W"	Class not defined in LEP or DCP	Geotechnical Report
H2	Coloured orange with "AE"	Class not defined in LEP or DCP	Geotechnical Report
	Any Excavation and Landfill activities which include:	Excavation >1m close to boundary or structure	Geotechnical Report required for any excavation or landfill activities as outlined.
		Any excavation > 1.5m	
		Excavation with potential to destabilise trees	
		Fill >1.0m	
		Any works which may be affected by geotechnical processes, for example sites with low bearing capacity soils	

Manly Landslide Risk Classes

Class	Description	Slope Angle (degrees)	Geology	Council Require
G1	Steeper slopes, generally near coastal or harbourside areas	>25	Not specified	Geotechnical assessment is required.
G2	Flanking slopes	15 to 25	Not specified	Geotechnical assessment may be required.
G3	Beach foredune and alluvial flats	<5	Not specified	Should follow good engineering practice
G4	Ridge crests, major spur slopes and dissected plateau areas	<15	Not specified	Geotechnical assessment may be required.

Notes:

- These zones are not shown on maps included in LEP – shown on a map included in DCP as Schedule 1.
- Boundaries approximate only
- Ref: Coffey Report S20199/1-AM November 1999.
- More details on Sheets 1 to 5 held at Manly Council's Customer Service Centre.

Warringah Landslide Risk Classes

Class	Topographic Position	Slope Angle (degrees)	Geology	From Checklist
A	Plateau areas, ridge crests, major spur slopes, footslope areas: and beach foredune and alluvial flats	<5	At higher elevations, generally shallow residual soils developed on Hawkesbury Sandstone. Hawkesbury Sandstone exposed in occasional outcrops and in near vertical road cuts. Some areas of fill. At lower elevations, unconsolidated marine and alluvial sands often overlying deep marine sediments.	Geotechnical report not normally required.
B	Flanking slopes	5 to 25	Colluvial and residual soils, possibly deeper than in Class A, developed on Hawkesbury Sandstone. Minor detached sandstone blocks, occasional exposures of sandstone in cliffs and road cuts. Occasional fill areas associated with playing fields, roads and some developments.	Preliminary assessment of site conditions required to determine whether a geotechnical report is required.
C	Steeper slopes, generally near coastal areas adjacent to creeks and major gullies	>25	Colluvial soils and bouldery talus, with detached blocks of sandstone on steep escarpment areas, developed on Hawkesbury Sandstone. Near vertical cliffs to approximately 50m high at Dee Why Head.	Geotechnical report required.
D	Flanking slopes (Collaroy Plateau area)	5 to 15	Colluvial and residual soils (possibly deeper than in Class A) developed on Narrabeen Group or Hawkesbury Sandstone. Minor detached sandstone blocks, occasional exposures of sandstone in cliffs and road cuts. Occasional fill areas associated with playing fields, roads and some developments.	Preliminary assessment of site conditions required to determine whether a geotechnical report is required.
E	Steeper slopes (Collaroy Plateau area)	>15	Colluvial & residual soils & bouldery talus, with detached blocks of sandstone on steeper escarpment areas, developed on Narrabeen Group or Hawkesbury Sandstone. Near vertical cliffs up to about 20m high.	Geotechnical report required.

Appendix B

Comparison of Detailed DCP Clauses

Table B1 - Existing DCP Landslide Clauses

Pittwater 21 Development Control Plan	Manly Development Control Plan 2013	Warringah Development Control Plan 2011	Suggested New Clause
Section B General Controls **B3 Hazard Controls** **B3.1 Landslip Hazard** **Land to which this control applies** Land identified on the Pittwater Local Environmental Plan 2014 Geotechnical Hazard Map **Uses to which this control applies** *See extensive list* **Outcomes** Protection of people. (S) Protection of the natural environment. (En) Protection of private and public infrastructure and assets (S) **Controls** All development on land to which this control applies must comply with the requirements of the Geotechnical Risk Management Policy for Pittwater (see Appendix 5). Development must be designed and constructed to ensure that every reasonable and practical means available is used to remove risk to an acceptable level as defined by the Geotechnical Risk Management Policy for Pittwater (see Appendix 5) for the life of the development. The development must not adversely affect or be adversely affected by geotechnical processes nor must it increase the level of risk for any people, assets and infrastructure in the vicinity due to geotechnical hazards. **Variations** Nil	**Part 4 Development Controls** **4.1.8 Development on Sloping Sites** Relevant DCP objectives to be met in relation to these paragraphs include: **Objective 1)** To ensure that Council and the community are aware of, and appropriately respond to all identified potential landslip & subsidence hazards. **Objective 2)** To provide a framework and procedure for identification, analysis, assessment, treatment and monitoring of landslip and subsidence risk and ensure that there is sufficient information to consider and determine DAs on land which may be subject to slope instability. **Objective 3)** To encourage development and construction this is compatible with the landslip hazard and to reduce the risk and costs of landslip and subsidence to existing areas. See also paragraph 4.4.5 Earthworks (Excavation and Filling) of this plan, Clause 6.2 of the Manly LEP 2013, paragraph 4.1.2 Height of Buildings in respect of sloping sites and paragraph 3.1.1.1.b Setback Principles in Low Density Areas **Note:** Development on sloping sites often require geological survey to consider the stability of the slope and the suitability of the proposed design for that slope. **Requirements** a) The design of development must respond to the slope of the site, to minimise loss of views and amenity from public and private spaces. b) Developments on sloping sites must be designed to: i. generally step with the topography of the site; and ii. avoid large undercroft spaces and minimise supporting undercroft structures by integrating the building into the slope whether to the foreshore or a street. <u>Driveways on sloping sites</u> c) On steep sites, driveways must be designed so they do not dominate the street frontage, by: i. limiting their height above existing ground level to avoid the need for elevated ramps and similar structures to access car parking areas, especially those which may encroach on public land; ii. limiting their width; iii. using materials that do not visually detract from the natural surroundings; and iv. retaining significant trees. **When is a Site Stability (Geotechnical Survey) Report required?** a) A Site Stability Report is required with a DA when the proposed development involves: i. any land identified on the LEP Landslide Risk Map. DAs for development on land identified on the LEP Landslide Risk Map must consider certain matters under LEP clause 6.8; ii. any excavation greater than 1m below natural ground level for a basement or basement car parking area;	**E10 Landslip Risk** **Applies to Land** This control applies to land identified on the Warringah Local Environmental Plan 2011 – Landslip Risk Map as Area A, Area B, Area C, Area D or Area E. **Objectives** • To ensure development is geotechnical stable. • To ensure good engineering practice. • To ensure there is no adverse impact on existing subsurface flow conditions. • To ensure there is no adverse impact resulting from stormwater discharge. **Requirements** 1. The applicant must demonstrate that: i) The proposed development is justified in terms of geotechnical stability; and ii) The proposed development will be carried out in accordance with good engineering practice. 2. Development must not cause detrimental impacts because of stormwater discharge from the land. 3. Development must not cause detrimental impact on the existing subsurface flow conditions including those of other properties. 4. To address Requirements 1 to 3: i) For land identified as being in Area A: Council may decide that a preliminary assessment of site conditions is required. If Council so decides, a preliminary assessment of site conditions must be prepared, in accordance with the Checklist for Council's assessment of site conditions (see Notes) by a suitably qualified geotechnical engineer/engineering geologist. The preliminary assessment must be submitted to Council before the granting of any development consent. If the preliminary assessment determines that a geotechnical report is required, the same provisions apply in Area A as those that apply in Area B and Area D. ii) For land identified as being in Area B or D: A preliminary assessment of site conditions (see Notes) must be carried out for development. The preliminary assessment must be prepared by a suitably qualified geotechnical engineer/engineering geologist and must be submitted with the development application. If the preliminary assessment determines that a geotechnical report is required a report must be prepared by a suitably qualified geotechnical engineer / engineering geologist and	**Geotechnical Planning** **Land to which this control applies** All land to which Northern Beaches Local Environmental Plan 20xx applies. **Objectives** O1. To ensure development is geotechnical stable. O2. To ensure good engineering practice. O3. To ensure there is no adverse impact on existing subsurface flow conditions. O4. To ensure there is no adverse impact resulting from stormwater discharge. **Requirements** All development must comply with the requirements of the Geotechnical Planning Policy for Northern Beaches LGA (*naming of policy TBC*). Development must be designed and constructed to ensure that every reasonable and practical means available is used to remove geotechnical risk to an acceptable level as defined by the Geotechnical Planning Policy (*naming of policy TBC*) for the life of the development. The development must not adversely affect or be adversely affected by geotechnical processes, nor must it increase the level of risk for any people, assets and infrastructure in the vicinity due to geotechnical hazards.

	iii. building works (load bearing) on land contained in geotechnical area 'G1' in the Potential Geotechnical Landslip Hazard Map at Schedule 1 to this plan; or iv. building works (load bearing) on other land not contained in geotechnical area 'G1'. i.e. areas 'G2', 'G3' and 'G4' where a Preliminary Assessment of Site Conditions (Landslip) determines the need for a Site Stability Report, or where otherwise required by Council. **Note:** Applicants must consider which geotechnical area their property falls under in accordance with the Map of Geotechnical Areas at Schedule 1 to this DCP. Considerations for each geotechnical area include geotechnical implications on development; potential geotechnical hazards and typical consequences of failure. **Considerations required in Geotechnical area 'G1'** a) <u>Site Stability Report required in geotechnical Area 'G1'</u> DAs for load bearing building works to be carried out on land or in the vicinity of land in geotechnical area 'G1' on the Potential Geotechnical Landslip Hazard Map (see Schedule 1 to this plan) must be accompanied by a Site Stability Report. b) <u>Detailed Requirements:</u> When considering a Construction Certificate application, the Certifying Authority must be satisfied that any construction intended in the area includes appropriate precautions to prevent instability developing. Construction Certificate drawings should be viewed by the geotechnical engineer to confirm that the intent of the geotechnical recommendations has been correctly implemented. Site visits by geotechnical engineer may be appropriate during construction. Notwithstanding the above, Site Stability Report may not be required for minor works proposed in area G1 at the discretion of Council. c) <u>Potential Geotechnical Hazards & Typical Consequences of Failure:</u> i) Rock falls and rock toppling from natural cliffs, together with slumping of soil and fill materials from unsupported cuts onto public and private roadways and pathways are potential hazards in area G1. ii) Down slope creep of deeper talus materials may occur on steeper soil covered slopes as well as possible down slope movement of detached blocks of sandstone, soil slumps and flows. Typical consequences of failure include moderate damage to some of structure, ranging to possible extensive damage to most of structure, or extending beyond site boundaries. Significant part of site may require large stabilisation works if landslide occurs, or to prevent landslide occurring. **Considerations required in Other Geotechnical Areas (Areas G2, G3 and G4)** a) <u>Site Stability Report may be required in Geotechnical Areas G2, G3 and G4</u> i) The applicant should complete Council's Checklist for Preliminary Assessment of Site Conditions (Landslip) at Schedule 11 of this plan to determine whether a Site	must be submitted with the development application. Also if the preliminary assessment determines that a geotechnical report is required a hydrological assessment of stormwater discharge and subsurface flow conditions, prepared by a suitably qualified geotechnical/hydrological engineer, must be submitted with the development application. iii) For land identified a being in Area C or Area E. A geotechnical report, prepared by a suitably qualified geotechnical engineer / engineering geologist, must be submitted with the development application. Also a hydrological assessment of stormwater discharge and subsurface flow conditions, prepared by a suitably qualified geotechnical/hydrological engineer, must be submitted with the development application. iv) When a geotechnical report is required to be submitted, (determined in accordance with i) to iii) above), the report must include a risk assessment of landslip in relation to both property and life. The risk assessment must have regard to any guidelines published by the Australian Geomechanics Society. **Exceptions** 1. No preliminary assessment of site conditions will be required in Areas B and D and no geotechnical and hydrological reports will be required in Areas C and E if the proposed development does not involve any site, building or structural works. 2. Council may determine that no geotechnical report is required for development situated in Areas C or E whether this can be demonstrated by a preliminary assessment of site conditions, prepared by a suitably qualified geotechnical engineer / engineering geologist, in accordance with the Checklist for Council's Assessment of site conditions (see Notes). 3. Council may determine that no hydrological assessment is required for development situated in Areas C or E where it can be demonstrated by a preliminary assessment of site conditions, prepared by a suitably qualified geotechnical / engineering geologist, in accordance with the Checklist for Council's Assessment of site conditions (see Notes). **Note** Landslip Risk Classes A to E, described in the following table, correlate to Areas A to E of the Warringah LEP 2011 – Landslip Risk Map	

	Stability Report is required. All development involving load bearing building works must complete the checklist for Preliminary Assessment of Site Conditions (Landslip) to ensure developments follows good engineering practice. b) Area G2 – Potential Hazards i) Potential Geotechnical hazards in this area include: • Rock falls and slumping of soil and fill materials from unsupported cuts and natural cliffs onto public and private pathways and roadways. • Possible creep of talus materials on steeper soil covered slopes. • Possible movement of detached blocks of sandstone. Limited to moderate damage of some or part of structures (for example dwelling or roadway), with part of site requiring some stabilisation works. Large scale stabilisation works unlikely to be required. c) Area G3 – Potential Hazards i) Potential for Geotechnical Hazards includes settlement of foundations due to failure of unsupported excavations, dewatering & vibrations and other construction activity. Possibility of earthquake induced settlement of foundation also exists in this area. Typical consequences of failure comprise little to moderate damage of some or part of structures, including neighbouring land including dwellings or roadway and typically requiring some stabilisation works over part of the site. The need for large scale stabilisation works is unlikely in Area G3. d) Area G4 – Potential Hazards and Requirements i) Geotechnical assessment may be required depending on location and nature of development and man-made cut and fill. ii) Residential footings are to be in accordance with AS2870. iii) Potential hazards for this land include rock falls & minor slumping of soil and fill materials from top of unsupported cuts onto public and private pathways, roadways and building platforms. there is little to moderate typical consequences of failure involving damage of some or part of structures (for example, to a dwelling or roadway), with part of site requiring some stabilisation works. Large scale stabilisation works are unlikely to be required in Area G4.		
Appendix 5 - Geotechnical Risk Management Policy for Pittwater	Schedule 1 – Maps accompanying the DCP Map C Potential Geotechnical Landslip Hazard Areas	Definitions of Landslip Risk Classes A to E	Geotechnical Planning Policy for Northern Beaches (*naming of policy TBC)*
	Schedule 11 Checklist for Preliminary Assessment of Site Conditions	Suggested Checklist for Council's Assessment of Site Conditions	

Table B2 - Existing DCP Earthworks Clauses:

Pittwater 21 Development Control Plan	Manly Development Control Plan 2013	Warringah Development Control Plan 2011	Suggested New DCP Clause
Section B General Controls **B8 Site Works Management** **B8.1 Construction and Demolition – Excavation and Landfill**	**Part 4 Development Controls** **4.4.5 Earthworks (Excavation and Filling)**	**Part C Siting Factors** **C7 Excavation and Landfill**	**Excavation and Landfill**
Land to which this control applies All Land **Uses to which this control applies** *See extensive list* **Outcomes** Site disturbance is minimised. (En) Excavation, landfill and construction not to have an adverse impact. (En) Excavation and landfill operations not to cause damage on the development or adjoining property. (S) **Controls** Excavation and landfill on any site that includes the following: • Excavation greater than 1 metre deep, the edge of which is closer to a site boundary or structure to be retained on the site, than the overall depth of the excavation; • Any excavation greater than 1.5 metres deep below the existing surface; • Any excavation that has the potential to destabilize a tree capable of collapsing in a way that any part of the tree could fall onto adjoining structures (proposed or existing) or adjoining property; • Any landfill greater than 1.0 metres in height; and/or • Any works that may be affected by geotechnical processes or which may impact on geotechnical processes including but not limited to constructions on sites with low bearing capacity soils, must comply with the requirements of the Geotechnical Risk Management Policy for Pittwater (see Appendix 5) as adopted by Council and details submitted and certified by a Geotechnical Engineer and/or Structural Engineer with the detail design for the Construction Certificate. **Variations** Nil	**Note:** Before granting development consent for earthworks, consideration must be given to the matters listed in LEP clause 6.2(3)(a)-(h). Relevant DCP objectives in this plan in relation to these paragraphs include: **Objective 1)** To retain the existing landscape character and limit change to the topography and vegetation of the Manly Local Government Area by: • Limiting excavation, "cut and fill" and other earthworks; • Discouraging the alteration of the natural flow of ground and surface water; • Ensuring that development not cause sedimentation to enter drainage lines (natural or otherwise) and waterways; and • Limiting the height of retaining walls and encouraging the planting of native plant species to soften their impact. See also paragraph 4.1.8 *Development on Sloping Sites (Planning Principles)* See also paragraph 3.3.2 *Preservation of Trees and Bushland V.* **4.4.5.1 General** a) Earthworks must be limited to that part of the site required to accommodate the building and its immediate surrounds to protect significant natural features of the site including vegetation and prominent rock outcrops. b) Natural and undisturbed ground level must be maintained within 0.9m of side and rear boundaries. c) On steeply sloping sites, pier and suspended slab or an equivalent non-invasive form of construction technique must be used to minimise earthworks and vegetation loss and retain natural features. d) Excavation under the canopy of any tree (including those on neighbouring properties) will only be permitted providing its long-term survival and stability is not jeopardised. Such excavation must be supported by an Arborist report. e) Approved sediment, siltation and stormwater control devices must be in place (and maintained) prior to and during the carrying out of any earthworks and other works on the site. **4.4.5.2 Excavation** a) Excavation is generally limited to 1m below natural ground level with the exception of basement parking areas (which will be contained within the footprint of the building) and swimming pools: b) A dilapidation survey report and geotechnical assessment may be required for excavation works exceeding 1m. Dilapidation survey reports are to include photographic	**Applies to Land** This control applies to land to which Warringah Local Environmental Plan 2011 applies. **Objectives** • To ensure any land excavation or fill work will not have an adverse effect upon the visual and natural environment or adjoining and adjacent properties. • To require that excavation and landfill does not create airborne pollution. • To preserve the integrity of the physical environment. • To maintain and enhance visual and scenic quality. **Requirements** 1. All landfill must be clean and not contain any materials that are contaminated and must comply with the relevant legislation. 2. Excavation and landfill works must not result in any adverse impact on adjoining land. 3. Excavated and landfill areas shall be constructed to ensure the geological stability of the work. 4. Excavation and landfill shall not create siltation or pollution of waterways and drainage lines, or degrade or destroy the natural environment. 5. Rehabilitation and revegetation techniques shall be applied to the fill. 6. Where landfill is necessary, it is to be minimal and shall have no adverse effect on the visual and natural environment or adjoining and surrounding properties.	**Land to which this control applies** All land to which Northern Beaches Local Environmental Plan 20xx applies. **Objectives** O1. To ensure that excavation, landfill and construction will not have an adverse impact on the environment. O2. To ensure that excavation and landfill operations will not cause damage on the development site or adjacent properties. **Requirements** Excavation and landfill on any site that includes the following: • Excavation greater than 1 metre deep, the edge of which is closer to a site boundary or structure to be retained on the site, than the overall depth of the excavation; • Any excavation greater than 1.5 metres deep below the existing surface; • Any excavation that has the potential to destabilise a tree or other structures capable of collapsing in a way that any part could fall onto adjoining structures (proposed or existing) or adjoining property and cause significant damage; • Any landfill greater than 1.0 metres in height; • Basement excavation which extends to within 1 m of the groundwater table or lower, and/or • Any works that may be affected by geotechnical processes or which may affect geotechnical processes including but not limited to construction on sites with low bearing capacity soils, must comply with the requirements of the Geotechnical Planning Policy for Northern Beaches LGA (*naming of policy TBC*) as adopted by Council and details submitted and certified by a Geotechnical Engineer and/or Structural Engineer with the detailed design for the Construction Certificate. **General** Any excavation and landfill must comply with the following: • All landfill must be clean and not contain any materials that are contaminated and must comply with the relevant legislation. • Excavation and landfill shall not create air pollution, siltation or pollution of waterways and drainage lines, or degrade or destroy the natural environment.

	survey of the physical condition of adjoining properties, both internally and externally, including walls, ceilings, rook, structural members and other such items. Such records are to provide proper record in relation to the proposed development to particularly assist in any dispute over damage to adjoining proposed arising from the works. It is in the interests of applicants and adjoining landowners for it to be as full and as detailed as necessary commensurate with the nature of the proposed development. **4.4.5.3 Filling** a) Filling must not exceed 1m above natural ground level. b) Only natural rock, gravels or sand material (not builder's waste or demolition materials), obtained from approved sources, must be used as filling. **4.4.5.4 Retaining walls** a) Retaining walls within 1m of the front boundary must not exceed 1m above natural ground level. *Sketch included*		• Approved sediment, siltation and stormwater control devices must be in place prior to carrying out of the earthworks and other works on site and maintained for the duration of the construction of the development.

Appendix C

Suggested New Planning Controls

Table C1 - New Geotechnical Planning Classes

Planning Class	Geology	Topographic Position	Slope Angle (degrees)	Description	Potential Geotechnical Issues			Typical requirements
					Slope Instability	Groundwater	Settlement due to poor soils	
C1	Hawkesbury Sandstone or Narrabeen Group	Plateau areas, ridge crests, and major spur slopes	<5	Generally shallow residual soils developed on bedrock. Some areas of fill.				Geotechnical report only required for excavations >1.5m or fills >1m
C2	Hawkesbury Sandstone	Flanking slopes	5 to 25	Colluvial and residual soils developed on Hawkesbury Sandstone. Minor detached sandstone blocks, occasional exposures of sandstone in cliffs and road cuts. Occasional fill areas associated with playing fields, roads and some developments.	X			Preliminary geotechnical assessment of site conditions required to determine whether a detailed geotechnical report is required.
C3	Hawkesbury Sandstone	Steeper slopes, generally near coastal areas or along the harbour foreshore, or adjacent to creeks and major gullies	>25	Colluvial soils and bouldery talus, with detached blocks of sandstone on steep escarpment areas, developed on Hawkesbury Sandstone.	X			Detailed geotechnical report required.
C4	Narrabeen Group	Flanking slopes	5 to 15	Colluvial and residual soils developed on Narrabeen Group. Minor detached sandstone blocks, occasional exposures of sandstone in cliffs and road cuts. Occasional fill areas associated with playing fields, roads and some developments.	X			Preliminary geotechnical assessment of site conditions required to determine whether a detailed geotechnical report is required.
C5	Narrabeen Group	Steeper slopes	>15	Colluvial & residual soils & bouldery talus, with detached blocks of sandstone on steeper escarpment areas, developed on Narrabeen Group.	X			Detailed geotechnical report required.
C6	Alluvial deposits and other soils	Alluvial flats and beach foredune areas		Unconsolidated marine and alluvial sands, often overlying deep marine sediments, with shallow groundwater tables.		X	X	Preliminary geotechnical assessment of site conditions and proposed development required to determine whether a detailed geotechnical or hydrogeological report is required.
C7	Hawkesbury Sandstone or Narrabeen Group	Coastal Cliff Zone – from within 20 m of the crest of a steep slope or cliff along the coast line between the Spit Bridge and Barrenjoey Head, extending down to water level		For areas along the coast line which have slopes greater than 45 degrees, a Coastal Cliff Zone has been designated which extends 20 m inland from the crest of the steep slope or cliff, and downslope to the mean water level.	X			Detailed geotechnical report required.

Note – If the subject site is mapped as being affected by more than one Planning Class, then a Preliminary Geotechnical Assessment shall be undertaken to determine which Planning Class is most appropriate for the site and whether additional geotechnical investigations and reports are required.

Table C2 – Requirements for Geotechnical Reports to support Development Applications

Development Type	Geotechnical Planning Classes						
	C1	C2	C3	C4	C5	C6	C7
	Hawkesbury & Narrabeen Slopes <5 degrees	Hawkesbury Slopes 5 to 25 degrees	Hawkesbury Slopes > 25 degrees	Narrabeen Slopes 5 to 15 degrees	Narrabeen Slopes > 15 degrees	Alluvial and Soil Deposits	Coastal Cliff Zone
Minor Development / Alterations [1]	No Geotechnical Assessment required	No Geotechnical Assessment required	No Geotechnical Assessment required	No Geotechnical Assessment required	Preliminary Geotechnical Assessment required	No Geotechnical Assessment required	Preliminary Geotechnical Assessment required
Standard development up to two storeys – all excavation <1.5 m and landfill <1 m	No Geotechnical Assessment required	Preliminary Geotechnical Assessment required	Preliminary Geotechnical Assessment required	Preliminary Geotechnical Assessment required	Detailed Geotechnical Report required	Preliminary Geotechnical Assessment required	Detailed Geotechnical Report required
Development with more than two storeys [2]	Preliminary Geotechnical Assessment required	Preliminary Geotechnical Assessment required	Detailed Geotechnical Report required	Detailed Geotechnical Report required	Detailed Geotechnical Report required	Detailed Geotechnical Report required	Detailed Geotechnical Report required
Any excavation >1 m within 1 m of site boundaries or structures	Preliminary Geotechnical Assessment required	Preliminary Geotechnical Assessment required	Detailed Geotechnical Report required	Preliminary Geotechnical Assessment required	Detailed Geotechnical Report required	Preliminary Geotechnical Assessment required	Preliminary Geotechnical Assessment required
Any excavation >1.5 m	Preliminary Geotechnical Assessment required	Preliminary Geotechnical Assessment required	Detailed Geotechnical Report required	Preliminary Geotechnical Assessment required	Detailed Geotechnical Report required	Preliminary Geotechnical Assessment required	Preliminary Geotechnical Assessment required
Any excavation with potential to destabilise trees or other structures such that they could fall onto adjoining structures or properties and cause significant damage	Preliminary Geotechnical Assessment required	Preliminary Geotechnical Assessment required	Detailed Geotechnical Report required	Preliminary Geotechnical Assessment required	Detailed Geotechnical Report required	Preliminary Geotechnical Assessment required	Preliminary Geotechnical Assessment required
Landfill >1 m	Preliminary Geotechnical Assessment required	Preliminary Geotechnical Assessment required	Detailed Geotechnical Report required	Preliminary Geotechnical Assessment required	Detailed Geotechnical Report required	Preliminary Geotechnical Assessment required	Preliminary Geotechnical Assessment required
Basement excavation to extend to within 1 m of groundwater level or lower	Preliminary Geotechnical Assessment required	Preliminary Geotechnical Assessment required	Detailed Geotechnical Report required	Detailed Geotechnical Report required	Detailed Geotechnical Report required	Detailed Geotechnical and Hydrogeological Report required [3]	Preliminary Geotechnical Assessment required

Notes:

1 Minor Alterations and Additions to existing developments that do not affect the geotechnical conditions on or around the site.

2 Storey means a space within a building which is situated between one floor level and the floor level next above, or if there is no floor above, the ceiling or roof above, but not a mezzanine.

3 Hydrogeological reports must comply with the requirements of the NSW Water Management Act and the guidelines for hydrogeological investigations published by Water NSW and the NSW Department of Planning and Environment - Water

C3: Proposed New Appendix to DCP Geotechnical Planning Clause

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Draft Geotechnical Planning Policy
Northern Beaches Council - 2021

1. Introduction

The Geotechnical Planning Policy (the Policy) establishes the approach for assessing the geotechnical planning requirements for all properties within the Northern Beaches Local Government Area (LGA).

2. Policy Statement

The primary method of geotechnical risk management in the Northern Beaches LGA is through the application of geotechnical conditions as set out in a Geotechnical Report supporting a Development Application and through the review generated by the issue of Building Certificates.

Once geotechnical risk management measures have been identified for a site, it is the owners' responsibility to ensure their site is maintained in accordance with the recommendations of the geotechnical report for the site and on the basis that every reasonable and practical step that is available should be used to remove risk.

Development must be undertaken in accordance with the "Acceptable Risk Management" criteria defined in this document for Loss of Property and Loss of Human Life for a design project life, taken to be 100 years, unless otherwise justified by the applicant and accepted by Council. These criteria are based on the guidelines established initially in AGS 2000 and as further developed in AGS 2007.

3. Objectives

The objectives of this Policy are to ensure that:

a) geotechnical and related structural matters are adequately investigated and documented by applicants prior to the lodgement of any development application to carry out any development subject to this Policy, or wherever an application is lodged for a Building Certificate,

b) the proposed development is appropriate for the site and any relevant conditions are identified in the geotechnical report,

c) in the event that a proposed development is only appropriate if carried out subject to geotechnical and related structural engineering conditions, those geotechnical conditions are identified by applicants prior to lodgement of the development application and are able to be met, including all appropriate constraints and remedial maintenance actions required prior to, during and after the carrying out of the development,

d) effective geotechnical conditions are specified in the Geotechnical Reports and are incorporated into the architectural and structural engineering design plans at the Construction Certificate stage,

e) the preparation of geotechnical and related structural engineering information and certificates required to be lodged by this Policy are carried out by suitably qualified professionals with appropriate expertise in the applicable areas of engineering,

f) developments are only carried out if geotechnical and related structural engineering risks are identified and can be effectively addressed and managed for the life of the development.

g) the development is constructed in accordance with the recommendations of the Geotechnical Engineer or Engineering Geologist and checked by the Geotechnical Engineer or Engineering Geologist.

h) ongoing requirements to maintain the integrity of the geotechnical solution as contained in consent are effectively carried out to the specified requirements for the life of the development.

4. Application

This Policy is to be applied as follows:

a) to address both structural and geotechnical requirements relating to geotechnical issues only. Separate structural requirements will also apply for the erection of any structure in accordance with the *Building Code of Australia* (BCA), engineering standards and best engineering practice.

b) to any works within the LGA that may be affected by geotechnical processes or which may affect geotechnical processes.

5. Geotechnical Zoning

All of the land in the LGA has been mapped using seven geotechnical planning classes, which are based on the underlying geology, existing slopes and proximity to the coastal cliff line.

The planning classes are listed in Table 1 and the mapping for the LGA is shown on the Northern Beaches Geotechnical Planning Maps which are available on the Council website.

The requirements for geotechnical reports to support Development Applications or applications for Building Certificates for any site in the LGA are outlined in Table 2. The requirements are based on the Planning Class for the site as identified on the Geotechnical Planning Maps, the type of development and the extent of excavation and landfilling proposed for the development.

If the subject site is mapped as being affected by more than one Planning Class, then a Preliminary Geotechnical Assessment shall be undertaken to determine which Planning Class is most appropriate for the site and whether additional geotechnical investigations and reports are required, unless Table 2 indicates that no geotechnical assessment is required for any of the combinations of Planning Classes and development types affecting the site.

Table 1 - Geotechnical Planning Classes

Planning Class	Geology	Topographic Position	Slope Angle (degrees)	Description	Typical requirements
C1	Hawkesbury Sandstone or Narrabeen Group	Plateau areas, ridge crests, and major spur slopes	<5	Generally shallow residual soils developed on bedrock. Some areas of fill.	Geotechnical report typically only required for excavations >1.5m or fills >1m
C2	Hawkesbury Sandstone	Flanking slopes	5 to 25	Colluvial and residual soils developed on Hawkesbury Sandstone. Minor detached sandstone blocks, occasional exposures of sandstone in cliffs and road cuts.	Preliminary Geotechnical Assessment of site conditions required to determine whether a Detailed Geotechnical Report is required.
C3	Hawkesbury Sandstone	Steeper slopes, generally near coastal areas or along the harbour foreshore, or adjacent to creeks and major gullies	>25	Colluvial soils and bouldery talus, with detached blocks of sandstone on steep escarpment areas, developed on Hawkesbury Sandstone.	Detailed Geotechnical Report required.
C4	Narrabeen Group	Flanking slopes	5 to 15	Colluvial and residual soils developed on Narrabeen Group. Minor detached sandstone blocks, occasional exposures of sandstone in cliffs and road cuts.	Preliminary Geotechnical Assessment of site conditions required to determine whether a Detailed Geotechnical Report is required.
C5	Narrabeen Group	Steeper slopes	>15	Colluvial & residual soils & bouldery talus, with detached blocks of sandstone on steeper escarpment areas, developed on Narrabeen Group.	Detailed Geotechnical Report required.
C6	Alluvial deposits and other soils	Alluvial flats and beach foredune areas		Unconsolidated marine and alluvial sands, often overlying deep marine sediments, with shallow groundwater tables.	Preliminary Geotechnical Assessment of site conditions and proposed development required to determine whether a Detailed Geotechnical or Hydrogeological Report is required.
C7	Hawkesbury Sandstone or Narrabeen Group	Coastal Cliff Zone – from within 20 m of the crest of a steep slope or cliff along the coastline between the Spit Bridge and Barrenjoey Head, extending down to water level		For areas along the coastline which have slopes greater than 45 degrees, a Coastal Cliff Zone has been designated which extends 20 m inland from the crest of the steep slope or cliff and downslope to the mean water level.	Detailed Geotechnical Report required.

Note – If the subject site is mapped as being affected by more than one Planning Class, then a Preliminary Geotechnical Assessment shall be undertaken to determine which Planning Class is most appropriate for the site and whether additional geotechnical investigations and reports are required.

Table 2 – Requirements for Geotechnical Reports to support Development Applications

Development Type	Geotechnical Planning Classes						
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
	Hawkesbury & Narrabeen Slopes <5 degrees	Hawkesbury Slopes 5 to 25 degrees	Hawkesbury Slopes > 25 degrees	Narrabeen Slopes 5 to 15 degrees	Narrabeen Slopes > 15 degrees	Alluvial and Soil Deposits	Coastal Cliff Zone
Minor Development / Alterations [1]	None [4]	None	None	None	Prelim	None	Prelim
Standard development up to two storeys – all excavation <1.5 m and landfill <1 m	None	Prelim	Prelim	Prelim	Detailed	Prelim	Detailed
Development with more than two storeys [2]	Prelim [5]	Prelim	Detailed [6]	Detailed	Detailed	Detailed	Detailed
Any excavation >1 m within 1 m of site boundaries or structures	Prelim	Prelim	Detailed	Prelim	Detailed	Prelim	Prelim
Any excavation >1.5 m	Prelim	Prelim	Detailed	Prelim	Detailed	Prelim	Prelim
Any excavation with potential to destabilise trees or other structures such that they could fall onto adjoining structures or properties and cause significant damage	Prelim	Prelim	Detailed	Prelim	Detailed	Prelim	Prelim
Landfill >1 m	Prelim	Prelim	Detailed	Prelim	Detailed	Prelim	Prelim
Basement excavation to extend to within 1 m of groundwater level or lower	Prelim	Prelim	Detailed	Detailed	Detailed	Detailed Geotechnical and Hydrogeological Report required [3]	Prelim

Notes:
1. Minor Alterations and Additions to existing developments that do not affect the geotechnical conditions on or around the site
2. Storey means a space within a building which is situated between one floor level and the floor level next above, or if there is no floor above, the ceiling or roof above, but not a mezzanine.
3. Hydrogeological reports must comply with the requirements of the NSW Water Management Act and the guidelines for hydrogeological investigations published by Water NSW and the NSW Department of Planning and Environment - Water
4. None = No Geotechnical Assessment required
5. Prelim = Preliminary Geotechnical Assessment required
6. Detailed = Detailed Geotechnical Report required

Classes 1 to 6 are based on simply on combinations of the underlying geology and the ground slopes.

Class 7 (Coastal Cliff Zone) has been developed by identifying all slopes along the coastline between Barrenjoey Head and the Spit Bridge which are steeper than 45 degrees, and then plotting an area which starts 20 m upslope of the crest of the slope (refer Figure 1). While the zone shown on the maps is a uniform width of 40 m for plotting purposes only, in all cases the Coastal Cliff Zone extends to water level in the downslope direction.

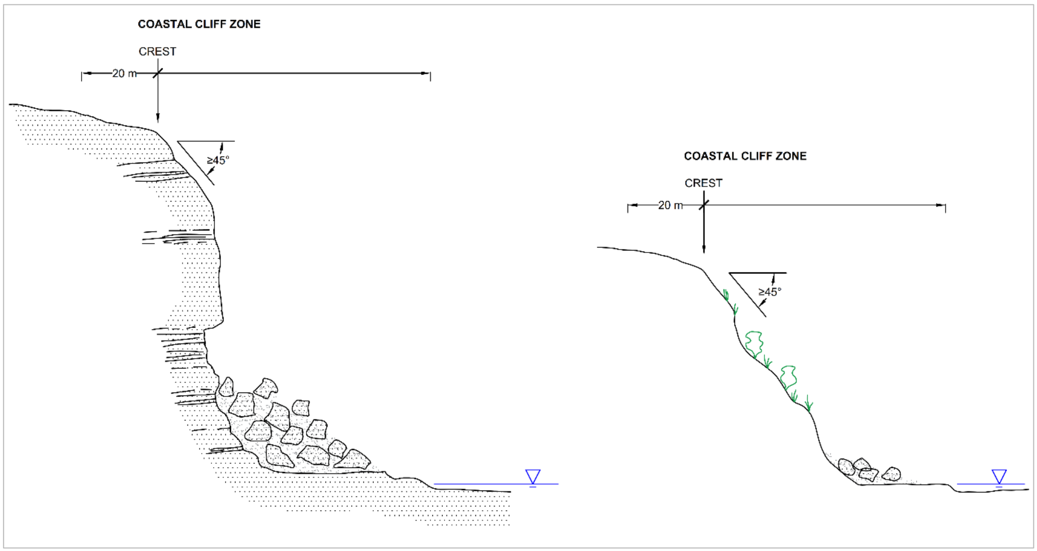


Figure 1: Definition of Coastal Cliff Zone used on maps

6. Preparation of Preliminary Geotechnical Assessments and Detailed Geotechnical Reports

6.1 Level of Geotechnical Investigation

It is the responsibility of the Geotechnical Engineer or Engineering Geologist to determine the level of investigation required for a particular site or proposed development.

At all times any decision regarding the degree of investigations and assessment required must be dictated by consideration of risk to Life and to Property and the recognition by the Geotechnical Engineer or Engineering Geologist that the Council will rely on the Geotechnical Assessment, Report or Opinion as the basis for ensuring that the geotechnical risk management aspects of the site and proposed development have been adequately addressed.

6.2 Minor Development, Minor Alterations and/or Development Separate from a Geotechnical Hazard

For minor development, minor alteration (refer to Definitions) and/or development separate from and not affected by a Geotechnical Hazard, in accordance with Table 2, no geotechnical assessment is required for the Planning Classes C1, C2, C3 C4 or C6.

For Planning Classes C5 and C7 a Geotechnical Engineer or Engineering Geologist must carry out a Preliminary Geotechnical Assessment and may determine that a Detailed Geotechnical Report is not required. This must be justified as a clear professional opinion with the supporting basis on which the opinion was formed presented in a Preliminary Geotechnical Assessment and certified on Form 1.

6.3 Structures Separate from the Primary Development

For structures separated from the primary development, for example, a swimming pool or retaining wall, the Geotechnical Engineer or Engineering Geologist may determine the level of investigation required for a particular site and proposal, particularly where the primary development is pre-existing. This must be justified as a clear professional opinion with the supporting basis on which the opinion was formed presented in a Preliminary Geotechnical Assessment and certified on Form 1.

6.4 Preliminary Geotechnical Assessment

Where a Preliminary Geotechnical Assessment is required, a brief report or letter prepared by a Geotechnical Engineer or Engineering Geologist (refer to Definitions) to be submitted with a Development Application, is to include the following elements:

a) An inspection of the site
b) A review of the regional geology in the area of the site
c) A review of the topographic features in the area
d) An assessment of the likely groundwater levels
e) Identification of any potential geotechnical hazards on the site or on neighbouring properties that may affect this land
f) A review of the proposed development and its impact on the geotechnical and/or groundwater conditions in or around the site
g) A preliminary geotechnical risk assessment for any identified hazards
h) A clear statement as to whether additional geotechnical or hydrogeological investigations or inspections are required.
i) A completed Form 1.

6.5 Detailed Geotechnical Report

Where a Detailed Geotechnical Report prepared by a Geotechnical Engineer or Engineering Geologist (refer to Definitions) is required, the report is to include the following elements:

a) Details of all site inspections and site investigations. A site inspection is required in all cases. Site investigation may require sub-surface investigation; appropriate investigation techniques may involve boreholes and/or test pit excavations or other methods necessary to adequately assess the geotechnical, geological and hydrogeological models for the site. For those sites where a Hydrogeological Report is required, the investigation is to comply with the requirements of the NSW Water Management Act and the guidelines for hydrogeological investigations published by Water NSW and the NSW Department of Planning and Environment- Water.

b) Plans and sections of the site and related land from survey and field measurements with contours and spot levels to AHD. Key features are to be identified, including the locations of the proposed development, buildings/structures on both the subject site and adjoining site, storm water drainage, sub-surface drainage, water supply and sewerage pipelines. Where possible, the survey plan should be augmented by geomorphological mapping.

c) Photographs and/or drawings of the site and related land adequately illustrating all geotechnical features referred to in the Detailed Geotechnical Report, as well as the locations of the proposed development.

d) Presentation of an interpreted geological model of the site and related land showing the proposed development, including an assessment of sub-surface conditions, taking into account thickness of the topsoil, colluvium and residual soil layers, depth to underlying bedrock, and the location and depth of groundwater.

   Hydrogeological conditions including seepage inflows and/or dewatering impacts should also be modelled and assessed, where applicable.

   For Geotechnical Planning Class C7 (Coastal Cliff Zones) the model must also include an assessment of the potential mechanisms of cliff or slope failure and assessment of the potential scale of failure that may affect the site.

e) An assessment of the risk posed by all identifiable Geotechnical Hazards that have the potential to either individually or cumulatively affect people or property upon the site or adjoining properties in accordance with the guidelines set out in AGS 2007(c) and in particular, in the format as outlined in Figure 1 “Framework for Landslide Risk Management” contained therein. Risk of loss of life should be determined quantitatively. Risk of loss of property can be determined quantitatively or in accordance with the qualitative terminologies and matrices presented in AGS 2007(c).

   Specific risk assessment outcomes to be targeted are as follows:

   - For new sites or developments
     - a maximum acceptable Loss of Life Risk of 10^{-6} per annum
     - a Low Risk to Property
   - For existing sites or developments
     - a maximum acceptable Loss of Life Risk of 10^{-5} per annum

- a Low Risk to Property. Moderate Risk may be tolerated in some circumstances provided treatment options are implemented as soon as practical to reduce the risk to Low.

This Policy requires that "Acceptable Risk" Criteria are achieved and maintained for Development Application approval.

f) A conclusion as to whether the site is suitable for the development proposed to be carried out. This must be in the form of a specific statement that *"The site is suitable (or can be made suitable) for the development proposed and the site and/or the development proposal can achieve the Acceptable Risk Management required by this Policy provided that ………………".*

g) Details of all geotechnical conditions or information that are required for the different stages of development, including the following:

   i. For Development Approval:

   - Footing levels and supporting rock quality (where applicable)
   - Extent of earth and rock cut and fill (where applicable)
   - Recommendations for excavation and batters (where applicable)
   - Parameters, bearing capacities and recommendations for use in the design of all structural works with geotechnical components, including footings, retaining walls, surface and sub-surface drainage.
   - Recommendations for the selection of building structure systems consistent with the geotechnical risk assessment
   - Any other conditions required to ensure the proposal can achieve the "Acceptable Risk Management" level as defined in this Policy.
   - Any other conditions required to remove geotechnical risks that can reasonably and practically be addressed.

   ii. For Construction Certificate:

   - Any structural design relating to the geotechnical aspects of the proposal is to be checked and certified by a suitably qualified and experienced Structural/Civil Engineer and Geotechnical Engineer/Engineering Geologist as being in accordance with the geotechnical recommendations.
   - Any other design, excavation or construction conditions required in the design phase in order to ensure the design will achieve the "Acceptable Risk Management" level as defined in this Policy for potential loss of both property and life.

   iii. For Construction:

   - Constructed works relating to the geotechnical aspects of the proposal that require the sign off by a suitably qualified and experienced Geotechnical Engineer or Engineering Geologist. The report must highlight and detail the inspection regime to provide the builder with adequate notification for all necessary inspections.
   - Any other design, excavation or construction conditions including works methodology and temporary works required in the construction phase in order to ensure the design will achieve the "Acceptable Risk Management" level as defined in this Policy for the potential loss of both property and life.

iv. For ongoing management of the site or structure:

- Any conditions that may be required for the ongoing mitigation and maintenance of the site and the proposal, from a geotechnical viewpoint. Such conditions to be in the form of a recommendation for ongoing maintenance to ensure that any owner or future owners are clearly notified of their ongoing responsibility.

v. For Occupation/Subdivision Certificate:

- Any conditions that may be required for the Occupation/Subdivision stage, from a geotechnical viewpoint

h) For bushfire prone lands, as identified as Council Asset Protection Zones, the Detailed Geotechnical Report is to assess the potential geotechnical impacts of any bushfire management, such as clearing of vegetation for fire breaks.

i) A statement with supporting information to the effect that every reasonable and practical step available has been identified to remove any foreseeable geotechnical risk from the site over and above attainment of the "Acceptable Risk Management" criterion.

j) A copy of Form 1 bearing the signature of the Geotechnical Engineer or Engineering Geologist as defined by this Policy, who has either prepared or technically reviewed the Geotechnical Report.

6.6 Geotechnical Report to Support a Building Certificate

Where a geotechnical report prepared by a Geotechnical Engineer or Engineering Geologist (refer to Definitions) is to be submitted in support of a Building Certificate Application, it is the responsibility of the Geotechnical Engineer or Engineering Geologist to determine, from consideration of the site, the structures and the risk to life and property, whether a Detailed Geotechnical Report is required.

Where, in the opinion of the Geotechnical Engineer, the site and structures have been in existence for at least 10 years and have demonstrated a performance at a tolerable risk level, or better, during that period, and there is not a foreseeable reason why this situation should change, the geotechnical report to be submitted with the application for a Building Certificate should at least address the following elements:

a) An assessment of the risk posed by the identifiable Geotechnical Hazards that have the potential to either individually or cumulatively affect people or property upon the site or adjoining properties in accordance with the guidelines set out in AGS 2007 (c) and in particular, in the format as outlined in Figure 1 "Framework for Landslide Risk Management" contained therein. Risk of loss of life should be determined quantitatively. Risk of loss of property can be determined quantitatively or in accordance with the qualitative terminologies and matrices presented in AGS 2007(c).

   This Policy requires that "Tolerable Risk" Criteria are achieved and maintained for Building Certificate approval for sites and structures which have not been altered for at least 10 years. For all other sites and structures "Acceptable Risk" Criteria must be achieved.

b) Details of all site inspections and site investigations and any other information used in preparation of the Geotechnical Report. A site inspection is required in all cases. Site investigation may require sub-surface investigations; appropriate investigation techniques may involve bore holes and/or test pit excavation or other methods necessary to adequately assess the geotechnical/geological model for the site. It is the responsibility of the Geotechnical Engineer or Engineering Geologist to determine the level of investigation required to adequately address the issues of risk to life and property.

c) Photographs and/or drawings of the site and related land adequately illustrating all geotechnical features referred to in the Geotechnical Report, as well as the existing structure.

d) A conclusion as to whether the site and the existing development achieves the ‘Tolerable Risk Management criteria’ and if not, what specific actions are required to achieve this criterion to enable a Building Certificate to be issued.

e) Any further reasonable and practical action that should be undertaken to remove risk.

f) Any covenant that would be necessary to ensure the ongoing mitigation and maintenance of the site from a geotechnical viewpoint.

g) A copy of Form 4 bearing the signature of the Geotechnical Engineer or Engineering Geologist as defined by this Policy who has either prepared or technically reviewed the Geotechnical Report.

7. Circumstances in which Council would not support an Application

Council may not support a Development Application or application for a Building Certificate as follows:

a) Where a geotechnical report accompanying a Development Application has been prepared by an engineer(s) with qualifications that do not meet the requirements of this policy, then Council shall refuse to support the development application, until the geotechnical report has been technically reviewed and certified by a Geotechnical Engineer or Engineering Geologist as defined by this policy.

b) Where a geotechnical report accompanying a Building Certificate Application has been prepared by an engineer(s) with qualifications that do not meet the requirements of this policy, then Council shall refuse to support the application, until the geotechnical report has been Technically reviewed and certified by a Geotechnical Engineer or Engineering Geologist as defined by this policy.

c) Where a geotechnical report or an independent review of a geotechnical report accompanying an application, identifies the risk to property and/or life posed by the geotechnical hazard as greater than the level of “Acceptable Risk Management” in the case of a Development Application or “Tolerable Risk Management” in the case of a Building Certificate as defined in this Policy after all feasible measures to reduce the risk have been considered.

8. General Requirements

The following general requirements are also applicable:

a) Northern Beaches Council may, if appropriate, impose conditions on a development consent requiring the lodgement of interim Geotechnical Certificates related to the stages of the construction of any development. The form of any such interim certificate must be consistent with Form 3, amended as required to reflect its status as an interim certificate only.

It is the responsibility of the Geotechnical Engineer or Engineering Geologist preparing the geotechnical report in support of the Development Application submission to ensure the necessary Geotechnical Conditions requiring interim inspections are included in the Detailed Geotechnical Report.

b) All conditions relating to the geotechnical aspects of the proposal for the design and construction phase are to be incorporated in the Detailed Geotechnical Report. Council will rely on those conditions as being the complete set required to ensure the proposed outcome achieves an "Acceptable Risk Management" level as defined in this Policy.

c) Any development application for a development subject to this Policy must incorporate any conditions the Geotechnical Engineer or Engineering Geologist believes are necessary to incorporate into a covenant on title to ensure that the land owner both at the time of application and into the future is aware of their responsibilities for any necessary on-going works or monitoring to ensure the site and the development remain within the "Acceptable Risk Management" level.

9. Other Analysis Requirements

Other analysis requirements are as follows:

a) Where a Preliminary Geotechnical Assessment or a Detailed Geotechnical Report contains a recommendation for a separate analysis of the site to be carried out by another consultant, for example, a flood study to be compiled by a hydrological consultant, this recommendation is to be highlighted to the applicant in the geotechnical report. This would enable the applicant to engage the required consultant and obtain the necessary report prior to the lodgement of the Development Application.

b) This policy requires that the civil or structural engineer, who prepares the structural documentation, is a civil or structural engineer as defined by this Policy. This Policy also requires that the engineer, in preparing the structural documentation, has viewed and where necessary used the recommendations given in the Preliminary Geotechnical Assessment or the Detailed Geotechnical Report for the same development. These requirements need to be verified by accompanying the submission of the structural documentation with a completed copy of Form 2.

c) Northern Beaches Council retains the right to have a geotechnical report submitted with a Development Application peer reviewed by an independent Geotechnical Engineer or Engineering Geologist at the applicant's cost.

10. Community Awareness

10.1 Section 10.7 Certificates

Notification of properties known to be potentially affected by Geotechnical Hazards is to be undertaken by inclusion on the Section 10.7 Certificate (previously known as the Section 149 Certificate). This provides advice to current owners as to the potential for geotechnical risk and the advice transfers to new owners with the sale of the property.

10.2 88B Instruments

Where there are specific management, maintenance or monitoring requirements to ensure the geotechnical risk is managed within the "Acceptable Risk Management" criterion, and/or reasonable practical steps can be taken to remove risk, then these are to be included as a covenant on the title of the property to ensure current and future owners are aware of their responsibilities.

Any recommendation for inclusion of a covenant on the title of the property must be contained in the Geotechnical Conditions attached to the Geotechnical Report

11. Forms

The forms required to be submitted with different applications to Council are summarised in Table 3. Copies of blank forms are attached to this Policy.

Table 3 – Forms required to be submitted with Applications to Council

Form No.	When is it required?	Prepared & signed by	Why is it necessary?	
1	Development Application	Geotechnical Engineer or Engineering Geologist	Confirms that the geotechnical assessment or geotechnical report has been prepared or technically reviewed by a Geotechnical Engineer or Engineering Geologist (as defined by this policy)	Attached to a Preliminary Geotechnical Assessment, or a Detailed Geotechnical Report accompanying a Development Application
2A	Application for Construction Certificate	Structural Engineer or Civil Engineer	Confirms that the structural design has been prepared by a Structural Engineer (as defined by this policy) in accordance with the recommendations set out in the geotechnical report for the development.	Attached to structural or civil documentation submitted with application for Construction Certificate
2B		Geotechnical Engineer or Engineering Geologist	Confirms that the Geotechnical Engineer has reviewed the structural documentation and agrees that the geotechnical requirements have been correctly interpreted and incorporated. into the design documents.	
3	Application for Occupation Certificate or Subdivision Certificate (at the completion of a project prior to occupation of premises)	Geotechnical Engineer or Engineering Geologist	Confirms that the recommendations in the Geotechnical Report have been complied with during construction, as well as any subsequent geotechnical requirements introduced during construction.	In most cases a Geotechnical Engineer or Engineering Geologist will need to observe foundation materials, excavations, retaining structures and subsoil drainage prior to signing Form 3
4	Application for Building Certificate, or Response to an Order issued by Council	Geotechnical Engineer or Engineering Geologist	Confirms that the site and structures on the site have been assessed by a Geotechnical Engineer or Engineering Geologist and achieve at least a 'Tolerable Risk Management' status. Confirms that reasonable and practical measures to reduce foreseeable geotechnical risk have been identified and suitable recommendations have been included in a geotechnical report accompanying the Building Certificate Application or a response to an Order.	If the Geotechnical Engineer or Engineering Geologist assess that the geotechnical risks on the site and development are not at the 'Tolerable Risk Management' level then the remedial actions required must be identified in a report and indicated on Form 4. If the remedial action requires works that would need Development Approval then a Development Application must be lodged.

12. Definitions

Any terms which are defined in the Environmental Planning & Assessment Act 1979 or the Environmental Planning & Assessment Act Regulations 2000 have the same meaning when used in this Policy.

In this Policy, the following terms have the meanings set out below:

Acceptable Risk – Acceptable Risk includes the risk to life and the risk to property; both must be considered. The guidance for the establishment of acceptable risk criteria in this Policy has been based on the contents of AGS 2007(c & d).

- Acceptable Risk for Loss of Life for the person(s) most at risk, per annum is taken as having a probability of
  - 1×10^{-6} per annum for new sites or developments, and
  - 1×10^{-5} per annum for existing sites or developments.
- Acceptable Risk for Loss of Property is taken as "Low" as defined in AGS 2007.

Risk levels for both loss of life and property should be determined in accordance with the methodologies presented in AGS 2007(c). Risk of loss of life should be determined quantitatively. Risk of loss of property can be determined quantitatively or in accordance with the qualitative terminologies and matrices presented in AGS 2007(c).

Acceptable Risk Management – The complete process of risk assessment and control of risk to the level defined as "Acceptable Risk" in this Policy.

AGS – Australian Geomechanics Society.

AGS 2000 – Australian Geomechanics Society 2000, "Landslide Risk Management Concepts and Guidelines", AGS Sub-Committee on Landslide Risk Management, Australian Geomechanics Journal Vol 35 No. 1 March 2000, also reprinted in Australian Geomechanics Journal Vol 37 No. 2, May 2002.

AGS 2007 (a, b, c, d, e) – Australian Geomechanics Society 2007, "Landslide Risk Assessment and Management", Australian Geomechanics Journal Vol 42, No 1, March 2007. AGS 2007 may be purchased on www.australiangeomechanics.org

AHD - Australian Height Datum

Application - means any development application which relates to land in the Northern Beaches LGA

BCA - means the Building Code of Australia.

Building - includes any structure or part of a structure.

Building Certificate – A Certificate under Section 6.26 of the EPA Act that, if issued by Council, confirms that:

(a) the building or part thereof is in accordance with a consent or approval, or

(b) no action will be taken by Council in relation to a building or part thereof that was not originally approved.

The issuance of the certificate may be contingent on the carrying out of works.

Building Certificate Geotechnical Report – means a Geotechnical Report associated with the lodgement of a Building Certificate Application. The report must conform to the requirements of AGS 2007 for identification and treatment of risk to the "Acceptable Risk Management" criteria stated in this policy and the requirement to remove risk wherever reasonable and practical. For sites and structures which have been in existence for at least 10 years without change and no foreseeable changes in the future then the "Tolerable Risk Management" criteria may be applied.

Civil Engineer or Structural Engineer - means a civil or structural engineer who is a registered professional engineer and has an appropriate level of professional indemnity insurance.

Covenant – An agreement between the Council and a landowner for the landowner to do, or to refrain from doing, certain acts in relation to the land. A restrictive covenant prevents a proprietor from carrying out specified actions. A positive covenant binds a proprietor to do or complete specified action(s).

Detailed Geotechnical Report - means a report prepared by and/or technically reviewed by a Geotechnical Engineer or Engineering Geologist as defined by this policy, which incorporates each of the elements, where applicable to the type of development, described in the "Detailed Geotechnical Report" section of this policy.

Development - has the same meaning as set out in Part 4 of the Environmental Planning & Assessment Act 1979 or any replacement or substitution of that provision and includes not only that specific development but also the overall site on which the development is located.

Engineering Geologist - means a specialist Engineering Geologist who is a registered professional engineering geologist and has an appropriate level of professional indemnity insurance.

EPA Act 1979 - means Environmental Planning & Assessment Act 1979 (NSW).

Final Geotechnical Certificate - means a certificate of a Geotechnical Engineer or Engineering Geologist in accordance with Form 3.

Geotechnical Engineer - means a specialist Geotechnical Engineer who is a registered professional engineer and has an appropriate level of professional indemnity insurance.

Geotechnical Hazard - means a condition with the potential for causing the movement of rock, debris or earth, which may cause injury or death to persons or damage to, or destruction of property

Geotechnical Maps - means the maps identifying sites subject to Northern Beaches Council's Geotechnical Planning Policy for the Northern Beaches Local Government Area.

Geotechnical Works - means the elements of site modification designed by the geotechnical engineer.

Hydrogeological Report – means a report prepared by and/or technically reviewed by an experienced Hydrogeologist or a Geotechnical Engineer as defined by this policy, which presents details of the existing subsurface flows and the potential impacts of the proposed development. The report should be prepared in accordance with the guidelines published by Water NSW and NSW Department of Planning and Environment to comply with the NSW Water Management Act.

Life of the Structure – This provides the context within which the geotechnical risk assessment should be made. The required 100 year baseline broadly reflects the expectations of the community for the anticipated life of a residential structure and hence the timeframe to be considered when undertaking the geotechnical risk assessment and making recommendations as to the appropriateness of a development, its design and any remedial measures that should be put in place to control risk. It is recognized that in a 100-year period external factors that cannot reasonably be foreseen may affect the geotechnical risks associated with a site. Hence, the Policy does not seek the Geotechnical Engineers to warrant the development for a 100-year period, rather to provide a professional opinion that foreseeable geotechnical risks to which the development may be subjected in that timeframe have been reasonably considered.

Minor Development and/or Minor Alteration – Minor alterations or additions to existing developments that do not affect the geotechnical conditions on or around the site. Some examples include:

- Non-structural alterations to a building;
- Minor structural alterations that do not result in the current load-bearing capacity of the building or its foundations being exceeded;
- A minor addition, verandah, deck, porch, pergola or similar that is fully supported by an existing building;
- The erection of a minor structure or addition that does not require any excavation deeper than 500 mm below existing ground level; and
- Minor earthworks, including landscaping, that does not include any filling in excess of 500 mm in thickness.

Occupation Certificate – means a Certificate under Sections 6.9 and 6.10 of the EPA Act that, if issued by Council or an accredited certifier, authorizes occupation and use of a building or part thereof.

Orders Process – Orders issued under Protection of the Environment Operations Act, 1997; Local Government Act, 1993; Environmental Planning & Assessment Act, 1979; Roads Act, 1993; and the Biosecurity Act 2015.

Policy - means this Geotechnical Planning Policy.

Preliminary Geotechnical Assessment - means a geotechnical report prepared by and/or technically reviewed by a Geotechnical Engineer or Engineering Geologist as defined by this policy, which identifies any geotechnical hazards on or around a site based on a review of available information and the proposed development and a physical inspection of the site, and provides recommendations for any additional geotechnical investigations and reports, if required.

Related Land - means land including roads and thoroughfares that could affect or could be affected by any development proposed on a site.

Remove Risk – It is recognized that, due to the many complex factors that can affect a site, the subjective nature of the science of geotechnical engineering, the risk for a site and/or development cannot be completely removed. It is, however, essential that risk be reduced to at least that which could be reasonably anticipated by the community in everyday life. Further, landowners should be made aware of the reasonable and practical measures available to them to reduce risk as far as possible. Hence where the Policy requires that *"reasonable and practical measures have been identified to remove risk*" it refers to the process of risk reduction. The Policy is not requiring the Geotechnical Engineer to warrant that risk has been completely removed, as this is not meaningfully achievable.

Requirements - include all acts, statutes, regulations, by-laws, ordinances, codes, delegated legislation, all approvals granted under any such instrument, the BCA, any applicable Australian Standard.

Risk - means a measure of the probability and severity of an adverse effect to health, property or the environment.

Site - means the whole of any parcel of land to which the carrying out of any development relates.

Site Classification - means a classification of the site in accordance with AS 2870.1 Australian Standard Residential Slabs and Footings.

Structure – Any building including, but not limited to residences, residential, industrial and commercial buildings, out buildings, pools and retaining walls.

Structural Design - means the selection and proportioning of load carrying elements incorporated in a structure, which require certification by a structural engineer.

Structural Document - means a document (which may be in the form of drawings) from a Structural Engineer or Civil Engineer which makes recommendations in respect of the Structural Design and Structural Works required for any structure to be erected on the site which, under this Policy, requires certification in accordance with Form 2.

Structural Works - means the elements of any structure designed by a structural engineer.

Tolerable Risk – The Tolerable Risk criteria is only applicable to sites with structures that have been in existence in their present form for at least 10 years and have demonstrated a performance at a Tolerable Risk level, or better, during that period and there is not a foreseeable reason why this situation should change. Tolerable risk can only be considered as a criterion for the purpose of Building Certificates and under the Orders process.

Tolerable Risk includes the risk to life and the risk to property; both must be considered. The guidance for the establishment of acceptable risk criteria in this Policy has been based on the contents of AGS 2007(c & d).

- Tolerable Risk for Loss of Life for the person(s) most at risk, per annum is taken as having a probability of
  - 1×10^{-5} per annum for new sites or developments, and
  - 1×10^{-4} per annum for existing sites or developments.

- Acceptable Risk for Loss of Property is taken as "Moderate" as defined in AGS 2007.

Risk levels for both loss of life and property should be determined in accordance with the methodologies presented in AGS 2007(c). Risk of loss of life should be determined quantitatively. Risk of loss of property can be determined quantitatively or in accordance with the qualitative terminologies and matrices presented in AGS 2007(c).

Tolerable Risk Management – The complete process of risk assessment and control of risk to the level defined as "Tolerable Risk" in this Policy.

Reviewer - means a Geotechnical Engineer or Engineering Geologist as defined by this policy who technically reviews a geotechnical report or aspects of a geotechnical report.

GEOTECHNICAL PLANNING POLICY FOR NORTHERN BEACHES

FORM NO. 1 – To be submitted with Development Application *Page 1 of 2*

Development Application for:	
	Name of Applicant
Address of site:	

Declaration made by geotechnical engineer or engineering geologist as part of a geotechnical report

I, ______________________ on behalf of ______________________

Insert Name *Trading or Company Name*

on ______________________

Date

certify that I am a geotechnical engineer or engineering geologist as defined by the Geotechnical Planning Policy for Northern Beaches Council. I am authorised by the above organisation/company to issue this document and to certify that the organisation/company has a current professional indemnity policy of at least $2 million.

I: *(Please mark appropriate box)*

- ☐ have examined the site and the proposed development or alterations in detail and I am of the opinion that the Development Application only involves Minor Development/Alteration that does not require a Preliminary Geotechnical Assessment or Detailed Geotechnical Report and hence my opinion is in accordance with the Geotechnical Planning Policy for Northern Beaches Council.
- ☐ have examined the site and the proposed development/alteration is separate from and is not affected by a Geotechnical Hazard and does not require a Preliminary Geotechnical Assessment or Detailed Geotechnical Report and hence my opinion is in accordance with the Geotechnical Planning Policy requirements.
- ☐ have examined the site and the proposed development in detail and have prepared the Preliminary Geotechnical Assessment report referenced below. I confirm that the results of the preliminary risk assessment for the proposed development are in compliance with the Geotechnical Planning Policy for Northern Beaches Council and further detailed geotechnical investigation and reporting is not required for the subject site.
- ☐ have prepared the geotechnical report referenced below in accordance with the Geotechnical Planning Policy for Northern Beaches Council.
- ☐ have technically reviewed the geotechnical report referenced below and can confirm that it has been prepared in accordance with the Geotechnical Planning Policy for Northern Beaches Council.

Geotechnical Report or Letter Details

Report Title:	
Report Date:	
Author:	
Author's Company:	

Documentation which relate to or are relied upon in report preparation:

GEOTECHNICAL PLANNING POLICY FOR NORTHERN BEACHES

FORM NO. 1 (contd) – Checklist of Requirements for Geotechnical Reports *Page 2 of 2*

The following checklists cover the minimum requirements to be addressed in either a Preliminary Geotechnical Assessment or a Detailed Geotechnical Report.

Preliminary Geotechnical Assessment

- ☐ Visual inspection of the site
- ☐ Review of regional geology and topography
- ☐ Assessment of the likely groundwater levels
- ☐ Identification of potential geotechnical hazards on the site or neighbouring properties that may affect the site
- ☐ Review of proposed development and its impact on the geotechnical conditions on or around the site
- ☐ A preliminary risk assessment conducted in accordance with the Geotechnical Planning Policy for Northern Beaches Council
- ☐ A statement as to whether additional geotechnical or hydrogeological investigations or inspections are required.

Detailed Geotechnical Report

- ☐ Comprehensive site mapping conducted on ______________________ (date)
- ☐ Mapping details presented on contoured site plan
- ☐ Subsurface investigation required
  - ☐ No Justification ________________________________
  - ☐ Yes Date conducted ________________________________
- ☐ Geotechnical model developed and reported as an inferred subsurface type-section
- ☐ Suitable foundation strata and footing types identified
- ☐ Recommendations for excavation batter slopes or support provided
- ☐ Design parameters for retaining structures and footings provided
- ☐ Recommendations for stormwater disposal provided
- ☐ Level of groundwater identified and impacts on development assessed.
- ☐ Existing groundwater affected by development
  - ☐ Yes - Hydrogeological investigation and impact assessment completed
  - ☐ No
- ☐ Geotechnical hazards identified
  - ☐ Above the site ☐ Below the site
  - ☐ On the site ☐ Beside the site
- ☐ Geotechnical hazards described and reported
- ☐ Risk assessment conducted in accordance with the Geotechnical Planning Policy for Northern Beaches Council
- ☐ Risk assessment for property conducted
- ☐ Risk assessment for loss of life conducted
- ☐ Assessed risks have been compared to "Acceptable Risk Management" criteria as defined in the Geotechnical Planning Policy
- ☐ Opinion has been provided that the design can achieve the "Acceptable Risk Management" criteria provided that the specified conditions are achieved.
- ☐ Design Life Adopted:
  - ☐ 100 years ☐ Other ________________________________ (specify)
- ☐ Geotechnical Conditions to be applied to all stages of development, as described in the Geotechnical Planning Policy, have been specified
- ☐ Additional actions to remove risk where reasonable and practical have been identified and included in the report.
- ☐ On-going maintenance requirements and responsibilities have been clearly outlined in the report
- ☐ Risk assessment within Bushfire Asset Protection Zone.

I am aware that the Geotechnical Report, prepared for the abovementioned site is to be submitted in support of a Development Application for this site and will be relied on by Council as the basis for ensuring that the Geotechnical Planning aspects of the proposed development have been adequately addressed to achieve an "Acceptable Risk Management" level for the life of the structure, taken as at least 100 years unless otherwise stated and justified in the Report and that reasonable and practical measures have been identified to remove foreseeable risk.

Signature:	Date:
Name:	
Registration Status:	
Company:	

GEOTECHNICAL PLANNING POLICY FOR NORTHERN BEACHES

FORM NO. 2 – PART A - To be submitted with detailed design for Construction Certificate

Development Application for:		
	Name of Applicant	
Address of site:		
D. A. No.:		Date of consent:

PART A: Declaration made by Structural or Civil Engineer in relation to the incorporation of the Geotechnical issues into the project design

I, ______________________ on behalf of ______________________
Insert Name *Trading or Company Name*

on ______________________
Date

certify that I am a Structural or Civil Engineer as defined by the Geotechnical Planning Policy. I am authorised by the above organisation/company to issue this document and to certify that the organisation/company has a current professional indemnity policy of at least $2 million. I also certify that I have prepared the below listed structural documents in accordance with the recommendations given in the Geotechnical Report for the above development and that:

Please mark appropriate box

☐ the structural design meets the recommendations as set out in the Geotechnical Report or any revision thereto.

☐ the structural design has considered the requirements set out in the Geotechnical Report for both the excavation/construction phase and the final installation.

Geotechnical Report Details

Report Title:	
Report Date:	
Author:	
Author's Company:	

Structural Documents List:

I am also aware that Northern Beaches Council relies on the processes covered by the Geotechnical Planning Policy, including this certification as the basis for ensuring that the geotechnical risk management aspects of the proposed development have been adequately addressed to achieve an "Acceptable Risk Management" level for the life of the structure, taken as at least 100 years unless otherwise stated and justified.

Signature:	Date:
Name:	
Registration Status:	
Company:	

GEOTECHNICAL PLANNING POLICY FOR NORTHERN BEACHES

FORM NO. 2 – PART B - To be submitted with detailed design for Construction Certificate

Development Application for:		
	Name of Applicant	
Address of site:		
D. A. No.:		Date of consent:

PART B: Declaration made by Geotechnical Engineer or Engineering Geologist in relation to the incorporation of the Geotechnical issues into the project design

I, ______________________ on behalf of ______________________

Insert Name *Trading or Company Name*

on ______________________

Date

certify that I am a Geotechnical Engineer or Engineering Geologist as defined by the Geotechnical Planning Policy. I am authorised by the above organisation/company to issue this document and to certify that the organisation/company has a current professional indemnity policy of at least $2 million. I also certify that I have reviewed the design plans and structural design plans for the Construction Certificate Stage and that I am satisfied that:

Please mark appropriate box

☐ the structural design meets the recommendations as set out in the Geotechnical Report or any revision thereto.

☐ the structural design has considered the requirements set out in the Geotechnical Report for both the excavation/construction phase and the final installation.

Geotechnical Report Details

Report Title:	
Report Date:	
Author:	
Author's Company:	

Documentation which relates to or is relied upon in report preparation:

I am also aware that Northern Beaches Council relies on the processes covered by the Geotechnical Planning Policy, including this certification as the basis for ensuring that the geotechnical risk management aspects of the proposed development have been adequately addressed to achieve an "Acceptable Risk Management" level for the life of the structure, taken as at least 100 years unless otherwise stated and justified.

Signature:	Date:
Name:	
Registration Status:	
Company:	

GEOTECHNICAL PLANNING POLICY FOR NORTHERN BEACHES

FORM NO. 3 – Post Construction Geotechnical Certificate - to be submitted with Occupation Certificate or Subdivision Certificate

Development Application for:		
	Name of Applicant	
Address of site:		
D. A. No.:		Date of consent:

Declaration made by Geotechnical Engineer or Engineering Geologist on completion of the Development

I, ______________________ on behalf of ______________________
Insert Name *Trading or Company Name*

on ______________________
Date

certify that I am a geotechnical engineer or engineering geologist as defined by the Geotechnical Planning Policy for Northern Beaches Council. I am authorised by the above organisation/company to issue this document and to certify that the organisation/company has a current professional indemnity policy of at least $2 million. I have reviewed the following geotechnical report prepared for the site.

Geotechnical Report Details

Report Title:	
Report Date:	
Author:	
Author's Company:	

I have reviewed the original structural design and, where applicable, the subsequently amended structural details (below listed) which have been incorporated into the completed project.

List of all work as executed drawings and ongoing maintenance plans relevant to geotechnical risk management:

I have inspected the site during construction or reviewed information relating to the construction (eg photos, reports etc) as listed below. I am satisfied that the foundation materials, upon which the structural elements (as detailed in the original and amended structural documents) of the development have been erected, comply with the requirements specified in the Geotechnical Report and the Construction Certificate approved Structural Plans.

Construction Information which has been relied upon:

To the best of my knowledge, I am satisfied that the development referred to in the development consent has been constructed in accordance with the intent of the Geotechnical Report for the development, the requirements of the conditions of Development Consent and the Construction Certificate approved Structural Plans relating to the geotechnical issues (including any treatment and/or maintenance plans that may be required to remove risk where reasonable and practical).

I am aware that Council require this certificate prior to issuing an occupancy certificate for the development identified above and will rely on this certificate in regard to the development having achieved the "Acceptable Risk Management" criterion defined in the Policy and that reasonable and practical measures have been taken to remove foreseeable risk.

Signature:	Date:
Name:	
Registration Status:	
Company:	

GEOTECHNICAL PLANNING POLICY FOR NORTHERN BEACHES

FORM NO. 4 – To be submitted with Application for a Building Certificate or Response to an Order

Building Certificate Application or Response to Order for:	
	Name of Applicant
Address of site:	
Order No. (if applicable)	

Declaration made by Geotechnical Engineer or Engineering Geologist in relation to the submission of an application for a Building Certificate or Response to an Order

I, ______________________ on behalf of ______________________
Insert Name *Trading or Company Name*

on ______________________
Date

certify that I am a geotechnical engineer as defined by the Geotechnical Planning Policy for Northern Beaches Council. I am authorised by the above organisation/company to issue this document and to certify that the organisation/company has a current professional indemnity policy of at least $2 million.

☐ I have inspected the site and the existing development and am satisfied that both the site and the development achieve at least the “Acceptable Risk Management” requirement of the Geotechnical Planning Policy. The attached report provides details of the assessment in accordance with the Geotechnical Planning Policy. The report also contains recommendations as to any reasonable and practical measures that can be undertaken to remove foreseeable risk. I am aware that Council will rely on this certification as the basis for ensuring that the geotechnical risk management aspects of the site and the development have been adequately addressed to achieve at least a “Acceptable Risk Management” level for the life of the structure taken as 100 years unless otherwise stated and justified in the Report.*

☐ I have inspected the site and the existing development and am satisfied that both the site and the development have been in place for at least 10 years without change and with no foreseeable future changes. I am satisfied that the site and the development achieve at least the “Tolerable Risk Management” requirement of the Geotechnical Planning Policy. The attached report provides details of the assessment in accordance with the Geotechnical Planning Policy. The report also contains recommendations as to any reasonable and practical measures that can be undertaken to remove foreseeable risk. I am aware that Council will rely on this certification as the basis for ensuring that the geotechnical risk management aspects of the site and the development have been adequately addressed to achieve at least a “Tolerable Risk Management” level for the life of the structure taken as 100 years unless otherwise stated and justified in the Report.*

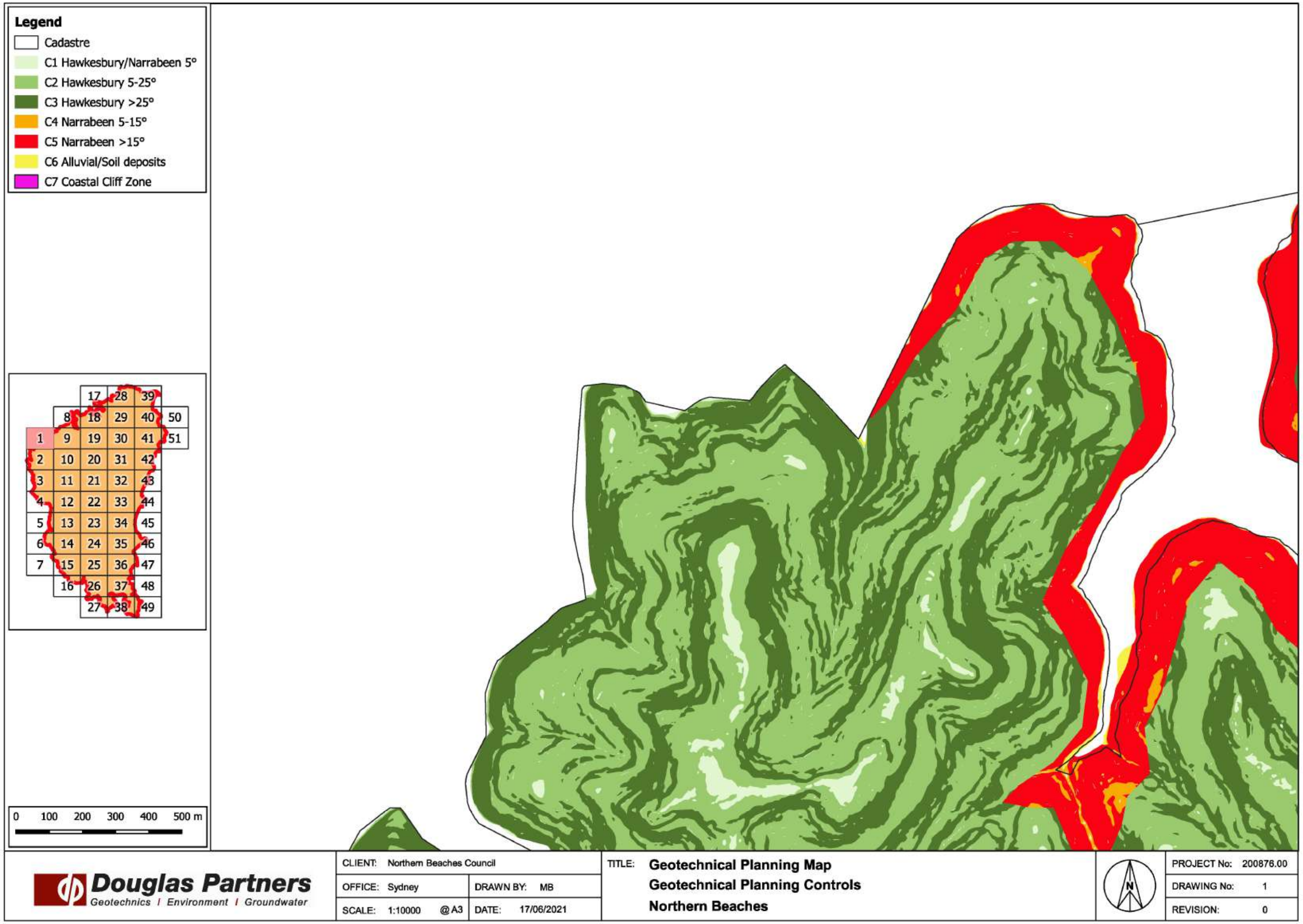
☐ I have inspected the site of the existing development. The attached report details the remedial actions required to be undertaken prior to me being prepared to certify that the site and the development achieves at least the “Tolerable Risk Management” criteria required in accordance with the Policy.

* Note: If the life of the structure is less than 100 years, please indicate the assessed design life _________ years.

Geotechnical Report Details

Report Title:	
Report Date:	
Author:	
Author’s Company:	

Signature:	Date:
Name:	
Registration Status:	
Company:	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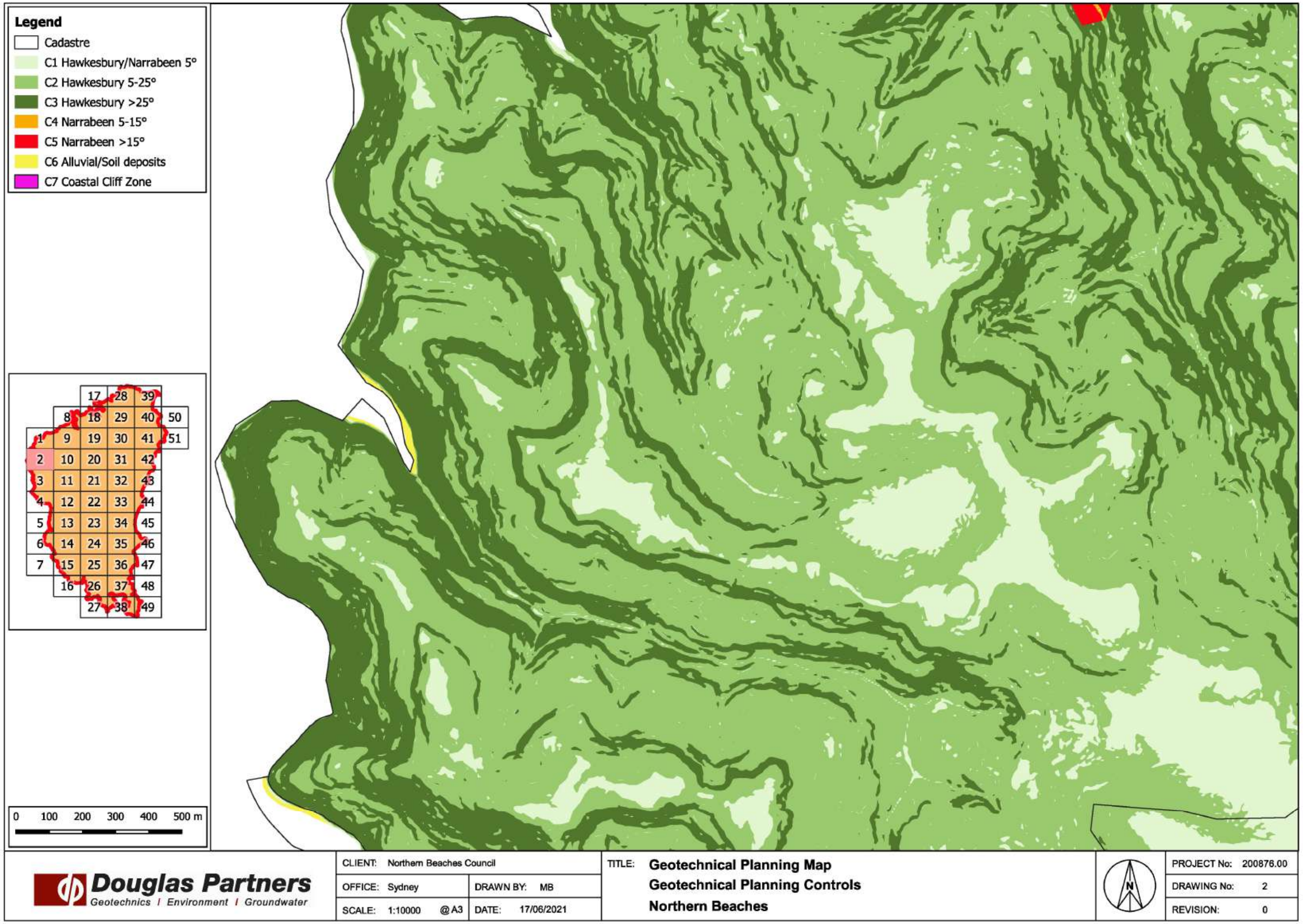
C1 Hawkesbury/Narrabeen 5°
C2 Hawkesbury 5-25°
C3 Hawkesbury >25°
C4 Narrabeen 5-15°
C5 Narrabeen >15°
C6 Alluvial/Soil deposits
C7 Coastal Cliff Zone
0 100 200 300 400 500 m
Douglas Partners
Geotechnics / Environment / Groundwater
CLIENT: Northern Beaches Council
OFFICE: Sydney
DRAWN BY: MB
SCALE: 1:10000 @A3
DATE: 17/06/2021
TITLE: Geotechnical Planning Map
Geotechnical Planning Controls
Northern Beaches
N
PROJECT No: 200876.00
DRAWING No: 1
REVISION: 0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Cadastre
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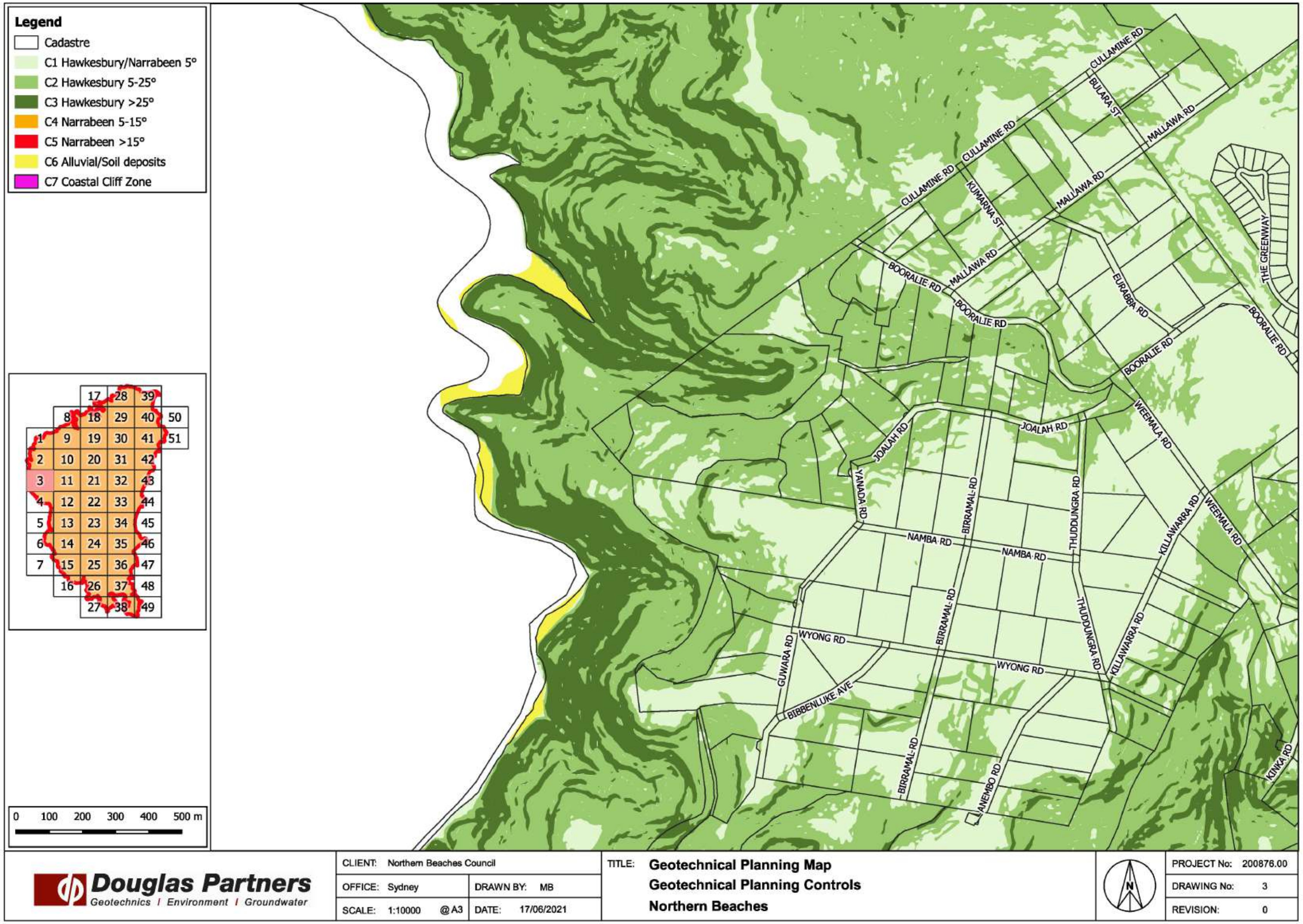
C2 Hawkesbury 5-25°
C3 Hawkesbury >25°
C4 Narrabeen 5-15°
C5 Narrabeen >15°
C6 Alluvial/Soil deposits
C7 Coastal Cliff Zone
17 28 39
8 18 29 40 50
1 9 19 30 41 51
2 10 20 31 42
3 11 21 32 43
4 12 22 33 44
5 13 23 34 45
6 14 24 35 46
7 15 25 36 47
16 26 37 48
27 38 49
0 100 200 300 400 500 m
Douglas Partners
Geotechnics / Environment / Groundwater
CLIENT: Northern Beaches Council
OFFICE: Sydney
DRAWN BY: MB
SCALE: 1:10000 @A3
DATE: 17/06/2021
TITLE: Geotechnical Planning Map
Geotechnical Planning Controls
Northern Beaches
N
PROJECT No: 200876.00
DRAWING No: 2
REVISION: 0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Cadastre
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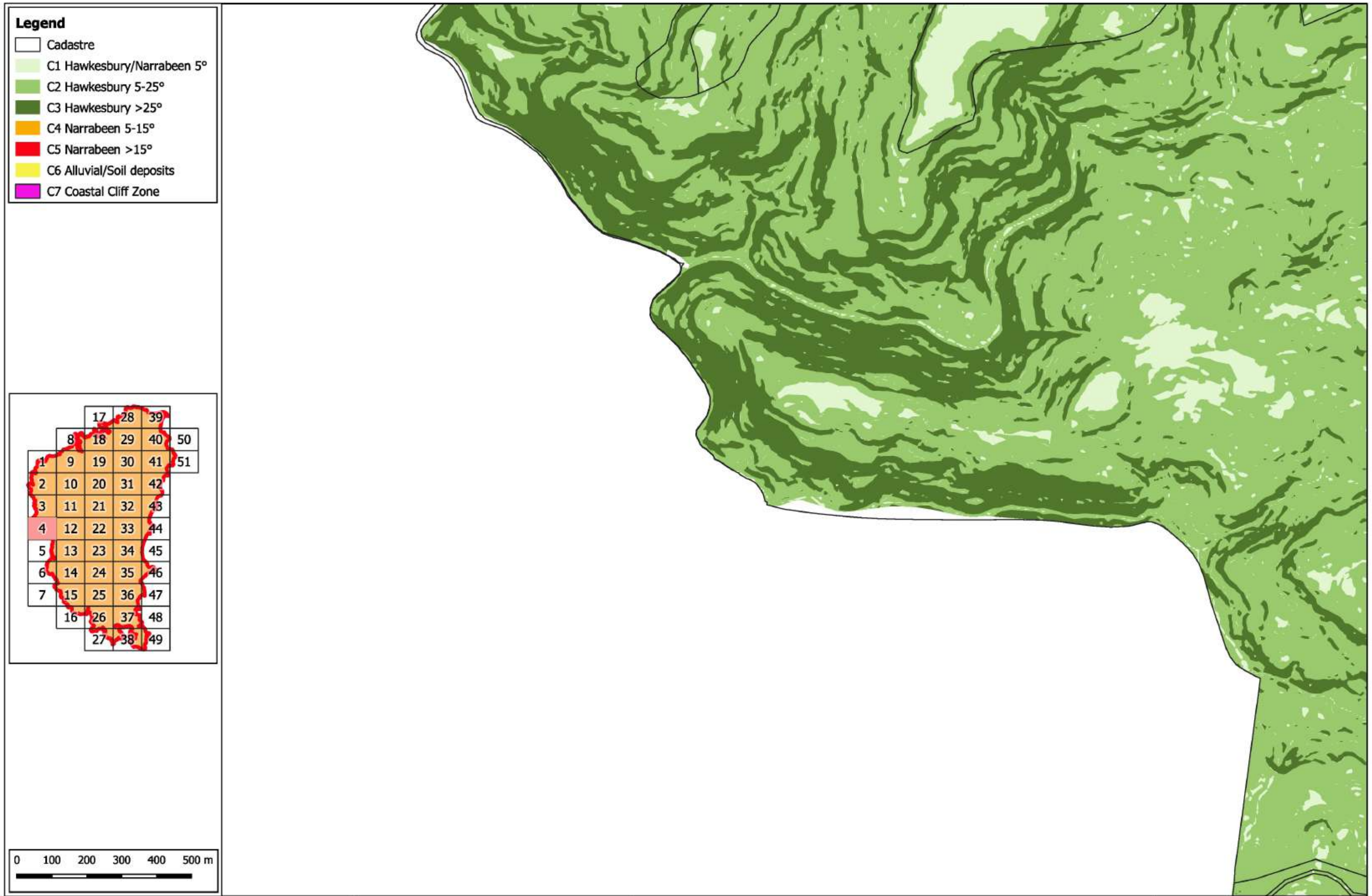
C2 Hawkesbury 5-25°
C3 Hawkesbury >25°
C4 Narrabeen 5-15°
C5 Narrabeen >15°
C6 Alluvial/Soil deposits
C7 Coastal Cliff Zone
0 100 200 300 400 500 m
CULLAMINE RD
BULARA ST
MALLAWA RD
KUMARNA ST
THE GREENWAY
BOORALIE RD
EURABBA RD
JOALAH RD
WEEMALA RD
YANADA RD
BIRRAMAL RD
THUDDUNGRA RD
NAMBA RD
KILLAWARRA RD
WYONG RD
GUWARA RD
BIBBENLUKE AVE
ANEMBO RD
KINKA RD
Douglas Partners
Geotechnics / Environment / Groundwater
CLIENT: Northern Beaches Council
OFFICE: Sydney
DRAWN BY: MB
SCALE: 1:10000 @A3
DATE: 17/06/2021
TITLE: Geotechnical Planning Map
Geotechnical Planning Controls
Northern Beaches
PROJECT No: 200876.00
DRAWING No: 3
REVISION: 0



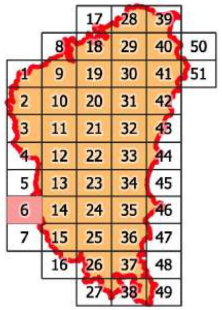
Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Northern Beaches Council		TITLE: Geotechnical Planning Map Geotechnical Planning Controls Northern Beaches	PROJECT No: 200876.00
OFFICE: Sydney	DRAWN BY: MB		DRAWING No: 4
SCALE: 1:10000 @ A3	DATE: 17/06/2021		REVISION: 0

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Northern Beaches Council		TITLE: **Geotechnical Planning Map**	PROJECT No: 200876.00
	OFFICE: Sydney	DRAWN BY: MB	**Geotechnical Planning Controls**	DRAWING No: 5
	SCALE: 1:10000 @A3	DATE: 17/06/2021	**Northern Beaches**	REVISION: 0

Legend

- Cadastre
- C1 Hawkesbury/Narrabeen 5°
- C2 Hawkesbury 5-25°
- C3 Hawkesbury >25°
- C4 Narrabeen 5-15°
- C5 Narrabeen >15°
- C6 Alluvial/Soil deposits
- C7 Coastal Cliff Zone



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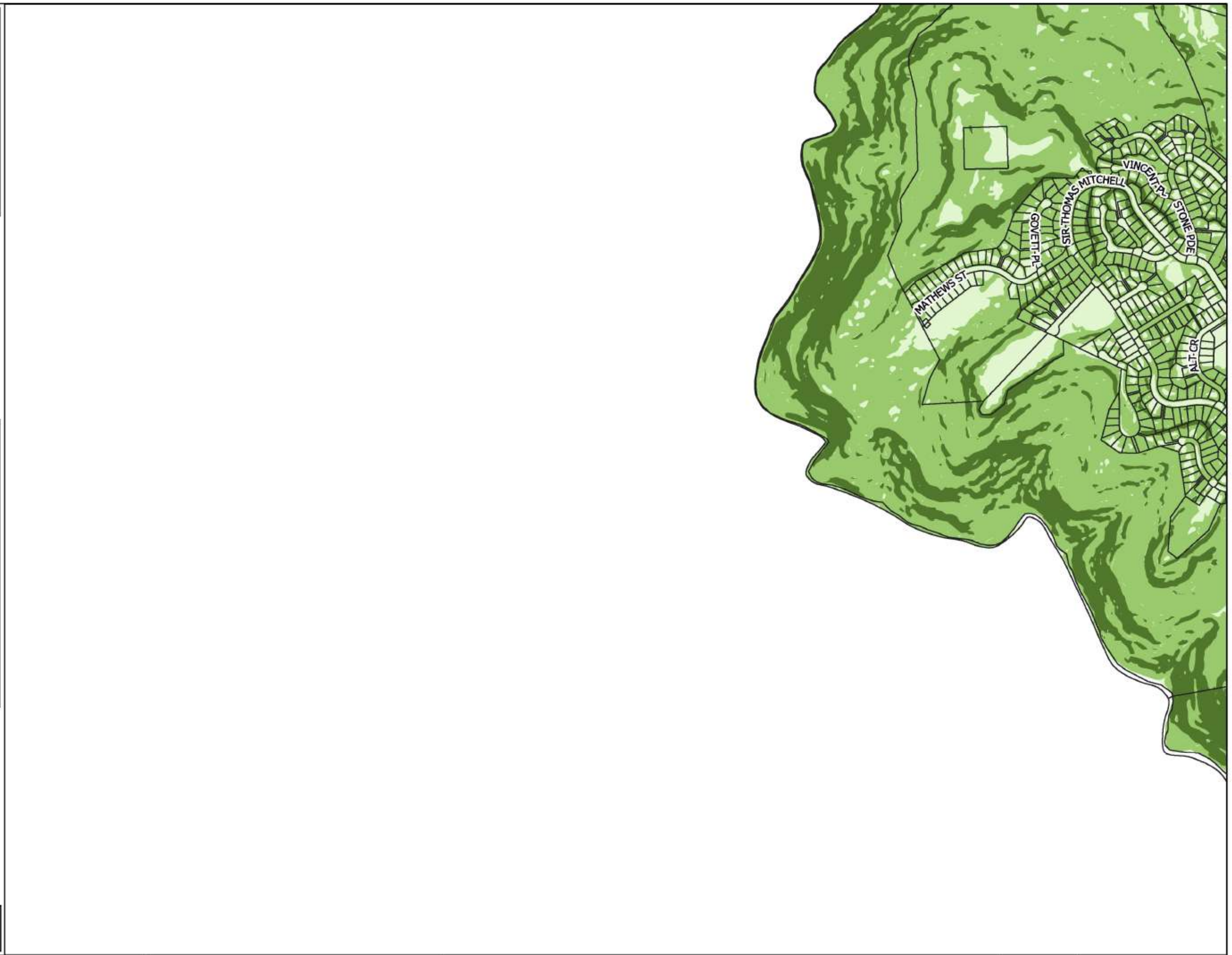
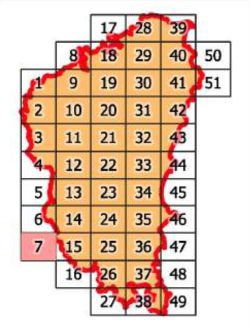


Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Northern Beaches Council	TITLE: **Geotechnical Planning Map**	PROJECT No: 200876.00
	OFFICE: Sydney — DRAWN BY: MB	**Geotechnical Planning Controls**	DRAWING No: 6
	SCALE: 1:10000 @A3 — DATE: 17/06/2021	**Northern Beaches**	REVISION: 0

Legend

- Cadastre
- C1 Hawkesbury/Narrabeen 5°
- C2 Hawkesbury 5-25°
- C3 Hawkesbury >25°
- C4 Narrabeen 5-15°
- C5 Narrabeen >15°
- C6 Alluvial/Soil deposits
- C7 Coastal Cliff Zone



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Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Northern Beaches Council		TITLE: Geotechnical Planning Map Geotechnical Planning Controls Northern Beaches
	OFFICE: Sydney	DRAWN BY: MB	
	SCALE: 1:10000 @A3	DATE: 17/06/2021	

PROJECT No:	200876.00
DRAWING No:	7
REVISION:	0

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Northern Beaches Council		TITLE: Geotechnical Planning Map	PROJECT No: 200876.00
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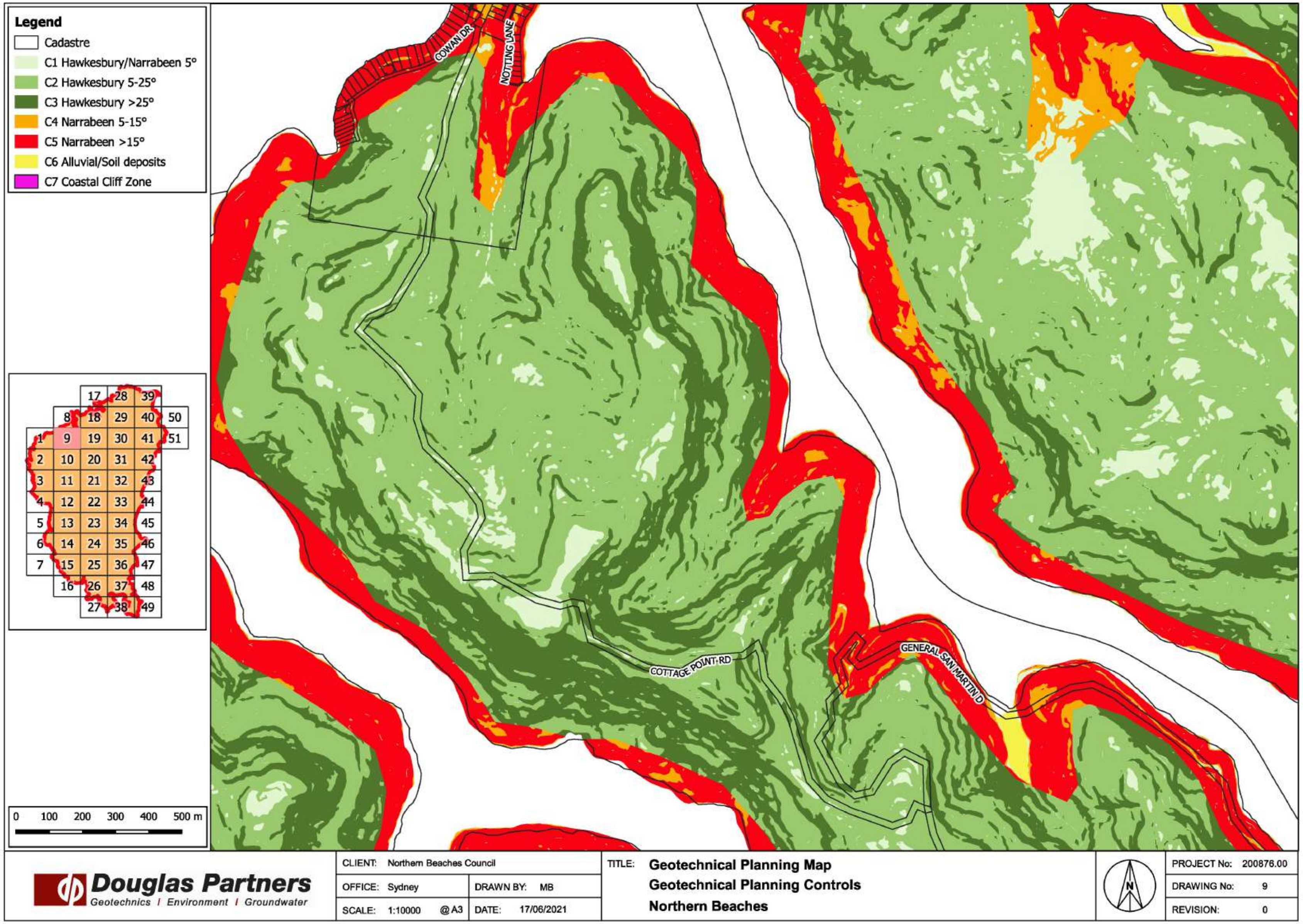
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Cadastre
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C2 Hawkesbury 5-25°
C3 Hawkesbury >25°
C4 Narrabeen 5-15°
C5 Narrabeen >15°
C6 Alluvial/Soil deposits
C7 Coastal Cliff Zone
COWAN DR
NOTTING LANE
COTTAGE POINT RD
GENERAL SAN MARTIN D
0 100 200 300 400 500 m
Douglas Partners
Geotechnics / Environment / Groundwater
CLIENT: Northern Beaches Council
OFFICE: Sydney
DRAWN BY: MB
SCALE: 1:10000 @A3
DATE: 17/06/2021
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Geotechnical Planning Controls
Northern Beaches
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PROJECT No: 200876.00
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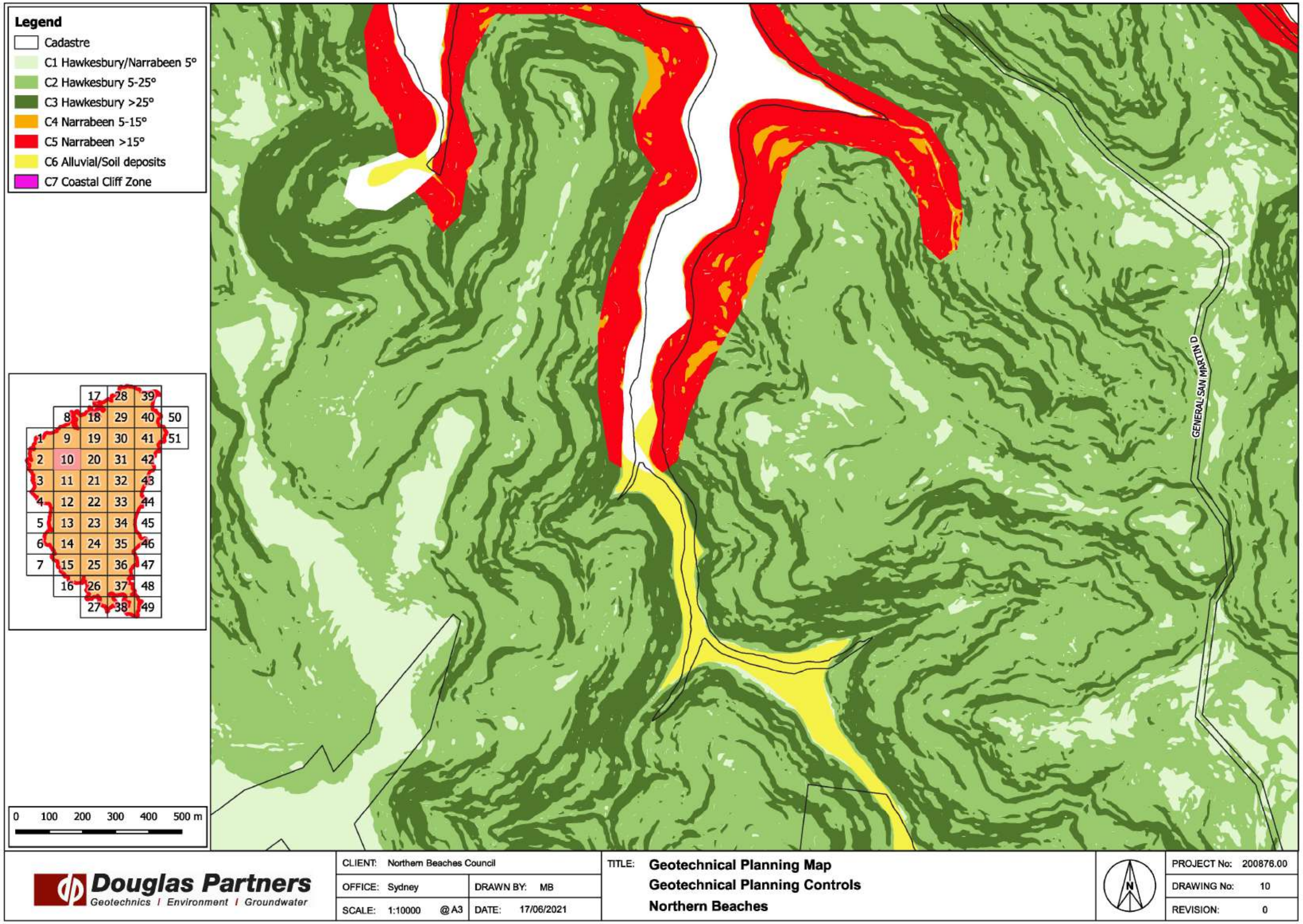
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C2 Hawkesbury 5-25°
C3 Hawkesbury >25°
C4 Narrabeen 5-15°
C5 Narrabeen >15°
C6 Alluvial/Soil deposits
C7 Coastal Cliff Zone
0 100 200 300 400 500 m
GENERAL SAN MARTIN D
Douglas Partners
Geotechnics / Environment / Groundwater
CLIENT: Northern Beaches Council
OFFICE: Sydney
DRAWN BY: MB
SCALE: 1:10000 @A3
DATE: 17/06/2021
TITLE: Geotechnical Planning Map
Geotechnical Planning Controls
Northern Beaches
PROJECT No: 200876.00
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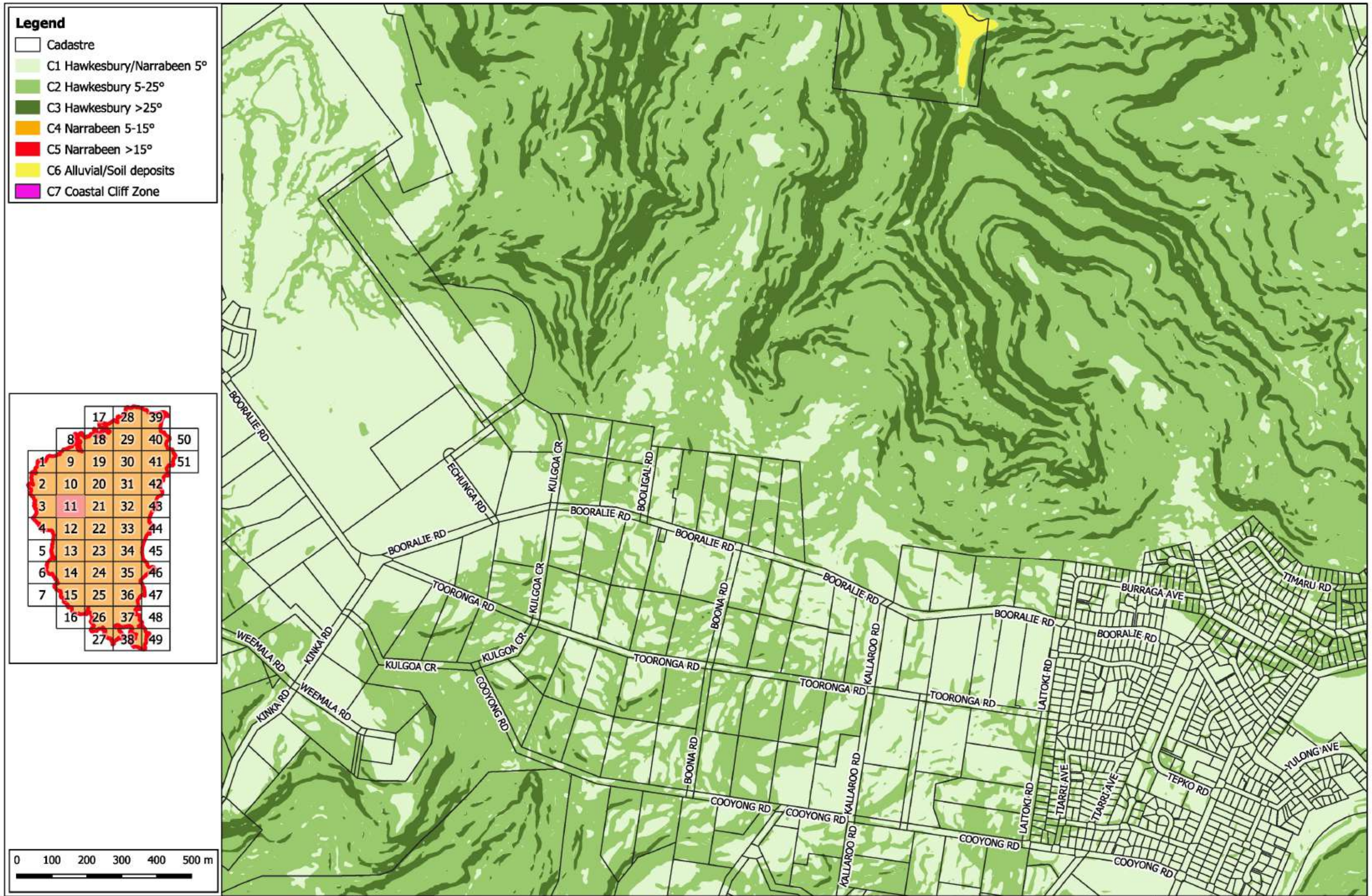

CLIENT: Northern Beaches Council		TITLE: Geotechnical Planning Map	PROJECT No: 200876.00
OFFICE: Sydney	DRAWN BY: MB	Geotechnical Planning Controls	DRAWING No: 11
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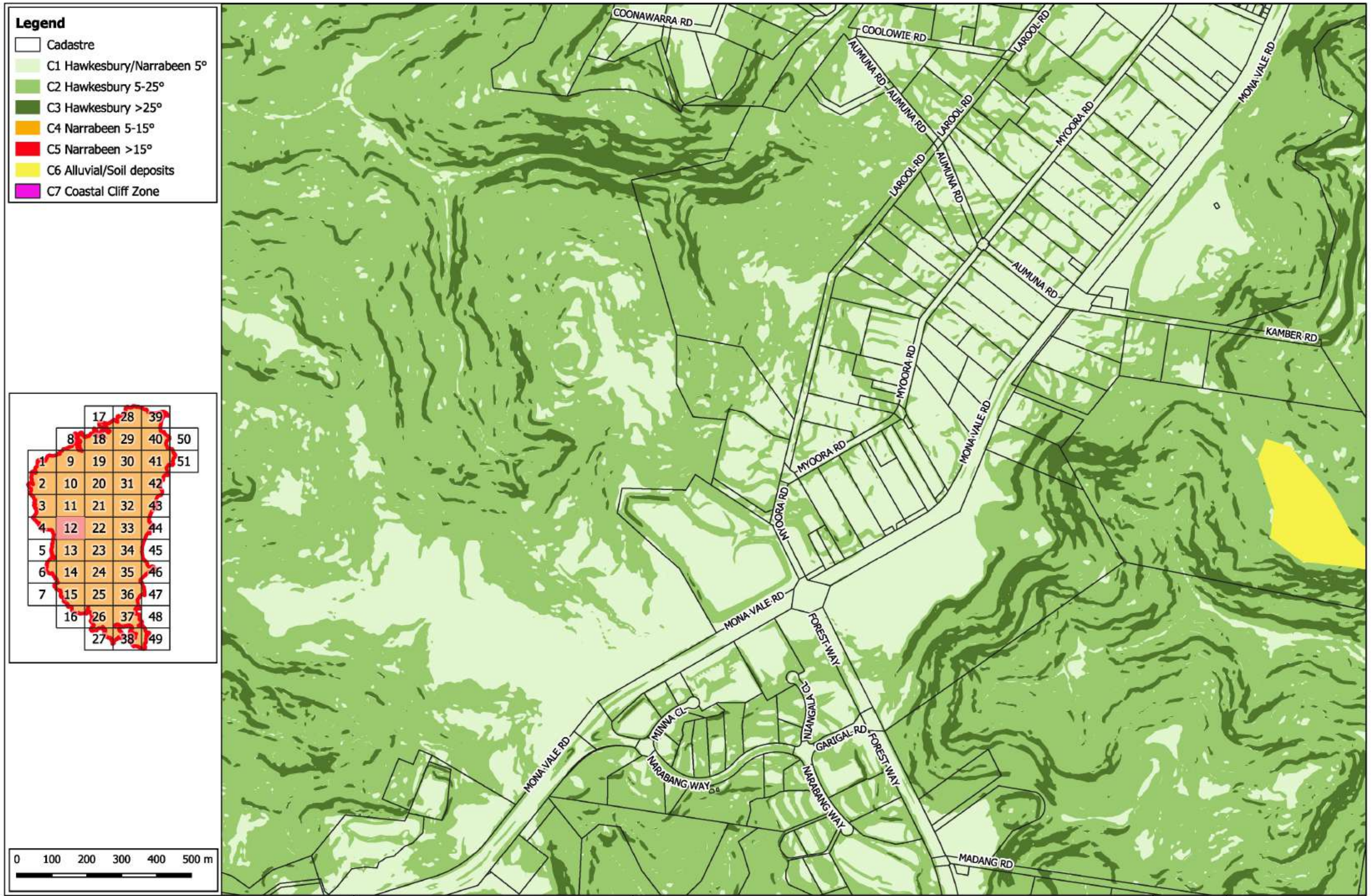
Douglas Partners
Geotechnics / Environment / Groundwater



Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Northern Beaches Council	TITLE: **Geotechnical Planning Map**	PROJECT No: 200876.00
	OFFICE: Sydney — DRAWN BY: MB	**Geotechnical Planning Controls**	DRAWING No: 12
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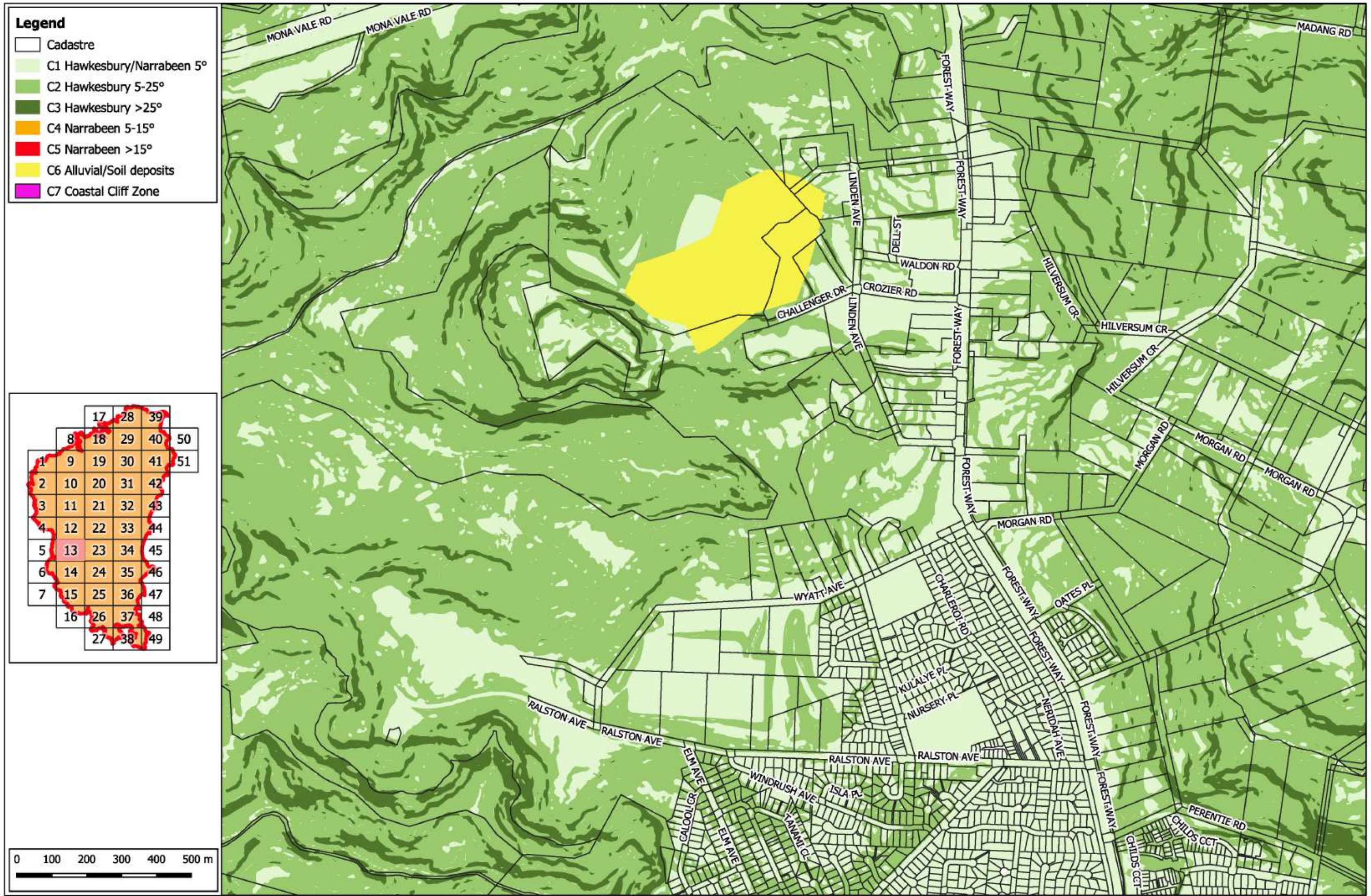

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Northern Beaches Council	TITLE: **Geotechnical Planning Map**	PROJECT No: 200876.00
	OFFICE: Sydney — DRAWN BY: MB	**Geotechnical Planning Controls**	DRAWING No: 13
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Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Northern Beaches Council		TITLE: **Geotechnical Planning Map** **Geotechnical Planning Controls** **Northern Beaches**	PROJECT No: 200876.00
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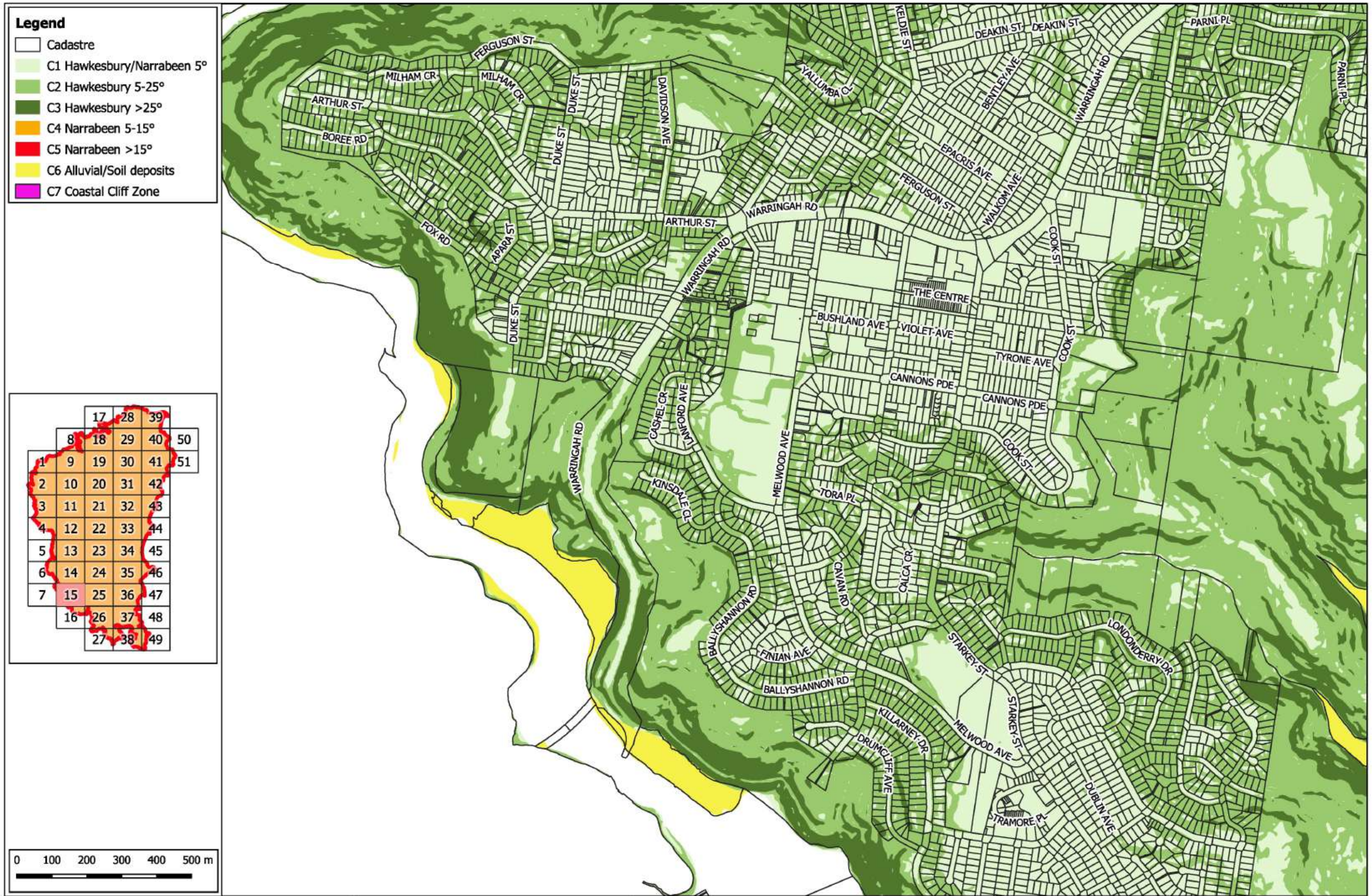

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OFFICE: Sydney	DRAWN BY: MB	**Geotechnical Planning Controls**	DRAWING No: 15
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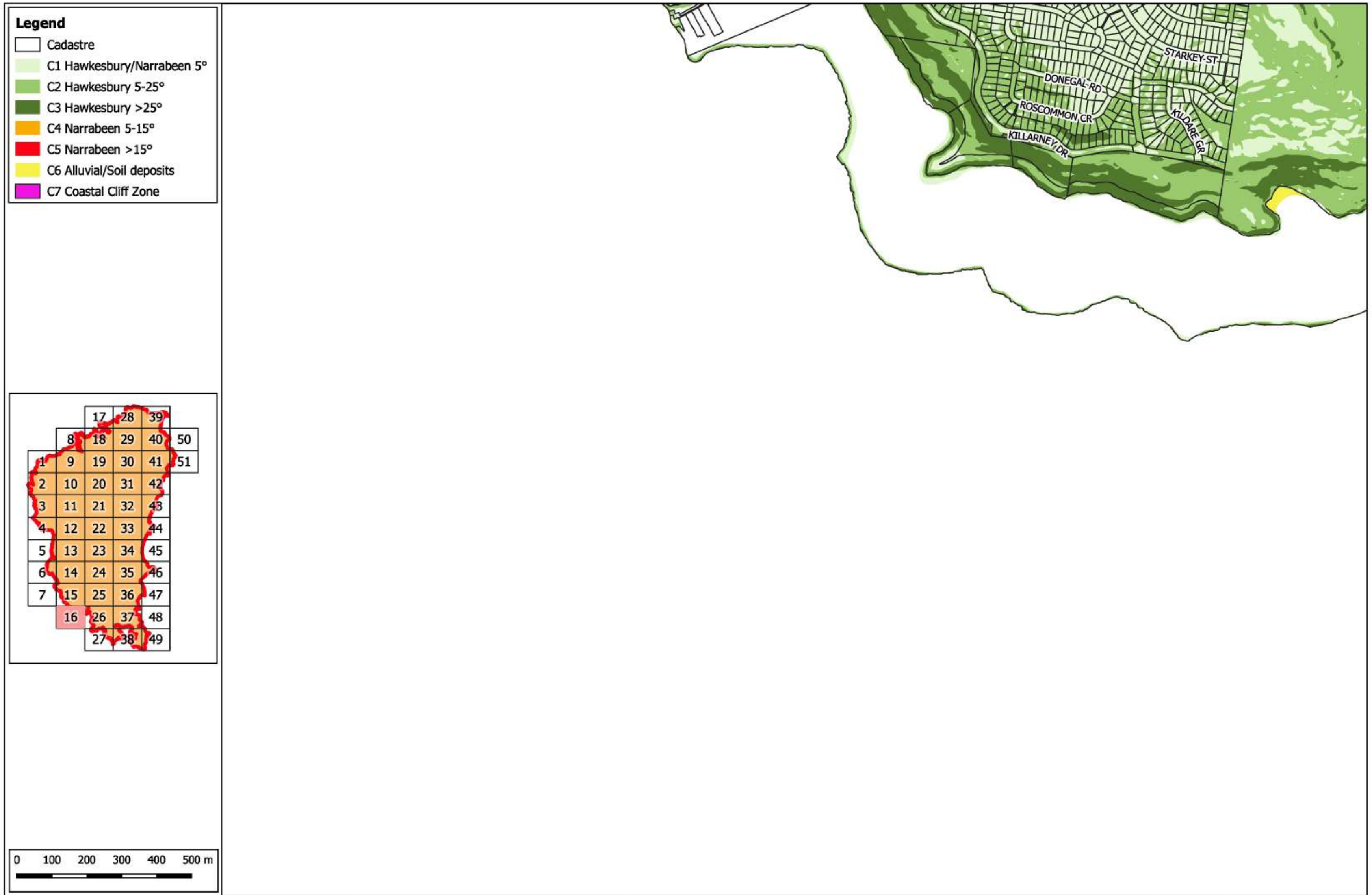
Douglas Partners
Geotechnics / Environment / Groundwater



Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Northern Beaches Council		TITLE: **Geotechnical Planning Map**	PROJECT No: 200876.00
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Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Northern Beaches Council	TITLE: **Geotechnical Planning Map**	PROJECT No: 200876.00
	OFFICE: Sydney / DRAWN BY: MB	**Geotechnical Planning Controls**	DRAWING No: 17
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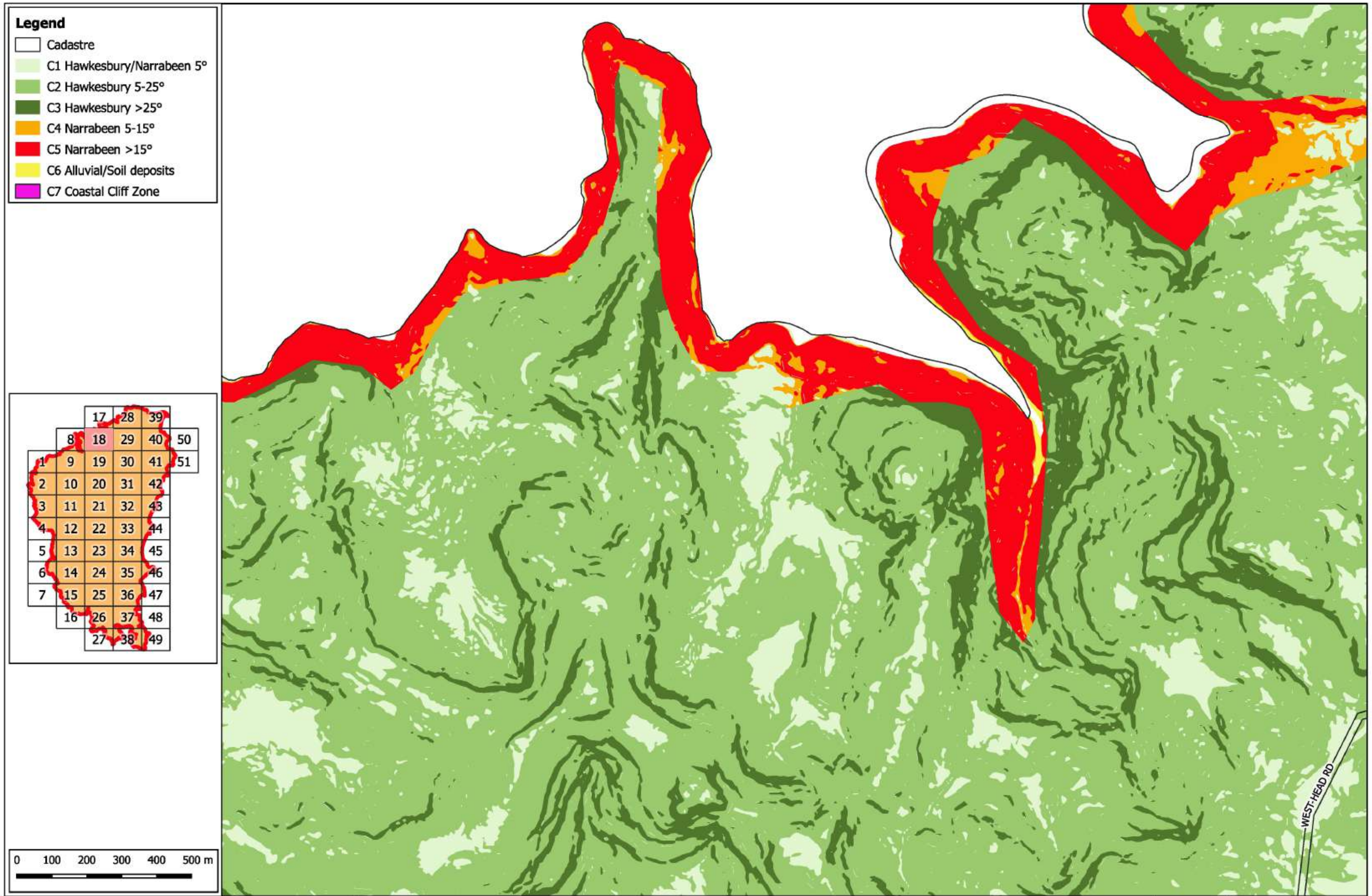

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Northern Beaches Council	TITLE: **Geotechnical Planning Map**	PROJECT No: 200876.00
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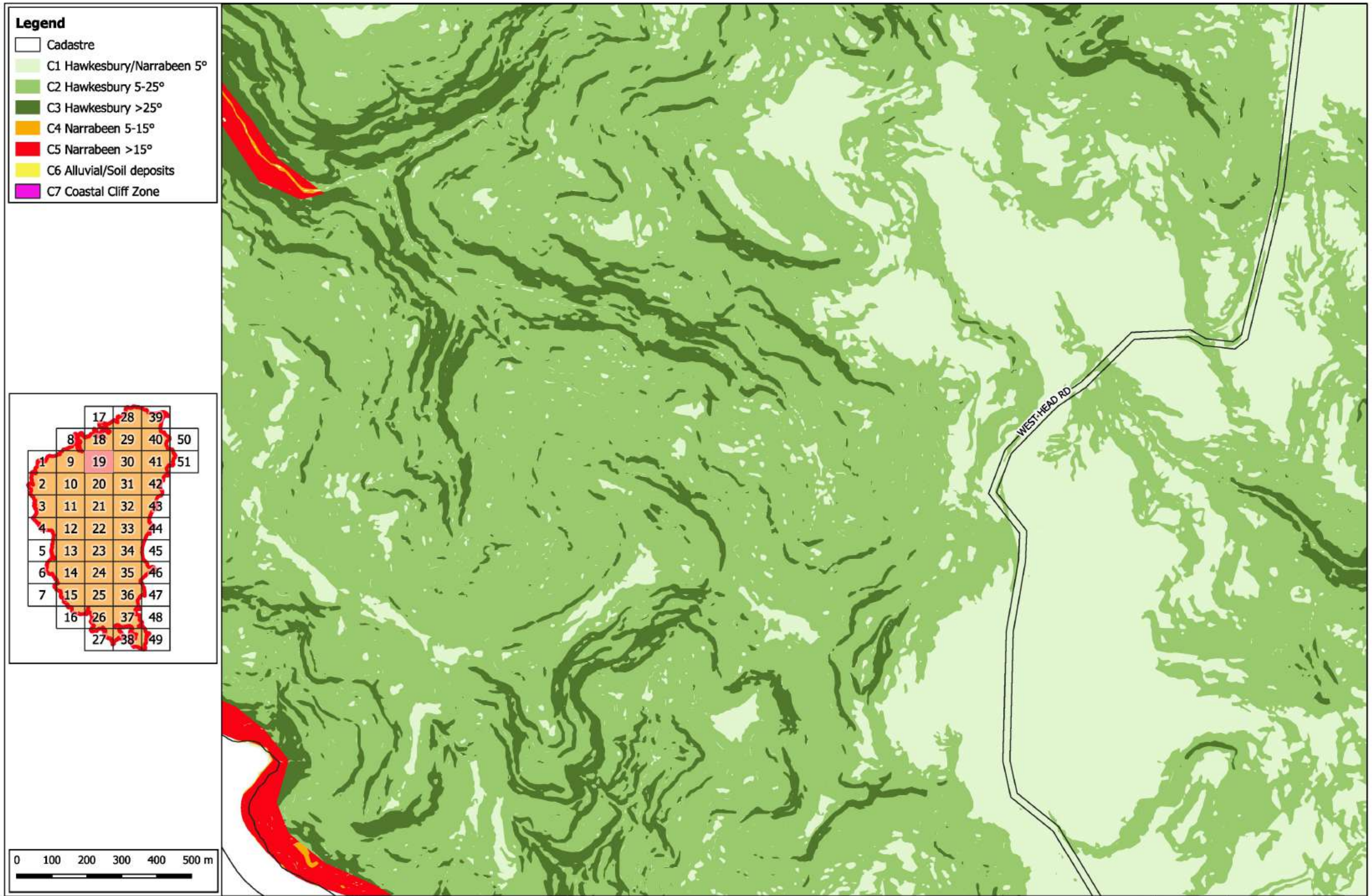

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Northern Beaches Council		TITLE: **Geotechnical Planning Map**	PROJECT No: 200876.00
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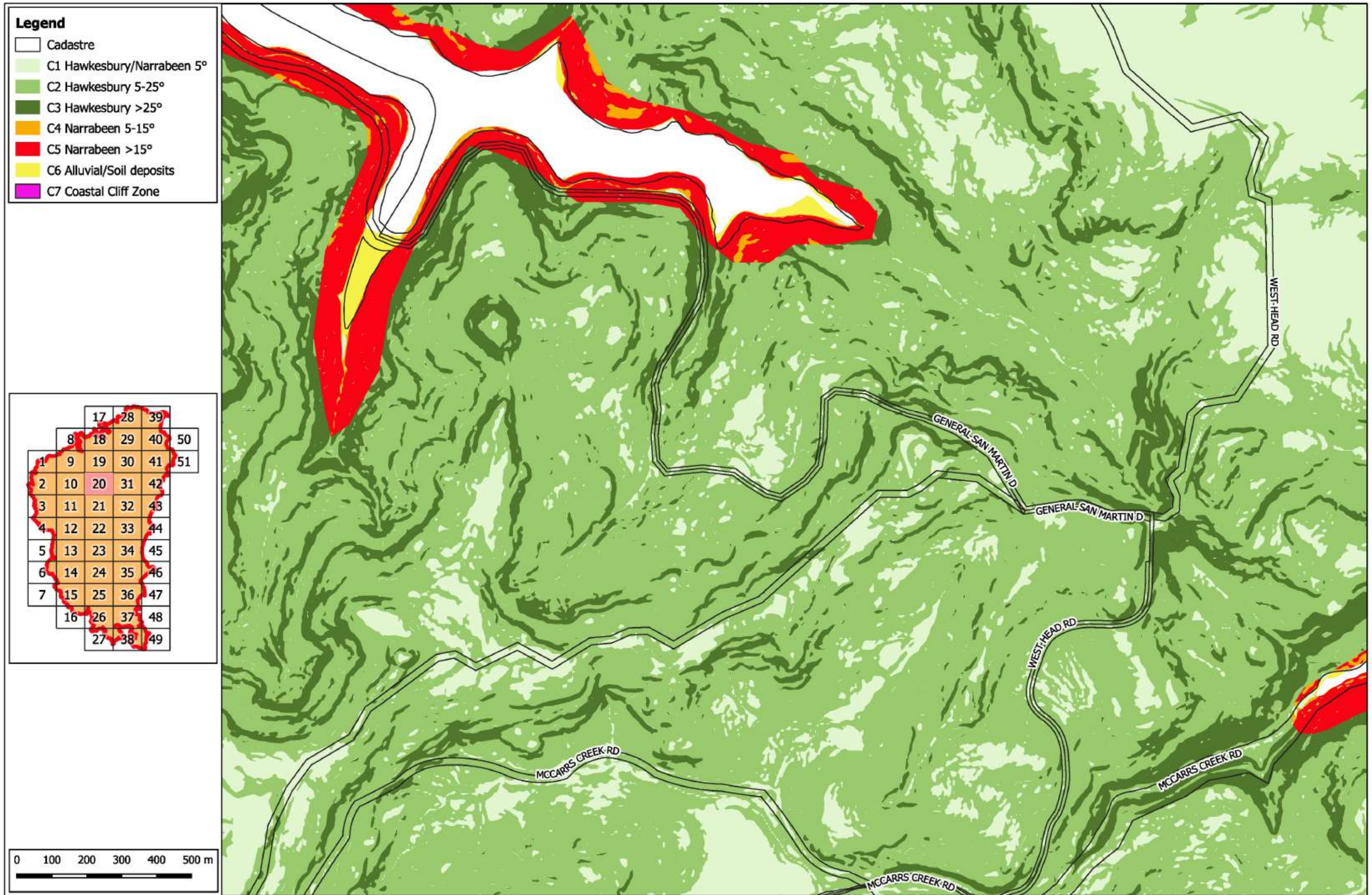

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Northern Beaches Council		TITLE: **Geotechnical Planning Map**	N	PROJECT No: 200876.00
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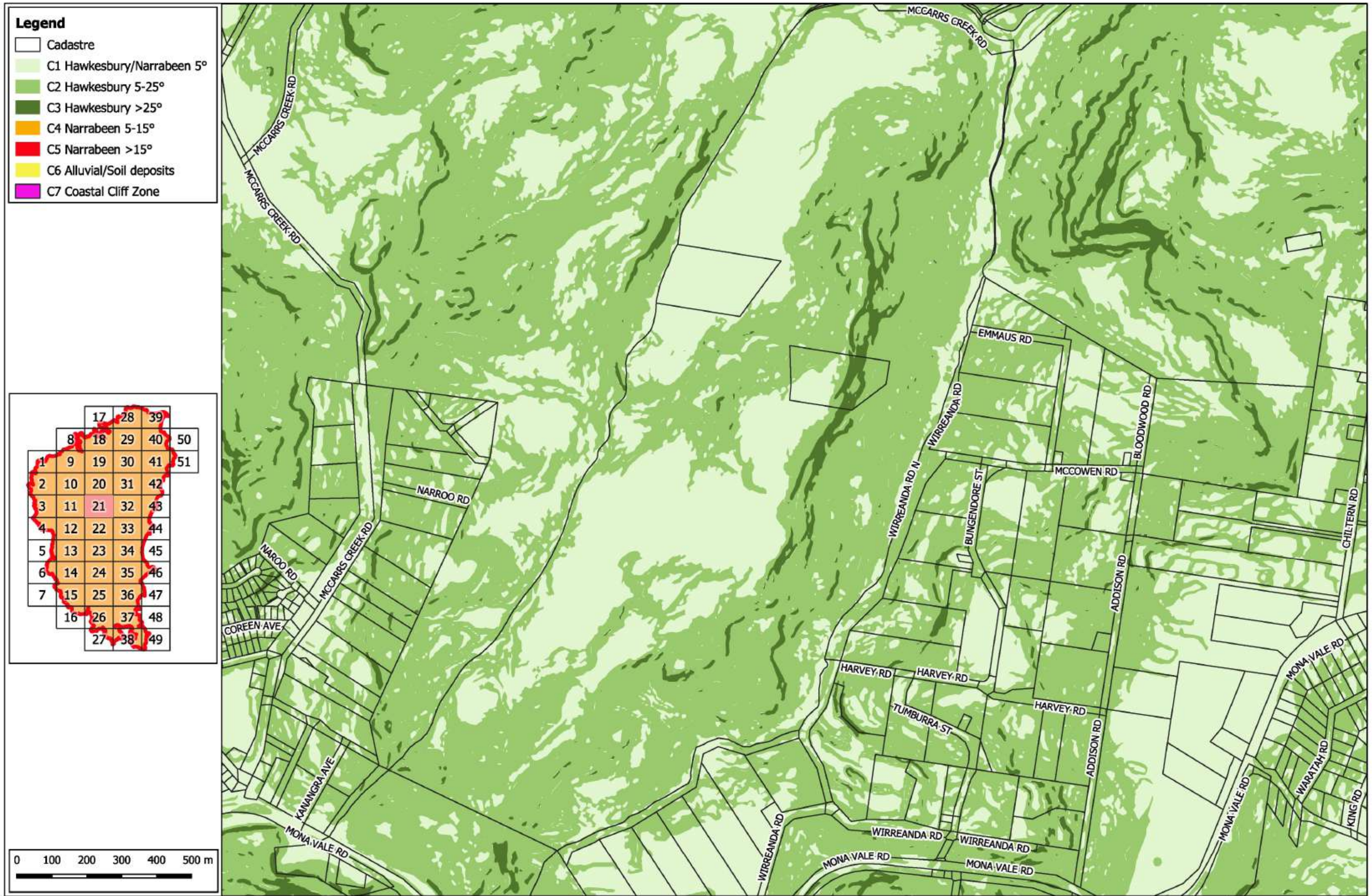

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Northern Beaches Council	TITLE: Geotechnical Planning Map	PROJECT No: 200876.00
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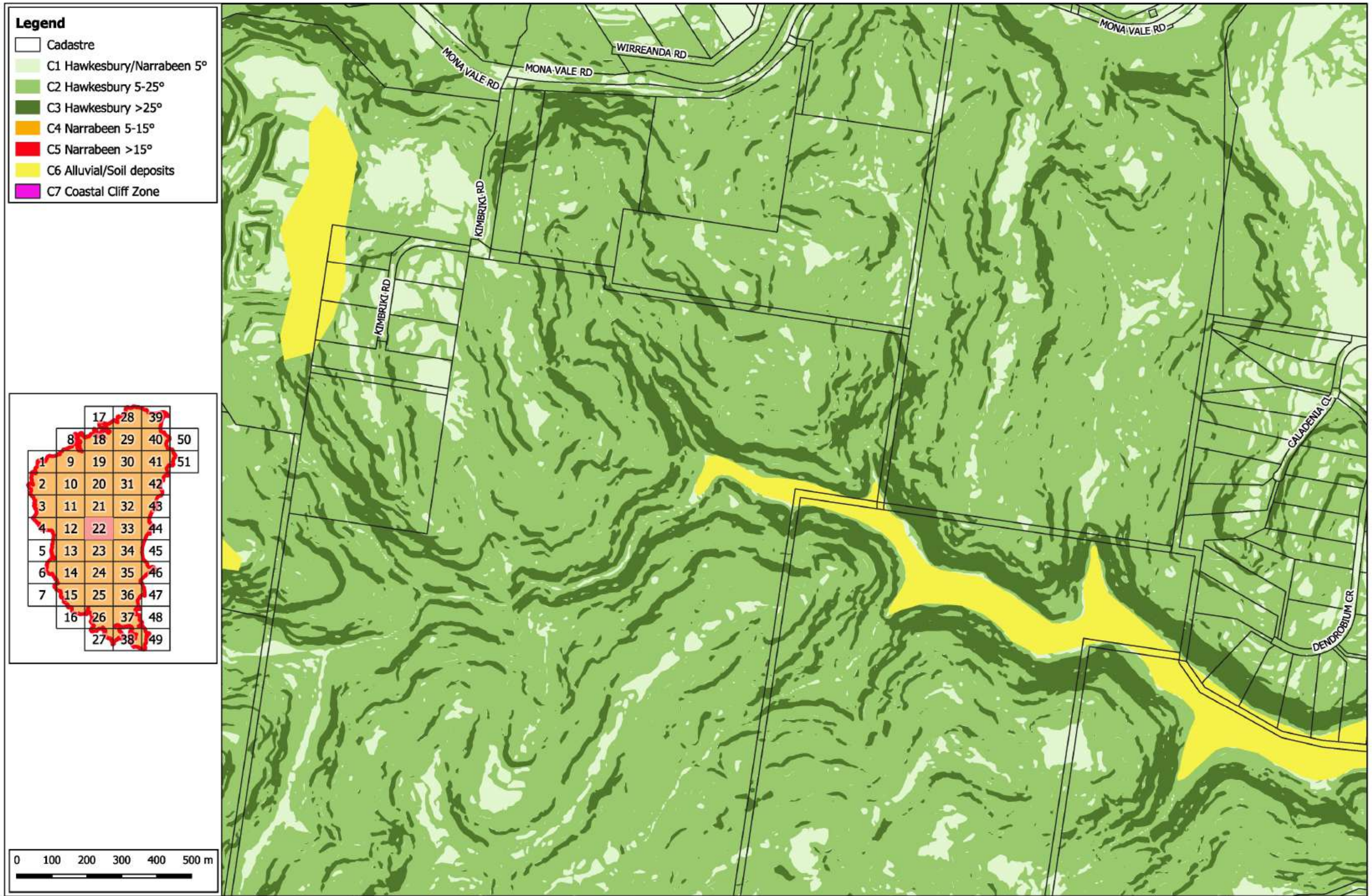
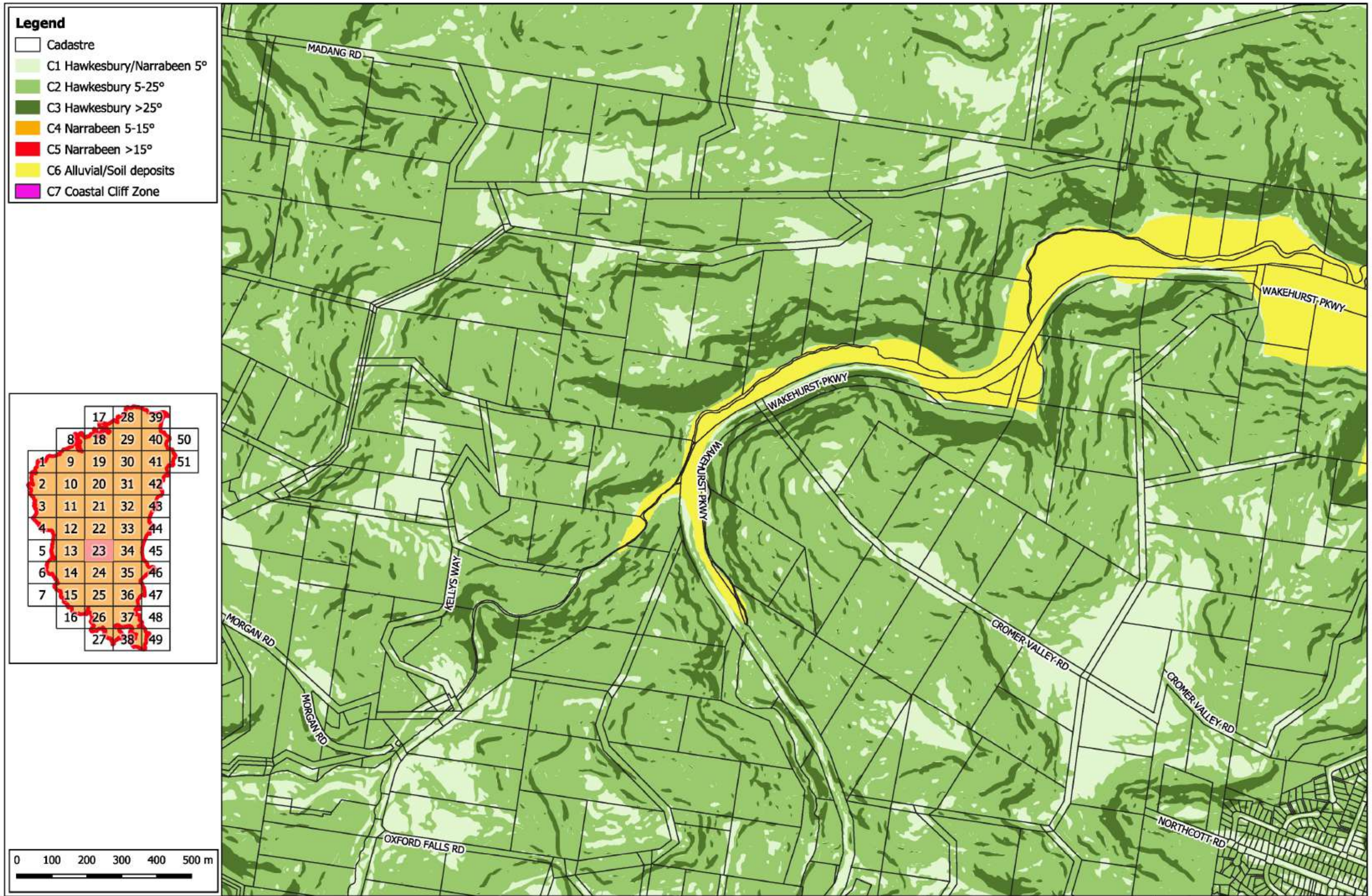


CLIENT: Northern Beaches Council		TITLE: Geotechnical Planning Map	PROJECT No: 200876.00
OFFICE: Sydney	DRAWN BY: MB	Geotechnical Planning Controls	DRAWING No: 22
SCALE: 1:10000 @ A3	DATE: 17/06/2021	Northern Beaches	REVISION: 0

Douglas Partners
Geotechnics / Environment / Groundwater



Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Northern Beaches Council		TITLE: **Geotechnical Planning Map**	PROJECT No: 200876.00
OFFICE: Sydney	DRAWN BY: MB	**Geotechnical Planning Controls**	DRAWING No: 23
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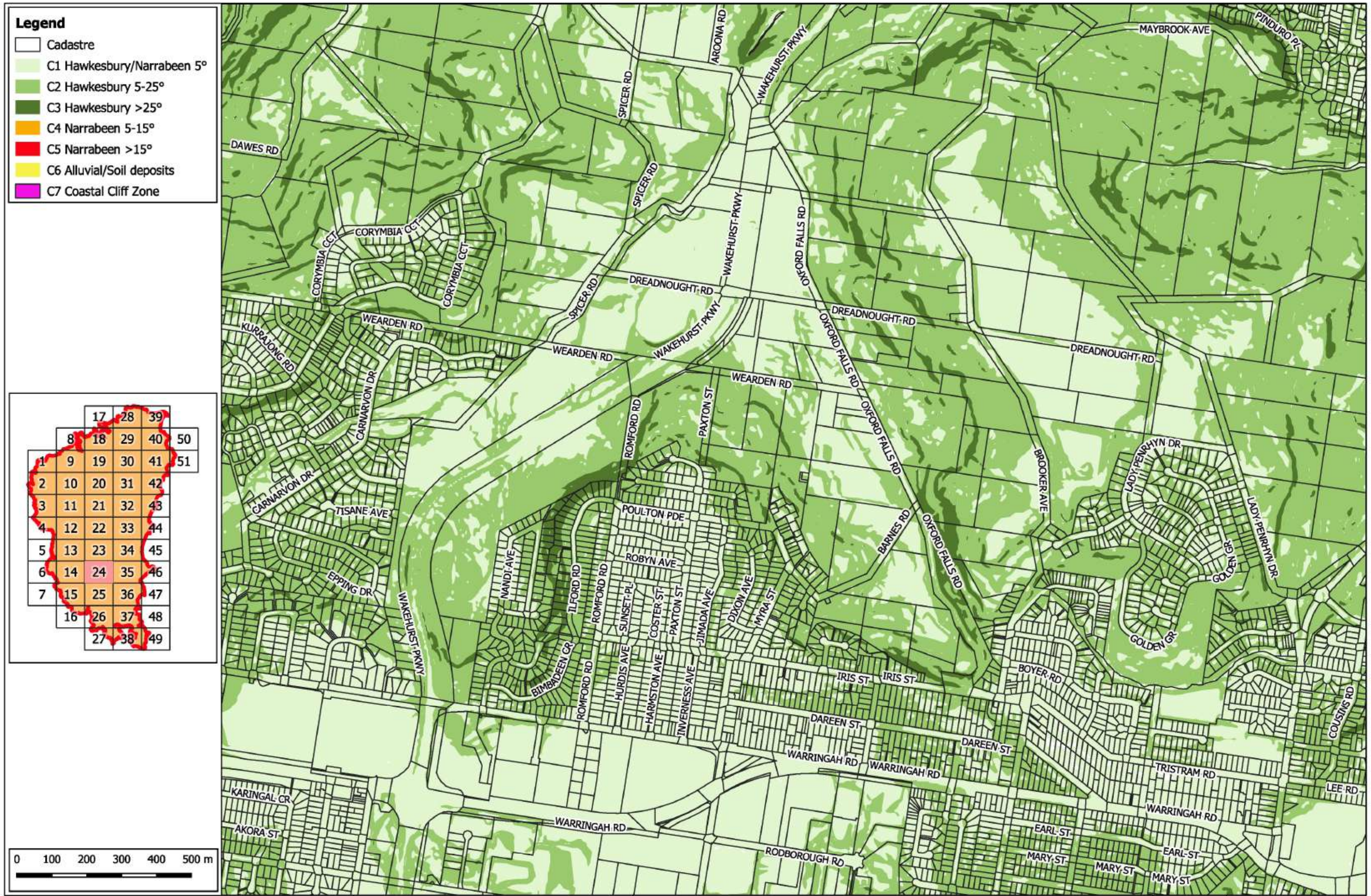

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Northern Beaches Council		TITLE: Geotechnical Planning Map	PROJECT No: 200876.00
OFFICE: Sydney	DRAWN BY: MB	Geotechnical Planning Controls	DRAWING No: 24
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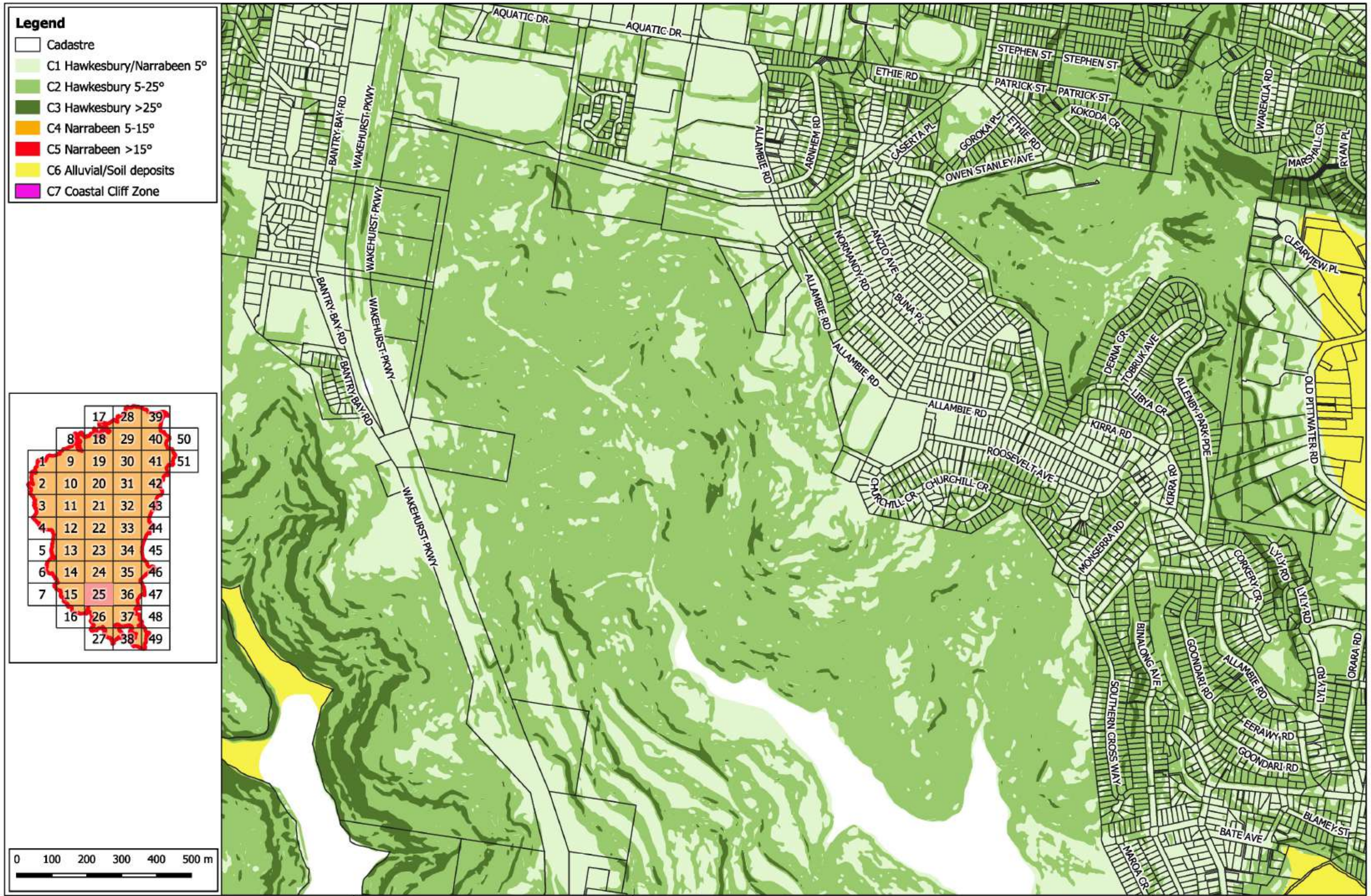

Douglas Partners *Geotechnics / Environment / Groundwater*	CLIENT: Northern Beaches Council	TITLE: **Geotechnical Planning Map**	PROJECT No: 200876.00
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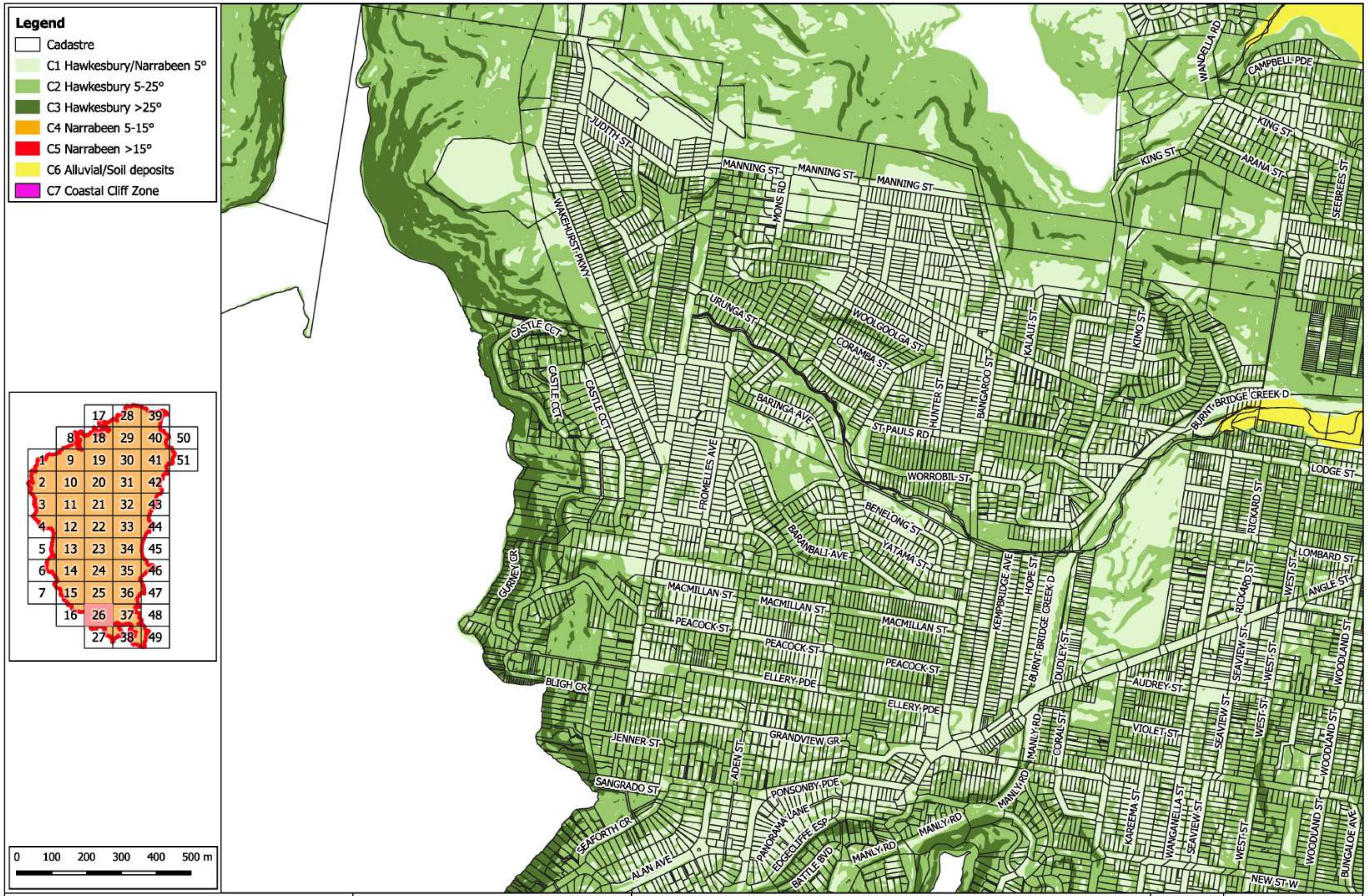

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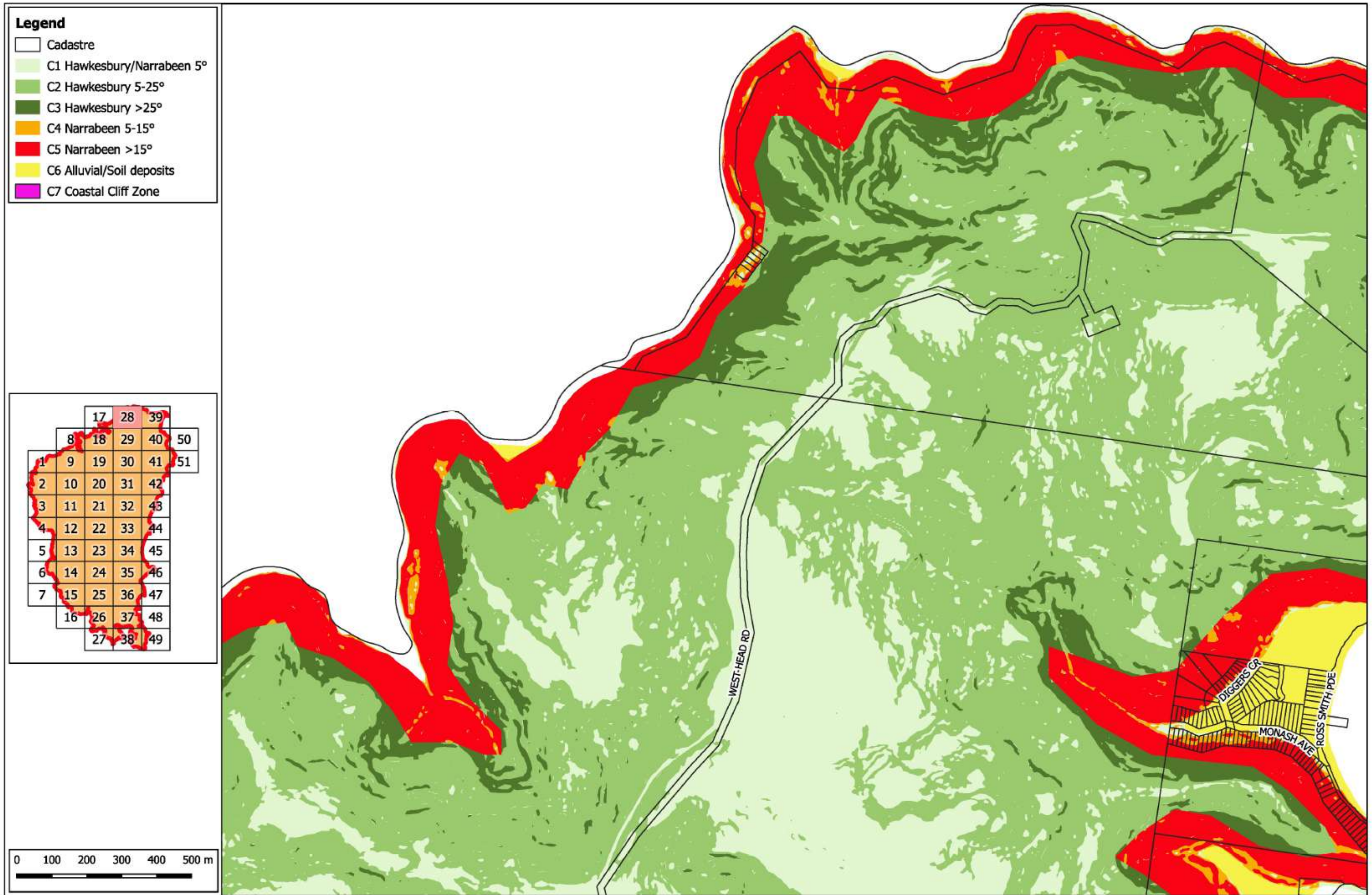

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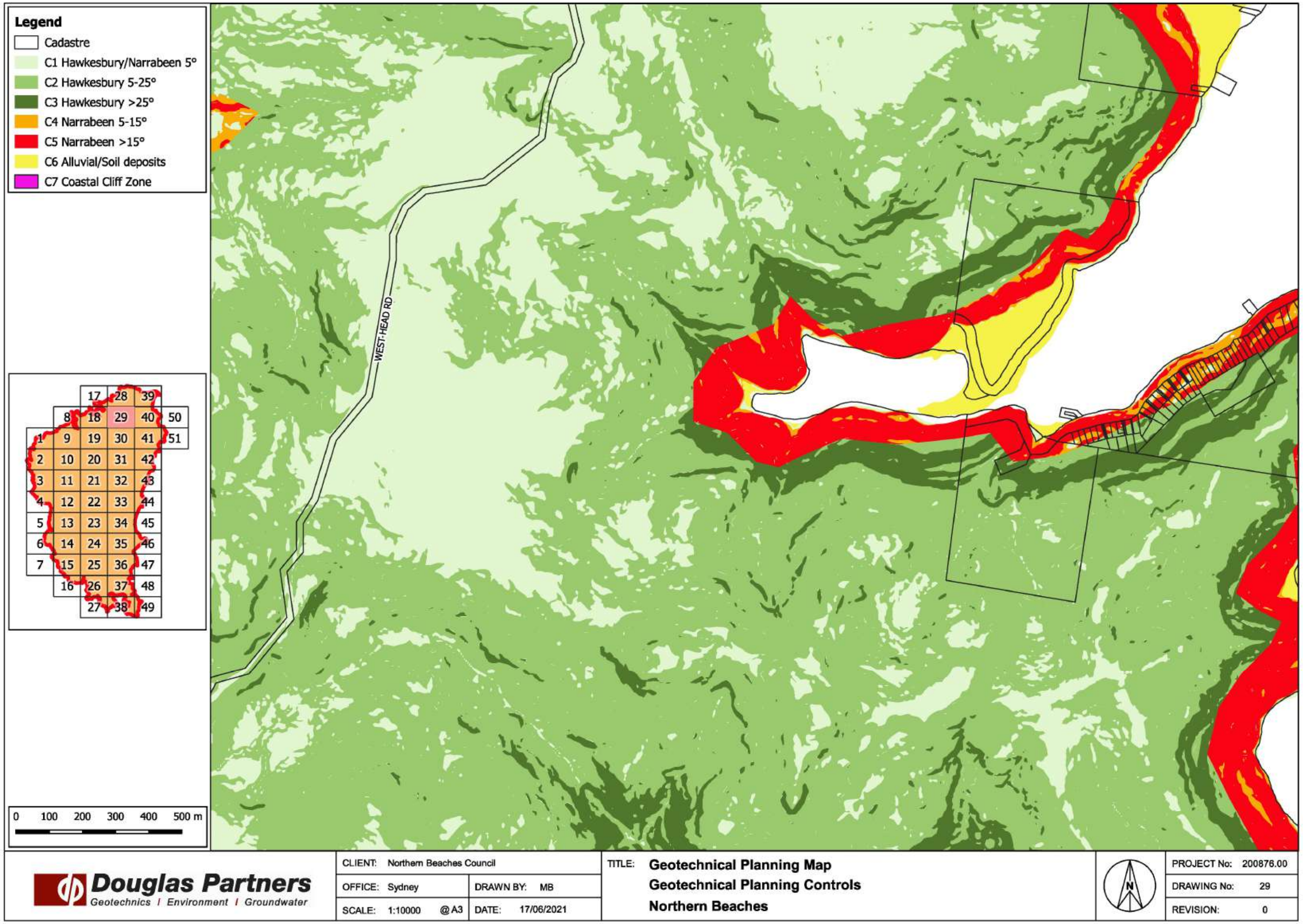
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C6 Alluvial/Soil deposits
C7 Coastal Cliff Zone
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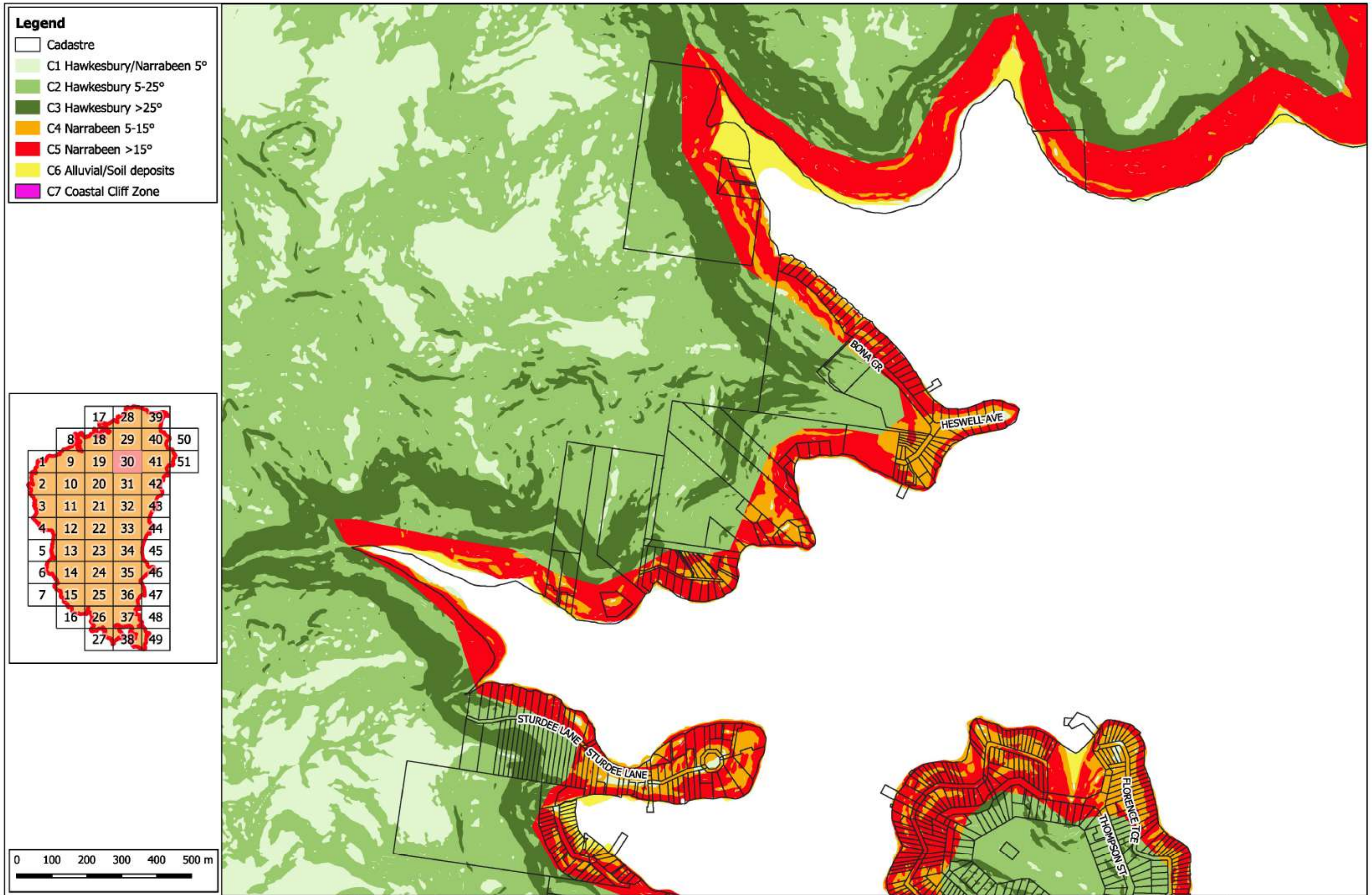

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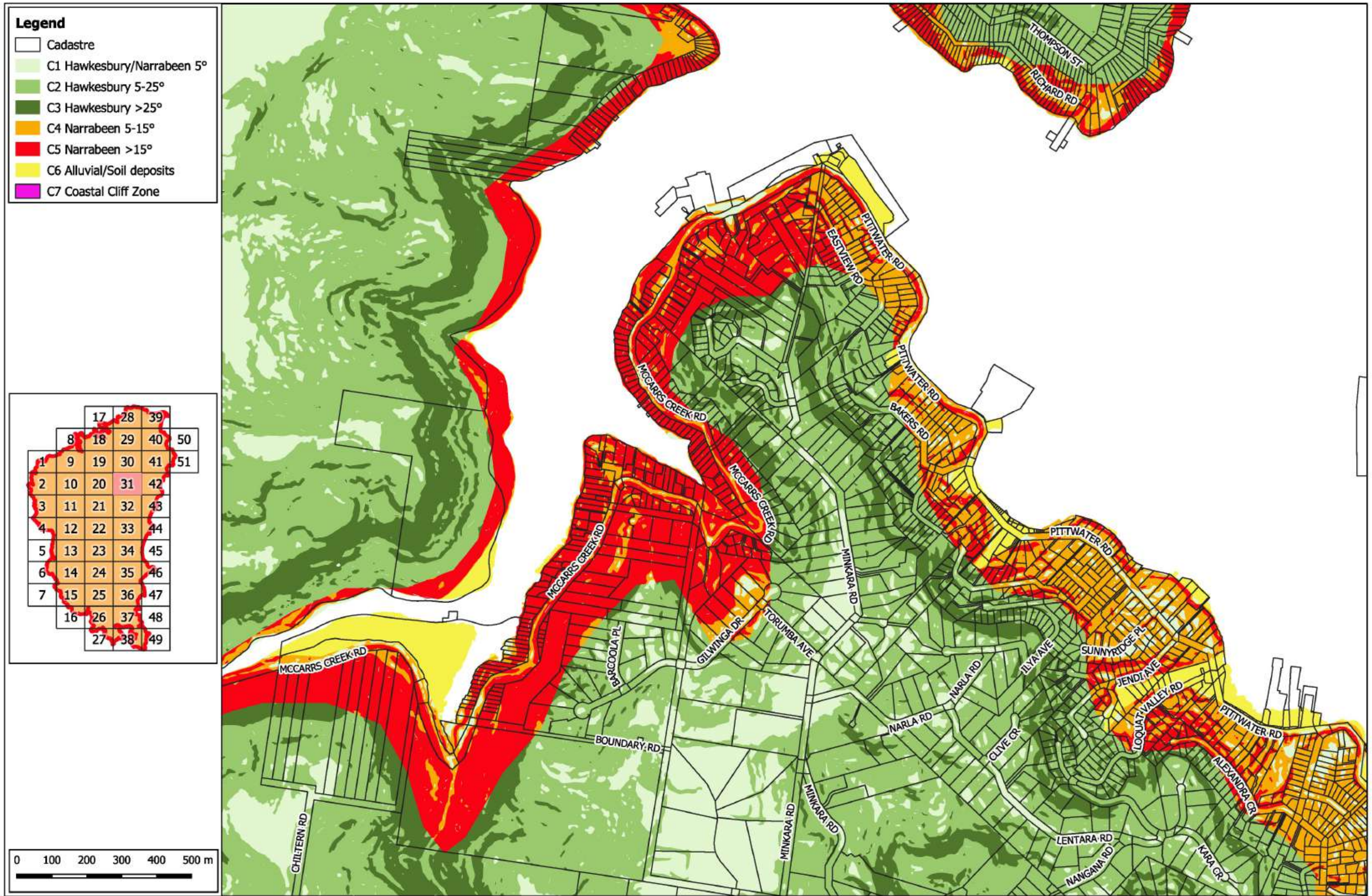

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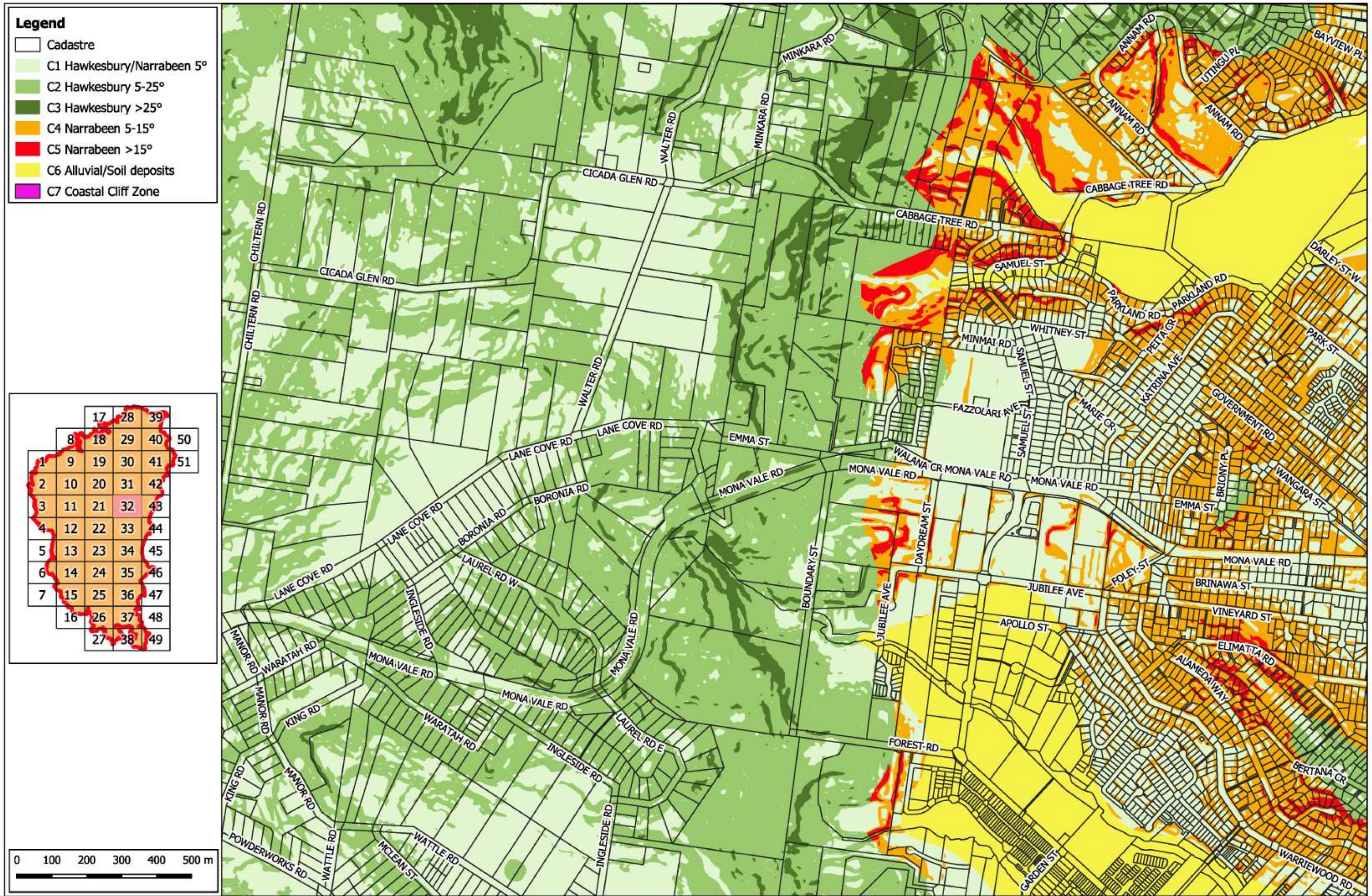

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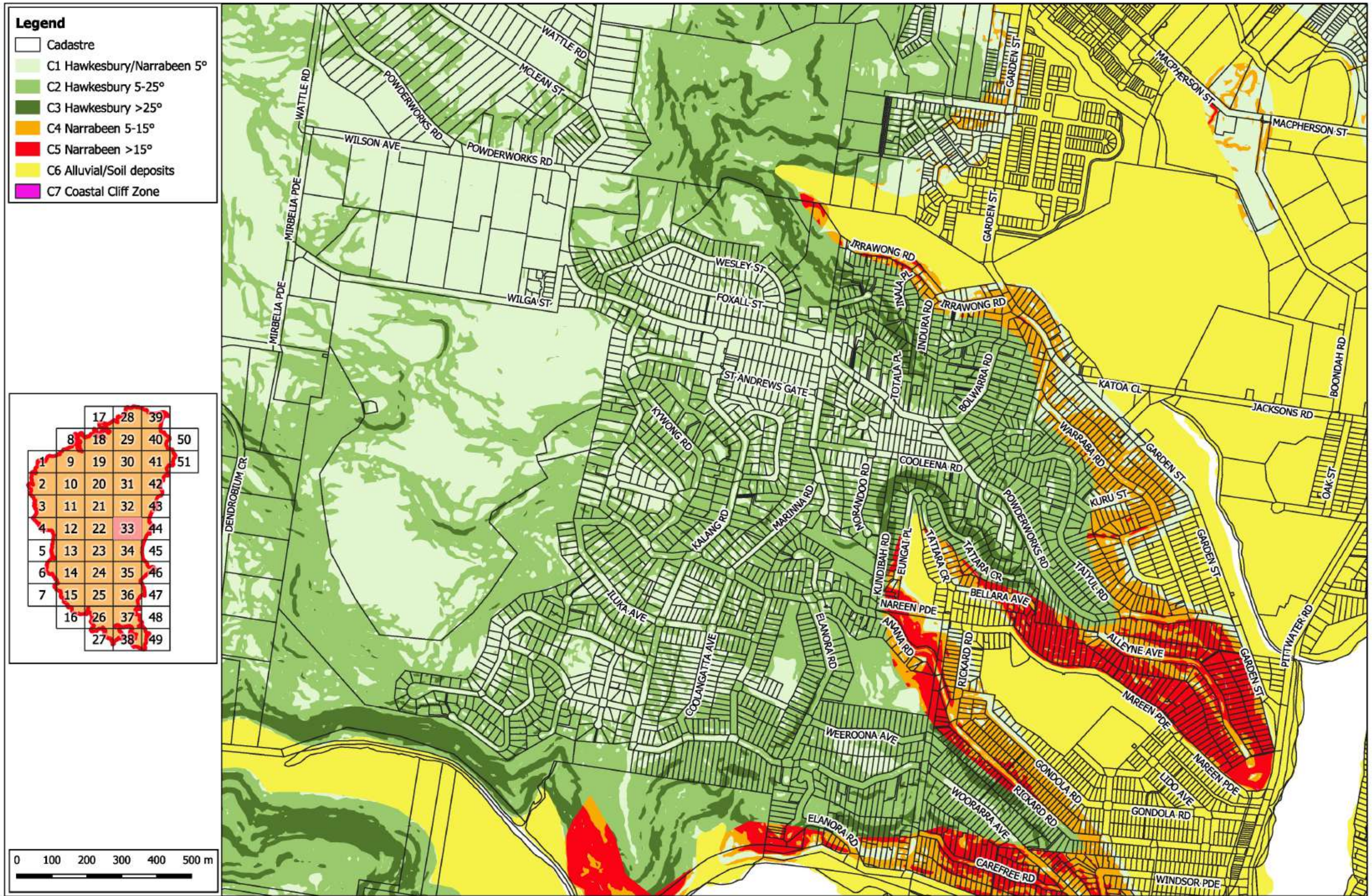

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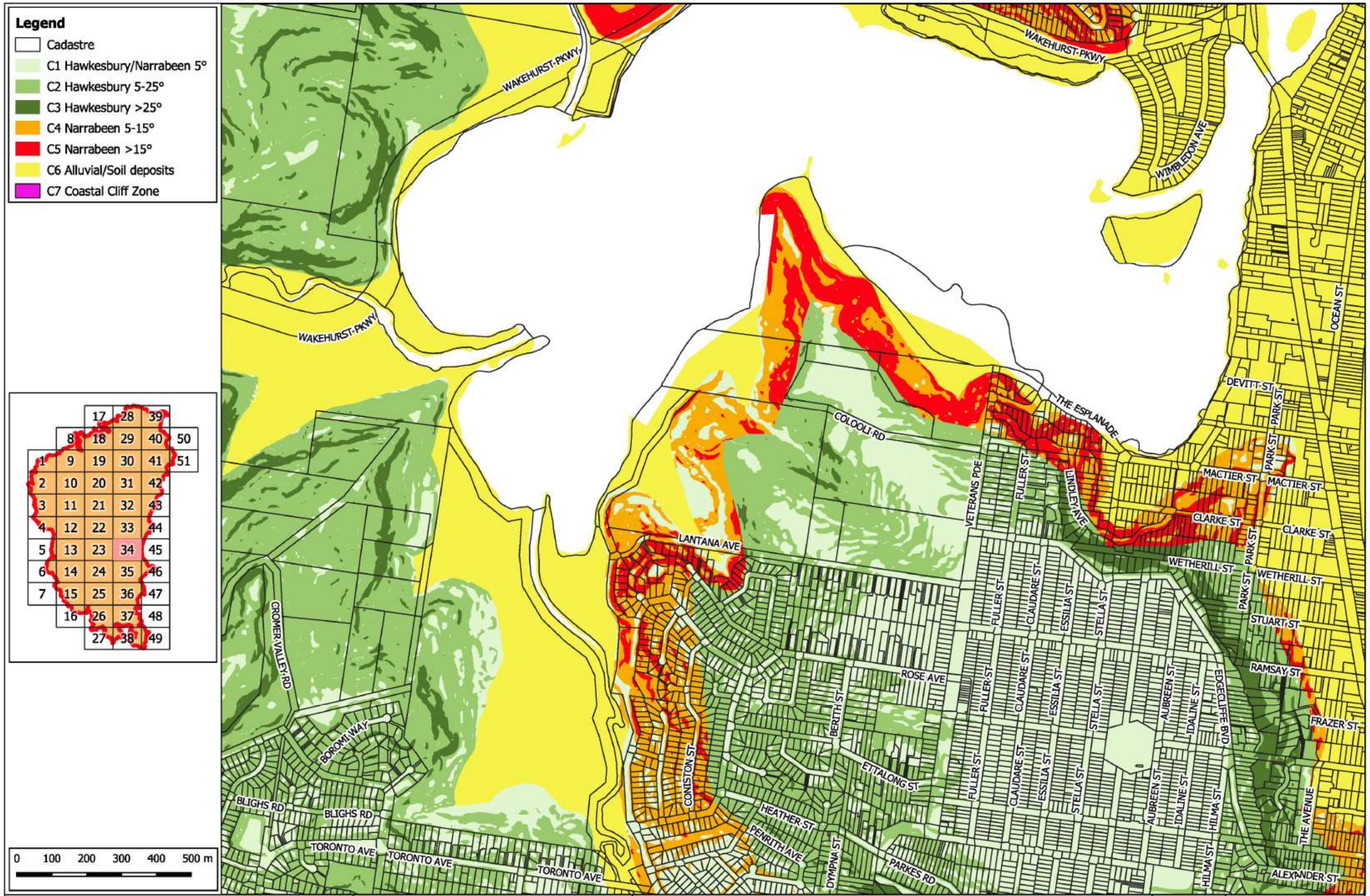

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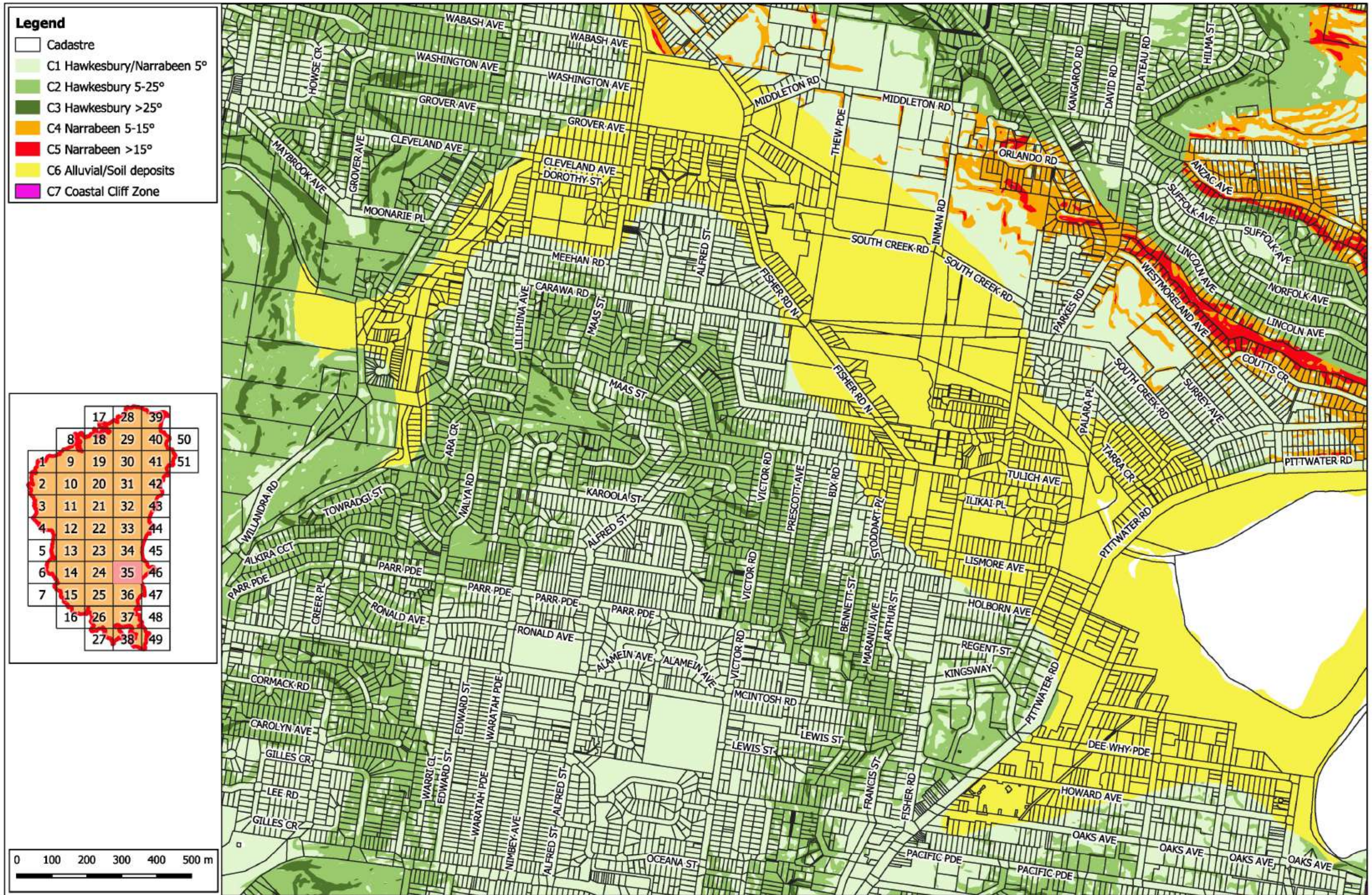

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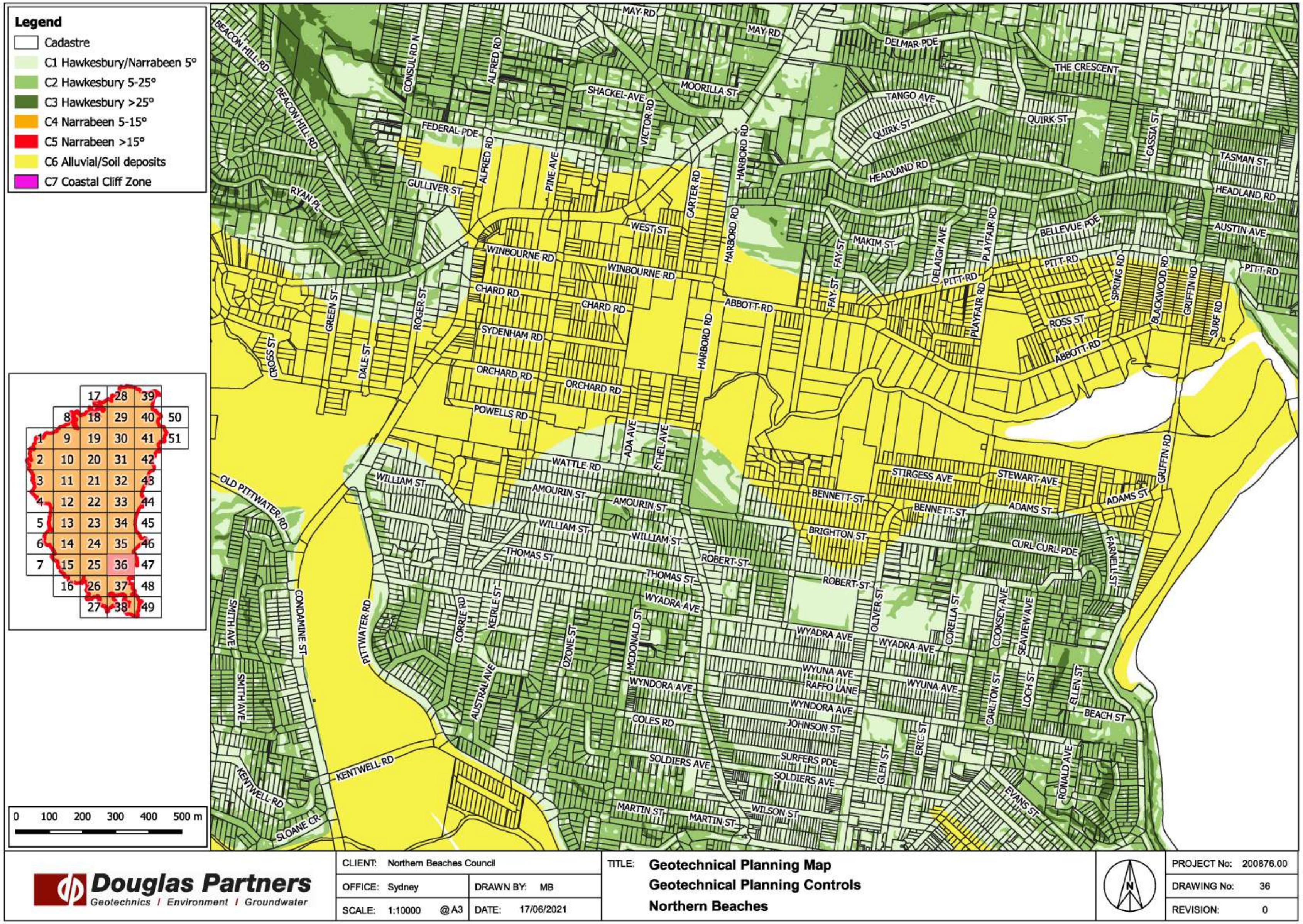
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C6 Alluvial/Soil deposits
C7 Coastal Cliff Zone
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HARBORD RD
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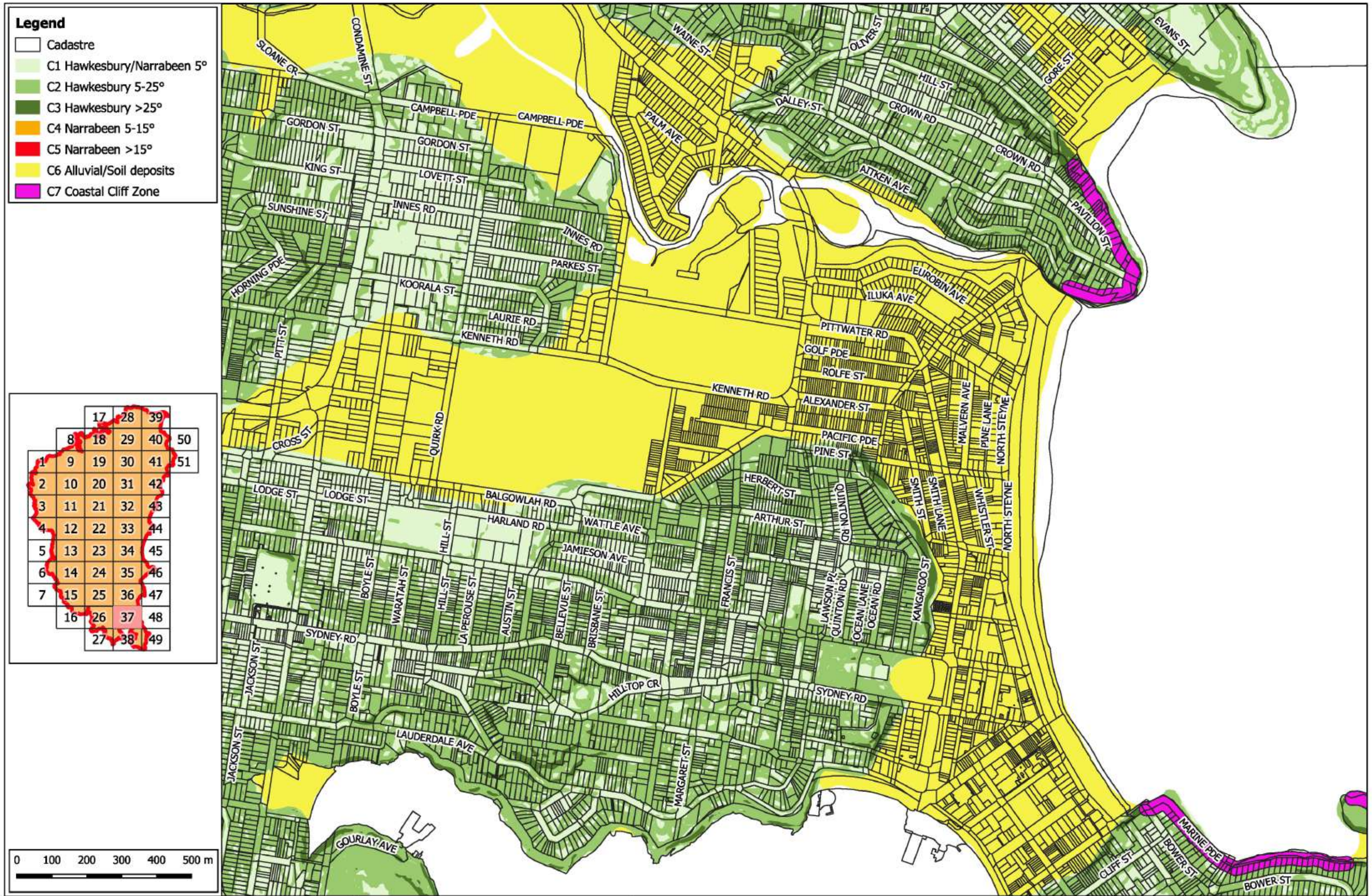

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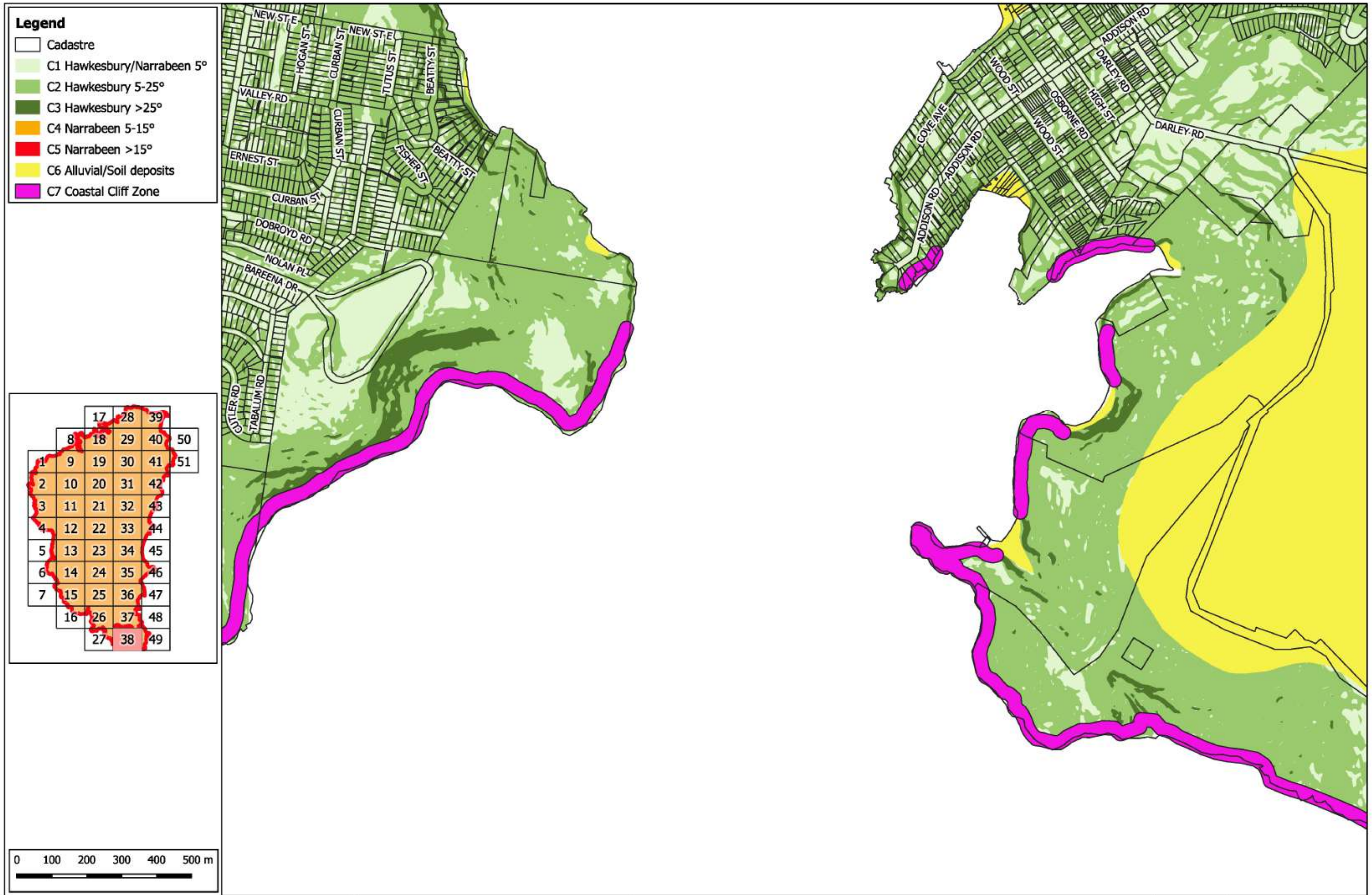

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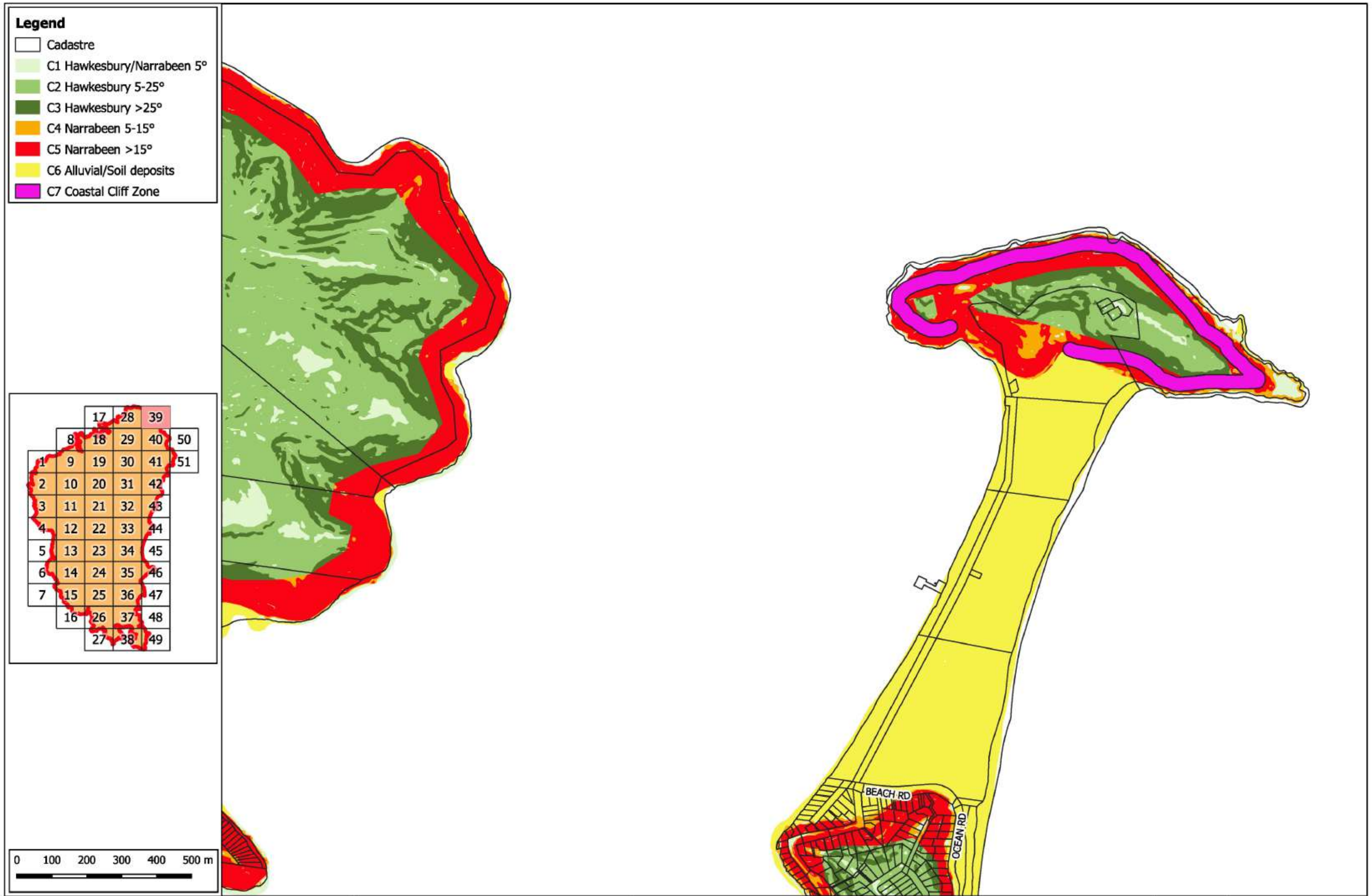

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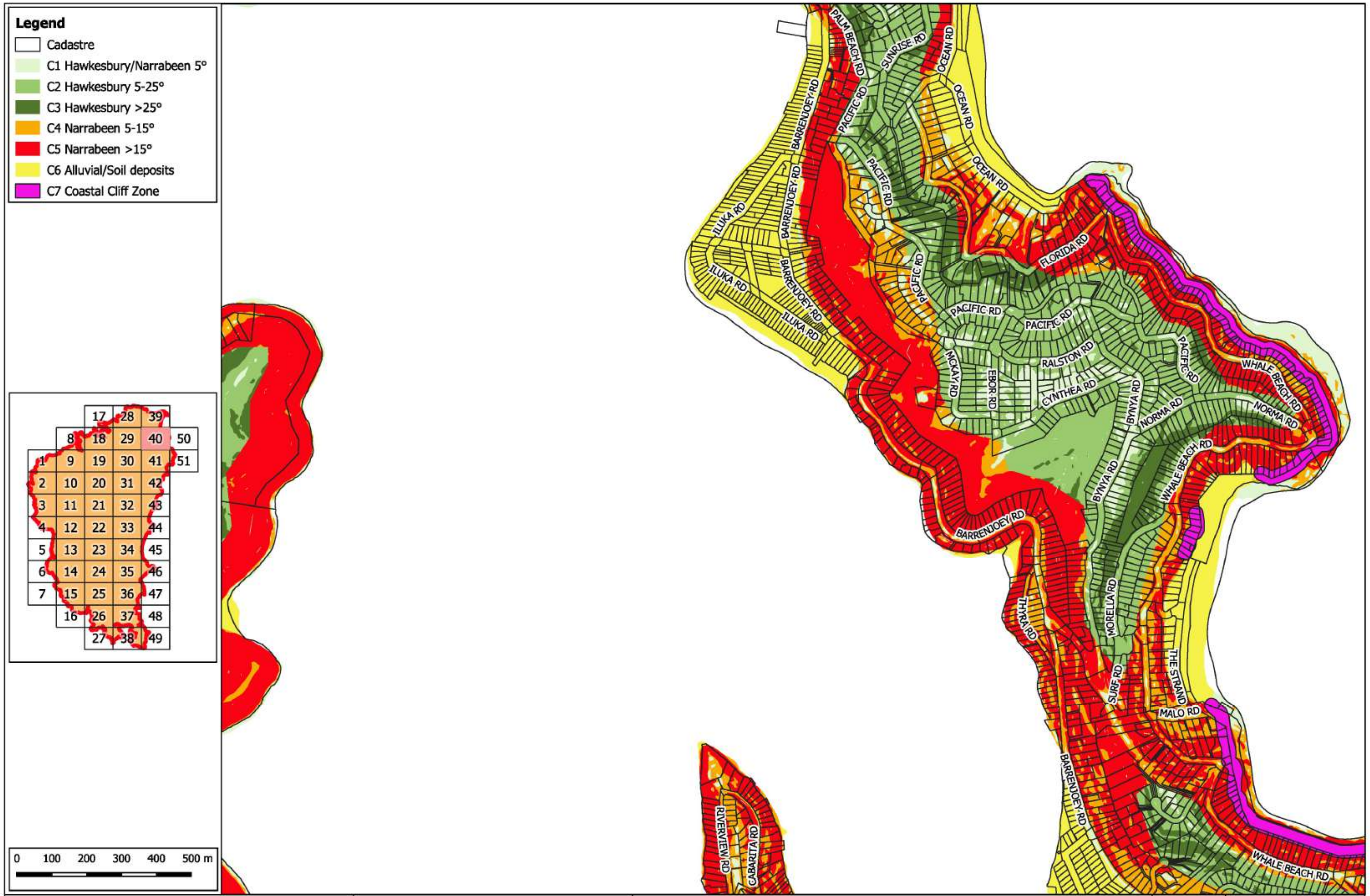

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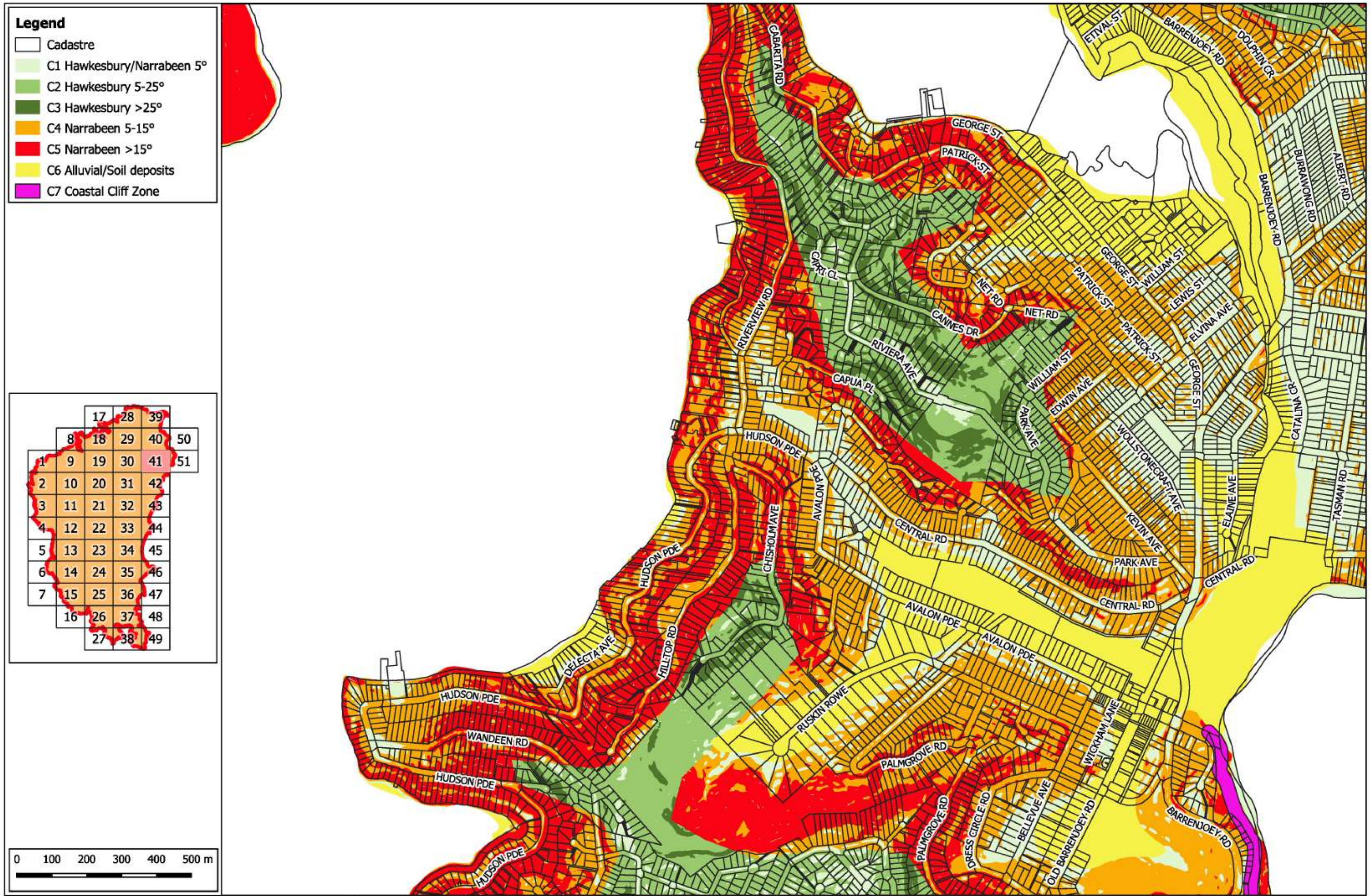

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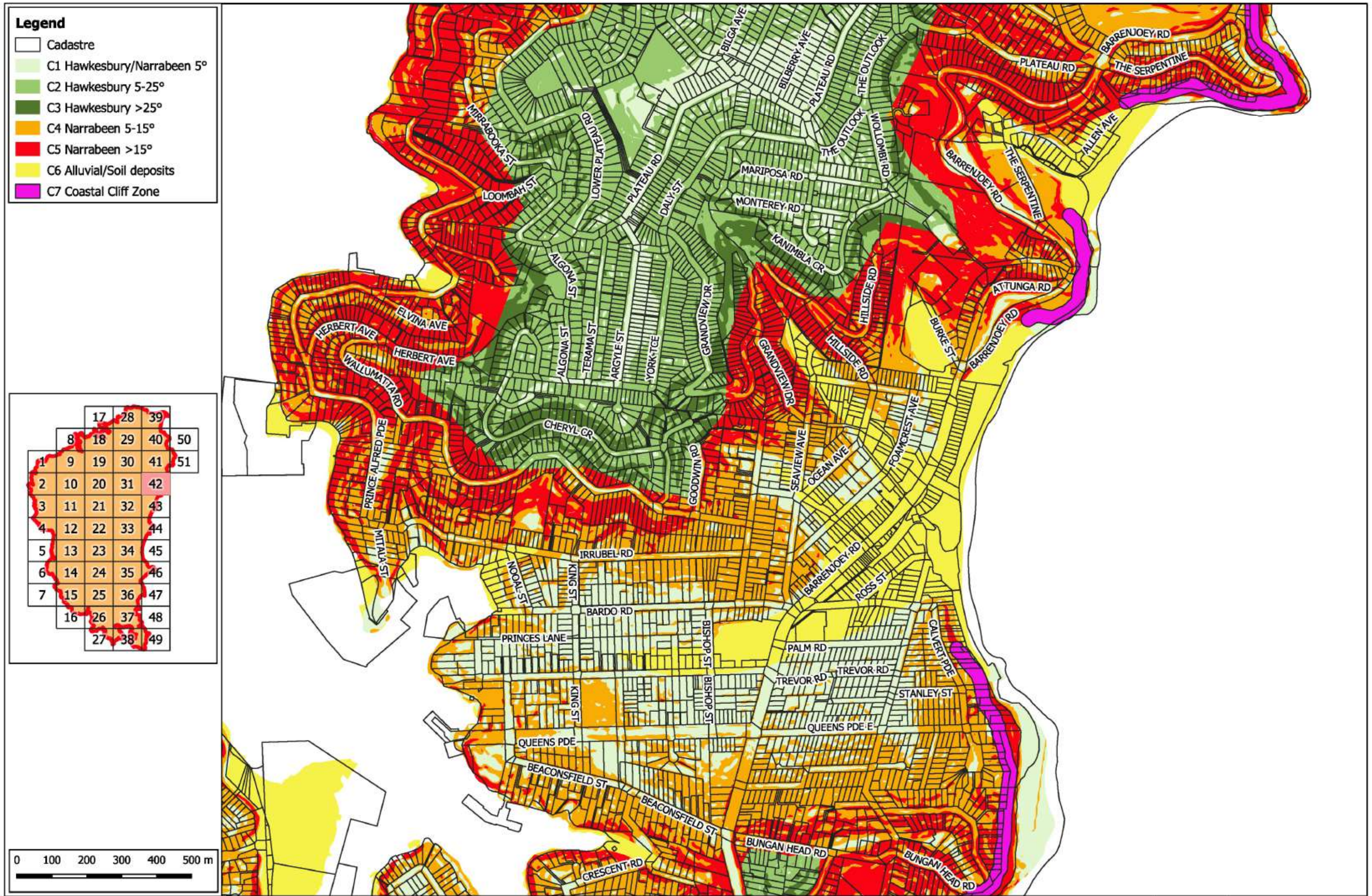

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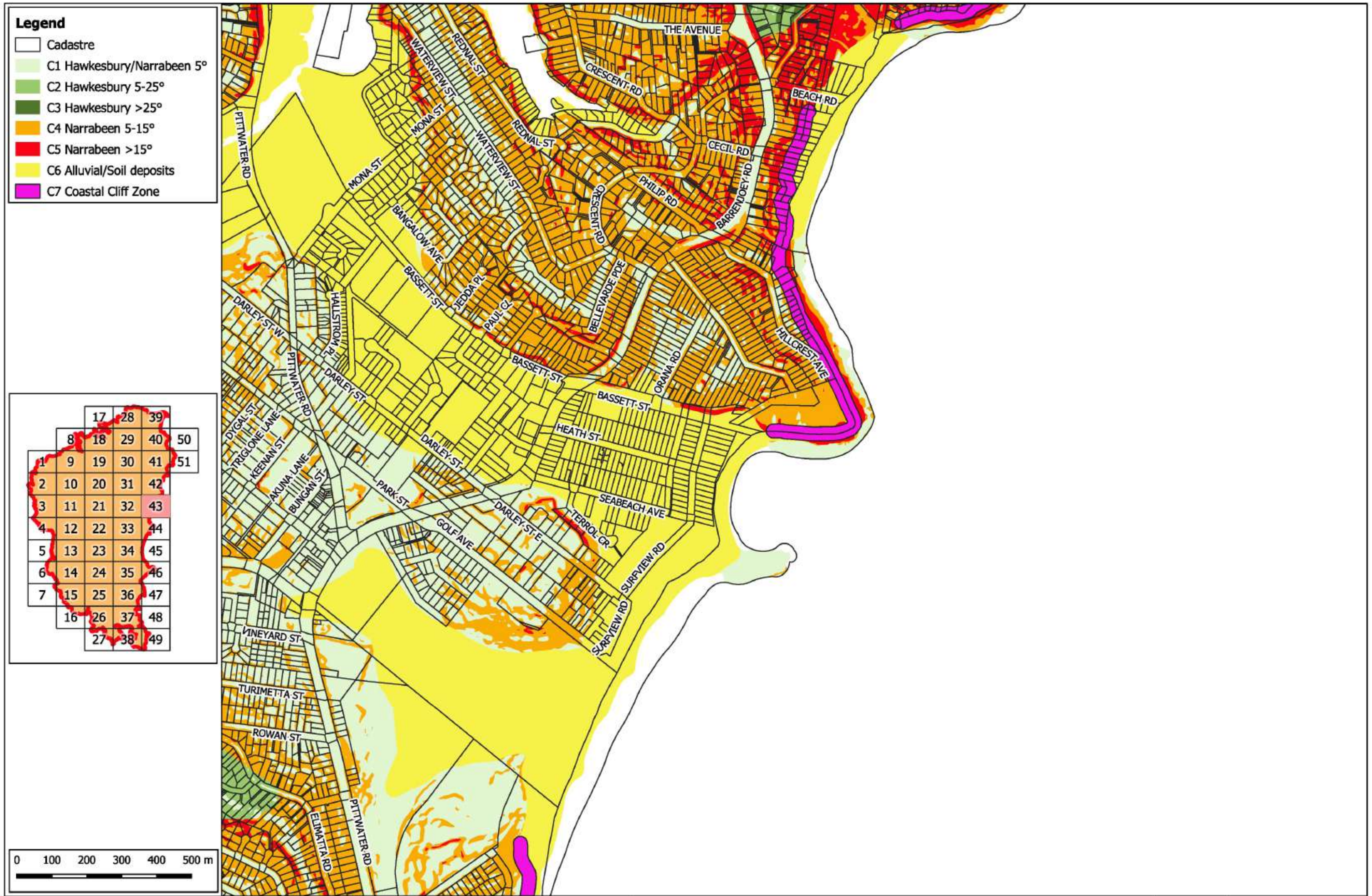

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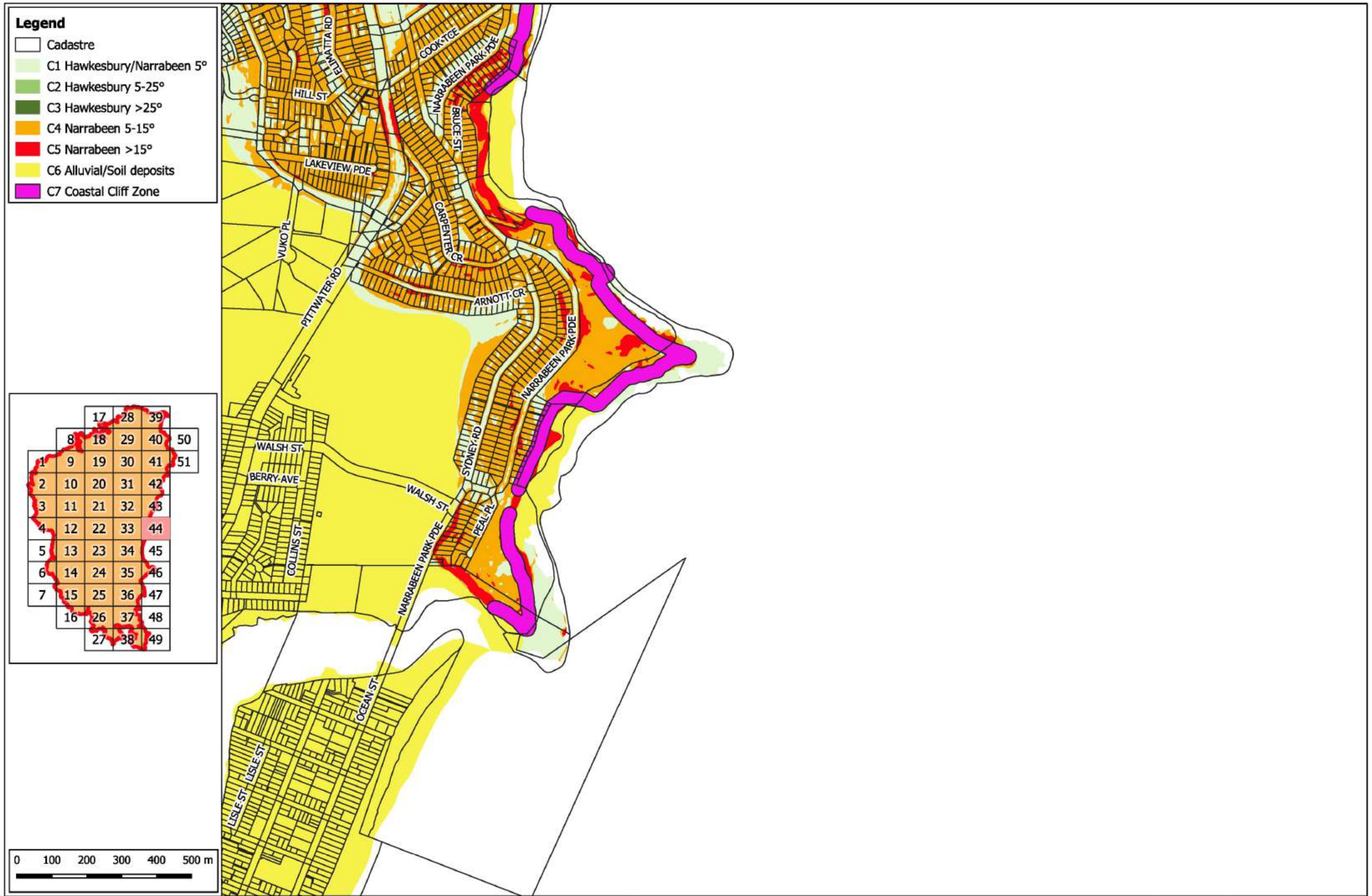

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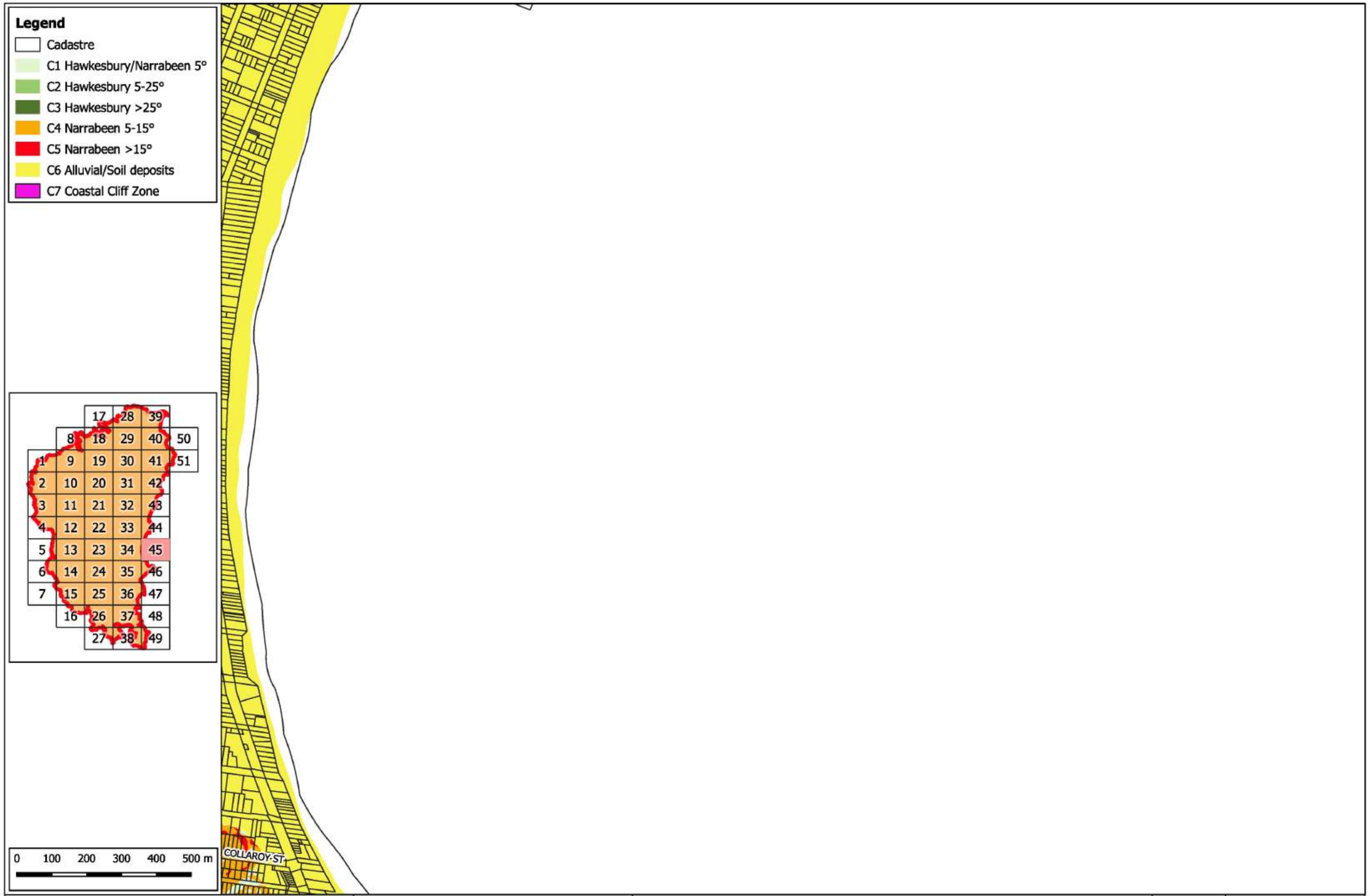

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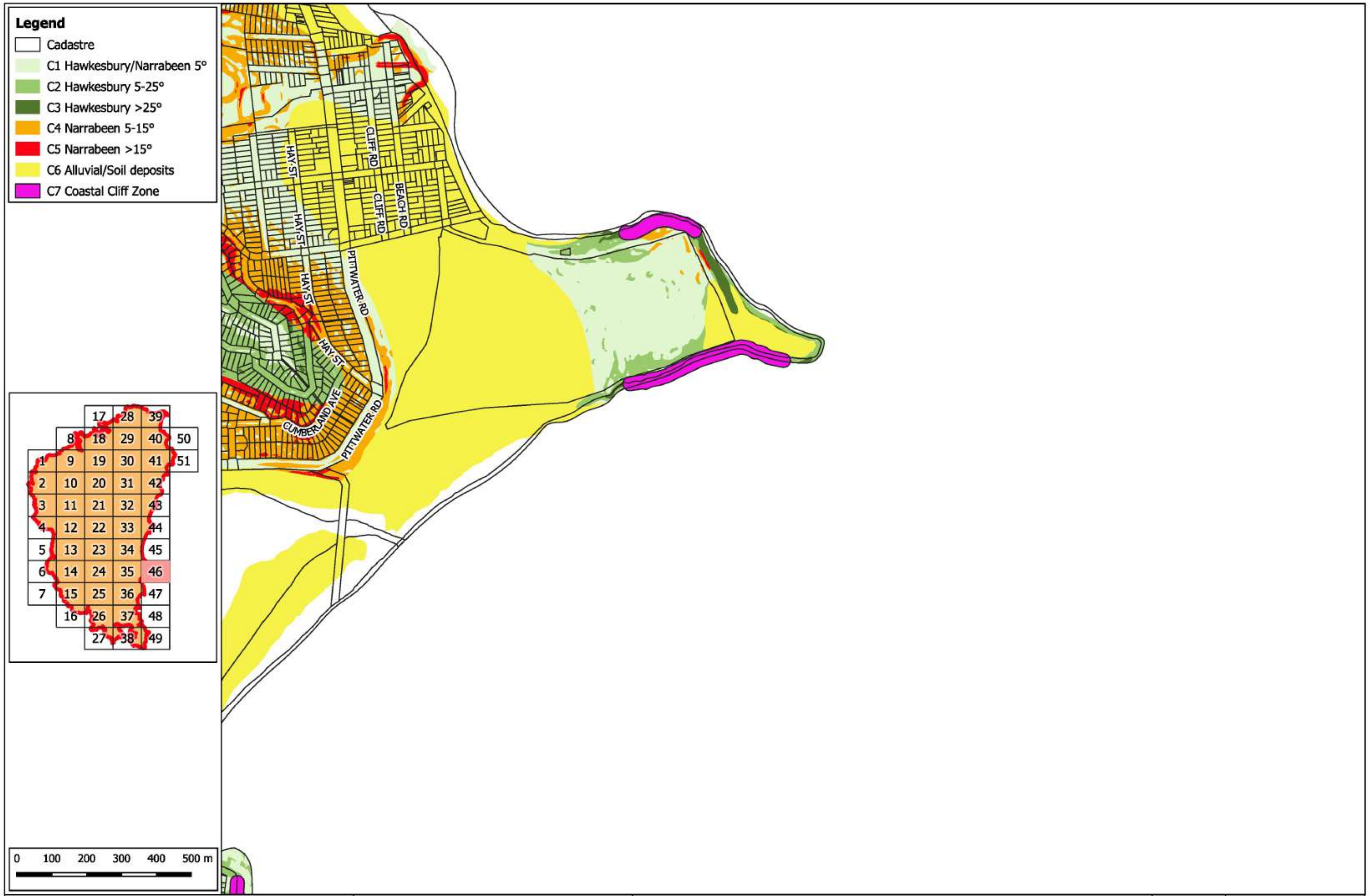

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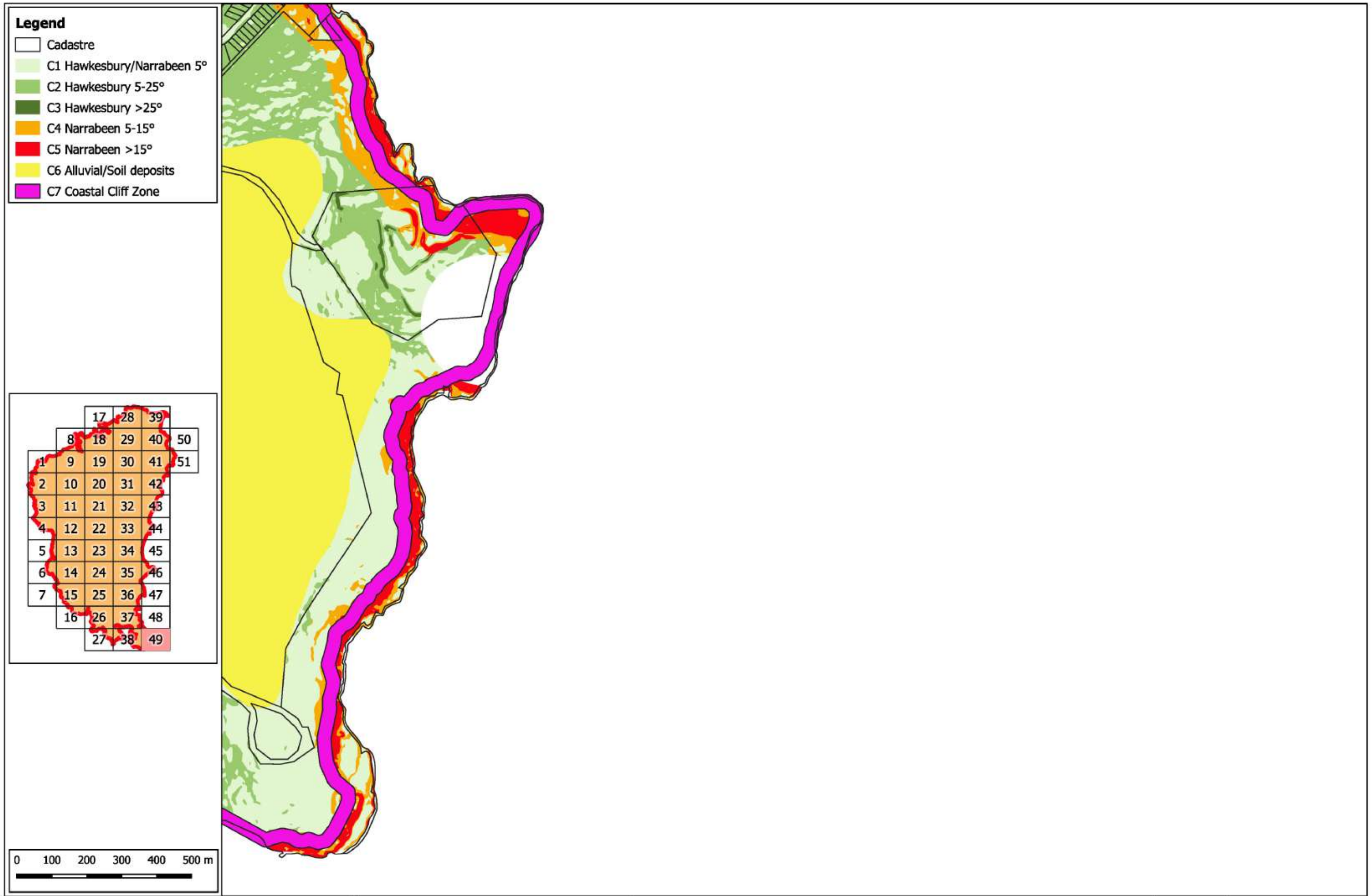

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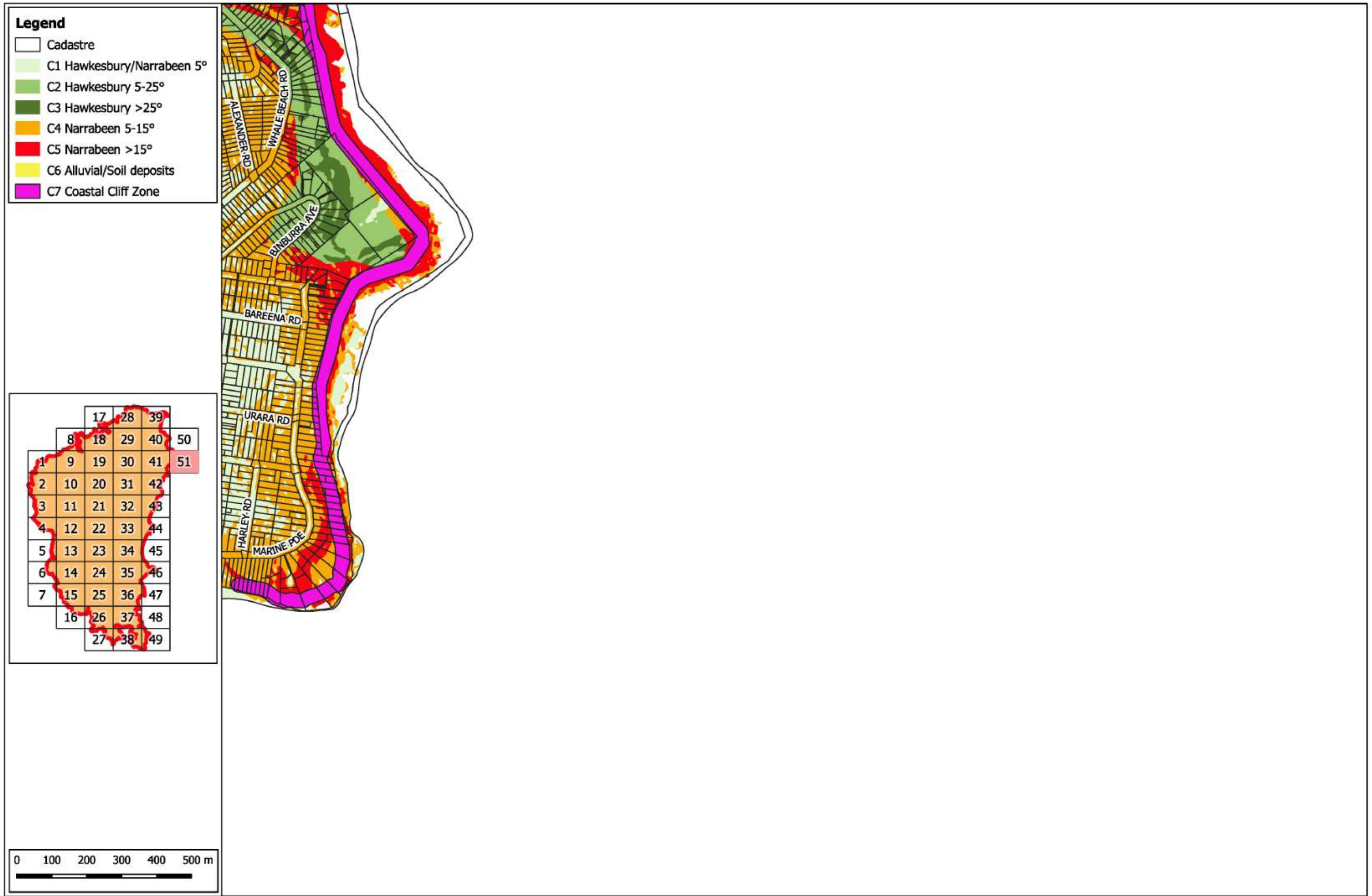

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DRAFT FINAL REPORT:

Northern Beaches Council Stormwater Management Study

February 2022

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Abbreviations

Alluvium	Alluvium Consulting Australia Pty Ltd
CVS	Confined Valley Settings
DPIE	NSW Department of Primary Industries and Environment (DPIE)
EES	Environment, Energy and Science (EES) Group of DPIE
GDE	Ground Dependent Ecosystems
HEV	High Ecological Value
MRA	Metropolitan Rural Area
NBC	Northern Beaches Council
LEP	Local Environmental Plan
LUV CC	Laterally unconfined valley setting – continuous channel
LGA	Local Government Area
DCP	Development Control Plan
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids

Glossary

Term	Definition
Waterway objectives	Objectives for waterway hydrology, water quality, riparian condition and physical condition to meet community environmental values and uses
Stormwater management targets	Stormwater flow and pollutant load management to meet waterway objectives

1 Introduction

Alluvium Consulting was engaged by the Northern Beaches Council to undertake a Stormwater Management Study for the LGA. The objective of the project was to develop a Stormwater Management Strategy and qualitative targets for stormwater quality and quantity for each catchment in the LGA in order to inform the Northern Beaches Council's Local Environmental Plans (LEP). It is intended that future investigation will be undertaken to quantify the stormwater quantity and quality targets.

This report documents the approach used to develop the Stormwater Management Strategy. A map has been produced to show how the strategy and targets apply across the LGA. It is proposed that the map and a summary of this report forms part of Northern Beaches Council LEP discussion paper for public exhibition.

2 Background

Urbanisation has an impact on both the quantity and quality of stormwater runoff that is generated from impervious surfaces. This can have an impact on the health of waterways by:

- Disrupting the natural water cycle, reducing water from infiltrating into the ground and reducing evapotranspiration.
    - Lower groundwater contributions to base flows in creeks means they are more likely to cease to flow in dry periods.
    - In coastal groundwater aquifers, this increases saltwater intrusion and impacts vegetation health.
- Increasing the frequency and volume of stormwater entering waterways from regular small storm events, as well as increasing peak flows in large storm events. This impacts waterway health by:
    - Degrading water quality (i.e. from pollutants and contaminants in stormwater)
    - Affecting the fauna community present (some require permanent water and others are naturally adapted to periods without flow, and it can impact lifecycle activities such as spawning)
    - Affecting aquatic and riparian vegetation condition
    - Affecting waterway physical condition (e.g. erosion/sedimentation)
    - Increasing flooding risk (a direct impact to the community).

It should be noted that detention measures manage peak flows (and therefore flooding risk) but alone do not have a significant impact in reducing the frequency and volume of stormwater runoff associated with regular small storm events which is a key pressure on waterway health.

2.1 Community environmental values and uses

The beaches, lagoons, creeks and estuaries of the Northern Beaches LGA are highly valued by the community for primary contact (swimming) and secondary contact (fishing, boating) recreation, and passive recreation (walking, picnics). Local tourism is heavily reliant on the waterways being healthy and having amenity. The waterways support many threatened ecological communities, including endangered species of flora and fauna. Some waterways support a thriving marine industry that includes commercial fishing.

The community environmental values and uses of the waterways in the Northern Beaches LGA are included in the Local Strategic Planning Statement (LSPS) as outlined in Figure 1 with definitions in Table 1. The NSW Government policy for managing water quality and waterway health is underpinned by the community environmental values and uses. The timeframes targeted to achieve the community environmental values and uses are also outlined in Figure 1 (i.e. maintain or improve existing condition, for achievement in 5-10 years, or for achievement in 10 years of more). It should be noted that the community environmental values and uses that are relevant to the Northern Beaches LGA are a subset of values and uses adopted by the NSW Government and are specified in the NSW Water Quality and River Flow Objectives (https://www.environment.nsw.gov.au/ieo/).

Table 1. Definition of community environmental values and uses

Community environmental values and uses	Definition
Aquatic ecosystems	Maintaining or improving the ecological condition of waterbodies and their riparian zones over the long term
Visual amenity (non-contact recreation)	Maintaining or improving the aesthetic qualities of waters
Secondary contact recreation	Maintaining or improving water quality for activities such as boating and wading, where there is a low probability of water being swallowed
Primary contact recreation	Maintaining or improving water quality for activities such as swimming in which there is a high probability of water being swallowed
Aquatic foods (to be cooked before eating)	Refers to protecting water quality so that it is suitable for the production of aquatic foods for human consumption and aquaculture activities.

2.2 Water Sensitive Urban Design (WSUD)

Waterway health impacts of urban development can be mitigated or avoided through the application of Water Sensitive Urban Design (WSUD) – an approach that:

- Aims to replicate the natural water cycle by targeting more balanced infiltration, evaporation and evapotranspiration.
- Improves water quality flowing into receiving waters
- Reduces reliance on potable water sources by providing alternate water supply.

Northern Beaches Council currently applies WSUD through its "Water Management for Development Policy", which is referred to in all three DCPs. The Warringah and Manly LEPs refer specifically to WSUD, whilst the Pittwater LEP requires that development does not adversely impact on water quality. The current development controls for stormwater management in the Northern Beaches LGA generally allow developments to reduce the quality of stormwater, through the adoption of best practice targets requiring the removal of 80% of total suspended solids, 65% of phosphorus and 45% of nitrogen generated at the sites post-development. Typically, there is a shortfall between the export loads that are achieved at the site post-development and pre-development (e.g. for a site with existing imperviousness less than 10%). The controls also do not address stormwater quantity issues that affect waterway health i.e. frequency and volume of stormwater runoff associated with regular small storm events. However, there are requirements for on-site detention (OSD) which aims to reduce peak flows to assist with flood management.

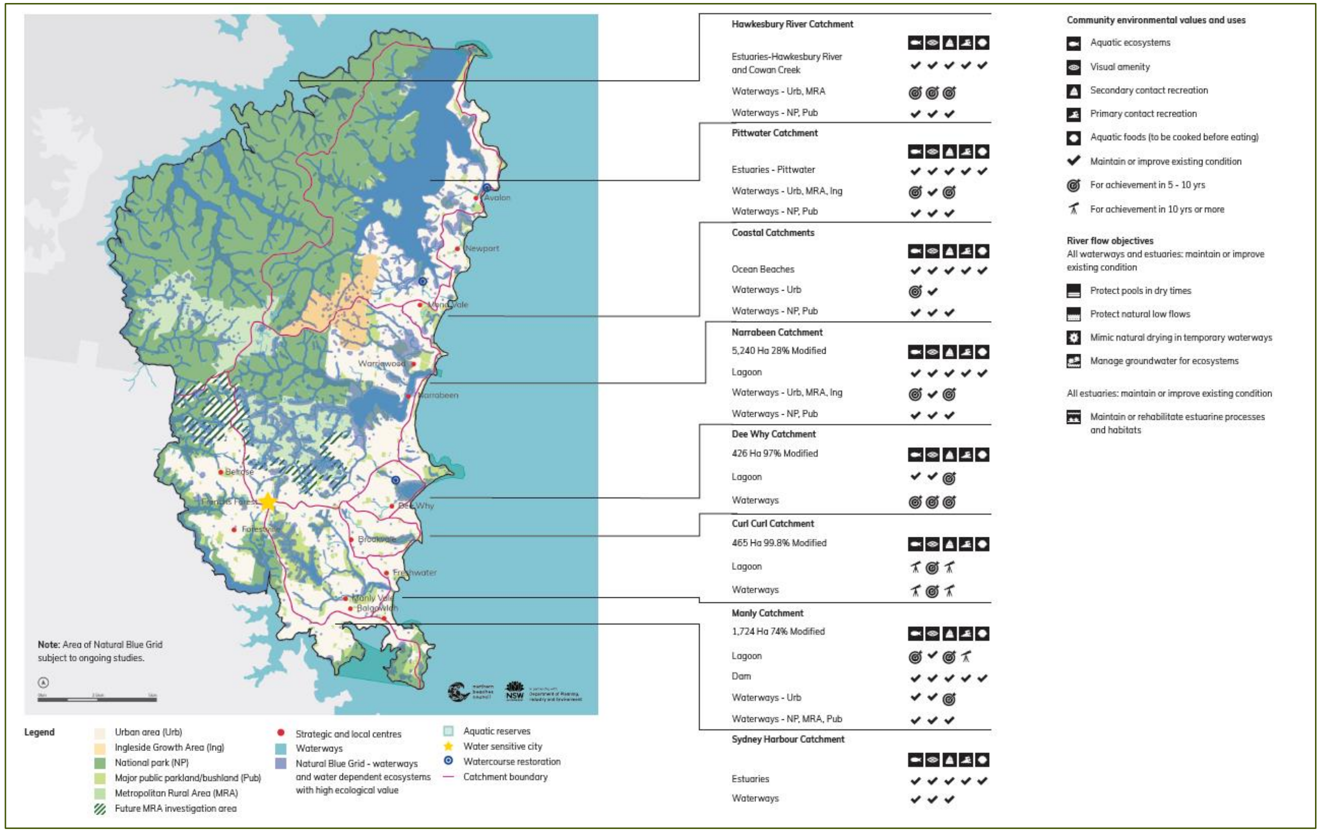


Figure 1. *Community environmental values and uses (Northern Beaches Council, Towards 2040: Local Strategic Planning Statement, 2020)*

2.3 Current stormwater management policy and practices

Stormwater quality
Under the Northern Beaches Council "Water Management for Development Policy", the general stormwater quality requirements (load reduction targets) outlined in Table 2 applies to sub-divisions resulting in:

- Creation of 2 lots (where the total post development imperviousness of the new lots exceeds 40%)
- Creation of 3 lots of more.

The "General stormwater quality requirements" also apply to residential flat buildings, multi-residential dwelling houses, commercial, mixed-use or industrial developments with a site area greater than 1000 m^2. A development that is less than 1000 m^2 and is not a sub-division is required to install a filtration device (catch pit) to remove organic matter and coarse sediments from stormwater if the development proposes to increase impervious area by more than 50 m^2.

However, if a development is proposed in "undeveloped land" in Wheeler Creek, Deep Creek and Oxford Creek catchments (termed as a high-quality catchments), the stormwater water quality management strategy is to have no impact on the waterway (Table 3). There is also a stormwater quantity (flow) target to *maintain* the natural flow regime. Undeveloped land is defined as land that has not been subject to prior development, or is in a state of nature, or with an impervious area of less than 10%. The same stormwater management strategy applies for land containing or adjoining wetlands, bushland and saltmarsh endangered ecological communities, and land adjacent to estuarine habitat and areas containing seagrass, and land within the riparian buffer of a Coastal Upland Swamp in the Sydney Basin Bioregion Endangered Ecological Community.

Table 2. General stormwater quality requirements (Northern Beaches Council, 2020)

Pollutant	Performance Requirements
Total Phosphorous	65% reduction in the post development mean annual load[1]
Total Nitrogen	45% reduction in the post development mean annual load[1]
Total Suspended Solids	85% reduction in the post development mean annual load[1]
Gross Pollutants	90% reduction in the post development mean annual load[1] (for pollutants greater than 5mm in diameter)
pH	6.5 - 8.5
Hydrology	The post-development peak discharge must not exceed the pre-development peak discharge for flows up to the 50% AEP

Table 3. Stormwater quality objectives e.g. for development in "undeveloped land" in a high-quality catchment or development in or in proximity of an ecologically sensitive area (Northern Beaches Council, 2020)

Criteria	Objectives
Stormwater Quality	Stormwater quality (temperature, salinity, chemical makeup and sediment loads) discharging from the development shall not impact the receiving waters. Reference shall be made to local data if available, including the Warringah Creek Management Study and the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC), or other widely accepted guidelines. Stormwater and other drainage shall not be discharged into saltmarsh.
Sediment	Disturbance to stream and wetland sediments is to be minimised by regulated discharge of stormwater and dissipation of flows at discharge locations. Runoff from the development must be retained at natural discharge rates and sediments controlled at the source.
Hydrology	Stormwater and groundwater flow is to mimic natural conditions and ensure a dispersed pattern of flow, avoiding centralised or concentrated discharge points into the wetland or waterway. Natural flow regimes must be retained. The reduction or increase in flows, alteration in seasonality of flows, changes to the frequency, duration, magnitude, timing, predictability and variability of flow events, altering surface and subsurface water levels and changing the rate of rise or fall of water levels must be avoided.

2.4 Key aspects of Northern Beaches Council's LEPs and DCPs that need to be resolved

- The current LEPs and DCPs are similar in that no clear guidance is provided on how Water Sensitive Urban Design is to be implemented by development applicant.
- The controls for stormwater management principally focus on stormwater quality (the removal of pollutants) and not on Water Sensitive Urban Design (quality and quantity), leading to developments largely responding to this aspect of WSUD only and not stormwater flow management. This is despite Northern Beaches Council's "Water Management for Development Policy" having a stormwater quantity requirement for development to *maintain* the natural flow regime in high-quality catchments. Clear requirements for stormwater quantity management are therefore required to inform developers.
- The majority of developments use grey infrastructure solutions such as proprietary filtration cartridges to manage the removal of pollutants from stormwater rather than green infrastructure which includes filtration through planted gardens and wetlands. The controls fail to outline how developers must deliver WSUD outcomes when proprietary solutions are used.
- Targets for pollutant removal are inconsistent and based on differing methodologies. For instance, the previous Warringah LGA divides catchments into those that must achieve a neutral or beneficial impact (NorBE) on water quality and those that can apply stormwater quality targets that allow some deterioration in water quality of receiving waterways. This study was based on a comprehensive catchment study in 2004 (which has not been updated for current conditions). The previous Pittwater LGA simply notes the McCarrs Creek catchment (including Cicada Glen Creek) as a priority, but there is no supporting study.
- Targets for stormwater quality management are not related to the water quality objectives for waterways. The LSPS for instance notes that swimming is possible in Narrabeen Lagoon, which therefore requires water quality suitable for primary contact recreation, whereas swimming is less likely to be achieved in Curl Curl Lagoon due to existing poor water quality. The catchments therefore have very different objectives, yet a development in Narrabeen catchment has the same targets for pollutant removal as a development in the Curl Curl catchment.
- Stormwater and water cycle management is currently addressed via the recently adopted Water Management for Development Policy, with the DCP simply directing applicants to the policy.

2.5 Narrabeen Lagoon catchment pilot study

Northern Beaches Council is participating in a pilot study with the NSW Department of Planning, Industry and Environment (DPIE) and Alluvium Consulting to apply the *Risk-Based Framework for Considering Waterway Health Outcomes in Strategic Land-Use Planning Decisi*ons (Dela-Cruz et al., 2017) in the Narrabeen Lagoon catchment.

The Risk Based Framework is a protocol that has been developed to help decision makers such as councils, planners and environmental regulators manage the impact of land-use activities on the health of waterways in New South Wales. The benefit of the Risk-Based Framework is that it allows decision makers to determine management strategies (including stormwater management strategies) that meet waterway health outcomes and reflect the community's environmental values and uses of the waterways. By applying the steps in the Risk Based Framework (Figure 2) in the pilot study, there was a clear line of sight between the proposed stormwater management strategy and targets, waterway objectives, and the community environmental values and uses of the waterways.

The pilot study was completed in 2021 with a recommended stormwater management strategy and targets for the Narrabeen Lagoon catchment. In order to develop stormwater management strategy and targets across the LGA, the Risk-Based Framework was applied to the remaining catchments of the Northern Beaches Council as part of this project.

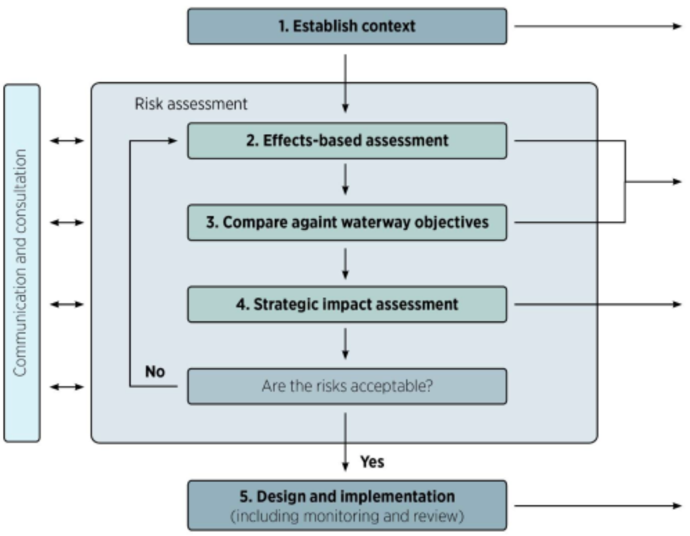
3 Methodology

This section outlines the approach undertaken to develop the Stormwater Management Strategy and targets for each catchment in the Northern Beaches LGA (Figure 3). The approach is based on a desktop assessment following the first three steps of the Risk-Based Framework (Figure 2).

As outlined in the background, stormwater quantity and quality both need to be managed to address the impact of stormwater runoff on the health of waterways. As such, it is important to define and establish a link between waterway health objectives and stormwater management strategy and targets.

Waterway objectives are established by considering:

- the “existing condition” of the waterway
- the “desired condition” of the waterway based on the community environmental values and uses as outlined in section 2.1
- risk of impacts on waterways including from current and future pressures.



1. Identify community environmental values and uses for the waterways
2. Identify the existing condition of the waterways
3. Establish existing land use and future development trajectory up to 2040.
4. Gain an understanding of Northern Beaches Council’s current stormwater management policy and practices (Business-As-Usual approach).
5. Assess the impact of land use on freshwater creeks and lagoons (Narrabeen, Dee Why, Manly and Curl Curl)
6. Develop waterway objectives
7. Develop stormwater management targets

Figure 2. *Application of the Risk Based Framework in the Narrabeen Lagoon Catchment*

For this project, draft waterway objectives have been established from existing data, findings in previous studies and initial consultation with Northern Beaches Council. It is important to note that the waterway objectives from this study are in draft form as they have been established using limited recent local data and limited consultation. For a significant proportion of catchments data has been limited to remotely sensed data (not ground-truthed). It is recommended that additional consultation and field verification of the draft waterway objectives be undertaken with an initial focus on catchments with higher existing and anticipated future pressures.

To test the methodology, the steps above were applied for catchment case studies. The findings for the case studies are presented in section 4. The steps were then applied for remaining catchments (see Appendix A).

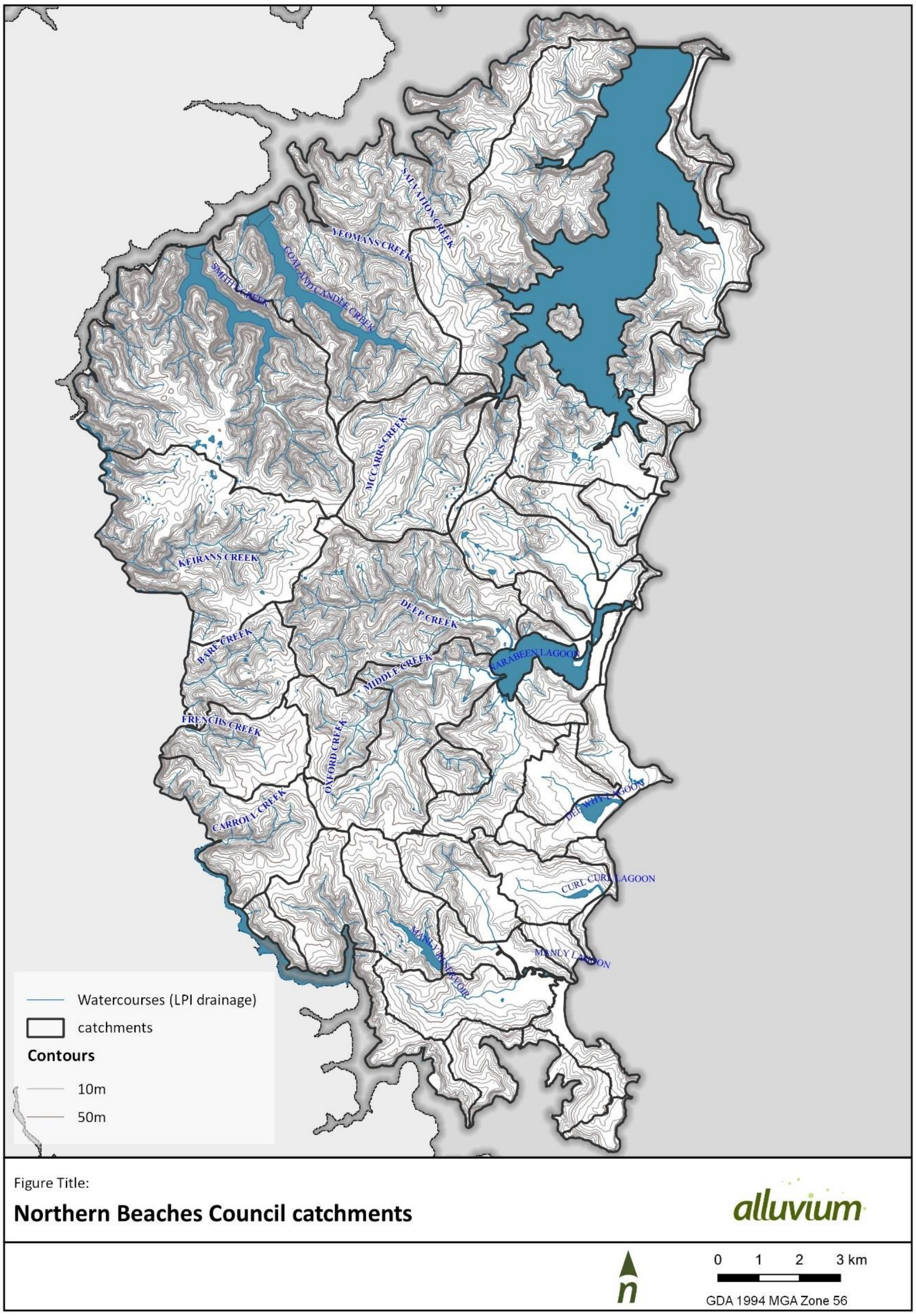


Figure 3. *Northern Beaches Council catchments*

Waterway condition and indicators
In this study, waterway condition has been assessed by investigating the following four conditions:

1. Hydrology
2. Water quality
3. Riparian vegetation
4. Physical form

The combined assessment of the four conditions (see Table 4 for definitions) provides an indication of the overall waterway condition. Indicators are identified which can be measured to provide useful information on the waterway condition. "Key indicators" have been selected for this project based on data available (see section 3.1). The four waterway conditions have also been mapped to show how they support community environmental values and uses (Table 5).

Table 4. Definition of four waterway conditions and indicators

Condition	Definition	Indicators
1. Hydrology	Flow or water regime into, within and out of the waterway or receiving water is managed to support community environmental values and uses.	Catchment imperviousness, annual runoff volume, flow obstructions, flow diversions, flow extractions.
2. Water quality	Water quality is managed to support community environmental values and uses:	
	Aquatic ecosystems	Turbidity, nutrients, macroinvertebrates, Chlorophyll-a
	Visual amenity (i.e. non-contact recreation)	Turbidity, litter, debris, nuisance organisms (e.g. phytoplankton scums, blue-green algae)
	Secondary contact recreation	Turbidity, litter, debris, nuisance organisms, surface films and microbial
	Primary contact recreation	Turbidity, litter, debris, nuisance organisms, surface films and microbial
	Aquatic foods	Algae, microbial
3. Riparian vegetation	Riparian vegetation extent and quality is managed to support community environmental values and uses including aquatic habitat. • Extent refers to in-stream vegetation and stream side vegetation that support the health of the waterway. • Vegetation quality refers to the level vegetation is intact or disturbed.	Riparian vegetation extent and quality Extent of weed infestation
4. Physical form	Physical form is managed to support community environmental values and values including aquatic habitat.	Geomorphic condition, shape and size, bed and bank stability, sedimentation, sand slugs, debris

Table 5. Condition attributes that support community environmental values and uses

Community environmental values and uses	Conditions that support values and uses
Aquatic ecosystems	Hydrology Water quality Riparian vegetation Physical form
Visual amenity	Hydrology Water quality Riparian vegetation Physical form
Secondary contact recreation	Water quality Physical form
Primary contact recreation	Water quality Physical form
Aquatic foods (to be cooked before eating)	Water quality

3.1 Data availability

We have reviewed existing data and previous studies to identify current understanding of catchment values, issues and pressures, and waterway existing condition and trajectory. These are summarised in the catchment summaries (section 4 and Appendix A).

Two reports were particularly useful as they applied a consistent methodology to assess a large number of waterways.

- Creek Management Study Warringah Council (MWH Australia Pty Ltd, 2004)
- Creek Monitoring, Evaluating and Reporting Project Spring 2015 and Autumn 2016 (NSW OEH, not dated).

The first study provided a useful historical summary of waterway values, issues and pressures, noting that the study was completed over 15 years ago. The second study provides data on water quality, macroinvertebrates diversity, and physical form but is only limited to four sampling events and assessment at one or two specific locations along each waterway.

Given data availability, we have selected key indicators to inform existing condition and trajectory of waterways (Table 6).

Table 6. Selected indicators

Conditions		Key indicators	Description	Data source
1.	Hydrology	Catchment imperviousness	Imperviousness represents the portion of the catchment that is impermeable as a result of hard surface such as roofs and roads. It provides an indication of the extent to which the waterway hydrology has been modified.	DPIE using a combination of "Buildings Geospaces" and NSW government land use layers
2.	Water quality	Turbidity, nutrients, macroinvertebrates, microbial	Turbidity, nutrients and macroinvertebrates provide an indication of the health of aquatic ecosystems. Microbial levels indicate suitability for secondary and primary contact.	Creek Management Study Warringah Council (MWH Australia Pty Ltd, 2004) Northern Beaches Council Creek Monitoring, Evaluating and Reporting Project Spring 2015 and Autumn 2016 (NSW OEH, undated) Mullet Creek Water Quality Monitoring Program and Design, Bio-analysis, 2010
3.	Riparian vegetation	Riparian vegetation extent and quality	Extent and quality of riparian vegetation: Category 1: Riparian Corridor that potentially supports relatively intact native vegetation and habitats within a nominated width measured from the channel Category 2: Riparian Corridor that potentially supports disturbed lands within a nominated width measured from the edge of the channel	Riparian Mapping Methodology for the Northern Beaches Council LEP and DCP, BMT, 2021
4.	Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	Reach geomorphic type and condition Erosion issues and description	NSW River Styles Database Creek Management Study Warringah Council (MWH Australia Pty Ltd, 2004) Northern Beaches Council Creek Monitoring, Evaluating and Reporting Project Spring 2015 and Autumn 2016 (NSW OEH, undated). A variety of creek, lagoon, estuary and coastal management plans as documents in catchment summaries.

Key findings

A summary of the two studies is presented in Table 7. The key findings are:

- There is an apparent correlation between catchment imperviousness and macroinvertebrates diversity. For creeks where the number of macroinvertebrates groups collected is similar to those expected to be present (referred to as Band A), catchment imperviousness was observed to be less than 10%. For creeks where the number of macroinvertebrates groups collected is less than those expected to be present (referred to as Band B), catchment imperviousness was generally between 20% and 30%. For creeks where the number of macroinvertebrates groups collected is significant less than those expected to be present (referred to as Band C), catchment imperviousness generally exceeds 30%.

  Different macroinvertebrates can withstand different levels of pollution. Macroinvertebrate diversity is therefore a useful indicator for understanding the level of pollution and associated waterway health (a healthy waterway will contain diverse species of macroinvertebrates).

  The data suggests that there is a tipping point in macroinvertebrates diversity (i.e. from Band A to B) when the catchment imperviousness reaches between 10-20% and a tipping point to Band C when imperviousness reaches about 30%.

- Curl Curl Creek and Kierans Creek have lower water quality despite catchment imperviousness being less than 10%. This is attributed to a number of other pollution sources overriding stormwater pollution including on-site wastewater effluent, runoff from horse paddocks, landscape suppliers and nurseries for Kierans Creek, and polluted groundwater or fertiliser use resulting in high nitrogen levels for Curl Curl Creek. Despite the lower water quality, macroinvertebrates diversity is similar to those expected to be present (Band A) which was attributed to resilience and good physical form of the National Park or urban parkland reaches that would provide some buffering of water quality.

- Waterways with urbanised upper reaches and downstream reaches in National Park or large urban parklands can be characterised with degraded urban reaches which in turn affects the health of downstream reaches in terms of weed encroachment, water quality and macroinvertebrate diversity e.g. Frenchs Creek, Carroll Creek and Bates Creek all with catchment imperviousness exceeding 20%. For waterways with similar development characteristics but lower catchment imperviousness (e.g. Bare Creek and Oxford Creek), water quality and macroinvertebrate diversity in the downstream reaches has remained in good condition (noting however significant sand slugs in the downstream reaches of Oxford Creek).

- Turbidity was observed to be higher in catchments with lower imperviousness. This is possibly due to increased erosion associated with recent construction activity and soil disturbance, walking tracks and fire trails in close proximity to the waterways. It also suggests that sediment loads from catchments with higher imperviousness have stabilised. Although, the limited water quality data available makes it challenging to draw any definitive conclusions.

It should also be noted that there are no specific environmental flow studies undertaken for waterways or lagoons in the LGA which would have assisted in evaluating waterway existing hydrologic conditions in relation to flow indicators (e.g. wetting and drying patterns, frequency of low flows and over-bank flows, and baseflow). For this project, we have therefore relied primarily on catchment imperviousness to infer existing hydrology. Additional investigation is recommended in the future to define waterway flow objectives in order to quantify stormwater quantity (flow) targets.

Table 7. Summary of findings from key waterway assessment studies

Creek	Current estimated imperviousness (%)	Group*	Total Nitrogen score ** (1-5)	NOx score** (1-5)	Total Phosphorus score** (1-5)	Turbidity score** (1-5)	Macroinverte -brates band**	Physical form (100 m)**	Coliforms above trigger values*
Deep Creek (U/S)	3.4%	A	1	1	1	1	A	Excellent	No
Wheelers Creek	6.2%	A	1	1	1	2	B	Fair	Yes (D/S dev)
Bare Creek (D/S)	7.2%	B	2	1	1	1	A	Excellent	Not sampled
Kierans Creek	7.6%	B	5	4	5	3	A	Very good	Not reported
Curl Curl Creek	11.7%	A	3	1	2	2	A	Excellent	Not sampled
Oxford Creek	14.3%	B	1	1	1	3	A	Fair	Not sampled
Middle Creek (D/S)	16.8%	C	1	1	1	1	A	Very good	Not sampled
Middle Creek (U/S)	NA	C	3	2	3	2	B	Fair	Yes
Mullet Creek	19.8%		Inferred from separate study ***				***		
Bates Creek (Bantry Bay)	21.0%	C	3	2	2	1	B	Very good	Not sampled
Carroll Creek	24.2%	C	2	3	1	1	B	Very good	Not sampled
Frenchs Creek	24.2%	C	1	2	1	1	B	Very good	Not sampled
South Creek	32.2%	C	1	2	2	3	C	Fair	Yes
Brookvale Creek (D/S)	39.9%	C	5	5	2	1	C	Very good	Yes
Dee Why Creek	42.9%	C	4	4	3	1	C	Poor	Yes
Burnt Bridge Creek	43.8%	C	3	2	2	1	C	Very good	Yes

*Creek Management Study Warringah Council, MWH Australia Pty Ltd, 2004; ** Northern Beaches Council Creek Monitoring, Evaluating and Reporting Project Spring 2015 and Autumn 2016, NSW OEH, undated. Limited to four sampling events
*** Mullet Creek Water Quality Monitoring Program and Design, BioAnalysis Pty Ltd, 2010

Creek group:

Group A: Creeks unaffected by development

Group B: Creeks with highly modified reaches in urban and rural areas but good condition in National Parks

Group C: Creeks with significant and potentially irreversible changes to ecology and geomorphology

Macroinvertebrates Band

A – Number of macroinvertebrates groups collected is similar to those expected to be present; B – Number of macroinvertebrates groups collected is less than those expected to be present; C – Number of macroinvertebrates groups collected significantly less than those expected to be present

Water quality score categories

Category 1 to 5 represent how far the measured value is above the ANZECC guidelines trigger value with 5 being the furthest.

4 Catchment case studies

This section presents seven case studies (Table 8) with different receiving water environments for which existing waterway condition, trajectory and draft waterway objectives were established.

Summaries for remaining catchments are provided in Appendix A.

Table 8. Catchment case studies

Catchment case study	Downstream receiving waters	Estimated current imperviousness (%)	Potential increase in imperviousness over next 20 years (%)
Oxford Creek	Narrabeen Lagoon	14%	>10%
Carroll Creek	Middle Harbour Creek	24%	<3%
Dee Why Creek	Dee Why Lagoon	43%	<3%
Curl Curl Creek	Manly Dam	12%	<2%
Manly Beach	Ocean	32%	<2%
Manly Cove	Middle Harbour	24%	<2%
Careel Creek	Pittwater Estuary	28%	<4%

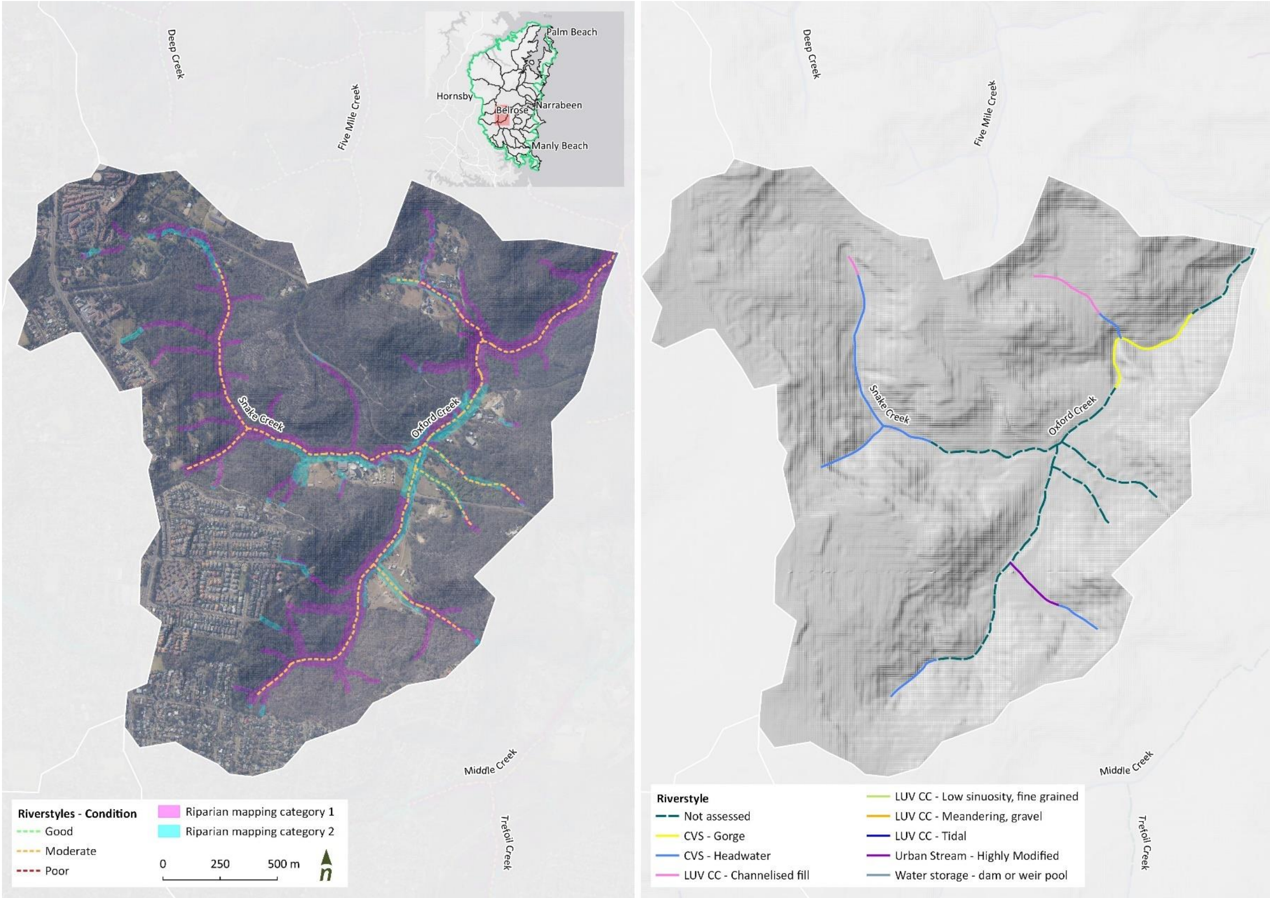
Current imperviousness in each catchment was estimated by DPIE-EES based on a combination of the commercially available layer "Buildings Geospaces" and the NSW government land use layer. The data captured roof surfaces, road pavement and car parks but not driveways and other outdoor paved areas on lots. As such, it is expected that the data underestimated imperviousness. However, given that the impervious surfaces captured by the data are directly connected to the stormwater network, it is expected that the imperviousness data is a reasonable estimate of Directly Connected Imperviousness (DCI) – a metric which has been established as a catchment indicator of waterway ecological condition.

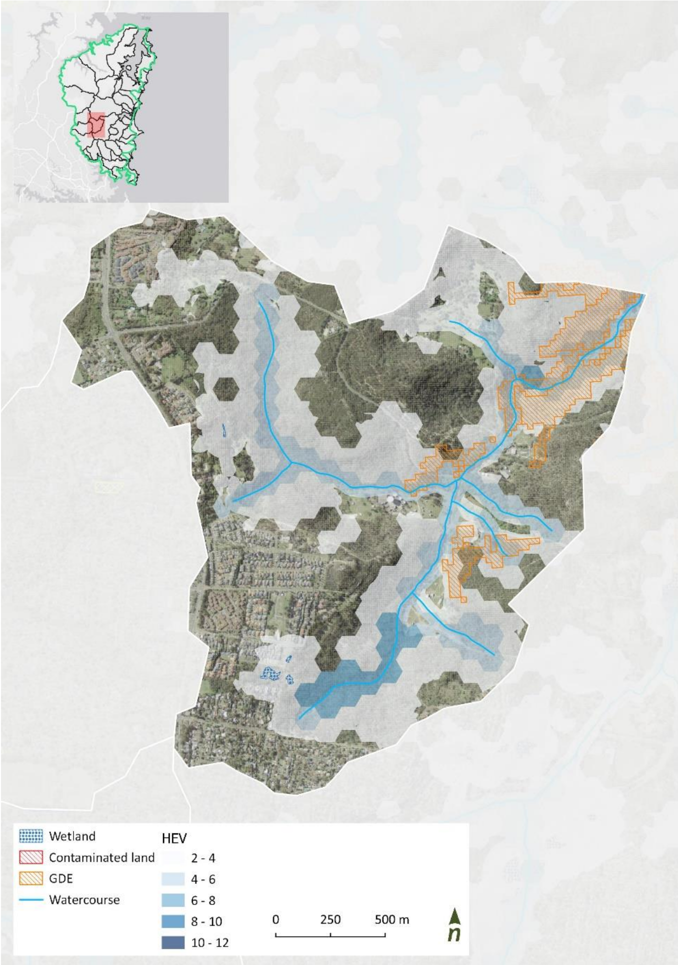
Potential increase in imperviousness within each catchment is based on assumed increases in imperviousness within future development areas in Northern Beaches LGA (Table 9).

Table 9. Assumed increase in imperviousness within future development areas

Future development areas	Potential increase in imperviousness over next 20 years (%)
Centre Investigation Areas	20%
Frenchs Forest Release Area	30%
Housing Diversity Areas	20%
Ingleside Growth Area	50%
Warriewood Growth Area	50%

4.1 Oxford Creek




Wetland
Contaminated land
GDE
Watercourse
HEV
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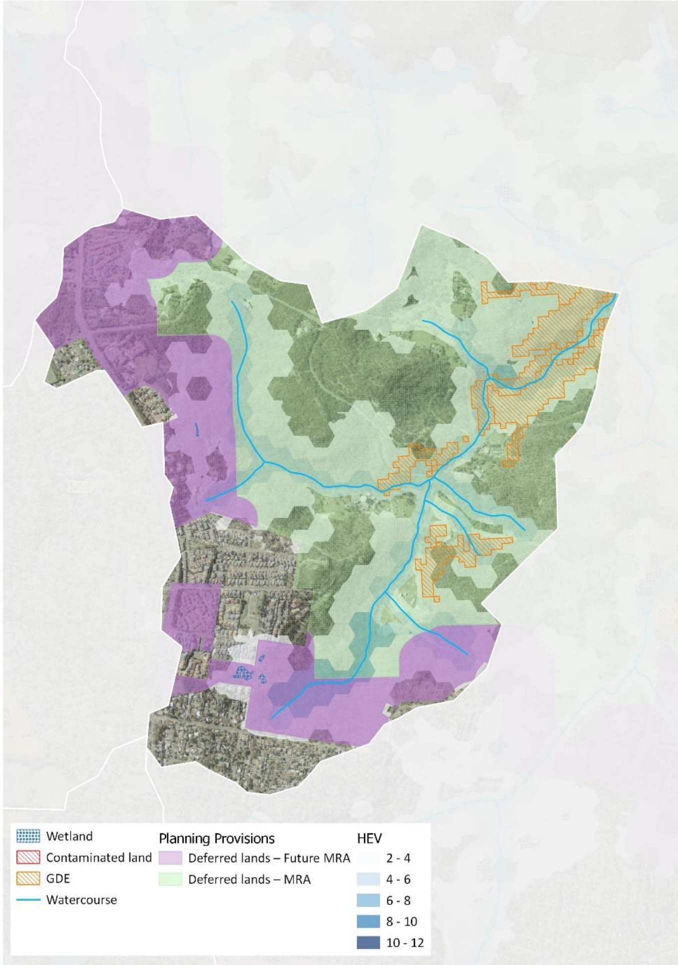
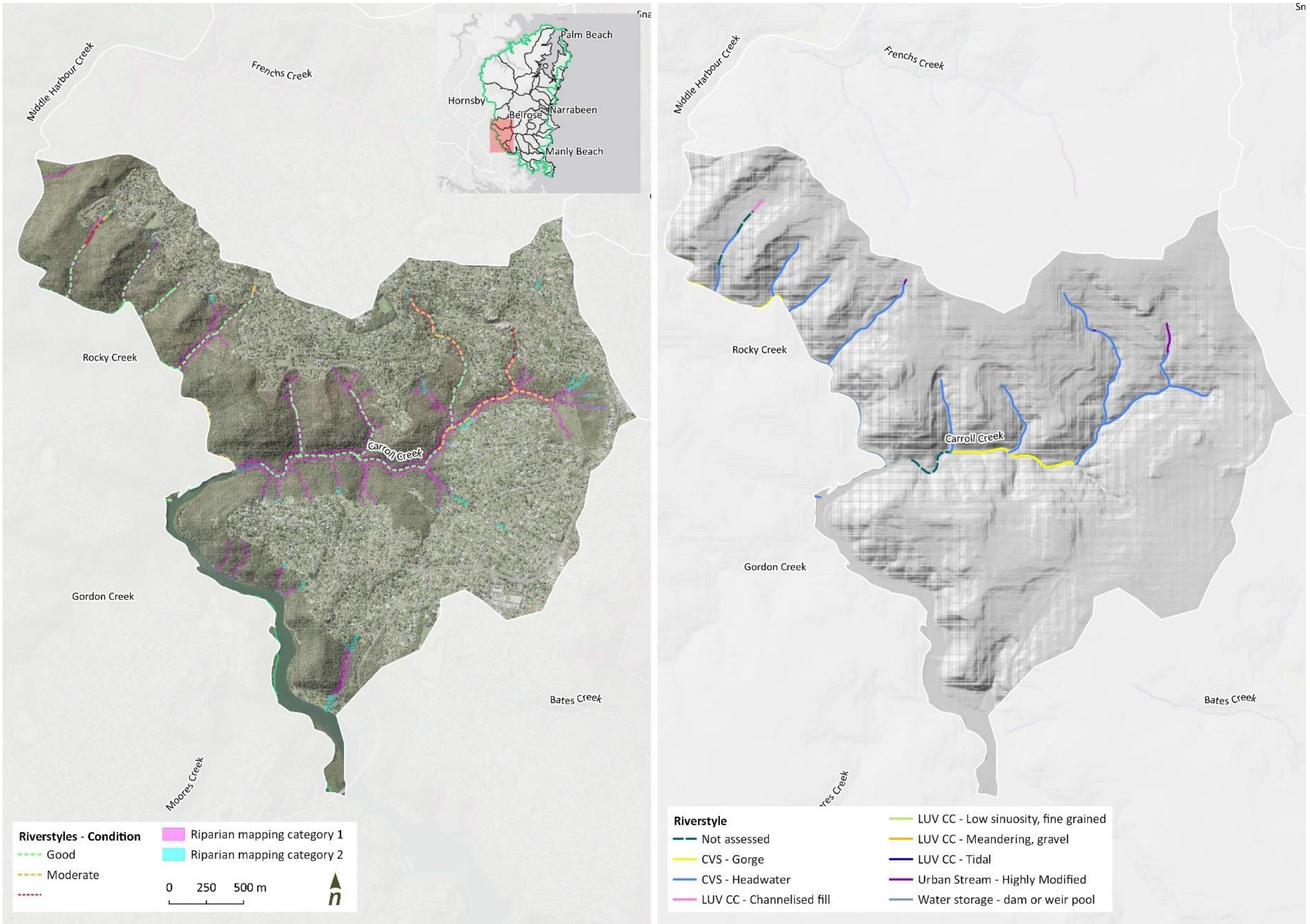
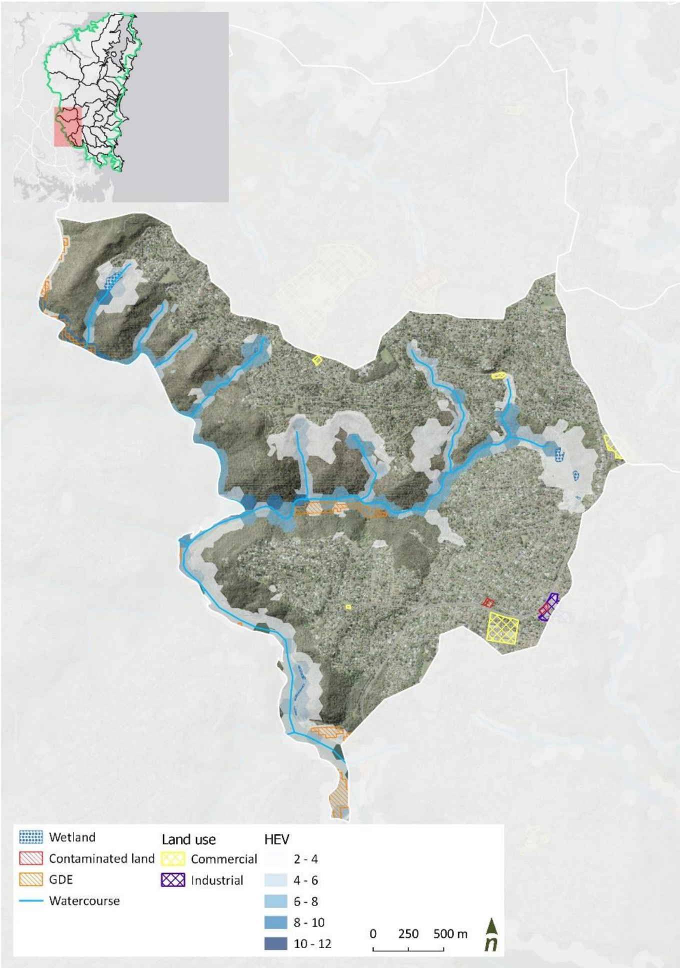

Wetland
Contaminated land
GDE
Watercourse
Planning Provisions
Deferred lands – Future MRA
Deferred lands – MRA
HEV
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12

Oxford Creek	**Current fraction imperviousness: 14 % (Potential increase>10%)**			**References**
Objectives and timeframe for community environmental values and uses	*Maintain or Improve* existing condition for visual amenity; *Improve* condition for aquatic ecosystems and secondary contact recreation (5-10 year timeframe); *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems.			Local Strategic Planning Statement (LSPS)
Existing values	• Varies between reaches owing to weed infestation and cleared agricultural lands • High landscape value and fine example of streamside vegetation close to waterfall • In-stream biodiversity in good condition (similar to that expected to be present) • HEV score higher for upper reaches of Oxford Creek • GDE at lower reaches of Oxford Creek			Creek MER Assessment Report Card 2014-2015 Final Report - Creek Monitoring Evaluating and Reporting (MER) Project 20152016
Existing catchment pressures and stressors	• Urbanisation in upper parts of the catchment • Bank eroding in places • High sediment load enters the creeks during and after heavy rainfall (based on high turbidity measurements) • Weed invasion			Creek MER Assessment Report Card 2014-2015 Final Report - Creek Monitoring Evaluating and Reporting (MER) Project 20152016
Conditions	**Key indicators**	**Existing condition**	**Trajectory**	**Draft waterway objectives**
1. Hydrology	Imperviousness	Expected to be slightly to moderately modified (Imperviousness 14%)	Potential to decline given imperviousness can exceed 20% in the next 20 years	**Maintain condition**
2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	TN, NOx and TP at or just above trigger value for aquatic ecosystems (ANZECC Guidelines for NSW and Victoria lowland, east flowing coastal rivers). Macroinvertebrates diversity similar to that expected to be present Turbidity elevated possibly due to localised erosion and erosion of informal bike tracks and fire trails Sediment plumes have been observed at stormwater outlets	Potential to decline given imperviousness can exceed 20% in the next 20 years	**Maintain or improve condition** (e.g. improve condition in upper urban reaches)

3.Riparian vegetation	Riparian vegetation extent and quality, weed infestation.	- Category 1 riparian vegetation classified in the upper and lower reaches (BMT, 2021). Good connectivity and width maintained. - The mid reaches is significantly disturbed, with a narrow width limited by the road on the eastern side. Some natives in the canopy layer (approx. 50%), understory and ground cover primarily weeds. *Some weed infestation observed immediately downstream of outlets. Area is extending over time. Likely causes are higher wetting and nutrient inputs.*	- Invasive weeds disturbance to downstream likely Declining with development and potentially with climate change (higher flows exposing banks)	**Maintain condition** Potential to improve condition at stormwater outlets and at disturbed sites
4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	- Upper reaches are steep and bedrock confined with moderate geomorphic condition. - The mid reaches (upstream of Oxford Falls Cascade) are partially confined with a relatively continuous but narrow floodplain on the eastern side. Some bedrock evident in the channel limiting vertical adjustment, banks are typically steep with some active erosion present but generally constrained by the road. A sand slug identified in this reach (NSW OEH, 2016). - The lower reaches flow through a confined gorge setting until its confluence with Middle Creek where significant sand slug has been identified. *Some widening and localised erosion observed*	- No significant lateral adjustment likely in confined upper reaches - Ongoing erosion possible through the partly confined mid reaches upstream of Oxford Falls Cascade - Ongoing aggradation in the channel around the confluence with Middle Creek	**Maintain condition**

4.2 Carroll Creek




Wetland
Contaminated land
GDE
Watercourse
Land use
Commercial
Industrial
HEV
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6 - 8
8 - 10
10 - 12
0 250 500 m
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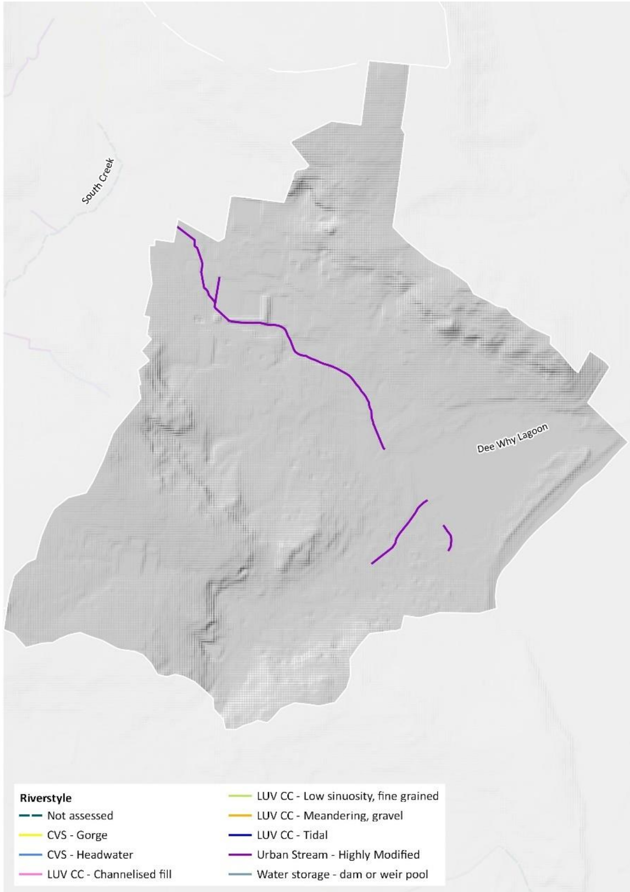
Wetland
Contaminated land
GDE
Watercourse
Land use
Commercial
Industrial
Planning Provisions
Centre Investigation Areas (800m R2)
Frenchs Forest Release Area
Housing Diversity Areas (400m R2)
HEV
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12

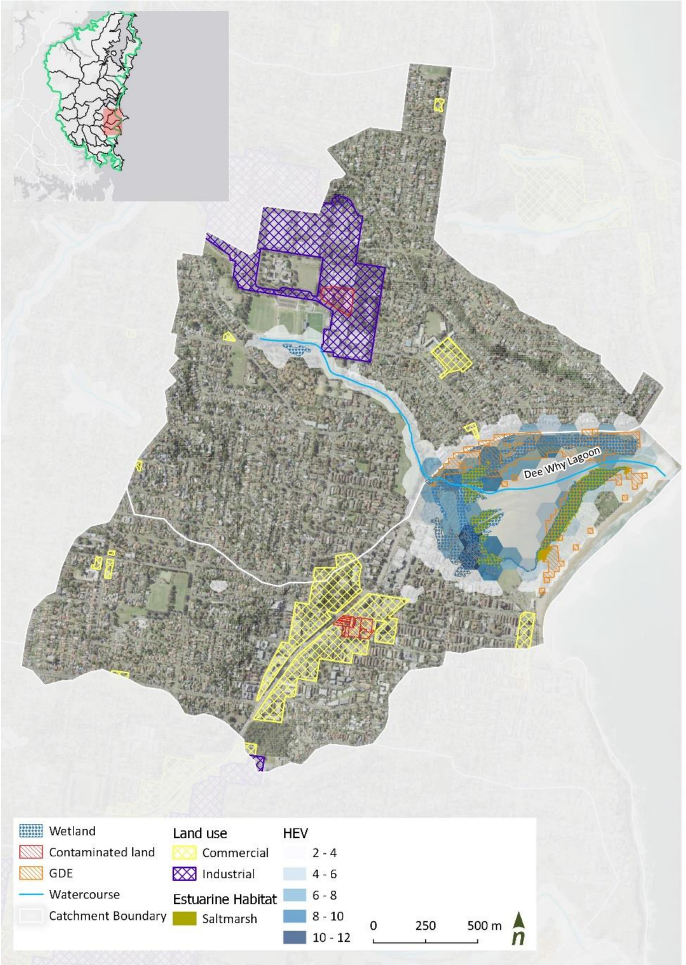
Carroll Creek	**Current fraction imperviousness: 24 % (potential increase <3%)**	**References**
Objectives and timeframe for community environmental values and uses	*Maintain or Improve* existing condition for aquatic ecosystems, visual amenity and secondary contact recreation; *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems.	Local Strategic Planning Statement (LSPS)
Existing values	• High native species richness immediately upstream of National Park with reasonable connectivity and habitat quality • Ecological value high both within and outside National Park • HEV score higher in National Park • GDE existing along main creek line.	Middle Harbour Catchment Stormwater Management Plan July 1999 Final Report - Creek Monitoring Evaluating and Reporting (MER) Project 20152016
Existing catchment pressures and stressors	• Polluted urban runoff. TN concentrations at Prahran Avenue poor. • Degradation of upstream reaches threatening high values downstream • Weeds encroachment in National Park resulting from uncontrolled invasion and deliberate cultivation of exotics in upstream urban reaches. • Land development, sediment input, nutrient input, freshwater input are catchment pressures to health of Middle Harbour. • *Old Sydney Water sewers – leaking, sewer overflows. Sydney Water improving system*. • *Warringah Rd impacts on from road runoff tyres, brakes, accidents*	Warringah Creek Management Study 2004 Estuary Health Assessment Clontarf Bantry Bay Final Report 2017

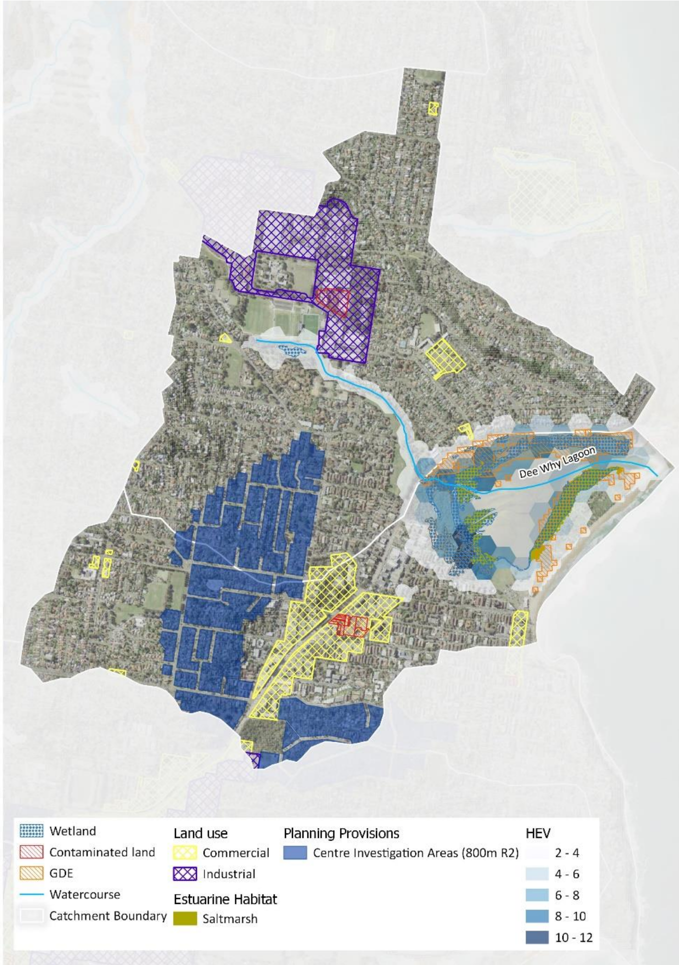
Conditions	**Key indicators**	**Existing condition**	**Trajectory**	**Draft waterway objectives**
1. Hydrology	Imperviousness	Expected to be moderately modified	Stable with small increase in imperviousness expected in the next 20 years	**Maintain condition**
2. Water quality	Turbidity, nutrients, macroinvertebrates	TN, NOx above trigger value for aquatic ecosystems. TP at or just above trigger value for aquatic ecosystems (ANZECC Guidelines for NSW and Victoria lowland, east flowing coastal rivers). Macroinvertebrates diversity is less that expected to be present	Stable given small increase in imperviousness. Note: Sydney Water improving sewerage system.	**Improve condition** *noting multiple sources of pollution
3.Riparian vegetation	Riparian vegetation extent and quality, weed infestation	Local weed encroachment in National Park	Expect to decline. New DAs suggest that planting proposed	**Improve condition** along degraded reaches

			may incorporate more invasive species	
4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	Highly confined. Low turbidity – large urban development disturbance in the catchment have now been completed.	Stable	**Improve condition** along degraded reaches

4.3 Dee Why Creek



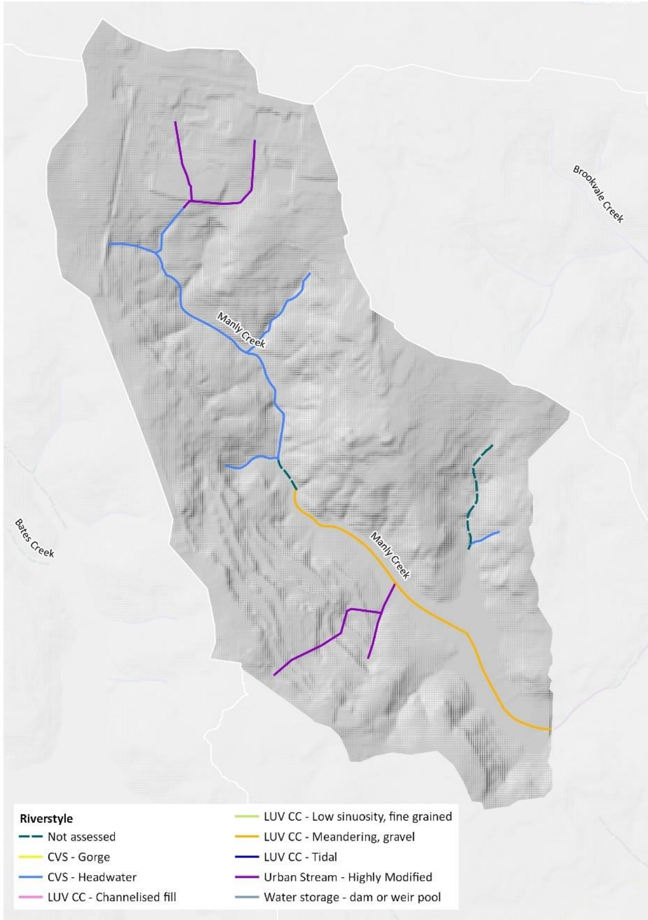

Dee Why Lagoon
Wetland
Contaminated land
GDE
Watercourse
Catchment Boundary
Land use
Commercial
Industrial
Estuarine Habitat
Saltmarsh
HEV
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12
0
250
500 m
n

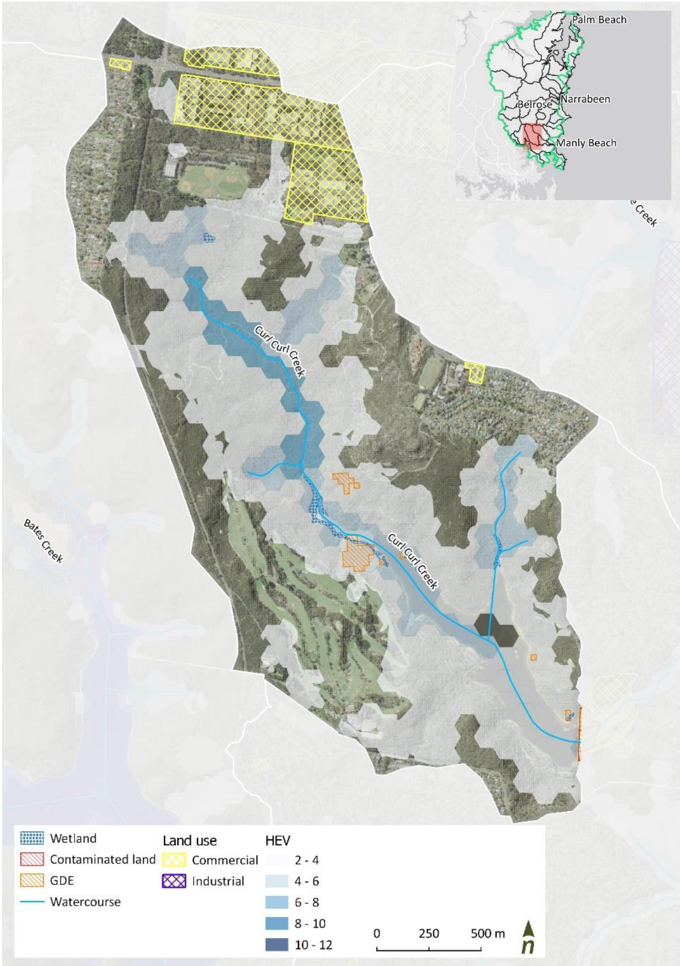

Dee Why Lagoon
Wetland
Contaminated land
GDE
Watercourse
Catchment Boundary
Land use
Commercial
Industrial
Estuarine Habitat
Saltmarsh
Planning Provisions
Centre Investigation Areas (800m R2)
HEV
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12

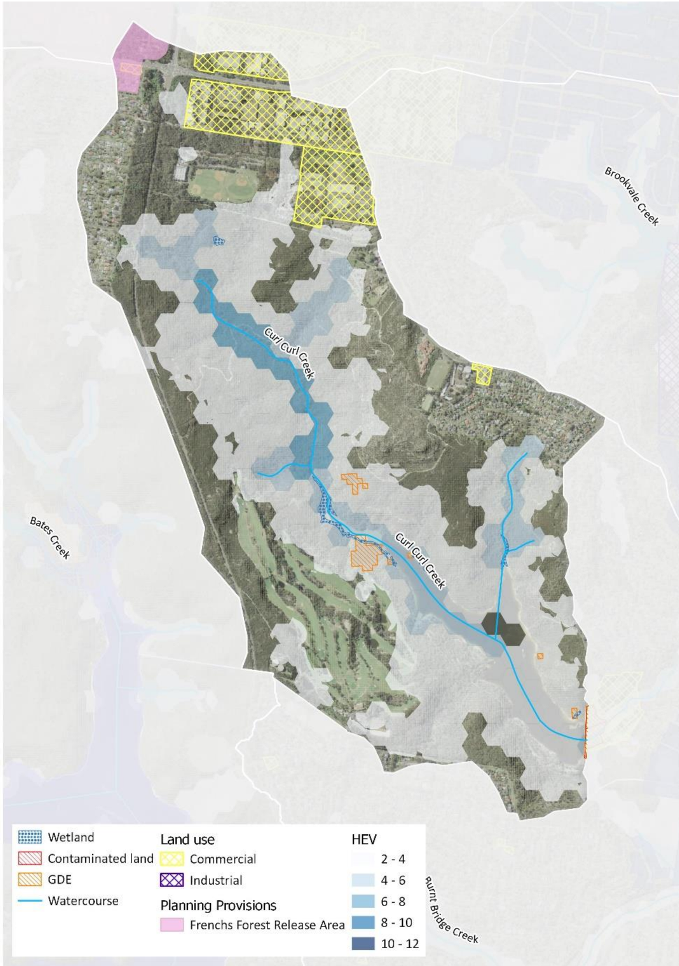
Dee Why Creek	**Current fraction imperviousness: 43 % (Potential increase < 3%)**	**References:**
Objectives and timeframe for community environmental values and uses	**Freshwater creeks**: *Improve* condition for aquatic ecosystems, visual amenity and secondary contact recreation (5-10 year timeframe). *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems. **Lagoon**: *Maintain or Improve* existing condition for aquatic ecosystems and visual amenity; *Improve* condition for secondary contact recreation (5-10 year timeframe)	Local Strategic Planning Statement (LSPS)
	Improve water quality in terms of managing inputs of sediments, nutrients and other contaminants	Dee Why Lagoon Estuary Management Plan 2004
Existing values	Dee Why Creek: • Low ecological value (bush regeneration activities) Dee Why Lagoon: • Waterbirds and small mammals • Recreational, educational, amenity • Saltmarsh	Dee Why Lagoon Estuary Management Plan 2004
Existing catchment pressures and stressors	**Dee Why Creek** • Weed infestation • Poor water quality including microbial levels • High flow velocities contributing to bank erosion and sediment deposition in D/S reaches • High levels of urbanisation • Cromer Industrial estate **Dee Why Lagoon** • Polluted runoff • Fair to good water quality (in terms of clarity and algae) • Frequent break-out assist with water quality • Infilling with sediment • Leachate from old tip sites • Weed invasion • Human impacts (sports, dredging)	Final Report - Creek Monitoring Evaluating and Reporting (MER) Project 20152016 Warringah Creek Management Study 2004

Conditions	Key indicators	Existing condition	Trajectory	Draft waterway objectives
1. Hydrology	Imperviousness	Expected to be highly disturbed	Stable – small change in imperviousness	**Maintain condition**
2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	MER data suggest aquatic ecosystem indicators well above trigger values and macroinvertebrates diversity significantly less than that expected to be present	Stable given small increase in imperviousness.	**Improve condition**
3.Riparian vegetation	Riparian vegetation extent and quality, weed infestation	Significant weed infestation in upper reaches and wetland portions (NSW OEH, 2016)	Ongoing weed disturbance	**Improve condition**
4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	- Upper reaches highly modified with evidence of sedimentation and channel chocked with aquatic weeds (NSW OEH, 2016) -poor geomorphic condition. - Mid reaches flow into wetland adjacent to Cromer park. - Lower reaches highly modified, low sinuosity, unconfined channel in poor geomorphic condition	Increased flows could increase erosion potential of lower reach	**Improve condition**

4.4 Curl Curl Creek



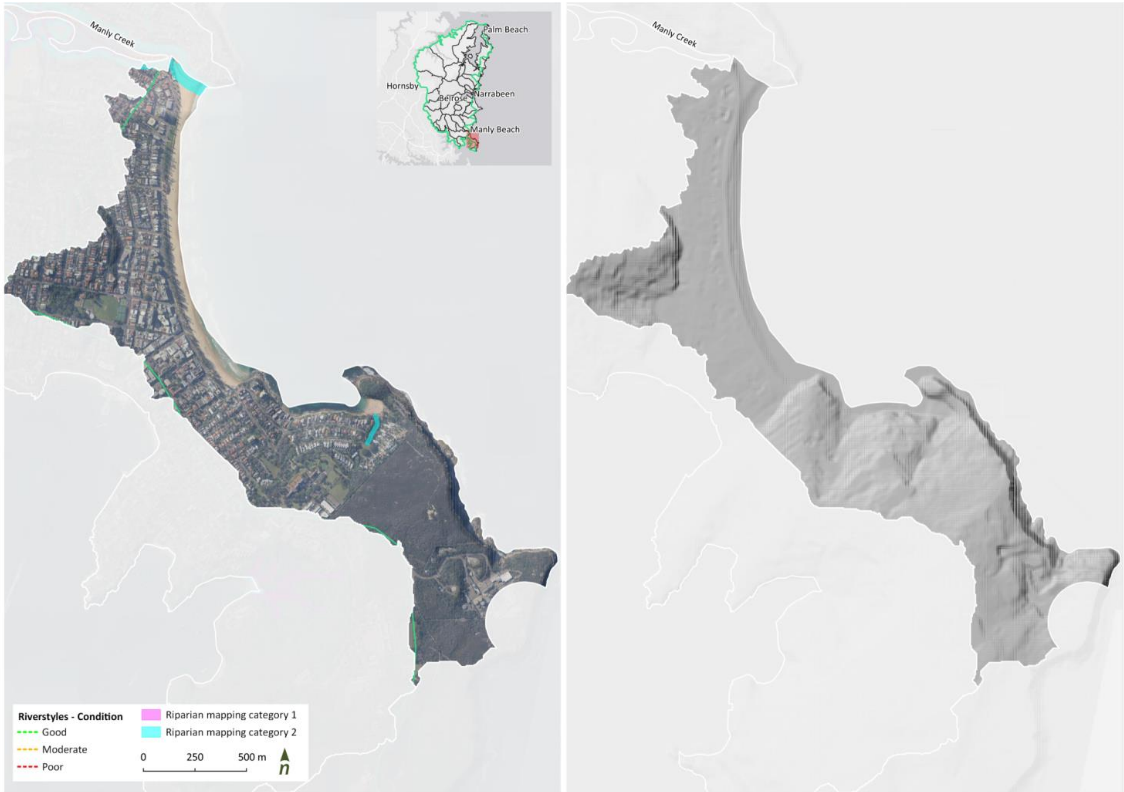

Palm Beach
Belrose
Narrabeen
Manly Beach
Curl Curl Creek
Curl Curl Creek
Bates Creek
Wetland
Contaminated land
GDE
Watercourse
Land use
Commercial
Industrial
HEV
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12
0
250
500 m

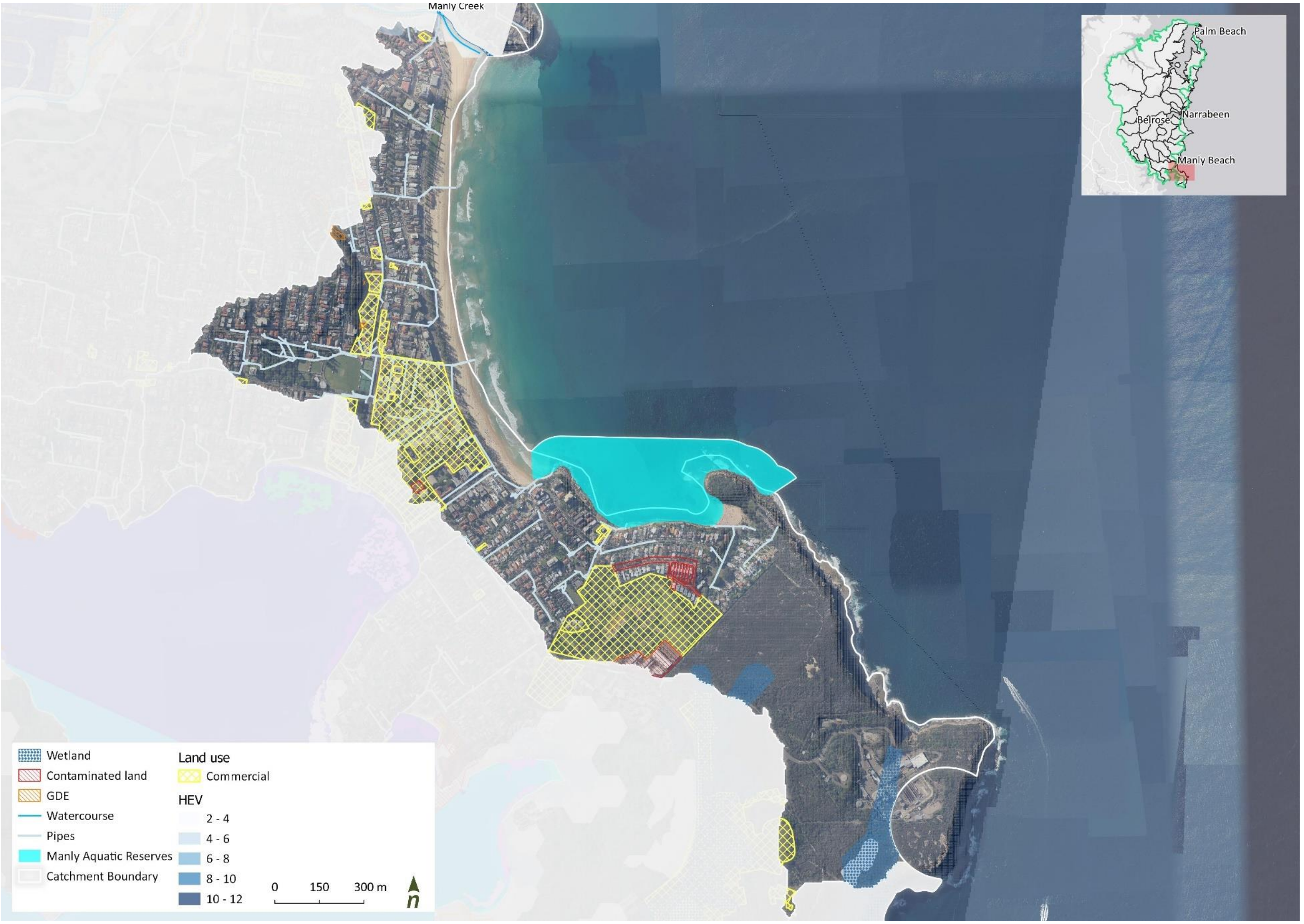

Brookvale Creek
Curl Curl Creek
Curl Curl Creek
Bates Creek
Burnt Bridge Creek
Wetland
Contaminated land
GDE
Watercourse
Land use
Commercial
Industrial
Planning Provisions
Frenchs Forest Release Area
HEV
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12

Curl Curl Creek	**Current fraction imperviousness: 12 % (Potential increase <2%)**			**References**
Objectives and timeframe for community environmental values and uses	**Freshwater creek**: *Maintain or Improve* condition for aquatic ecosystems, visual amenity and secondary contact recreation. *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems. **Dam**: *Maintain or Improve* existing condition for all environmental values and uses			Local Strategic Planning Statement (LSPS)
Existing values	• High ecological value • High recreational and scenic value • HEV score higher along main creek line upstream of dam			Monitoring Evaluating and Reporting (MER) Project 20152016 Warringah Creek Management Study 2004 Manly Dam Water Quality Draft Report _1July_2010
Existing catchment pressures and stressors	**Curl Curl Creek** • Poor water quality • Potentially polluted groundwater or fertiliser use resulting in high nitrogen levels • Elevated turbidity level points to soil disturbance in the catchment • Some weeds present **Manly Dam** • Wet weather increases nutrient flows to the dam which promote phytoplankton growth (e.g. in 2008). • Release of water from the dam which occurs occasionally and after major rainfall events flushes Cyanobacteria (and phytoplankton) improving water quality			
Conditions	**Key indicators**	**Existing condition**	**Trajectory**	**Draft waterway objectives**
1. Hydrology	Imperviousness	Expected to be slightly modified	Stable with small increase in imperviousness expected in the next 20 years	**Maintain condition**
2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	TP and TN above trigger value for aquatic ecosystems. NOx at or just above trigger value for aquatic ecosystems. Macroinvertebrates diversity is similar to that expected to be present	Stable with small increase in imperviousness expected in the next 20 years	**Improve condition** *noting multiple sources of pollution Address potential erosion issue in the catchment

		Elevated turbidity levels.		
3.Riparian vegetation	Riparian vegetation extent and quality, weed infestation	Riparian zone connected to good quality bushland, very few weeds and high conservation value (NSW OEH, 2016)	Stable	**Maintain condition**
4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	-Upper reach (500m) highly modified urban stream -Mid to lower reaches (to Manly Dam) primarily confined by bedrock with boulders and cobbles in channel and pools, riffles and waterfalls. Good geomorphic condition	Stable	**Maintain condition**

4.5 Manly Beach



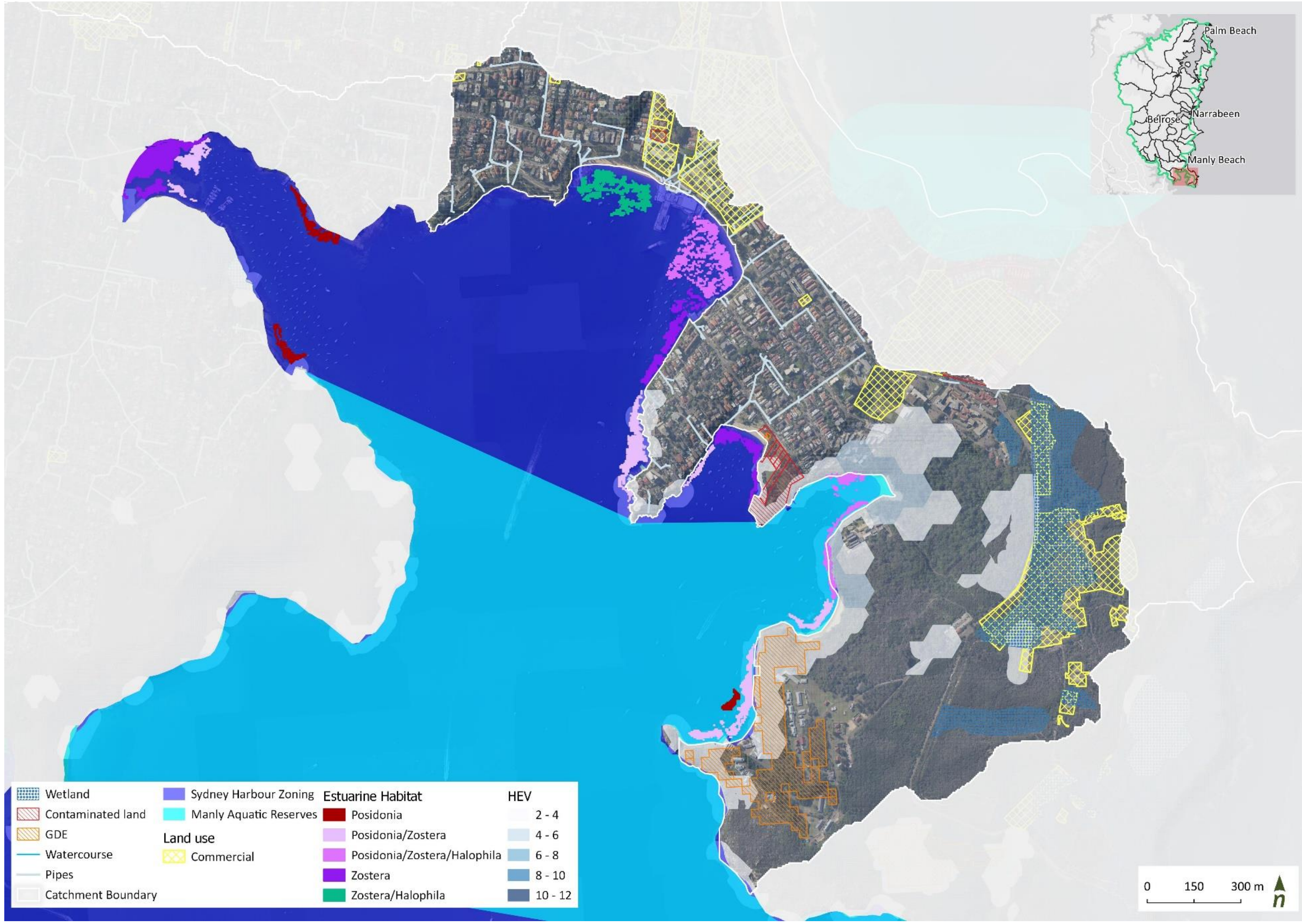

Manly Creek
Palm Beach
Narrabeen
Belrose
Manly Beach
Wetland
Contaminated land
GDE
Watercourse
Pipes
Manly Aquatic Reserves
Catchment Boundary
Land use
Commercial
HEV
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12
0
150
300 m
n

Manly Beach	**Current fraction imperviousness: 32 % (Potential increase <2%)**	**References:**
Objectives and timeframe for community environmental values and uses	**Ocean beaches:** *Maintain or Improve* existing condition for all environmental values and uses	Local Strategic Planning Statement (LSPS)
Existing values	High recreational value (swimming, boating and fishing) Fish, birds, seaweed, organisms within sediment, phytoplankton Aquatic reserve in proximity (kelp beds, seagrass, fish, invertebrates)	Manly Ocean Beach coastline management study 2008
Existing catchment pressures and stressors	• Beach erosion/shoreline recession (stormwater outlets, sea level rise) • Stormwater outlets impacting safety and amenity • Manly lagoon flood outlet affects amenity and water quality • Pollution from stormwater outlets and Manly Lagoon • Water quality is good during dry weather but declines following rainfall events • Faecal coliform and enterococci levels often exceed trigger values after rainfall events • High levels of urbanisation (flow rates and water quality) • Sea level rise • Beach activities (litter)	
Previously documented catchment objectives	• Ensure water quality meets the community's expectations and provides water quality suitable for swimming, boating and fishing • Manage beach erosion and shoreline recession in a manner that maintains or improves beach amenity • Ensure activities at Manly Ocean Beach are carried out in a manner that maintains or improves the ecological condition of aquatic habitats.	

Conditions	**Key indicators**	**Existing condition**	**Trajectory**	**Draft waterway objectives**
1. Hydrology	Imperviousness	High levels of imperviousness (32%) with runoff discharged directly into ocean beach.	Stable	Reduce beach erosion at stormwater outlets
2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	Faecal coliform and enterococci levels often exceed trigger values after rainfall events	Stable	**Maintain or improve condition**

3. Aquatic vegetation	Aquatic vegetation extent and quality e.g. seagrass	No data		**Maintain or improve condition**
4. Physical form	Shoreline erosion, recession, sand movement and volume	Local erosion at stormwater outlets	Stable	**Maintain or improve condition** (e.g. reduce erosion at stormwater outlets)

4.6 Manly Cove

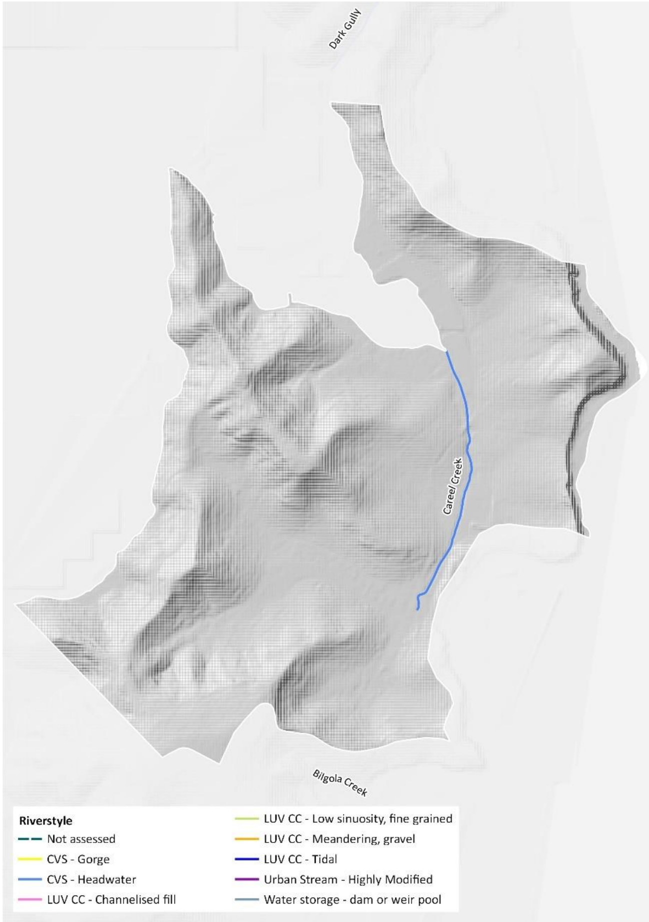

Palm Beach
Narrabeen
Belrose
Manly Beach
Wetland
Contaminated land
GDE
Watercourse
Pipes
Catchment Boundary
Sydney Harbour Zoning
Manly Aquatic Reserves
Land use
Commercial
Estuarine Habitat
Posidonia
Posidonia/Zostera
Posidonia/Zostera/Halophila
Zostera
Zostera/Halophila
HEV
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12
0 150 300 m
n

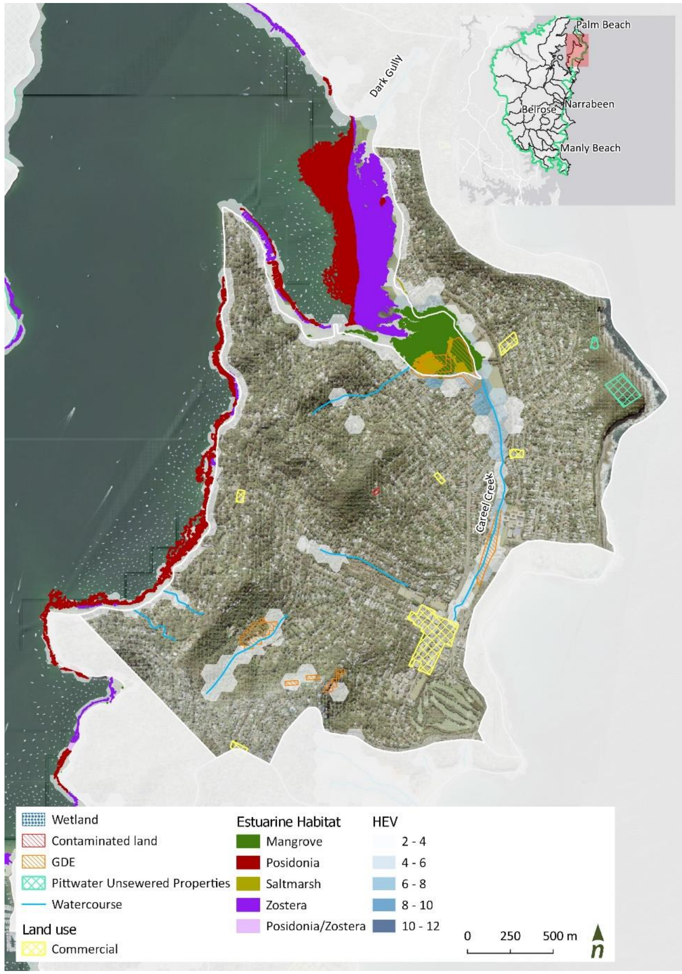
Manly Cove	**Current fraction imperviousness: 24 % (Potential increase < 2%)**	**References:**
Objectives and timeframe for community environmental values and uses	**Estuary**: *Maintain or Improve* existing condition for all environmental values and uses	Local Strategic Planning Statement (LSPS)
Existing values	Seagrass Fishing, boating, scuba diving, swimming in Middle Harbour	Middle Harbour Catchment Stormwater Management Plan July 1999
Existing catchment pressures and stressors	Erosion pushing seagrass from the beachfront arising from: • Boating activities/mooring • Stormwater outlets/sewerage pumping stations (quality and quantity of water) • Sediment loads from stormwater outlets Middle Harbour estuary: • Pollution from urbanised catchments. Estuary recovers 3 days after rainfall events (well flushed) • Estuary healthy based on Chlorophyll-a and turbidity sampling program • Extent of seagrass very poor. Loss of seagrass is continuing in recent years but could also be natural variation. • Direct discharge to foreshore resulting in nutrient loading and fast flows resulting in weeds and erosion at localised sites • High levels of urbanisation (flow and water quality, direct discharges) • Activities (boating/mooring)	Estuary Health Assessment Clontarf Bantry Bay Final Report 2017
Previously documented catchment objectives	• Preserve sea grass bed	

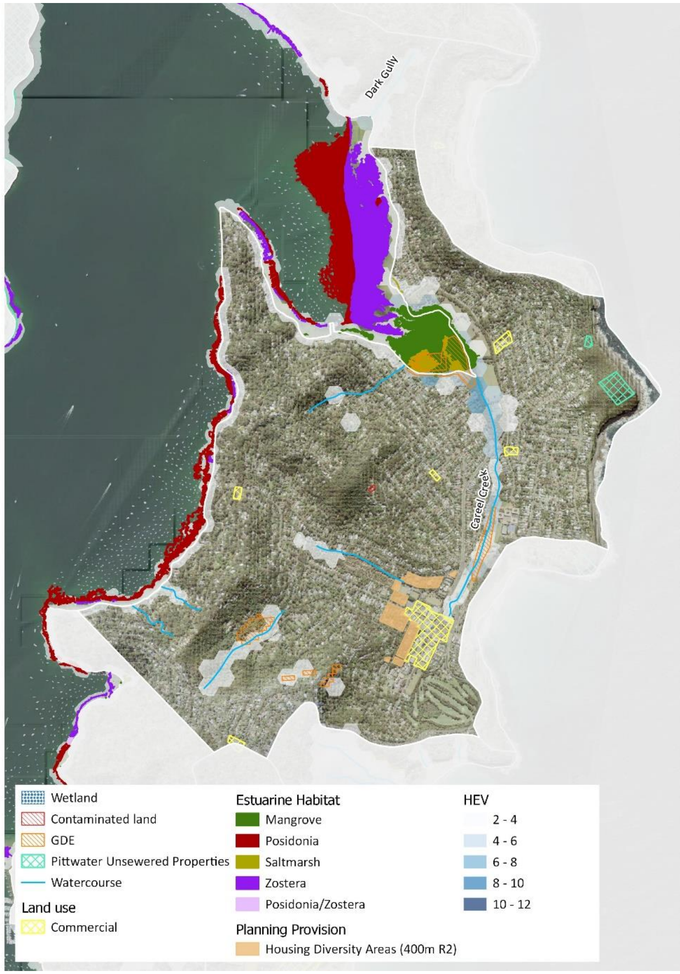
Conditions	**Key indicators**	**Existing condition**	**Trajectory**	**Draft waterway objectives**
1. Hydrology	Imperviousness	High levels of imperviousness (24%) with runoff discharged directly into ocean beach.	Stable with small increase in imperviousness	Reduce beach erosion at stormwater outlets

2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	Direct discharge to foreshore resulting in nutrient loading and fast flows resulting in weeds and erosion at localised sites Estuary is healthy based on Chlorophyll-a and turbidity monitoring program. Estuary recovers from catchment pollution 3 days after rainfall events.	Stable with small increase in imperviousness	**Maintain or improve condition** (e.g. reduce litter, sediment loads, nutrient loads and weeds in order to protect sea grass in proximity of outlets).
3. Aquatic vegetation	Aquatic vegetation extent and quality e.g. seagrass	Extent of seagrass very poor	Seagrass declining or stable noting that observed decline in recent years may be natural variation	**Maintain or improve condition**
4. Physical form	Shoreline erosion, recession, sand movement and volume	Local erosion at stormwater outlets	Stable	**Maintain or improve condition** (e.g. reduce erosion at stormwater outlets)

4.7 Careel Creek




Palm Beach
Narrabeen
Belrose
Manly Beach
Dark Gully
Careel Creek
Wetland
Contaminated land
GDE
Pittwater Unsewered Properties
Watercourse
Land use
Commercial
Estuarine Habitat
Mangrove
Posidonia
Saltmarsh
Zostera
Posidonia/Zostera
HEV
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12
0 250 500 m
n


Dark Gully
Careel Creek
Wetland
Contaminated land
GDE
Pittwater Unsewered Properties
Watercourse
Land use
Commercial
Estuarine Habitat
Mangrove
Posidonia
Saltmarsh
Zostera
Posidonia/Zostera
Planning Provision
Housing Diversity Areas (400m R2)
HEV
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12

Careel Creek	Current fraction imperviousness: 25 % (Potential increase < 4%)	
Objectives and timeframe for community environmental values and uses	**Freshwater creeks:** *Maintain or Improve* existing condition for visual amenity; *Improve* condition for aquatic ecosystems and secondary contact recreation (5-10 year timeframe); *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems. **Estuary (Careel Bay)**: *Maintain or Improve* existing condition for all environmental values and uses	Local Strategic Planning Statement (LSPS)
Existing values	**Careel Creek** • Substantially modified – large concrete channel • Low riparian vegetation along channel. Weeds present. • Endangered Ecological communities closer to Careel Bay **Careel Bay** • Wetland habitats (mangrove forest, saltmarsh, mudflats, seagrass beds) • Saltmarsh has decreased significantly since 1946 • Mangroves have spread over the saltmarsh	**References:** BMT-WBM Careel Creek Issues Paper Final - December 2010 FINAL REPORT Urban Sedimentation and Pollution Audit in the Pittwater Estuary - Environmental Investigation Report - AWC Consulting Sept 2012
Existing catchment pressures and stressors	**Careel Creek** • High volume of runoff and poor water quality • Gross pollutant/litter loads. Decaying organic matter source of odour • High tidal flow – flow can leave channel easily • High nutrient levels (decomposition of litter, stormwater input, sewer overflow) • Flooding (open channel has capacity up to 20% AEP) • Nutrient loads promoting weeds along creek line. Creek in turn contributing weeds to saltmarsh • High levels of urbanisation • Septic seepage **Careel Bay** • Poorly flushed bay. Stormwater inputs takes time to dissipate • Sewer overflows and stormwater inputs enhancing presence of mangroves • Sedimentation over saltmarsh enhances establishment of mangroves • Sediments are contaminated from boating, light industry and domestic activities • Faecal coliforms sometimes high especially in dry weather (septic seepage?) • Bike tracks affecting salt marsh area	
Previously documented catchment objectives	• Preserve sea grass bed	

Conditions	Key indicators	Existing condition	Trajectory	Draft waterway objectives
1. Hydrology	Imperviousness	Expected to be moderately to highly modified	Stable given small increase in imperviousness	**Improve condition** e.g. reduce runoff volume and flow rates to reduce flooding
2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	TP and TN expected to be above trigger value for aquatic ecosystems. Macroinvertebrates diversity likely to be less that expected to be present Microbial level expected to be above trigger values for secondary recreation.	Stable	**Improve condition**
3.Riparian vegetation	Riparian vegetation extent and quality	Very poor riparian condition upstream of Barrenjoey Road. Forested into estuarine wetlands in lower reaches - condition unknown	Stable	**Improve condition**
4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	Highly modified urban stream in upper and mid reaches (constructed concrete drain). Moderate geomorphic condition	Stable	**Improve condition where possible**

5 Estuary health risk

To understand the impact of land use on Narrabeen Lagoon Dee Why Lagoon, Curl Curl Lagoon and Manly Lagoon, EES developed an Estuary Health Risk map following the methods outlined in Dela-Cruz et al., 2019. The map identifies which sub-catchment pose the greatest risks of impacts on the health of estuaries to inform strategic priorities for managing nutrient and sediment runoff so that estuary health is protected, maintained and/or improved.

The data consists of likelihood scores, consequence scores and risk scores at a sub-catchment scale (see Table 10 and Table 11). Likelihood scores represent the extent and intensity of land-use pressure from each sub-catchment, with a score of 1 indicating the lowest likelihood of impact and a score of 4 the highest likelihood of impact on estuary health. Consequence scores represent the extent of impact on estuary health, with a score of 1 indicating the lowest chance of impact and a score of 4 indicating the highest chance of impact. Risk is a product of the likelihood and consequence scores (i.e. likelihood x consequence = risk), with a maximum score of 16 indicating the greatest risk and a score of 1 indicating the lowest risk.

The dataset is available for sub-catchments contributing to Narrabeen Lagoon, Dee Why Lagoon, Curl Curl Lagoon and Manly Lagoon (Figure 4).

Findings

Sub-catchments with the highest risk of impact on the lagoons can be interpreted as those with risk scores greater than 4 and those with the lowest risk of impact are those with risk scores ≤ 4. The risk scores show that the developed sub-catchments (i.e. existing urban areas) generally pose higher risk to the health of the estuaries (Narrabeen Lagoon, Dee Why Lagoon, Curl Curl Lagoon and Manly Lagoon) with risk scores generally > 4. This aligns with the findings for freshwater creeks (section 4 and Appendix A). For instance, the risk score for developed sub-catchments contributing to Manly Dam (or Curl Curl Creek) are > 4 whist the undeveloped sub-catchments contributing to Manly Dam are ≤ 4.

The risk scores also indicate areas which pose relatively higher risk to the health of the estuaries than others. For instance in the Narrabeen Lagoon catchment, the existing urban areas contributing to Middle Creek and South Creek pose a higher risk than existing urban areas contributing to Nareen Creek and Mullet Creek. Another observation is that the risk score for the sub-catchments covering the future Ingleside Growth Area has a maximum score of 16.

To integrate these results with the freshwater creek assessment in section 4 and Appendix A, the risk scores were categorised into two groups to correspond with a maintain or improve management objective:

- Maintain management objective – assigned to risk scores ≤ 4, and where nutrient and sediment loads to the lagoon should not exceed existing loads
- Improve management objective – assigned to risk scores > 4, and where nutrient and sediment loads to the lagoon should be reduced (i.e. less than existing loads).

The risk scores suggest that a suitable stormwater management strategy should aim to reduce nutrient and sediment loads from developed sub-catchments (i.e. existing urban areas). Priority can be placed on sub-catchments which pose a higher risk to the health of the estuaries.

Table 10. Likelihood scores define the chance that runoff from a sub-catchment will have an impact on the health of an estuary*

LIKELIHOOD	SCORE	DESCRIPTION
High	4	Health of estuaries has a high chance of impact from the sub-catchment because the per hectare surface flows, and TN, TP and TSS loads from a sub-catchment are large. Large inputs are those in the >75th percentile.
Moderate	3	Health of estuaries has a moderate chance of impact from the sub-catchment because the per hectare surface flows, and TN, TP and TSS loads from a sub-catchment are moderate. Moderate inputs are those in the >50th and ≤75th percentile.
Low	2	Health of estuaries has a low chance of impact from the sub-catchment because the per hectare surface flows, and TN, TP and TSS loads from a sub-catchment are relatively low. Low inputs are those in the ≥25th and <50th percentile.
Very Low	1	Health of estuaries has a very low chance of impact from the sub-catchment because the per hectare surface flows, and TN, TP and TSS loads from a sub-catchment are very low. Very low inputs are those in the <25th percentile.

*Adapted from Dela-Cruz et al., 2019

Table 11. Consequence scores define the magnitude of impact on the health of an estuary*

CONSEQUENCE	SCORE	DESCRIPTION
High	4	Impacts on the health of an estuary are high because the residence time, base exceedance, the extent of potential impact and the extent of high ecological value assets are in the >75th percentile.
Moderate	3	Impacts on the health of an estuary are moderate because the residence time, base exceedance, the extent of potential impact and the extent of high ecological value assets are in the >50th and ≤75th percentile.
Low	2	Impacts on the health of an estuary are low because the residence time, base exceedance, the extent of potential impact and the extent of high ecological value assets are in the >25th and ≤50th percentile.
Very Low	1	Impacts on the health of an estuary are very low because the residence time, base exceedance, the extent of potential impact and the extent of high ecological value assets are in the ≤25th percentile.

*Adapted from Dela-Cruz et al., 2019

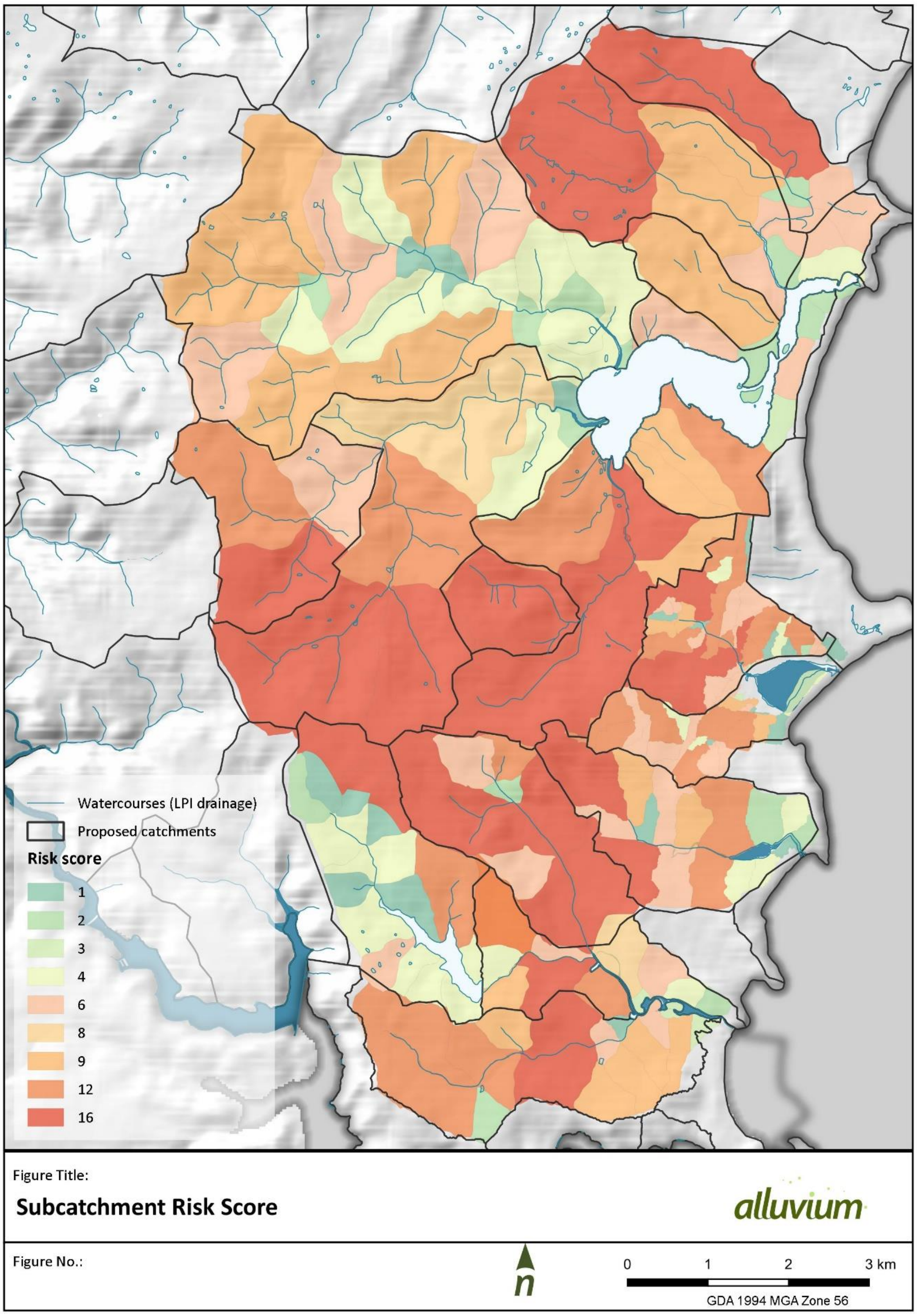


Figure 4. *Map ranking sub-catchment based on their relative risk of impact (risk score 1-16) on the ecological health of Narrabeen Lagoon, Dee Why Lagoon, Curl Curl Lagoon and Manly Lagoon (derived from Dela-Cruz, 2019).*

6 Stormwater Management Strategy and Targets

Based on the assessment of land use impact on freshwater creeks and lagoons in the Northern Beaches LGA, a Stormwater Management Strategy has been defined outlining stormwater management quantity and quality targets for each catchment (Figure 5, Table 12 and Table 13). The strategy addresses the risks of impacts to freshwater creeks and lagoons and is in line with the objectives and timeframe for community environmental values and uses as outlined in the LSPS. Targets have been identified for four catchment groups. Additional investigation is required to quantify the stormwater quantity and quality targets.

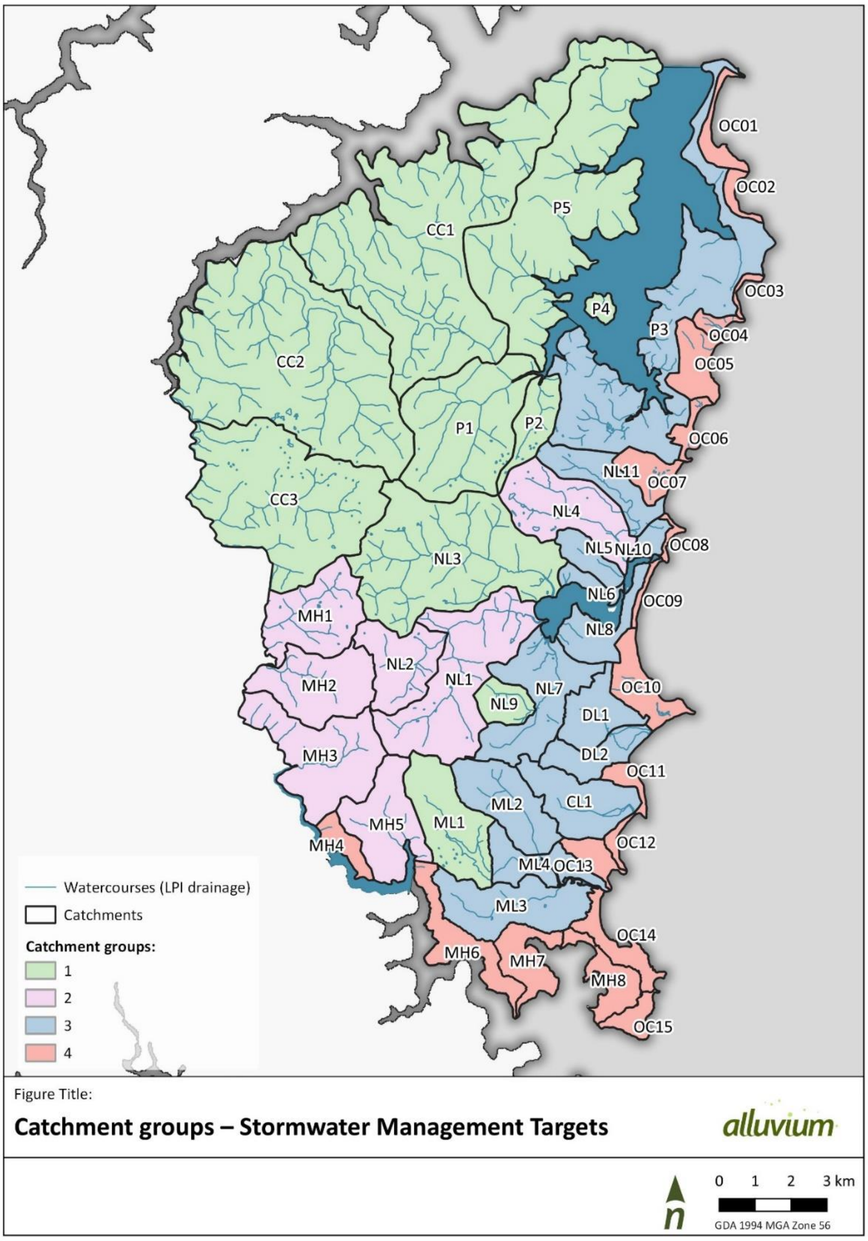


Figure 5. *Catchment groups in terms of stormwater management targets*

Table 12. Stormwater management strategy and targets

Group	Description	Catchments	Stormwater quantity target	Stormwater quality target
1	Creeks in National Park in catchments with very low existing imperviousness and low development pressure in the future OR creeks with high ecological value but slightly disturbed in catchments with existing imperviousness approximately 10% or lower with development pressure in the next 20 years likely to push imperviousness closer to or above 10%.	Smiths Creek, Coal and Candle Creek, and Salvation creek. McCarrs Creek, Cicada Glen Creek, Deep Creek, Wheelers Creek, Kierans Creek, Curl Curl Creek	Avoid impact to existing hydrological regime (e.g. to meet environmental flow targets or to avoid additional erosion)	Avoid increase in amount of stormwater pollution entering creek (compared to existing loads)
2	Creeks that are at the point where any increase in flows or pollutants from the catchment could result in significant deterioration OR creeks with highly disturbed reaches in urban and rural areas in catchments with existing imperviousness of 10-25% where an increase in flows or pollutants can further degrade downstream reaches and values.	Bare Creek, Frenchs Creek, Carroll Creek, Bates Creek, Middle Creek, Oxford Creek, Mullet Creek	Avoid impact to existing hydrological regime (e.g. to meet environmental flow targets or to avoid additional erosion)	**Existing urban areas**: Reduce amount of stormwater pollution entering creek (compared to existing loads) **Areas proposed for greenfield development**: Avoid increase in amount of stormwater pollution entering creek (compared to existing loads)
3	Creeks that are highly disturbed and in need of rehabilitation in catchments with existing imperviousness > 30 %.	Careel Creek, Cahill Creek, Brookvale Creek, Narrabeen Creek, Burnt Bridge Creek, Manly Creek, Greendale Creek, Dee Why Creek, and other southern catchment (unnamed) contributing to Dee Why Lagoon, Nareen Creek, South Creek, catchments NL6, NL8 and NL10.	Avoid or minimise impact to existing hydrological regime (e.g. to avoid additional erosion)	Reduce amount of stormwater pollution entering creek (compared to existing loads)
4	Catchments discharging directly into well flushed permanently open estuary or to the ocean	Catchments MH4, MH6, MH7 and MH8 and catchments OC1 to OC15		Reduce amount of stormwater pollution entering estuary or ocean (compared to existing loads focusing on litter and coarse sediments)

Table 13. Detailed summary

ID	Name	Ex. Imp (%)	↑ Imp (%)	Group	Draft waterway objectives				Stormwater management targets	
					Hydrology	Water quality	Riparian or aquatic Vegetation	Physical form	Quantity	Quality
CC1	Coal and Candle Creek	1%	<2%	1	Maintain	Maintain	Maintain	Maintain	Avoid impact to existing hydrological regime (e.g. to meet environmental flow targets or to avoid additional erosion)	Avoid increase in amount of stormwater pollution entering creek (compared to existing loads)
CC2	Smiths Creek	1%	<2%	1	Maintain	Maintain	Maintain	Maintain		
P4	Unnamed	18%	<2%	1	Maintain	Maintain	Maintain	Maintain		
P5	Salvation Creek	1%	<2%	1	Maintain	Maintain	Maintain	Maintain		
CC3	Kierans Creek	8%	<2%	1	Maintain	Improve (* note multiple sources)	Improve degraded reaches	Improve U/S where possible, otherwise maintain		
ML1	Curl Curl Creek	12%	<2%	1	Maintain	Improve (multiple sources)	Maintain	Maintain		
NL3	Deep Creek	3%	7%	1	Maintain	Improve in degraded reaches otherwise maintain	Maintain	Maintain		
NL9	Wheelers Creek	6%	>10 %	1	Maintain		Maintain	Maintain Improve D/S		
P1	McCarrs Creek	4%	>10 %	1	Maintain		Maintain	Maintain		
P2	Cicada Glen Creek	7%	>10 %	1	Maintain		Maintain	Maintain		

ID	Name	Ex. Imp (%)	↑ Imp (%)	Group	Draft waterway objectives				Stormwater management targets	
					Hydrology	Water quality	Riparian or aquatic Vegetation	Physical form	Quantity	Quality
MH1	Bare Creek	7%	>10 %	2	Maintain	Improve	Improve urban reaches	Improve urban reaches	Avoid impact to existing hydrological regime (e.g. to meet environmental flow targets or to avoid additional erosion)	**Existing urban areas**: Reduce amount of stormwater pollution entering creek (compared to existing loads) **Areas proposed for greenfield development**: Avoid increase in amount of stormwater pollution entering creek (compared to existing loads)
MH2	Frenchs Creek	24%	7%	2	Maintain	Improve	Improve urban reaches	Improve urban reaches		
MH3	Carroll Creek	24%	3%	2	Maintain	Improve	Improve urban reaches	Improve urban reaches		
MH5	Bates Creek	21%	3%	2	Maintain	Improve	Improve	Improve		
NL1	Middle Creek	17%	>10 %	2	Maintain	Improve	Improve	Improve		
NL2	Oxford Creek	14%	>10 %	2	Maintain	Improve	Maintain	Maintain		
NL4	Mullet Creek	20%	>10 %	2	Improve	Improve	Improve	Improve		

ID	Name	Ex. Imp (%)	↑ Imp (%)	Group	Draft waterway objectives				Stormwater management targets	
					Hydrology	Water quality	Riparian or aquatic Vegetation	Physical form	Quantity	Quality
CL1	Greendale Creek	42%	2%	3		Improve	Improve	Improve	Avoid or minimise impact to existing hydrological regime (e.g. to avoid additional erosion)	Reduce amount of stormwater pollution entering creek (compared to existing loads)
DL1	Dee Why Creek	43%	2%	3		Improve	Improve	Improve		
DL2	Unnamed	35%	4%	3		Improve	Improve	Improve		
ML2	Brookvale Creek	40%	6%			Improve	Maintain U/S Improve D/S	Maintain U/S Improve D/S		
ML3	Burnt Bridge Creek	44%	2%	3		Improve	Improve	Improve		
ML4	Manly Creek	38%	4%	3		Improve	Improve	Improve		
NL10	Unnamed	29%	<2%	3		Improve	Improve	Improve		
NL5	Nareen Creek	38%	<2%	3		Improve	Improve	Improve		
NL6	Unnamed	33%	<2%	3		Improve	Improve	Improve		
NL7	South Creek	32%	9%	3		Improve	Improve	Improve		
NL8	Unnamed	39%	<2%	3		Improve	Improve	Improve		
P3	Careel and Cahill creek	28%	4%	3		Improve	Improve	Improve		
NL11	Narrabeen Creek	31%	>10 %	3		Improve	Improve	Improve		

ID	Name	Ex. Imp (%)	↑ Imp (%)	Group	Draft waterway objectives				Stormwater management targets	
					Hydrology	Water quality	Riparian or aquatic Vegetation	Physical form	Quantity	Quality
MH4	Unnamed	26%	<2%	4		Maintain or improve	Maintain or improve	Maintain or improve		Reduce amount of stormwater pollution entering estuary or ocean (compared to existing loads focusing on litter and coarse sediments)
MH6	Unnamed	34%	<2%	4		Maintain or improve	Maintain or improve	Maintain or improve		
MH7	Multiple Beaches	34%	<2%	4		Maintain or improve	Maintain or improve	Maintain or improve		
MH8	Multiple Beaches	24%	<2%	4		Maintain or improve	Maintain or improve	Maintain or improve		
OC01	North Palm Beach	25%	<2%	4		Maintain or improve	Maintain or improve	Maintain or improve		
OC02	Whale Beach	27%	<2%	4		Maintain or improve	Maintain or improve	Maintain or improve		
OC03	Avalon Beach	19%	<2%	4		Maintain or improve	Maintain or improve	Maintain or improve		
OC04	Bilgola Beach	27%	<2%	4		Maintain or improve	Maintain or improve	Maintain or improve		
OC05	Newport Beach	38%	2%	4		Maintain or improve	Maintain or improve	Maintain or improve		
OC06	Bungan Beach	26%	<2%	4		Maintain or improve	Maintain or improve	Maintain or improve		
OC07	Mona Vale Beach	29%	4%	4		Maintain or improve	Maintain or improve	Maintain or improve		
OC08	Turimetta Beach	4%	<2%	4		Maintain or improve	Maintain or improve	Maintain or improve		
OC09	Narrabeen Beach	10%	3%	4		Maintain or improve	Maintain or improve	Maintain or improve		
OC10	Collaroy Beach	31%	<2%	4		Maintain or improve	Maintain or improve	Maintain or improve		
OC11	Unnamed	42%	2%	4		Maintain or improve	Maintain or improve	Maintain or improve		

ID	Name	Ex. Imp (%)	↑ Imp (%)	Group	Draft waterway objectives				Stormwater management targets	
					Hydrology	Water quality	Riparian or aquatic Vegetation	Physical form	Quantity	Quality
OC12	Curl Curl Beach	29%	<2%	4		Maintain or improve	Maintain or improve	Maintain or improve		
OC13	Freshwater Beach	45%	5%	4		Maintain or improve	Maintain or improve	Maintain or improve		
OC14	Multiple Beaches	32%	<2%	4		Maintain or improve	Maintain or improve	Maintain or improve		
OC15	Unnamed	2%	<2%	4		Maintain or improve	Maintain or improve	Maintain or improve		

7 Summary and next steps

The objective of this project was to develop a Stormwater Management Strategy and qualitative targets for stormwater quality and quantity for each catchment in the LGA in order to inform the Northern Beaches Council's Local Environmental Plans (LEP). The Risk-Based Framework was adopted as the approach at it provides a clear line of sight between Stormwater Management Strategy and targets, waterway objectives and the community environmental values and uses of the waterways.

Draft waterway objectives were established for this project to assist in the development of the Stormwater Management Strategy and targets. Waterway objectives were established for four waterway conditions: hydrology, water quality, riparian vegetation and physical form. It is important to note that the waterway objectives for this study are in *draft form* as they have been established using limited recent local data and limited consultation. For a significant proportion of catchments data has been limited to remotely sensed data (not ground-truthed).

We undertook an assessment of land use impact on freshwater creeks and lagoons in the Northern Beaches LGA. The assessment was based on previous studies – in particular the Creek Management Study Warringah Council (MWH Australia Pty Ltd, 2004) and the Creek Monitoring, Evaluating and Reporting Project Spring 2015 and Autumn 2016 (NSW OEH, not dated) – as well as the Estuary Health Risk dataset by DPIE-EES (Dela-Cruz et al., 2019). Based on our understanding of land use impact on the waterways and the draft waterway objectives, a Stormwater Management Strategy was defined outlining stormwater management quantity and quality targets for each catchment with Northern Beaches LGA.

Based on the findings of this investigation, we recommend the following next steps for Northern Beaches Council:

- Develop waterway flow objectives to inform stormwater quantity (flow) targets that achieve the community environmental values and uses of the waterways.
- Improve knowledge including data collection on waterway:
    - Hydrology (e.g. flow studies to confirm waterway flow objectives)
    - Water quality including macroinvertebrates diversity
    - Physical form (e.g. field surveys to determine extent of erosion and to determine reaches where there is an erosion risk).
- Undertake additional consultation with Northern Beaches Council stakeholders and field verification to confirm the draft waterway objectives in this report. The initial focus can be on catchments with higher existing and anticipated future pressures.
- Complete the remaining steps (steps 4 and 5) of the Risk-Based Framework to assess effectiveness and cost-benefit analysis (feasibility) of stormwater management approaches/responses to achieve the proposed stormwater management strategy in this report
- Quantify stormwater management quality and quality targets for each catchment. These targets can form requirements to be met by developers.
- Begin a program of Council-funded stormwater quality improvement works in existing urban areas to improve condition of urban waterway reaches which also serves to protect downstream reaches and other receiving environments.
- Undertake additional consultation with Northern Beaches Council stakeholders and external stakeholders such as the community to prioritise catchments for Council-funded works for improving stormwater condition from existing urban areas.

8 References

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Dela-Cruz J, Kuo W, Floyd J, Littleboy M, Young J, Swanson R, Cowood A, Dawson G (2019). NSW Estuary Health Risk Dataset – A first pass risk assessment to assist with the prioritisation of catchment management actions. Department of Planning, Industry and Environment, Sydney.

Hyder Consulting, 2008. 'Mullet Creek Rehabilitation Plan'. Prepared for Pittwater Council

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Pietsch, T. 2018, *'Middle Creek Sediment Study – Middle Creek Floodplain sediment characterisation'.* Griffith University and NSW Soil Conservation.

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Northern Beaches Council Creek Monitoring, Evaluating and Reporting Project Spring 2015 and Autumn 2016 (NSW OEH, undated).

Mullet Creek Water Quality Monitoring Program and Design, Bio-analysis, 2010

Appendix A
Remaining catchment summaries

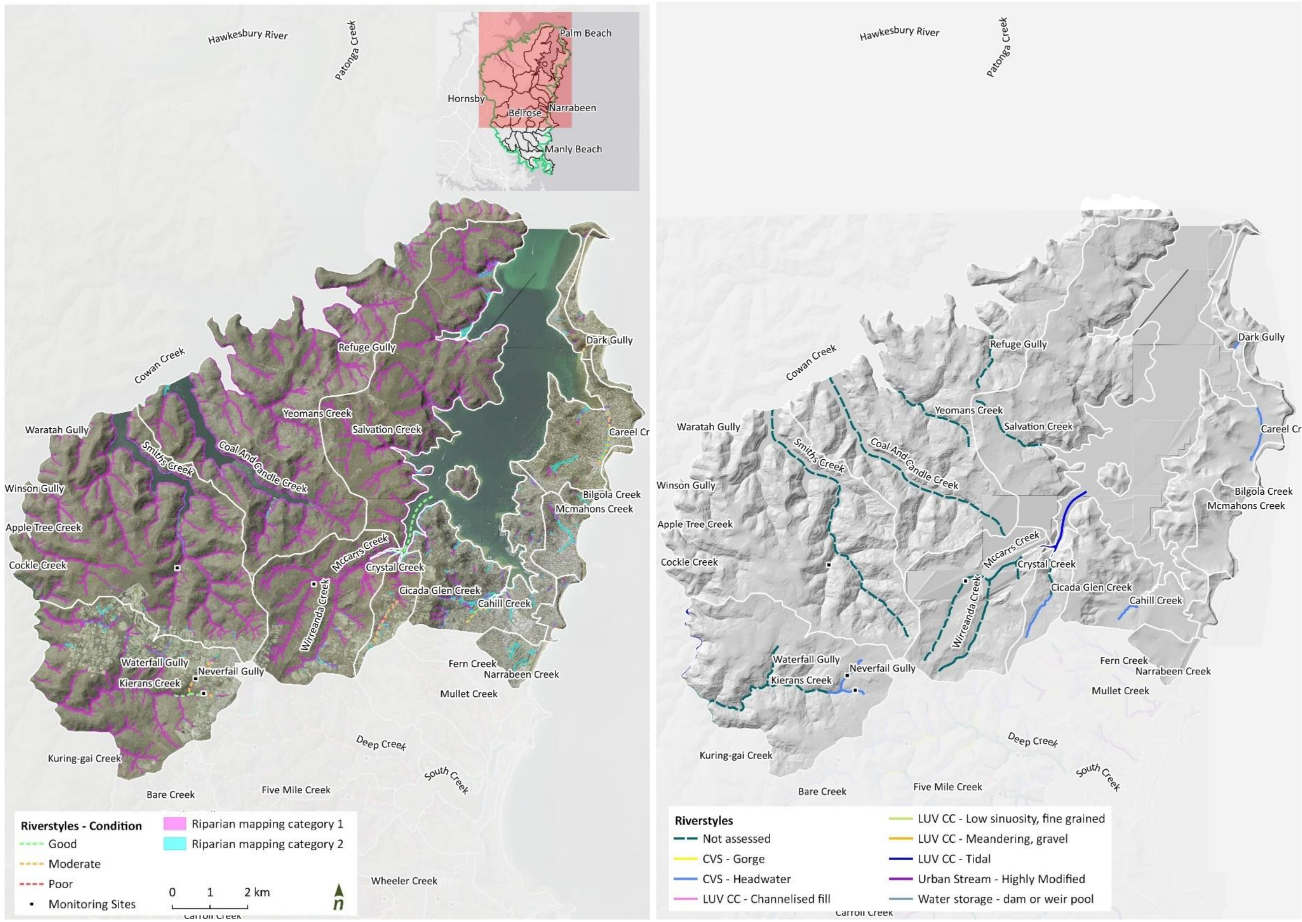

Figure 6. *Zone 1 waterway geomorphic type and condition*

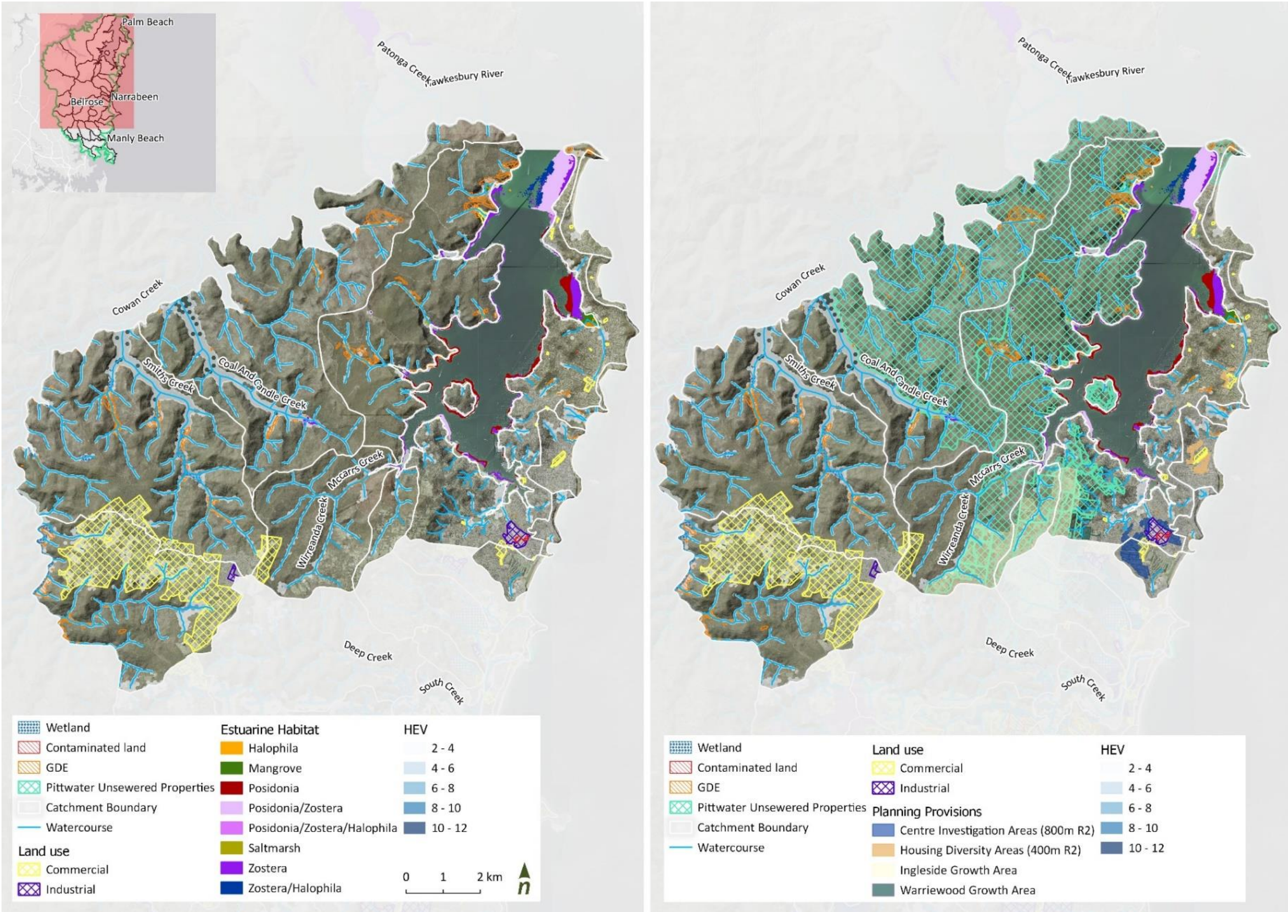

Figure 7. *Zone 1 Land use, High Ecological Values, and Planning Provisions*

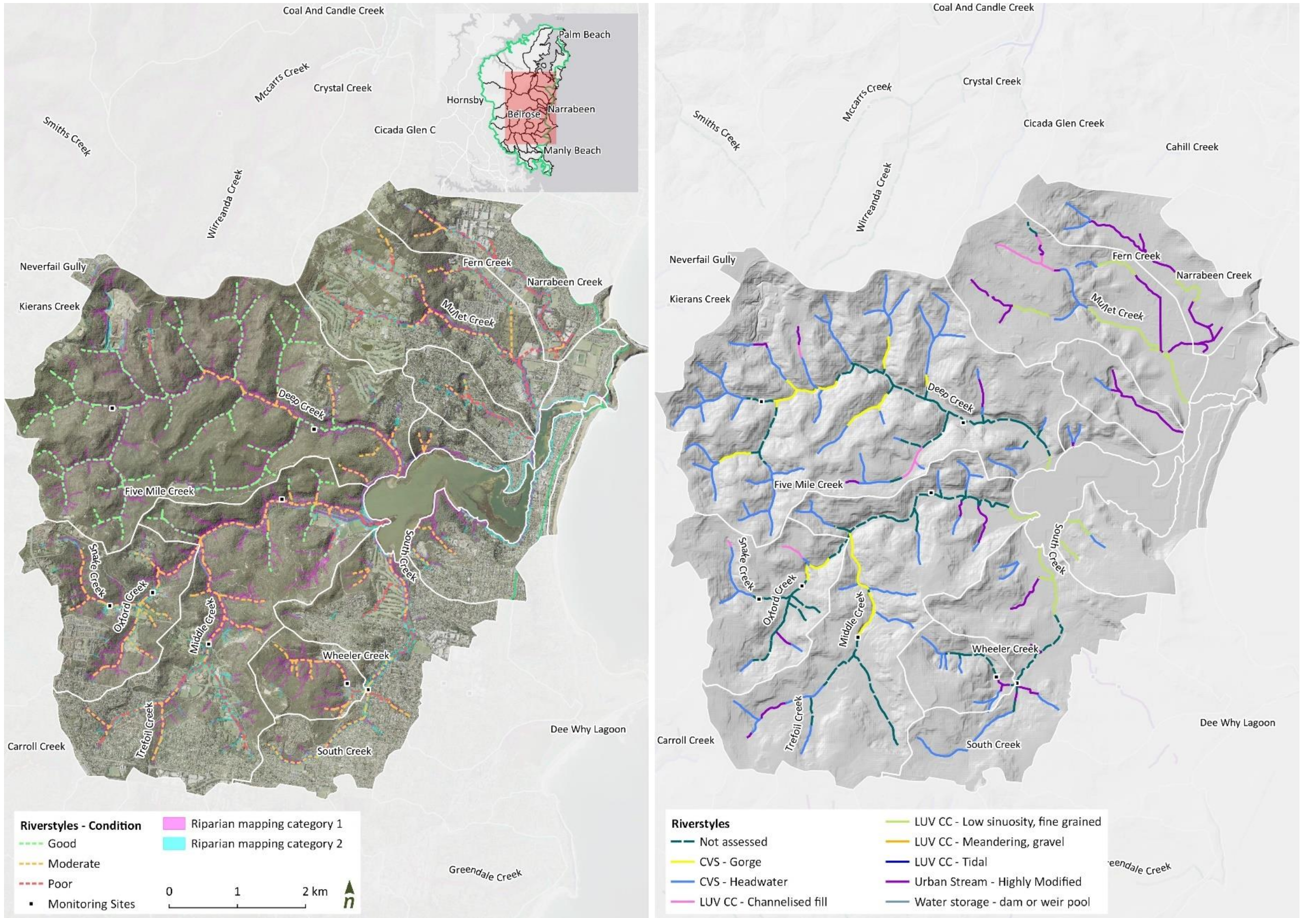

Figure 8. *Zone 2 waterway geomorphic type and condition*

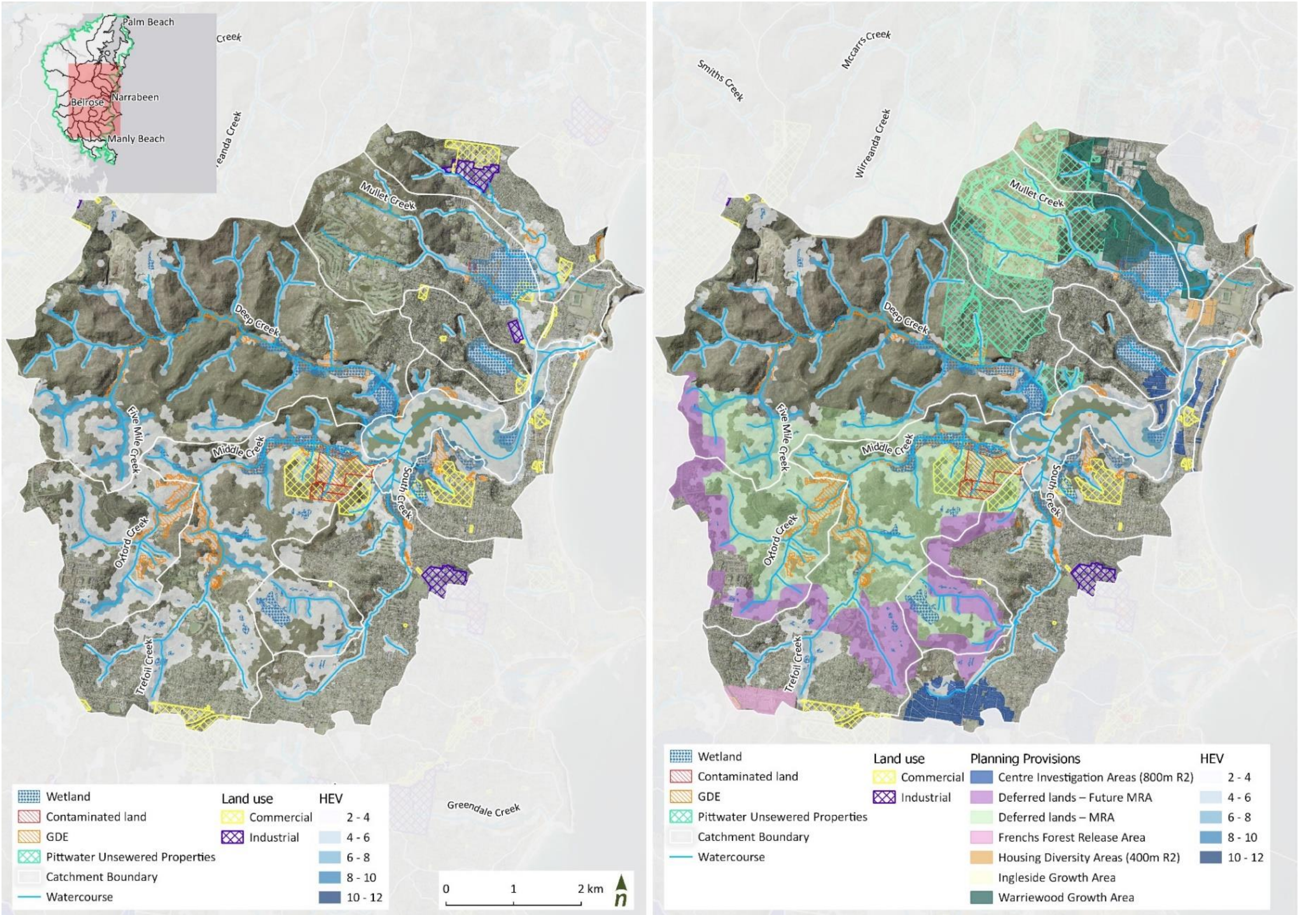

Figure 9. *Zone 2 Land use, High Ecological Values, and Planning Provisions*

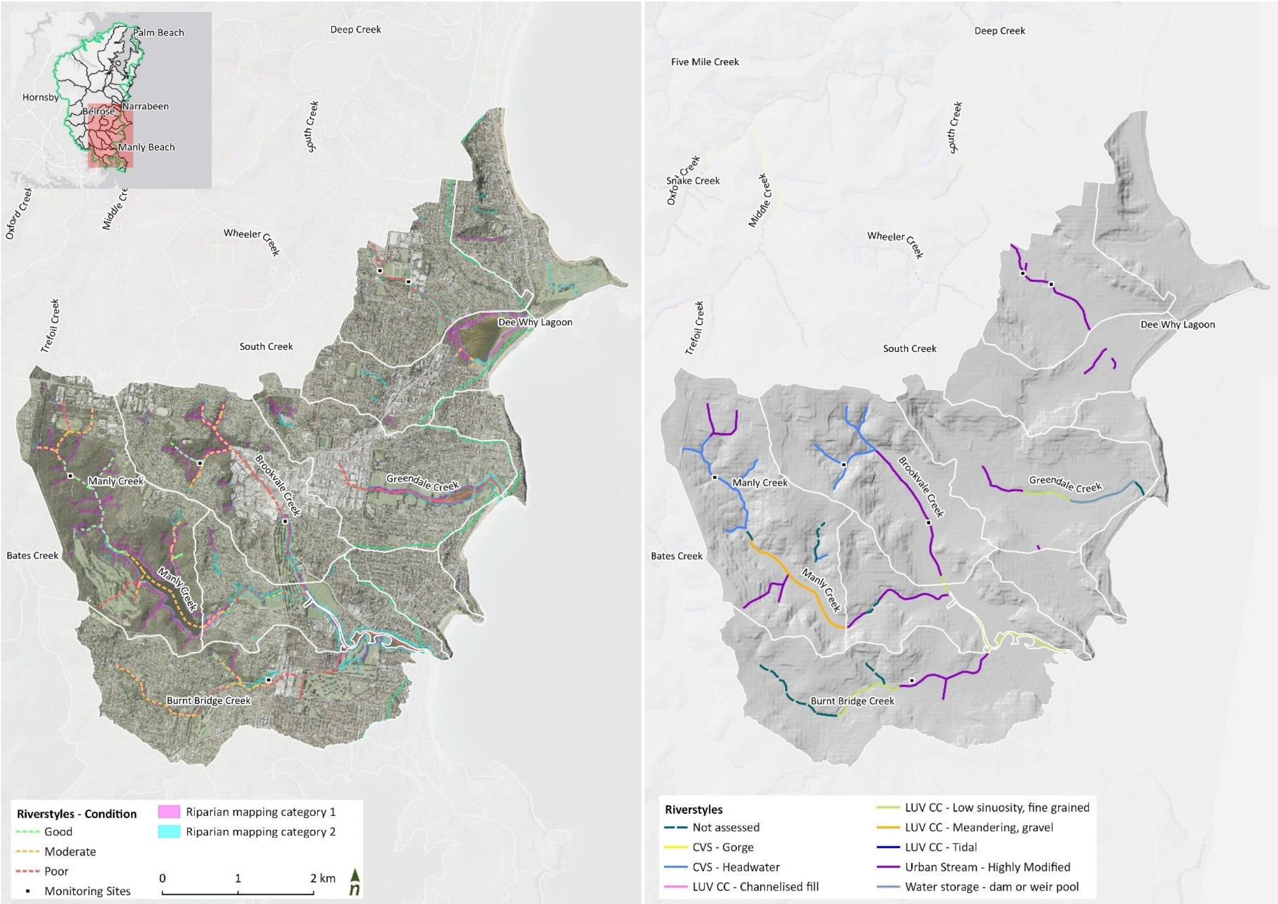

Figure 10. *Zone 3 waterway geomorphic type and condition*

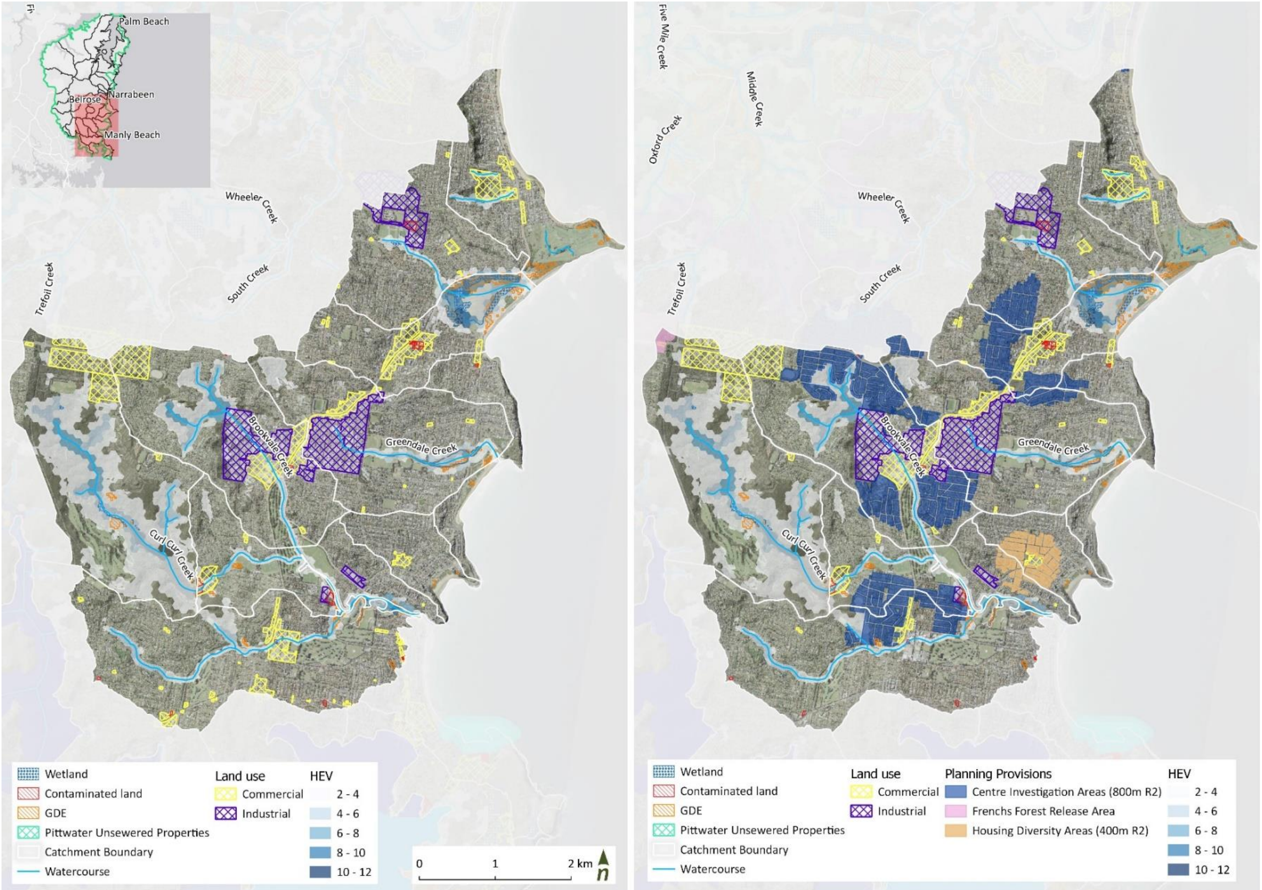

Figure 11. *Zone 3 Land use, High Ecological Values, and Planning Provisions*

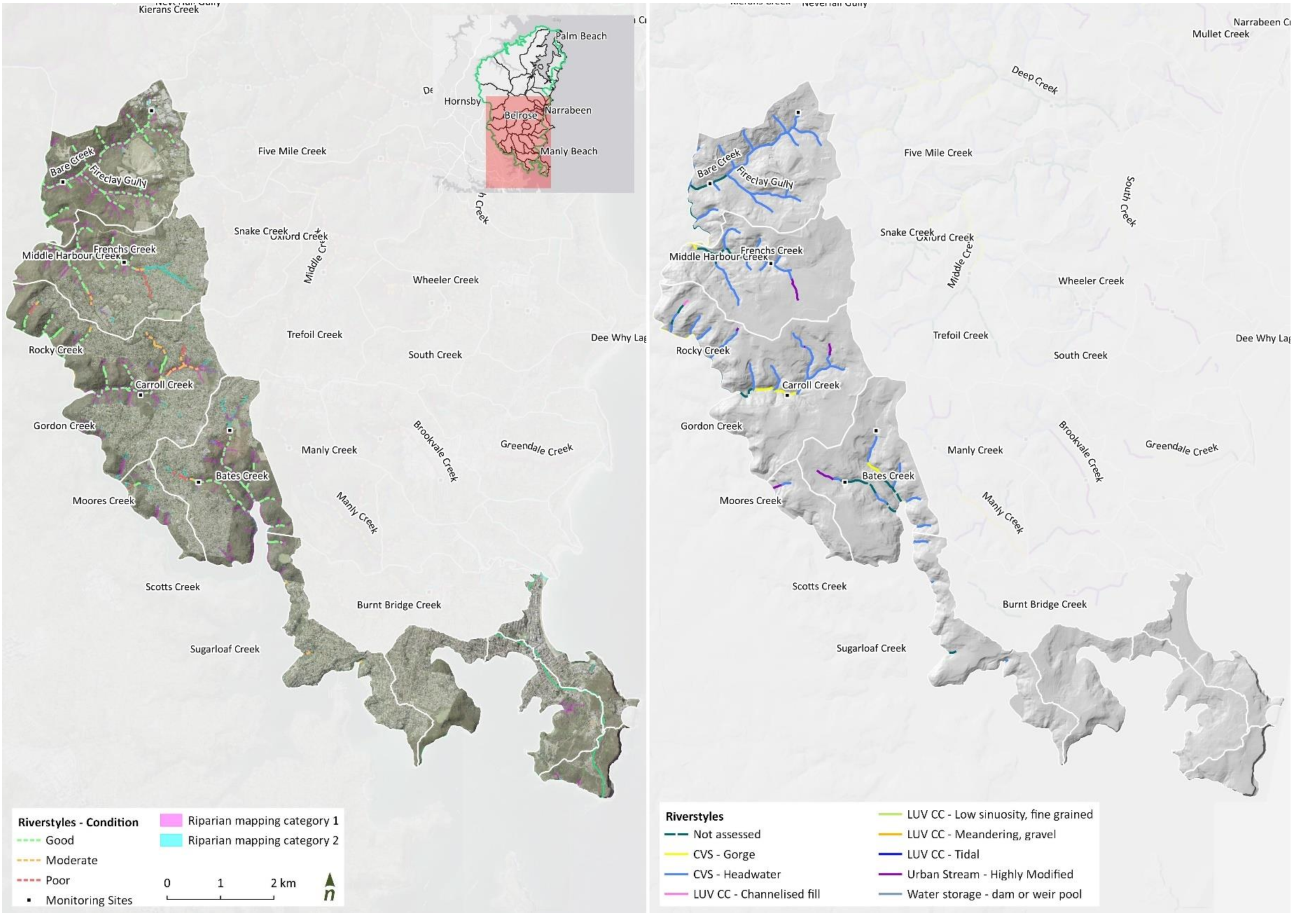

Figure 12. *Zone 4 waterway geomorphic type and condition*

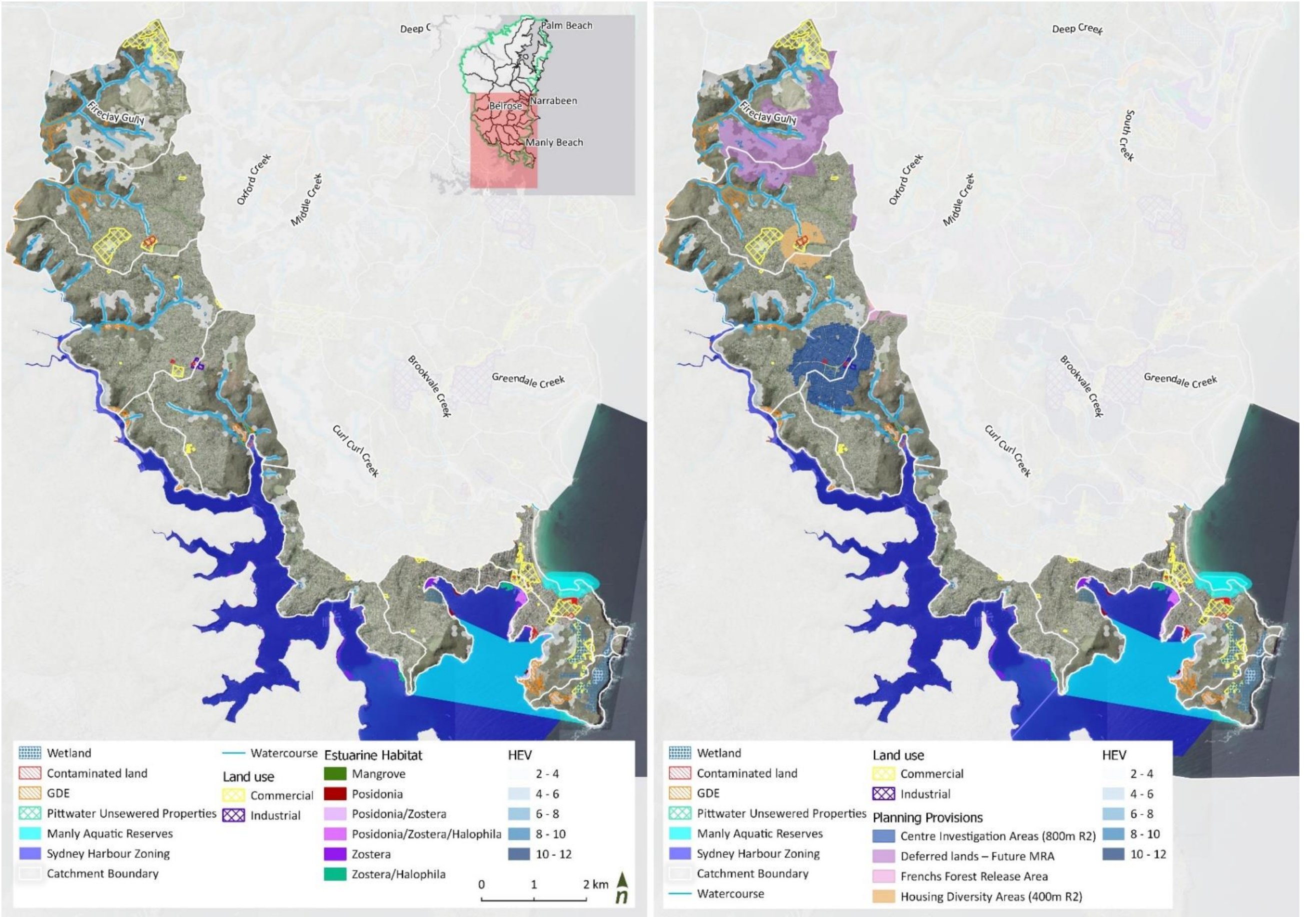

Figure 13. *Zone 4 Land use, High Ecological Values, and Planning Provisions*

9 Catchment summaries (Pittwater estuary)

9.1 McCarrs Creek

McCarrs Creek	Current fraction imperviousness: 4 % (potential increase >10%)			References:
Objectives and timeframe for community environmental values and uses	**Freshwater creeks:** *Maintain or Improve* existing condition for aquatic ecosystems, visual amenity and secondary contact recreation. *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems. **Estuary (Careel Bay)**: *Maintain or Improve* existing condition for all environmental values and uses			Local Strategic Planning Statement (LSPS)
Existing values	No information available			
Existing catchment pressures and stressors	• Land clearing and development in upper catchments • Runoff from development in upper catchments. • Monitoring of water quality shows pH rising in McCarrs Creek likely related to urbanisation in top of catchment (runoff over concrete). • Small amount of sewerage leakage from upper catchments/unsewered areas. • Pets and dog exercising areas. • Although not specific to McCarrs Creek, similar urbanisation pattern in upper catchments of Cowan Creek resulted in exotic species dominating the understorey of riparian zones.			Water Quality McCarrs Creek Cowan Lane Cove 2003
Conditions	**Key indicators**	**Existing condition**	**Trajectory**	**Draft waterway objective**
1. Hydrology	Imperviousness	Expected to be slightly modified	Potential to decline given imperviousness can exceed 10% in the next 20 years	Maintain condition
2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	TN, NOx and TP expected to be below trigger value for aquatic ecosystems Macroinvertebrates diversity likely to be similar	Potential to decline given imperviousness can exceed 10% in the next 20 years	Improve condition in degraded reaches otherwise maintain

		to that expected to be present		
3.Riparian vegetation	In-stream and stream side vegetation extent and quality	- Intact native vegetation, all within Ku-Ring-gai National Park. Good condition. Category 1 (BMT, 2021)	Potential to decline given imperviousness can exceed 10% in the next 20 years	Maintain condition
4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	- Predominately shallow channel, bedrock controlled with narrow continuous floodplain (NSW OEH, 2016). Good geomorphic condition	Potential to decline given imperviousness can exceed 10% in the next 20 years	Maintain condition

9.2 Circada Glen Creek

Circada Glen Creek	Current fraction imperviousness: 7% (potential to increase by >10%)			References
Objectives and timeframe for community environmental values and uses	**Freshwater creeks:** *Maintain or Improve* existing condition for aquatic ecosystems, visual amenity and secondary contact recreation. *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems. **Estuary (Careel Bay)**: *Maintain or Improve* existing condition for all environmental values and uses			Local Strategic Planning Statement (LSPS)
Existing values	The lower part of Cicada Glen Creek runs through National Park and has excellent vegetation condition.			Northern Beaches Council input
Existing catchment pressures and stressors	• Land clearing and development in upper catchments • Light industry eg. nurseries, landscaping supplies in upper catchment • EC values in Cicada Glen Greek similar to urbanised creeks • 50th and 90th percentile nutrient concentrations for Circada Glen Greek exceeded guidelines. • Small disturbances to sandstone catchments can have large impact on water quality			Water Quality McCarrs Creek Cowan Lane Cove 2003 Northern Beaches Council input
Conditions	**Indicators**	**Existing condition**	**Trajectory**	**Draft waterway objective**
1. Hydrology	Imperviousness	Expected to be slightly modified	Potential to decline given imperviousness can exceed 10% in the next 20 years	Maintain condition
2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	TN, NOx and TP expected at or just above trigger value for aquatic ecosystems Macroinvertebrates diversity likely to be similar to that expected to be present	Potential to decline given imperviousness can exceed 10% in the next 20 years	Improve condition in degraded reaches otherwise maintain
3.Riparian vegetation	In-stream and stream side vegetation extent and quality	Predominately Category 1 vegetation with isolated discontinuities	Increase weed disturbance possible	Maintain condition

4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	Partly confined headwater stream in upper and mid reaches flowing into confined gorge in lower reaches. Bed/bank erosion unclear. Moderate geomorphic condition	Possible increase in erosion potential outside of confined areas	Maintain condition

9.3 Cahill Creek

Cahill Creek	Current fraction imperviousness: 28% (potential increase <3%)	References:
Objectives and timeframe for community environmental values and uses	**Freshwater creeks:** *Maintain or Improve* existing condition for visual amenity; *Improve* condition for aquatic ecosystems and secondary contact recreation (5-10 year timeframe); *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems. **Estuary (Careel Bay)**: *Maintain or Improve* existing condition for all environmental values and uses	Local Strategic Planning Statement (LSPS)
Existing values	No information	
Existing catchment pressures and stressors	• Lower reaches of all creeks in both the Careel and Winnererremy catchments exhibited exposed sections of embankments devoid of vegetation, slumping and vertically cut banks. However, little evidence of significant, current sources of sediments in streams and creeks. • Large organic matter load • Sedimentation of the poorly flushed embayments of Careel and Winnererremy Bays has been due to increased development in the area since the 1920's and insufficient tidal motions to move deposited sediment out of the bays, thus forming large alluvial deltas • TN and TP values within Winnererremy Bay catchment exceeded ANZECC guideline values. Sites, located within the golf course and industrial area showed higher TP concentrations. • High Enterococci values across sampling sites within Winnererremy Bay points to leaky sewer pipes, sewer pump station overflows and/or faecal matter deposition from domestic and non-domestic pets/ animals. • Golf course impacting creek in lower reach	FINAL REPORT Urban Sedimentation and Pol_ttwater Estuary - Environmental Investigation Report - AWC Consulting Sept 2012

Conditions	Indicators	Existing condition	Trajectory	Draft waterway objective
1. Hydrology	Imperviousness	Expected to be moderately to highly modified	Stable given small increase in imperviousness	

2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	TP and TN expected to be above trigger value for aquatic ecosystems. Macroinvertebrates diversity likely to be less that expected to be present Microbial level expected to be above trigger values for secondary recreation.	Potential to decline further given increase in imperviousness	Improve condition
3.Riparian vegetation	Riparian vegetation extent and quality	Category 2 vegetation classification (BMT, 2021) Highly disturbed. Large discontinuities and very narrow width highly constrained by urban development in the upper reaches and limited through lower reaches (golf course)	Decline possible	Improve condition
4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	Highly modified urban stream in partly confined to unconfined setting. Moderate geomorphic condition	Decline possible	Improve condition where possible

10 Catchment Summaries (Cowan Creek)

10.1 Coal, Candle and Smith Creeks

Coal and Candle Creek, and Smith Creek have Intact native vegetation, all within Ku-Ring-gai National Park. The creeks are in good condition with category 1 riparian vegetation (BMT, 2021). Waterways are in confined headwater and gorge setting and in good geomorphic condition.

10.2 Kierans Creek

	Current fraction imperviousness: 8 % (potential increase <1%)			Dominant land uses:
Existing values	**National park reaches** • Native species diversity, habitat value good connectivity and retention of natural vegetation • High landscape/visual value in National Park • Recreational boating in Cowan Creek. • Fishing and oyster industries in Lower Hawkesbury			**References:** Cowan Creek Catchment Stormwater Management Plan June 1999
Existing catchment pressures and stressors	• Rural and urban developed areas and associated runoff • On-site wastewater effluent • Runoff from horse paddocks, landscape suppliers and nurseries • Stormwater fostering weed growth and infestation along riparian zones (nutrients and suspended solids Keirans creek is an anomaly with upstream section being weed infested and cleared in upper reaches with poor water quality, erosion and rubbish but nevertheless good fauna diversity (likely because of natural downstream conditions). This is similar as Neverfail Creek that has high nutrient levels but resilient fauna aided by fairly good in-channel condition and available habitat.			**References:** Final Report - Creek Monitoring Evaluating and Reporting (MER) Project 20152016
Previously documented catchment objectives				**References:**
Conditions	**Indicators**	**Existing condition**	**Trajectory**	**Draft waterway objective**
1. Hydrology	Imperviousness	Expected to be slightly modified	Stable given small increase in imperviousness	Maintain condition

2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	TP, TN and NOx are well above trigger value for aquatic ecosystems (pollution likely from multiple sources) Macroinvertebrates diversity similar to that expected to be present	Stable given small increase in imperviousness	Improve condition (noting multiple sources of pollution)
3.Riparian vegetation	Riparian vegetation extent and quality	- Upper reach has poor riparian vegetation including cleared areas as well as weed infestations including willows	Stable given small increase in imperviousness	Improve degraded reaches (weeds) along to a level that minimises the risk to natural habitats
4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	- Upper reach (250m) - highly modified partly confined urban stream in moderate geomorphic condition. Where banks aren't armoured by bedrock they are undercut. - Mid and lower reaches are bedrock confined with a series of waterfalls, riffles, pools and runs in good geomorphic condition	Stable given small increase in imperviousness	Maintain condition downstream Improve geomorphic condition where possible upstream (Extent of channel erosion issues unknown)

11 Catchment Summaries (Middle Harbour)

11.1 Bare Creek

Bare Creek	Current fraction imperviousness: 7 % (Potential to increase by >10%)			References:
Objectives and timeframe for community environmental values and uses	*Maintain or Improve* existing condition for aquatic ecosystems, visual amenity and secondary contact recreation; *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems.			Local Strategic Planning Statement (LSPS)
Existing values	In national park, creeks have high scenic value, swimming holes and used for fishing Large area of HEV with generally low score			Middle Harbour Catchment Stormwater Management Plan July 1999
Existing catchment pressures and stressors	• Most impact in section of creeks in the upper developed areas (urbanisation concentrated on flatter lands). • Reaches in Garigal National Park in good condition, However, weed infestation and accelerated sedimentation arises from upper developed areas. Condition of riparian reflect impact of development, wetting regime (wetter for longer promotes weeds), nutrient sources and disruption to natural channel. • One tributary in upper catchment next to commercial and industrial land uses in poor condition where nutrient pollution has been quite high on occasions. Small reach, lack of habitat and flow explain poor faunal diversity. • Land development, sediment input, nutrient input, freshwater input are catchment pressures to Estuary health.			Middle Harbour Catchment Stormwater Management Plan July 1999 Creek MER Assessment Report Card 2014-2015 Final Report - Creek Monitoring Evaluating and Reporting (MER) Project 20152016 Estuary Health Assessment Clontarf Bantry Bay Final Report 2017
Conditions	**Indicators**	**Existing condition**	**Trajectory**	**Draft waterway objective**
1. Hydrology	Imperviousness	Expected to be slightly modified	Potential to decline given imperviousness can exceed 10% in the next 20 years	Maintain condition
2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	TP and NOx at or just above trigger value for aquatic ecosystems	Potential to decline given imperviousness can exceed 10% in the next 20 years	Improve condition (particularly downstream of urban areas)

		TN above trigger value for aquatic ecosystems Macroinvertebrates diversity similar to that expected to be present		
3.Riparian vegetation	In-stream and stream side vegetation extent and quality	Classified as category 1 (BMT, 2021) however weed disturbance noted in upper reaches (NSW OEH, 2016)	Ongoing weed disturbance likely	Improve degraded reaches (weeds) along to a level that minimises the risk to natural habitats
4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	Confined headwater stream in good geomorphic condition	Stable	Improve condition along degraded reaches

11.2 Frenchs Creek

Frenchs Creek	**Current fraction imperviousness: 24 % (potential increase 7%)**	**References**
Objectives and timeframe for community environmental values and uses	*Maintain or Improve* existing condition for aquatic ecosystems, visual amenity and secondary contact recreation; *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems.	Local Strategic Planning Statement (LSPS)
Existing values	High native species richness immediately upstream of National Park with reasonable connectivity and habitat quality Ecological value high both within and outside National Park HEV score higher along main creek line. GDE existing along main creek line.	Middle Harbour Catchment Stormwater Management Plan July 1999 Final Report - Creek Monitoring Evaluating and Reporting (MER) Project 20152016
Existing catchment pressures and stressors	• Polluted urban runoff • Degradation of upstream reaches threatening high values downstream • Weeds encroachment in National park resulting from uncontrolled invasion and deliberate cultivation of exotics in upstream urban reaches. • Erosion along drainage lines as a result of a changed hydrologic regime although erosion process is likely to be completed now. • Sewage entering Frenchs Creek with discoloration of water for days after sewer overflows • Water quality: Poor EC. High concentration of nitrogen, phosphorus and suspended solids). • Land development, sediment input, nutrient input, freshwater input are catchment pressures to Estuary health.	Warringah Creek Management Study 2004 Estuary Health Assessment Clontarf Bantry Bay Final Report 2017

Conditions	**Key indicators**	**Existing condition**	**Trajectory**	**Draft waterway objective**
1. Hydrology	Imperviousness	Expected to be moderately modified	Potential to decline given new land development in Deferred lands – Future MRA	Maintain condition
2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	NOx above trigger value for aquatic ecosystems. TP and TN at or just above trigger value for aquatic ecosystems.	Potential to decline given imperviousness can exceed 30% in the next 20 years.	Improve condition (particularly downstream of urban areas)

		Macroinvertebrates diversity is less that expected to be present		
3.Riparian vegetation	Riparian vegetation extent and quality	Predominately good riparian vegetation throughout however weeds present in upper reaches including 'Giant Reed'	Ongoing weed disturbance likely	Improve degraded reaches (weeds) along to a level that minimises the risk to natural habitats
4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	- Upper reach (500 m) highly modified urban stream - poor geomorphic condition - Mid to lower reaches confined by bedrock, pools, riffles, runs, bedrock bars and waterfalls - good geomorphic condition	Stable	Improve condition along degraded reaches

11.3 Bates Creek

Bates Creek	**Current fraction imperviousness: 21 % (potential increase <5%)**			**References**
Objectives and timeframe for community environmental values and uses	*Maintain or Improve* existing condition for aquatic ecosystems, visual amenity and secondary contact recreation; *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems.			Local Strategic Planning Statement (LSPS)
Existing values	Very popular walking track alongside both side of the creek and also in Garigal National Park			Northern Beaches Council input
Existing catchment pressures and stressors	• Accelerated erosion at stormwater outlets • Pollution evident in estuary following rainfall events • Tidal fluctuations and mixing with freshwater are extremely effective in flushing contaminants after rainfall. In periods of wet weather, the estuary can become stratified with the more buoyant fresh water sitting as a thin layer on the surface of the salt water. This stratification process aided in the rapid transportation of pollutants from their upstream source to the lower parts of the estuary where tidal flushing aided in dispersal of the pollutants. • Water quality has improved but pollution still evident from stormwater runoff. • Highly urbanised catchment results in concentration of stormwater flows through artificial drainage networks resulting in erosion at end of pipe which is often surrounded by soft surface material such as soil or sand that is easily eroded by large runoff volume and high flow rates. Major stormwater pipes extend right to Middle Harbour and discharge either onto the foreshore or directly into the estuary. • Land development, sediment input, nutrient input, freshwater input are catchment pressures to Estuary health.			**References:** Estuary Health Assessment Clontarf Bantry Bay Final Report 2017
Conditions	**Indicators**	**Existing condition**	**Trajectory**	**Draft waterway objective**
1. Hydrology	Imperviousness	Expected to be moderately modified	Stable with small increase in imperviousness expected in the next 20 years	Maintain condition

2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	TN, NOx and TP above trigger value for aquatic ecosystems. Macroinvertebrates diversity is less that expected to be present	Stable given small increase in imperviousness.	Improve condition
3.Riparian vegetation	Riparian vegetation extent and quality	Category 1 vegetation through Garigal National Park, weed disturbance noted (BMT, 2021)	Ongoing weed disturbance from urban areas	Improve degraded reaches along to a level that minimises the risk to natural habitats
4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	- Upper reach (350 m) highly modified urban stream - poor geomorphic condition - Mid reaches partly confined by bedrock - good geomorphic condition - Lower reach confined - good geomorphic condition	Stable	Improve condition along degraded reaches

12 Catchment Summaries (Manly Lagoon)

12.1 Manly lagoon

Manly Lagoon	Current fraction imperviousness: 38 % (potential increase < 5%)	References
Objectives and timeframe for community environmental values and uses	**Lagoon**: *Maintain or Improve* existing condition visual amenity; *Improve* condition for aquatic ecosystem and secondary contact recreation (5-10 year timeframe); *Improve condition* for secondary contact recreation (10 years or more)	Local Strategic Planning Statement (LSPS)
Existing values	No information	Lagoon card Manly Lagoon Pollutant and Sediment Load - Water Quality MUSIC Model
Existing catchment pressures and stressors	• Manly Lagoon had consistently high algae concentrations and water clarity was poor in the upper zones. This is a common characteristic for Manly as it suffers from high organic loading and is poorly flushed due to its shape and size. Council is investigating groundwater inputs and nutrient levels to better understand why the lagoon has such high algae concentrations. • Urban stormwater is a higher source of pollutants (sediment, phosphorous and Nitrogen) compared to sewerage overflows. • Contaminated groundwater	
Previously documented catchment objectives	• Future works to improve the environmental condition in Manly Lagoon should focus on stormwater quality improvement	

12.2 Manly Creek

Manly Creek	**Current fraction imperviousness: 38 % (potential increase < 5%)**			**References:**
Objectives and timeframe for community environmental values and uses	*Maintain or Improve* existing condition for aquatic ecosystems and visual amenity; *Improve* condition for secondary contact recreation (5-10 year timeframe). *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems.			Local Strategic Planning Statement (LSPS)
Existing values	Mermaid Pool – very popular walking location, waterfall. People used to swim there, no longer possible due to weeds (and probably water quality)			Northern Beaches Council input
Existing catchment pressures and stressors	Weed infestations No riparian vegetation through golf course. Poor quality vegetation and weeds through David Thomas and Millers Reserves. Flows regulated by releases from Manly Dam. Groundwater contamination Can be subject to major flooding if releases from the dam aren't managed well.			Northern Beaches Council input
Conditions	**Key indicators**	**Existing condition**	**Trajectory**	**Draft waterway objective**
1. Hydrology	Imperviousness	Expected to be highly modified	Stable with small increase in imperviousness expected in the next 20 years	Potential to manage volume and flow rates to reduce ongoing erosion if erosion issues are better understood.
2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	TP and TN expected to well exceed trigger values for aquatic ecosystems Macroinvertebrates diversity expected to be significantly less than those expected to be present.	Stable with small increase in imperviousness expected in the next 20 years	Improve condition
3.Riparian vegetation	Riparian vegetation extent and quality	Primarily Category 2 vegetation. Reasonable connectivity, however largely exotics (BMT, 2021) between dam and golf	Ongoing weed disturbance	Improve condition

		course with narrow riparian width. Weeds present throughout.		
4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	Partly confined immediately downstream of Manly Dam moderate to poor geomorphic condition. Bank erosion identified (Manly Creek Rapid assessment, 2017) - Unconfined, highly modified lower reach between Condamine St and Brookvale Creek confluence - poor geomorphic condition	Ongoing erosion likely through the partly confined to unconfined reaches	Reduce channel erosion (extent of channel erosion issues unknown)

12.3 Burnt Bridge Creek

Burnt Bridge creek	Current fraction imperviousness: 44 % (Potential increase of <3%)			References
Objectives and timeframe for community environmental values and uses	*Maintain or Improve* existing condition for aquatic ecosystems and visual amenity; *Improve* condition for secondary contact recreation (5-10 year timeframe). *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems.			Local Strategic Planning Statement (LSPS)
Existing values	HEV has a low score Previously subject to a grant that improved riparian cover. Short section piped through Balgowlah.			Northern Beaches Council input HEV dataset
Existing catchment pressures and stressors	Future Beaches Link tunnel could significantly impact base flows due to loss of groundwater source. Maybe refer to future expansion of road networks? This will also reduce riparian for the creek as it is directly next to the Burnt Bridge Creek Deviation. Weeds Major issues with flooding in the lower reaches.			Northern Beaches Council input
Conditions	**Key indicators**	**Existing condition**	**Trajectory**	**Draft waterway objective**
1. Hydrology	Imperviousness	Expected to be highly modified	Stable with small increase in imperviousness expected in the next 20 years	Potential to manage volume and flow rates to reduce ongoing erosion if erosion issue is better understood.
2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	TN, NOx, and TP above trigger value for aquatic ecosystems. Macroinvertebrates diversity is significantly less that expected to be present	Stable with small increase in imperviousness expected in the next 20 years	Improve condition
3.Riparian vegetation	Riparian vegetation extent and quality	- Riparian zone highly disturbed, narrow and discontinuous. Ground and shrub layers dominated by weeds.	- Ongoing weed disturbance likely	Improve condition

4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	- Partly confined upper reaches flowing through dense urban area with moderate geomorphic condition - Mid reaches laterally unconfined, low sinuosity with poor geomorphic condition. Active bank erosion identified (NSW OEH, 2016) _ Lower reaches highly modified including piped and channelised sections connecting into Manly Creek	- Ongoing erosion likely through the partly confined to unconfined reaches	Reduce channel erosion (Extent of channel erosion issues unknown)

12.4 Brookvale Creek

Brookvale Creek	**Current fraction imperviousness: 40 % (potential increase in imperviousness >5%**			**References:**
Objectives and timeframe for community environmental values and uses	*Maintain or Improve* existing condition for aquatic ecosystems and visual amenity; *Improve* condition for secondary contact recreation (5-10 year timeframe). *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems.			Local Strategic Planning Statement (LSPS)
Existing values	HEV has a larger extent in upper reaches but low score Very nice section in Allenby Park upstream Popular walking trails alongside and across lower sections in Nolan Reserve Golf Club Piped through Brookvale Must be a lot of fish because a lot died during a major pollution event after a fire			Northern Beaches Council input
Existing catchment pressures and stressors	Significant pollution from Commercial/Industrial area of Brookvale Large GPT immediately below Condamine Street			Northern Beaches Council input
Conditions	**Key indicators**	**Existing condition**	**Trajectory**	**Draft waterway objective**
1. Hydrology	Imperviousness	Expected to be moderately modified	Potential to decline further with a reasonable increase in imperviousness	
2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	TN and NOx well above trigger value for aquatic ecosystems. TP above trigger value for aquatic ecosystems. Macroinvertebrates diversity is significantly less that expected to be present	Potential to decline further with a reasonable increase in imperviousness	Improve condition
3.Riparian vegetation	Riparian vegetation extent and quality	Upper reaches contain good riparian vegetation with	- Stable upper reaches	Maintain condition in upper reaches

		high proportion of native species and is well connected to bushland and is of high value. - Highly disturbed mid and lower reaches (Piped network and modified through golf course to Manly Creek)		Improve condition (lower reaches)
4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	Upper reaches - confined headwater streams in moderate to good geomorphic condition. - Mid reaches Highly modified urban (piped or constructed channel) - poor geomorphic condition - Lower reaches highly modified urban stream flowing through golf course - poor geomorphic condition	- Stable upper reaches	Maintain condition in upper reaches Improve condition in lower reaches

13 Catchment Summaries (Curl Curl Lagoon)

13.1 Curl Curl lagoon

Curl Curl lagoon	Current fraction imperviousness: 42 % (potential increase of <3%)	References
Objectives and timeframe for community environmental values and uses	**Lagoon**: *Improve* condition for visual amenity (5-10 year timeframe); *Improve condition* for aquatic ecosystem and secondary contact recreation (10 years or more)	Local Strategic Planning Statement (LSPS)
Existing values	• Highly degraded lagoon in terms of water quality and habitat	Curl Curl Lagoon Estuary Management Plan, 2000 Lagoon card Stormwater and Estuary Modelling for Curl Curl Lagoon FINAL REPORT 2012
Existing catchment pressures and stressors	• Poor water quality in Curl Curl lagoon is a combination of urban runoff and groundwater leachate from landfills • Leachate from old municipal rubbish tips lining the banks of the lagoon • Periodic sewerage overflows • Stormwater runoff including Brookvale Industrial estate, construction activity (silt and sediment) • Groundwater plays a very important role in the hydrodynamic regime of the lagoon, contributing a significant amount of flow to the lagoon. Groundwater quality is expected to be poor. When open, tidal flushing is limited to the area downstream of Griffin Road Bridge	
Previously documented catchment objectives	• Improve water quality by managing leachate and sewerage overflows • To provide strategies for mitigation, control, treatment of pollutant sources (focusing on stormwater) • To improve and maintain habitat value and associated biodiversity of the area • To improve amenity of the creek environment and lagoon • To improve aesthetic value of the lagoon • To improve ecological health of the lagoon in terms of flow regime (desirable flow regime to be determined) • Instead of modifying lagoon conditions, it is worth considering catchment-based works and activities to reduce diffuse and point source pollution, noting however that managing groundwater leachate into the lagoon can be very expensive	

13.2 Greendale Creek

Greendale Creek	Current fraction imperviousness: 42 % (potential increase of <3%)			References:
Objectives and timeframe for community environmental values and uses	*Improve* condition for visual amenity (5-10 year timeframe); *Improve condition* for aquatic ecosystem and secondary contact recreation (10 years or more). *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems.			Local Strategic Planning Statement (LSPS)
Existing values	Extensive community recreation facilities alongside, including walking trails. Creek itself is polluted but supports bird life.			Northern Beaches Council input
Existing catchment pressures and stressors	• Brookvale Industrial estate • Construction activity (silt and sediment) • Urban runoff • Contaminated groundwater from landfill			Northern Beaches Council input
Conditions	**Indicators**	**Existing condition**	**Trajectory**	**Draft waterway objective**
1. Hydrology	Imperviousness	Expected to be highly modified	Stable given small increase in imperviousness	
2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	TP and TN expected to be well above trigger value for aquatic ecosystems. Macroinvertebrates diversity expected to be significantly less that expected to be present	Stable given small increase in imperviousness	Improve condition
3.Riparian vegetation	Riparian vegetation extent and quality	Primarily category 1 vegetation downstream of Harbord road. Swamp Oak floodplain forest with good connectivity but limited width. Weed disturbance evident (BMT, 2021)	Ongoing weed disturbance	Improve condition

4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	Highly modified (piped) urban stream upstream of Harbord Road. Downstream to Cur Curl Lagoon has a low sinuosity planform in an unconfined valley setting. - Poor geomorphic condition.	Stable	Improve condition where possible

14 Catchment Summaries (Dee Why Lagoon)

14.1 Dee Why lagoon

Dee Why lagoon	Current fraction imperviousness: 43 % (potential increase of <3%)	References
Objectives and timeframe for community environmental values and uses	*Maintain or Improve* existing condition for aquatic ecosystems and visual amenity; *Improve* condition for secondary contact recreation (5-10 year timeframe).	Local Strategic Planning Statement (LSPS)
Existing values	Dee Why Lagoon: • Waterbirds and small mammals • Recreational, educational, amenity • Saltmarsh	Lagoon card Dee Why Lagoon Estuary **Management Plan 2004**
Existing catchment pressures and stressors	**Dee Why Lagoon** **Issues** • Fair to good water quality (in terms of clarity and algae. Frequent break-out assist with water quality • Polluted catchment runoff including from sports fields, open spaces and golf courses • Leachate from old tip sites • Sewer overflow • Infilling with sediment • Odour following break-out • Flooding (modified system and proximity of development resulting in flooding of some areas – not specified) • Weed invasion • Human impacts (sports, dredging)	
Previously documented catchment objectives	• To control and improve water quality in terms of managing inputs of sediments, nutrients and other contaminants • Stormwater flow rates controlled to reduce flood issues • To improve amenity, aesthetic value and ecological quality of the creek (tributary) and associated corridor environments • To maintain and improve the amenity, aesthetic and habitat value and associated biodiversity of the area	

- No further degradation of vegetation, maintain threatened species, populations and ecological communities
- Water quality suitable for environmental role and incidental human contact
- No further loss of depth or extent and consideration of some restoration of depth

15 Catchment Summaries (Narrabeen Lagoon)

15.1 Narrabeen lagoon

Narrabeen lagoon		References:
Objectives and timeframe for community environmental values and uses	*Maintain or Improve* existing condition for all environmental values and uses	Local Strategic Planning Statement (LSPS)
Existing values	Five key values • Natural Environment (Aquatic and Terrestrial Habitat) e.g. Foreshore reeds, seagrass and saltmarsh. Seagrass have experienced a decline in the 1970s and some areas have continued to decline. • Recreation (e.g. sailing, kayaking, boating, swimming, fishing and prawning). • Amenity • Flood Mitigation. • Heritage.	Narrabeen Lagoon Plan of Management 2013 FINAL
Existing catchment pressures and stressors	• Potential pressures for seagrass communities are changes in drainage, land management practices that lead to increased sedimentation, direct removal of seagrasses by dredging, boating, fishing, nutrient run-off and point source discharges from stormwater drains and introduced pests and diseases • Water quality in the lagoon can range from good at the entrance (due to effective tidal flushing) to poor in the western basin with elevated concentrations of nutrients and algae. Catchment runoff is a key factor affecting water quality. • Mullet Creek and South Creek have high nutrient concentrations and coliform counts. Middle Creek have moderate levels. • Faecal coliforms are higher in all of the tributaries but are generally low within the lagoon. However, in significant runoff events, the capacity of the lagoon to assimilate pollutant loads is limited. • Microbial water quality in the lagoon is generally good during dry weather, with elevated enterococci levels being measured during wet weather conditions. Swimming should be avoided after rainfall and when the entrance is closed	
Previously documented catchment objectives	To establish water quality outcomes suitable for protection of the natural environment and for public recreation: • Reduce litter entering the lagoon	

- Maintain or improve water quality entering the lagoon by addressing issues of concern as identified especially with consideration of aquatic ecosystems.
- Prevent increased rates of sedimentation above natural levels.
- Water quality in the lagoon appropriate for swimming

To maintain and enhance the Natural Environment

- Maintain and enhance aquatic habitat including key fish habitat such as seagrass and

  saltmarsh within the lagoon.

Other objectives are also outlined for amenity values and coastal environmental protection.

15.2 South Creek

South Creek	Current fraction imperviousness: 32% (potential to increase by 8%)			References:
Objectives and timeframe for community environmental values and uses	*Maintain or Improve* existing condition for visual amenity; *Improve* condition for aquatic ecosystems and secondary contact recreation (5-10 year timeframe); *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems.			Local Strategic Planning Statement (LSPS)
Existing values	Low HEV score along creek line GDE at lower reaches			HEV data set
Existing catchment pressures and stressors	No information			
Conditions	**Key indicators**	**Existing condition**	**Trajectory**	**Draft waterway objective**
1. Hydrology	Imperviousness	Expected to be highly modified	Potential to decline further given increase in imperviousness	
2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	TP and NOx above trigger value for aquatic ecosystems. Macroinvertebrates diversity is significantly less that expected to be present	Potential to decline further given increase in imperviousness	Improve condition
3.Riparian vegetation	Riparian vegetation extent and quality	- Upper reaches typically dry sclerophyll forest classified as Category 1 immediately adjacent to channel with broad weed disturbance, and Category 2 on the fringes (BMT, 2021). Relatively narrow riparian width. - Mid reaches predominately Category 2	- Ongoing weed disturbance likely	Improve condition

		with some longitudinal discontinuities and narrow width. Impacted by weeds. - Lower reaches primarily Swamp Oak floodplain forest classified as Category 1.		
4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	- Upper reaches significantly confined through suburb of Beacon Hill with moderate geomorphic condition. Typically bedrock controlled bed (Cardno, 2008) - Mid reaches partly confined with moderate to poor geomorphic condition. Active bank erosion and severe undercutting identified through reach. Some boulders and cobbles present in channel (NSW OEH, 2016). - Lower reaches unconfined channel with very low gradient draining into lagoon.	- No significant lateral adjustment likely in confined upper reaches - Ongoing erosion likely through the partly confined to unconfined mid reaches	Maintain condition upper reaches Limit channel erosion within mid reaches (Extent of channel erosion issues unknown)

15.3 Wheeler Creek

Wheeler Creek	**Current fraction imperviousness: 6 % (potential increase > 10%)**			**References:**
Objectives and timeframe for community environmental values and uses	*Maintain or Improve* existing condition for visual amenity; *Improve* condition for aquatic ecosystems and secondary contact recreation (5-10 year timeframe); *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems.			Local Strategic Planning Statement (LSPS)
Existing values	Large extent of HEV but generally low score			HEV data set
Existing catchment pressures and stressors	Urban development			
Conditions	**Key indicators**	**Existing condition**	**Trajectory**	**Draft waterway objective**
1. Hydrology	Imperviousness	Expected to be slightly modified	Potential to decline given imperviousness can exceed 10% in the next 20 years	Maintain condition
2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	TN, NOx and TP at or just above trigger value for aquatic ecosystems. Macroinvertebrates diversity is less that expected to be present	Potential to decline given imperviousness can exceed 10% in the next 20 years	Improve condition in degraded reaches otherwise maintain
3.Riparian vegetation	In-stream and stream side vegetation extent and quality	- Upper and mid reaches in typically in-tact dry sclerophyll forest classified as Category 1 (BMT, 2021). Good longitudinal connectivity and riparian width. - Lower reaches primarily classified as Category 2 however MER indicates good Riparian vegetation	- Weeds through garden escapees possible in lower reach	Maintain condition

		with many natives few weeds.		
4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	- Upper and mid reaches flow through confined valley setting with moderate geomorphic condition. - Lower reaches (approximately 400 m) partly confined with moderate to poor geomorphic condition. Some minor bank erosion identified through reach (NSW OEH, 2016).	- No significant lateral adjustment likely in confined upper reaches - Ongoing erosion likely through the partly confined to unconfined mid reaches	Maintain condition Potential to limit channel erosion within lower reaches (Extent of channel erosion issues unknown)

15.4 Middle Creek

Middle Creek	Current fraction imperviousness: 17 % (potential increase >10%)	References:
Objectives and timeframe for community environmental values and uses	*Maintain or Improve* existing condition for visual amenity; *Improve* condition for aquatic ecosystems and secondary contact recreation (5-10 year timeframe); *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems.	Local Strategic Planning Statement (LSPS)
Existing values	• Middle Creek and its floodplains supports a diversity of native flora and fauna, including a number of features of high conservation significance including seagrass Meadow is restricted to one location at the mouth of Middle Creek, but occurs more widely elsewhere in Narrabeen Lagoon. • Middle Creek and its tributary, Trefoil Creek, form part of an important wildlife corridor linking Manly Dam Reserve and the Bantry Bay section of Garigal National Park with the extensive bushland of the Narrabeen Lagoon catchment, including the Deep Creek section of Garigal National Park. • GDE ecosystem closer to the confluence with Oxford Creek • Wetland along the lower reaches	Middle Creek Biodiversity Assessment and Management Plan - Final Report - P & J Smith
Existing catchment pressures and stressors	• Middle Creek and its floodplain have been severely degraded by clearing, weed invasion, soil disturbance, sedimentation and other consequences of urban development. • Weed infestation on the Middle Creek floodplain is a massive problem	
Previously documented catchment objectives	• An important management objective for land categorised as a natural area or as bushland is to conserve biodiversity	Middle Creek Biodiversity Assessment and Management Plan - Final Report - P & J Smith

Conditions	Key indicators	Existing condition	Trajectory	Draft waterway objective
1. Hydrology	Imperviousness	Expected to be moderately modified	Potential to decline given imperviousness increase by more than 10% in the next 20 years	Maintain condition

2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	TN, NOx and TP above trigger value for aquatic ecosystems. Better water quality in lower reaches in deferred land Macroinvertebrates diversity is less that expected to be present	Potential to decline given imperviousness can exceed 20% in the next 20 years	Improve condition (particularly downstream of urban areas)
3.Riparian vegetation	In-stream and stream side vegetation extent and quality	- The upper reach flows through Jindabyne Reserve where it has a relatively wide and well-connected riparian zone. Classified as Category 1 (BMT, 2021). - The mid reaches have portions of Category 1 vegetation where significant native species were observed with large sections of Category 2 vegetation further downstream where woody weeds dominate the riparian vegetation. - The lower reaches (downstream of the gorge) are classified entirely as category 1. There is good longitudinal connectivity and riparian width in most places	- Ongoing weed disturbance likely	Improve condition including along trefoil creek (tributary) to a level that minimises the impact downstream
4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	- The upper reach has a combination of natural channel, piped and open grassed swales. Where there is channel, it is predominately constrained by the valley margins with some narrow sections of	- Unmitigated development may exacerbate the current widening process (upstream of gorge) resulting in loss of instream and riparian values and sediment loads to Narrabeen Lagoon	Limit channel erosion and improve condition including along trefoil creek (tributary) to a level that minimises impact downstream

alluvial floodplain development. - The mid reaches (upstream of gorge) is partly confined to laterally unconfined in sections with floodplain widths varying from 5m to 60m. The underlying bedrock provide a significant vertical control however lateral adjustment through channel widening is evident - Downstream of the Oxford Falls Gorge the reach is partly confined with discontinuous floodplain pockets of up to 50m in width. Significant channel (sand slug) and floodplain aggradation has been identified as ongoing since the 1940's through this reach (Pietsch, 2018). This has resulted in homogenous bed morphology.	- Continued sedimentation in lower reaches and into Narrabeen Lagoon

15.5 Deep Creek

Deep Creek	**Current fraction imperviousness: 3 % (Potential to increase by 7%)**			**References:**
Objectives and timeframe for community environmental values and uses	*Maintain or Improve* existing condition for aquatic ecosystems, visual amenity and secondary contact recreation; *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems.			Local Strategic Planning Statement (LSPS)
Existing values	Wetland and GDE ecosystems in lower reaches Mullet breeding estuary			
Existing catchment pressures and stressors	Kimbriki Resource Recovery Centre Mountain Bike trails clearing riparian veg and associated erosion Sedimentation at bottom of creek at the edge of the lagoon almost closes it off sometimes.			
Conditions	**Indicators**	**Existing condition**	**Trajectory**	**Draft waterway objective**
1. Hydrology	Imperviousness	Expected to be slightly modified	Potential to decline given imperviousness can exceed 10% in the next 20 years	Maintain condition
2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	TN, NOx and TP below trigger value for aquatic ecosystems Macroinvertebrates diversity similar to that expected to be present	Potential to decline given imperviousness can exceed 10% in the next 20 years	Improve condition in degraded reaches impacted by development, otherwise maintain
3.Riparian vegetation	In-stream and stream side vegetation extent and quality	- Riparian vegetation classified as category 1 throughout. Excellent connectivity and width with most of the reach within a national park. - Occasional weed identified in upper reaches (NSW OEH, 2016)	- Weed disturbance possible	Maintain condition

4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	- Upper reaches flow through Garigal National Park, confined by bedrock. Good geomorphic condition, channel bedrock dominated with long pools riffles, runs and cascades (NSW OEH, 2016) - The mid reaches are characterised by a poorly defined channel through a large and flat valley floor forming a floodplain up to 120 m in width. - The lower reaches a characterised by wide channel with very low gradient.	Potential to decline with increase in imperviousness (e.g. sedimentation, sand slugs from construction activity)	Maintain condition

15.6 Nareen Creek

Nareen Creek	Current fraction imperviousness: 38 % (potential increase <2%)	References:
Objectives and timeframe for community environmental values and uses	*Maintain or Improve* existing condition for visual amenity; *Improve* condition for aquatic ecosystems and secondary contact recreation (5-10 year timeframe); *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems.	Local Strategic Planning Statement (LSPS)
Existing values	• The area adjacent to the Nareen Creek corridor supports recreational pursuits such as walking, bird watching, and dog exercise. • Indigenous flora and fauna within the riparian zone • Wetland areas	Nareen Creek Rehabilitation Plan - June 2008 - Adopted 16 June 2008
Existing catchment pressures and stressors	• Changed hydrological regime (stormwater) • Sedimentation (stormwater, land development, erosion) • Riparian vegetation clearing and infestation of weeds (upper reaches) • Infestation of weeds (middle reaches) with removal of weeds undertaken • Artificial channel (lower reaches) • Bank erosion and channelisation in upper reaches (stormwater, lack of riparian vegetation) • Extremely high levels of nutrients (both nitrogen and phosphorus) and faecal coliforms were recorded in upper reaches. These levels indicate sewage contamination from a leaking sewer. • Poor water quality (TN, TP) in middle and lower reaches (stormwater, sewage inputs) • Low dissolved oxygen (lack of flow, decay of organic matter, euthrophication)	Nareen Creek Rehabilitation Plan - June 2008 - Adopted 16 June 2008
Previously documented catchment objectives	**Vision:** Maintain and improve existing natural physical and biological diversity in the catchment, and return as much as possible the diversity that has been lost from the riparian zone' **Management objectives:** • Improve water quality within Nareen Creek and the receiving waters of Narrabeen Lagoon • Encourage the deposition, settlement and removal of suspended solids, nutrients and bacteria to prevent them from being transported into Narrabeen lagoon	Nareen Creek Rehabilitation Plan - June 2008 - Adopted 16 June 2008

- Remove gross pollutants from the stormwater and prevent them from being transported into Narrabeen lagoon from the upstream catchment area.
- Enhance aquatic and riparian habitats and in-stream native diversity
- Provide improved scenic amenity, access and passive recreation opportunities
- Reduce erosion within Nareen Creek
- Maintain and restore (where possible) environmental flows within Nareen Creek

Conditions	Key indicators	Existing condition	Trajectory	Draft waterway objective
1. Hydrology	Imperviousness	Expected to be highly modified	Stable	
2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	TN, TP and NOx expected to be well above trigger value for aquatic ecosystems. Macroinvertebrates diversity is expected to be significantly less that expected to be present	Stable	Improve condition
3.Riparian vegetation	Riparian vegetation extent and quality	- Predominately classified as Category 2 (BMT, 2021) - Forest and freshwater wetland vegetation present through Nareen Reserve (Category 1) with weed disturbance identified.	- Ongoing weed disturbance	Improve condition
4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	- Highly modified urban stream in an unconfined valley setting. Discontinuous channel including a piped section in the upper reaches flowing into a wetland area within Nareen Reserve. - Wetland drained by a straight constructed drain	- Highly modified with little chance of lateral adjustment	Improve condition where possible

	that enters Narrabeen Lagoon - Poor geomorphic condition throughout

15.7 Mullet Creek

Mullet Creek	Current fraction imperviousness: 19.8% (potential increase of >20%)	References:
Objectives and timeframe for community environmental values and uses	*Maintain or Improve* existing condition for visual amenity; *Improve* condition for aquatic ecosystems and secondary contact recreation (5-10 year timeframe); *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems.	Local Strategic Planning Statement (LSPS)
Existing values	• Three distinct habitat types: i) the wetland upstream of Jackson's Road (Warriewood wetlands); ii) from the wetland to the first waterfall in Epworth Park; and iii) upstream of the confluence between the two arms of Mullet Creek that drain either side of Powderworks Road. • Dam below Powderworks Road attracting waterbirds, including feral ducks and geese. • Dragon flies, water boatmen, mosquito fish • indigenous flora and fauna within the riparian zone • biodiversity in creeks and wetlands • Mullet Creek corridor supports recreational pursuits such as walking, cycling, picnics or barbeques.	Bio-analysis - Mullet Creek Water Quality Monitoring Program and Design - Report 21May2010 Mullet Creek Rehabilitation Plan - June 2008 - Adopted 16 June 2008
Existing catchment pressures and stressors	• Middle reaches of the creek indicate generally have elevated levels of nutrients, suspended solids and faecal coliforms. Concentrations of total nitrogen (TN), oxidised nitrogen (NOx) and total phosphorous (TP) were found to exceed the recommended ANZECC (2000) guideline values. • Low dissolved oxygen. Macroinvertebrates assemblages at three sites were dominated by 'Very Tolerant' taxa and were ranked as "Fair" • Excessive growth of the algae, submerged macrophyte, free-floating aquatic plant, have been reported in the middle reaches of the creek • Channelisation, bank erosion and undercutting, which are likely to generate increased loads of sediment to downstream environments and Narrabeen Lagoon, and modification of creek flows • Release of land for development and associated work has the potential to further affect physical, chemical and biological processes in freshwater sections of Mullet Creek, the Warriewood Wetland and the saline sections downstream of the wetland. • It could also have implications for processes in the Narrabeen Lagoon system.	**References:** Bio-analysis - Mullet Creek Water Quality Monitoring Program and Design - Report 21May2010 Mullet Creek Rehabilitation Plan - June 2008 - Adopted 16 June 2008

- Large area of unsewered properties (rural large lots)

Upper reaches in moderate condition, middle reaches in good condition and lower reaches in poor condition

- weed invasion
- land clearing
- eutrophication
- rubbish dumping
- oxygen depletion
- faecal coliforms
- litter
- flow obstructions
- lack of flow
- obstruction to tidal flushing
- channelisation
- bank erosion
- sedimentation.

Previously documented catchment objectives	A range of objectives set for upper, middle and lower reaches of Mullet Creek • Improve water quality within Mullet Creek and the receiving waters of Narrabeen Lagoon • Encourage the deposition, settlement and removal of suspended solids, nutrients and bacteria to prevent them from being transported into Narrabeen lagoon • Enhance aquatic and riparian habitats and in-stream native diversity • Provide improved scenic amenity, access and passive recreation opportunities • Reduce erosion within Mullet Creek • Maintain and restore (where possible) environmental flows within Mullet Creek			**References:** Mullet Creek Rehabilitation Plan - June 2008 - Adopted 16 June 2008
Conditions	**Indicators**	**Existing condition**	**Trajectory**	**Draft waterway objective**
1. Hydrology	Imperviousness	Highly modified (dams, weirs, causeways, extractions)	Expected to decline given large increase in imperviousness (Ingleside	Improve condition (e.g. manage extractions for authorised water licenses. Maintain or restore (where possible)

			and Warriewood growth areas)	environmental flows within Mullet Creek and Warriewood wetlands (to be defined)
2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	Poor (stormwater, sewerage overflows, overflows from systems in unsewered areas, nurseries and golf courses)	Potential improvement from improved sewerage system during Ingleside development. Potential to decline from large increase in imperviousness.	Improve condition in degraded reaches (noting multiple sources of pollution).
3.Riparian vegetation	Riparian vegetation extent and quality	- Classified as Category 2 in the upper reaches (BMT, 2021), with several discontinuities and limited riparian width. Weeds prevalent (Hyder, 2008) - Good riparian connectivity and width through the mid to lower reaches through Irrawong Reserve and Warriewood Wetlands. Increased disturbance in the lower reaches downstream of Jacksons Road	- Ongoing weed disturbance	Improve condition
4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	- Upper reaches channelised fill in an unconfined valley setting in poor geomorphic condition (Upstream of Irrawong Reserve). Channelization, bank erosion and undercutting identified in upper reaches (Hyder, 2008) - Confined through mid reach (Irrawong Reserve) -Mid to lower reaches flowthrough a partly confined to unconfined setting with extensive floodplain width particularly on the northern side of the	- Bed and bank erosion likely to continue in the unconfined upper and lower reaches and will be susceptible to changes in hydrology	Improve condition where possible Limit channel erosion Extent of channel erosion issues (unknown)

	channel. Bed and bank erosion identified in this reach (Hyder, 2008)	

15.8 Narrabeen Creek

Narrabeen Creek	Current fraction imperviousness: 31 % (Potential increase of >10%)			References
Objectives and timeframe for community environmental values and uses	*Maintain or Improve* existing condition for visual amenity; *Improve* condition for aquatic ecosystems and secondary contact recreation (5-10 year timeframe); *Maintain or improve* existing condition for flows including 1) Protect pools in dry times; 2) Protect natural low flow; 3) Mimic natural drying in temporary waterways; and 4) Manage groundwater for ecosystems.			Local Strategic Planning Statement (LSPS)
Existing values	Upper catchment in bush reserve Lower extents largely reconstructed with wide riparian zones, mostly rock lined channel. Poor macroinvertebrates Has recently improved for nutrients and bacterial due to development removing original nursery/farming industry and septics Piped under Warriewood Square			
Existing catchment pressures and stressors	Pollution from Warriewood industrial area Development and road network expansion leading to heavy sediment pollution			
Conditions	**Indicators**	**Existing condition**	**Trajectory**	**Draft waterway objective**
1. Hydrology	Imperviousness	Expected to be highly modified	Stable	
2. Water quality	Turbidity, nutrients, macroinvertebrates, microbial	TP and TN expected to be above trigger value for aquatic ecosystems. Macroinvertebrates diversity likely to be significantly less that expected to be present	Stable	Improve condition
3.Riparian vegetation	Riparian vegetation extent and quality	_ Downstream of the escarpment the riparian zone typically classified as Category 2 (BMT, 2021). Several discontinuities and limited riparian width.	Stable	Improve condition where possible

4. Physical form	Geomorphic condition, bed and bank erosion, sedimentation, sand slugs	- Confined headwater through sandstone escarpment flowing into a highly modified urban stream in an unconfined valley setting. Several channelised or piped sections in lower reaches. Poor geomorphic condition	Stable	Improve condition where possible