

NORTHLAND REGIONAL COUNCIL NORTHLAND MAPPING PROJECT

NATURAL CHARACTER MAPPING METHODOLOGY REPORT

(including amendments following Council decisions)

FEBRUARY 2014

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Date: 28 September 2012

Report revised following Council decisions on the proposed Northland Regional Policy Statement:
May 2014

Report citation:

Froude, VA, 2014. Northland Regional Council Northland Mapping Project. Natural character methodology report- including amendments following Council decisions. Pacific Eco-Logic Ltd, Bay of Islands. 31pp.

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Acknowledgements

This section focuses on those who have contributed to various steps in the process of identifying and mapping areas of high and outstanding natural character.

Chris Richmond (Pacific Eco-Logic Ltd) managed the logistics for the field assessment process; and managed the initial digitising process and the quality control for the re-digitised maps. Other core members of the Northland Mapping Group provided support and feedback (especially Glenn Mortimer (Mortimer Consulting) and Mike Farrow (Littoralis)). Mike Farrow and Simon Cocker provided digital copies of aerial oblique images. Chris Kennedy of Geo Info provided the initial framework and support for establishing the project map grid and the digitising. Eva Grimme (Littoralis) undertook much of the initial digitising. Andrew Macdonald of Northland Regional Council re-digitised the entire area and produced the maps in the worksheets report. He also provided assistance with setting up the quality control process and worked on finding a less time consuming way for us to assemble our worksheets using the then newly created Northland Regional Council map grid (rather than the project grid).

Various landowners and land managers provided comment on the initial rankings and unit boundaries (through an informal consultation process). Some took time out to show a Northland Regional Council staff member, myself and/or another Northland Mapping Group member, the relevant areas on their properties.

Northland Regional Council staff, including Justin Murfitt, Jonathan Gibbard, Ben Lee, John Trewin and Kathryn Ross, provided assistance and feedback.

Disclaimer

Information sources for the worksheets included: satellite imagery assessments; oblique aerial photographs; published and unpublished documentation; and field assessments made from the coastal marine area, other waterbodies with public access, road-ways and other areas of public land (especially Department of Conservation and Council managed lands). Private properties were not visited except: where this was: part of the informal landowner consultation process undertaken prior to the notification of the Proposed Regional Policy Statement for Northland; or part of the formal submissions analysis process; or where access had been specifically organised.

Every care has been taken in the preparation of this report and the worksheets. Pacific Eco-Logic Ltd is not liable for decisions and actions taken using this information.

Executive summary

As part of the Northland Mapping Project (for the proposed regional policy statement) Northland Regional Council (Council) contracted Pacific Eco-Logic Ltd (as part of the Northland Mapping Group) to map and assess areas of high and outstanding natural character in the Northland coastal environment. This project arose from requirements specified in the New Zealand Coastal Policy Statement 2010.

This report describes the process and methodology used to assess and map natural character in the terrestrial, freshwater and marine coastal environments of Northland. It addresses: national policy requirements; the concept of natural character; and the methodology used to define the spatial extent and ranking of areas of high and outstanding natural character. It also describes changes to the natural character mapping as a result of Council decisions. The report also evaluates natural character restoration priorities for different types of Northland coastal environments.

To assist in the interpretation of the RPS natural character maps a series of worksheets has been developed. These include an A4 map showing unit numbers and an associated table that provides a summary of the key attributes for each unit on the relevant RPS map sheet. The summary worksheets are separate documents and are available from the Council. Each table includes a summary of key quantitative data calculated from the master spreadsheet.

Introduction

As part of the process of preparing the Northland regional policy statement, Northland Regional Council established the Northland Mapping Project in 2011. This project included the following components:

- defining the inland boundary of the coastal environment
- mapping the spatial extent of areas of high and outstanding natural character within the coastal environment
- mapping the spatial extent of areas of outstanding landscapes and outstanding natural features

The Northland Mapping Group, a consortium of Northland companies, was the successful tenderer for the project which also included various consultation processes relating to the methodology and the draft mapped areas. This report addresses the natural character component of this project.

This report covers: policy requirements; the concept of natural character; the methodology used to define the spatial extent and ranking of areas of high and outstanding natural character; the key areas included and their values; and priorities for restoration.

Policy context

Under section 6(a) of the Resource Management Act all those exercising powers and functions under the Act are to recognise and provide for the preservation of the natural character of the coastal environment. This is amplified further in the 2010 New Zealand Coastal Policy Statement. Here, policies 13 and 14 are of particular relevance.

Under policy 13 the adverse effects of activities in areas with outstanding natural character are to be avoided; while significant adverse effects are to be avoided, remedied or mitigated in all other areas. This is to be achieved by

- assessing the natural character of the coastal environment of the region/district, and by mapping or otherwise identifying at least areas of high natural character;
- ensuring that regional policy statements and plans identify areas where preserving the natural character requires objectives, policies and rules, and include those provisions

Policy 14 requires that the natural character of the coastal environment be restored or rehabilitated (using a variety of approaches).

Regional policy statements and Resource Management Act plans are required to give effect to the operative New Zealand Coastal Policy Statement (Resource Management Act s62(3), s67(3)(b) and s75(3)(b)).

What is natural character?

While the preservation of the natural character of the coastal environment and various freshwater environments and their margins has been a long-standing New Zealand policy-goal (since 1973), the relevant legislation and policies have not contained a definition of natural character. The first step in

the development of a methodology for measuring coastal natural character and its change (Froude 2011) was to develop a robust definition of natural character (Froude et al. 2010). Since this definition was published the 2010 New Zealand Coastal Policy Statement (Department of Conservation 2010) has been made operative. While this policy does not contain a definition of natural character, it does list some matters (in policy 13.2) which may be part of or contribute to natural character.

The process used to develop the definition in Froude et al. (2010) included analysing literature from a wide variety of disciplines to distil a set of interpretations and perspectives of natural character/ environmental naturalness. These interpretations were assessed against criteria which address New Zealand's environmental, legal and policy context. No previous interpretation addressed all criteria and so several of the "best-matched" interpretations were combined and refined to develop a comprehensive definition that fully addressed all the criteria as follows:

"Natural character occurs along a continuum. The natural character of a "site" at any scale is the degree to which it:

- is part of nature, particularly indigenous nature*
- is free from the effects of human constructions and non-indigenous "biological artefacts"¹*
- exhibits fidelity to the geomorphology, hydrology² and biological structure, composition and pattern of the reference conditions chosen*
- exhibits ecological and physical processes comparable with reference conditions*

Human perceptions and experiences of a "site's" natural character are a product of the "site's" biophysical attributes, each individual's sensory acuity and a wide variety of personal and cultural filters."

The definition has been compared with an analysis of the collective interpretations of natural character distilled from 100 Court decisions on appeals made under the Resource Management Act. This comparison showed that the comprehensive definition of natural character was generally consistent with (the sometimes variable) Court interpretations of natural character (Froude 2011).

The second New Zealand Coastal Policy Statement (Department of Conservation 2010) was gazetted in November 2010. Policy 13(2) states that *"...natural character is not the same as natural features and landscapes or amenity values and may include matters such as:*

- a) natural elements, processes and patterns;*
- b) biophysical, ecological, geological and geomorphological aspects;*
- c) natural landforms such as headlands, peninsulas, cliffs, dunes, wetlands, reefs, freshwater springs and surf breaks;*
- d) the natural movement of air, water and sediment;*
- e) the natural darkness of the night sky;*
- f) places or areas that are wild or scenic*
- g) a range of natural character from pristine to modified;*

¹ The term biological artefact is used in international scientific literature to represent human constructed and managed biological systems such as pasture for grazing, lawns, gardens, plantations and orchards. In the application of the methodology for measuring natural character such a distinction is not necessary

² In aquatic systems this includes water quality including nutrient levels

- h) experiential attributes, including the sounds and smell of the sea; and their context or setting*

These matters are a mixture of biophysical attributes including those that contribute to “experiential attributes”. Some of the listed attributes provide guidance about what constitutes natural character (e.g. a, b, d, and e). Others identify particular components of the coastal environment which are likely to possess natural character (e.g. c and f). Item (h) gives examples of biophysical attributes that contribute sensory information to human experiences, while item (g) contains the observation that natural character occurs along a continuum. Item (h) conflates two items that were separate but related items in the Board of Inquiry’s report (Proposed NZCPS (2008) Board of Inquiry 2009). Policy 13(2) clearly does not constitute a definition.

The 2010 New Zealand Coastal Policy Statement introduced thresholds for policy and management of coastal natural character for the first time. Policy 13(1)(a) requires any adverse effects of activities on natural character in the coastal environment be **avoided** in areas of “**outstanding** natural character”. For all other areas in the coastal environment policy 13(1)(b) requires that **significant** adverse effects on natural character be avoided and that **other** adverse effects of activities be avoided, remedied or mitigated. The threshold of high was introduced in policy 13(1)(c). This policy requires that natural character be assessed by mapping or otherwise identifying at least areas of “**high** natural character”

These thresholds have not been formally defined in legislation or national policy. The QINCCE³ methodology used to determine areas of high and outstanding natural character scores a number of variables. These scores are combined to give an overall score which is assessed against numerical thresholds for high and outstanding. The following preliminary working definitions have developed to assist Council and public to understand the differences between areas in the coastal environment that have outstanding or high natural character or where natural character is less than high. These working definitions are primarily based on factors affecting natural character scores and address matters listed in New Zealand Coastal Policy Statement policy 2. The definitions apply to both terrestrial and aquatic coastal environments.

Areas of outstanding natural character

- Consist entirely or almost entirely, of indigenous nature⁴
- Relative to other Northland coastal sites, there is a very high level of matching to reference conditions⁵ for all or most of:
 - Biological structure & composition and ecological processes⁶

³ Quantitative Indices for measuring the Natural Character of the Coastal Environment (described in the next section of this report)

⁴ This can include surfaces with minimal or no obvious biological cover

⁵ Reference conditions are compiled using a variety of information sources to represent a particular time or target. In the New Zealand context the reference conditions used is that of present-potential natural state. This is what would be expected if humans and their tools had not impacted an area but natural processes (e.g. earthquakes, tsunamis, storms, coastal erosion and accretion) had still occurred. High levels of natural disturbance characterise many coastal environments.

⁶ For the regional and district scale these are assessed based on various attributes of the biological cover and/or natural surface; and the level of animal pest control or freedom from animal pests or human harvest

- Geomorphology, hydrology, hydraulics, water quality and physical processes
 - Sound and odour environment , darkness regimes
- Exhibit minimal or no impacts from buildings, structures, paved surfaces, roading or vehicle tracks

Areas with high natural character

- Almost entirely consist of nature, especially indigenous nature⁷
- Relative to other Northland coastal sites, there is a moderate to high level of matching to reference conditions⁸ for:
 - Biological structures & composition and ecological processes⁹
 - Geomorphology or landform, hydrology, hydraulics, water quality and physical processes
 - Sound and odour environment, darkness regimes
- Exhibit minimal impacts from buildings, human built structures, paved surfaces, roading or vehicle tracks

Areas where natural character is less than high:

- May have low levels of nature (versus human constructed environments)
- Typically have moderate to low levels of indigenous nature
- May be dominated by human constructed and managed biological systems such as pasture for grazing, lawns, gardens, plantations and orchards which are typically dominated by introduced species
- May include moderate to high levels of invasive species
- Relative to other Northland coastal sites, there is usually a low level of matching to reference conditions for one or more of :
 - Biological structures & composition and ecological processes¹⁰
 - Geomorphology or landform, hydrology, hydraulics, water quality and physical processes
 - Sound and odour environment, darkness regimes
- May exhibit a variety of impacts from buildings, human built structures, paved surfaces, roading or vehicle tracks

Some areas of coastal environment sit just below the numerical threshold for high. Typically such areas are dominated by nature but may include higher levels of non-native species (often pest plants) and/or the biological cover is in the very early stages of development to what would be expected on the site if natural processes (including disturbance) had occurred in the absence of human impacts¹¹. Such areas may develop high natural character over time, especially if there is appropriate management of non-native species in those areas where they are a problem.

(depending on the environment type). Attributes relating to cover/ natural surface have greater impact on the scoring.

⁷ This can include surfaces with minimal or no obvious biological cover

⁸ Refer to equivalent footnote for outstanding natural character

⁹ Refer to equivalent footnote for outstanding natural character

¹⁰ For the regional and district scale these are assessed based on various attributes of the biological cover and/or natural surface; and the level of animal pest control or freedom from animal pests or human harvest (depending on the environment type). Attributes relating to cover/ natural surface have greater impact on the scoring.

¹¹ The concept of present potential cover and measuring progress towards this is discussed further in the next section

Areas of coastal environment with high or outstanding natural character, and sometimes less than high natural character, may also be places that are wild or scenic (New Zealand Coastal Policy Statement policy 13(2)(e)).

Methodology

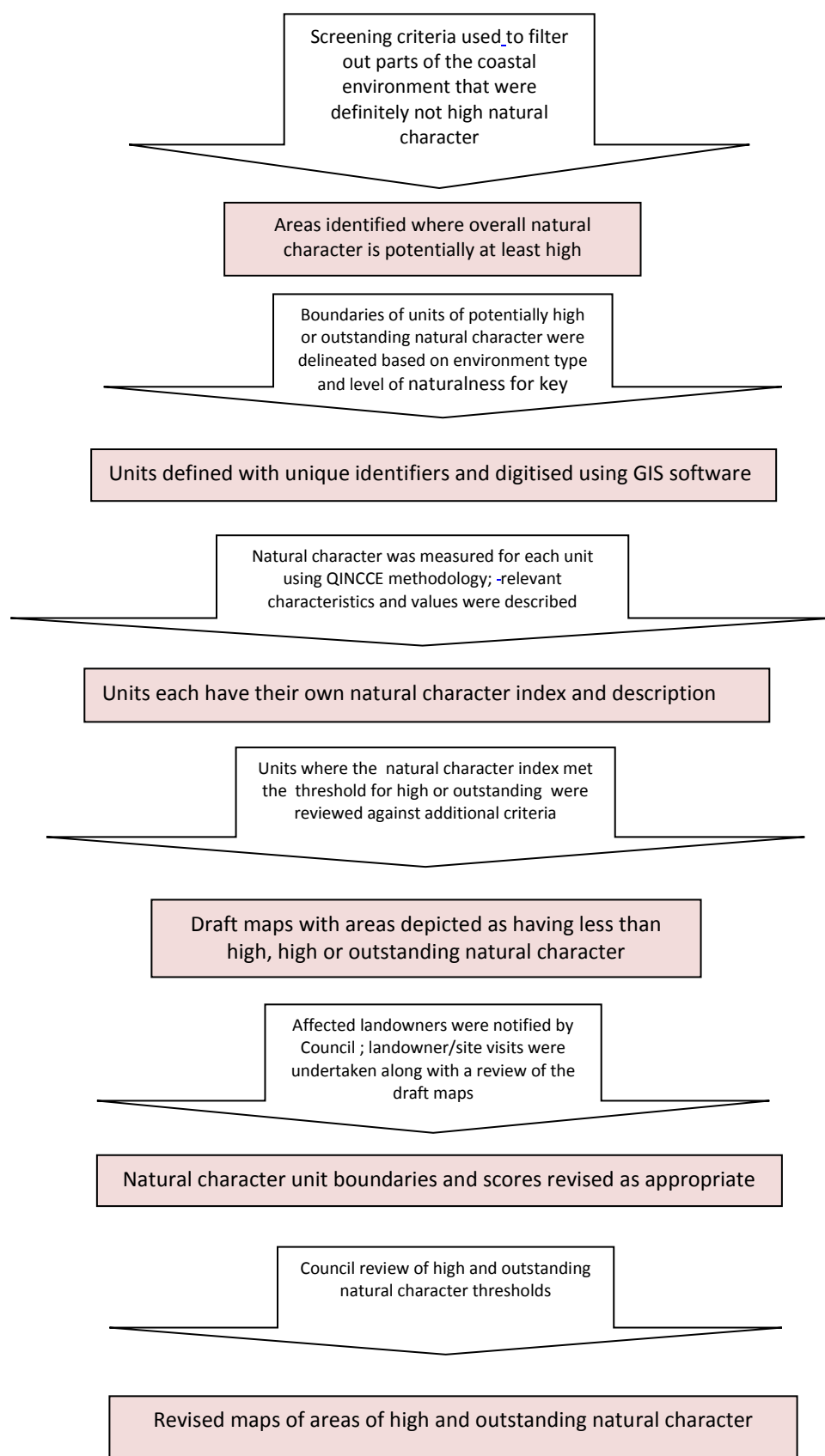
Overview of the project methodology

The methodology (scoring coastal natural character) used for this project is based the QINCCE (Quantitative methodology for measuring the natural character of the coastal environment) methodology. This was developed by and described in Froude (2011) with subsequent refinements based on work in Tasman, Waikato and Northland regions. Further refinements for this project included developing a set of screening criteria to identify areas that are clearly not of high natural character. The QINCCE methodology was not applied in these areas. The next section of this report summarises key features of that methodology. Box 1 sets out the key steps used to measure coastal natural character for the Northland proposed RPS. Figure 1 provides an overview of the process followed for this project.

Box 1: Steps used to measure Northland coastal natural character for the proposed RPS

1. A comprehensive set of criteria was used to determine which areas of the defined coastal environment were definitely not of high natural character. These areas were grouped into units (largely based on environment type), briefly described, assigned a unique identifier and mapped (firstly on aerial image mosaics and then digitised). This was a conservative assessment and so a number of locations that proceeded to Step 2 did not make the final proposed RPS maps of high or outstanding natural character.
2. For the remaining area, units (based on environment type and relatively homogeneous levels of natural character) were manually depicted on aerial images or marine charts, assigned a unique identifier, and then digitised with geo-referencing
3. Each defined unit in Step 2 was scored using the QINCCE methodology. To do this relevant descriptive and other evaluative information was collected for each unit. The primary methods for doing this were field evaluations and assessments of remote (satellite) imagery. The field assessments were made from water craft in the coastal marine area and other water bodies with public access, walking intertidal areas, driving along road-ways and walking in other areas of public land (especially Department of Conservation and Council managed lands). Where-ever possible dunelands were visited to ensure that there was an accurate assessment of the levels of weed invasion in different locations. Existing technical documents were also used in the assessment process, and were particularly important for inaccessible areas.
4. Indicative numerical thresholds (based on work in several regions of New Zealand) were used to create an indicative schedule of units of high and outstanding natural character. Each unit was then reviewed to determine whether it should be downgraded a rank. Reasons for such a downgrade included: very small size; high levels of anthropogenic sound and (night) light
5. The thresholds were adjusted upwards several times by Council and the unit boundaries were revised following informal landowner consultation. Step 4 was repeated before the revised maps were included in the proposed RPS

Figure 1: Process used to assess the natural character of the Northland coastal environment in the proposed RPS



The QINCCE methodology

The QINCCE methodology uses a consistent framework for measuring natural character for different types of terrestrial and aquatic environments. Units are depicted based on environment type and level of overall naturalness. For each broad class of coastal environment there is a *core* set of parameters that is used to calculate three sub-indices for each unit:

- Ecological naturalness index;
- Hydrological and geomorphological/landform naturalness index;
- Freedom from buildings and structures index.

The three sub-indices for each unit are combined multiplicatively into an overall index of natural character for each unit.

The parameters used to calculate these indices have been derived from a comprehensive definition of natural character (Froude et al (2010)¹² and emphasise state indicators (as in the Pressure-State-Response model.¹³ . The definition of natural character in Froude et al (2010) is consistent with an analysis of 100 Resource Management Act Court decisions¹⁴. Where possible measured data (e.g. % cover) is used and standardised to fit within the range of 0 to 1. Those parameters using categorical data are supported by comprehensive scoring tables. The relevant parameters are directly scored between 0 and 1 for some key parameters or a more limited range for those parameters that have intended to have a lesser impact on the overall natural character index.

The methodology and formulae can be used for terrestrial, freshwater and marine environments, although there are some differences in the specific parameters measured. Data and descriptive/evaluative information about each unit is stored in spreadsheets that can be electronically linked to the digitised units.

Parameters measured

Table 1 contains the indicators and the measured parameters for each of the three natural character sub-indices for each unit. Definitions of key terms used in the indicator and parameter descriptions are in Box 2.

Table 1: QINCCE methodology: core indicators and parameters arranged by sub-index

Ecological naturalness index (ENI)	
Indicator	Parameter(s)
Cover type extent (natural area, natural surface and biological artefact cover) ¹	% of unit with each cover type
Impact of alien mammals on native flora and fauna (terrestrial	Score representing the level of pest control for terrestrial and the level and diversity of alien fish

¹² Froude VA, Rennie HG, Bornman JF 2010 The nature of natural: defining natural character for the New Zealand context. *New Zealand Journal of Ecology* 34(3): 332-341
http://www.newzealandecology.org/nzje/new_issues/NZJECol34_3_332.pdf

¹³ E.g. Ministry for the Environment, 2010. International reporting pressure-state-response (PSR) framework. <http://www.mfe.govt.nz/environmental-reporting/international/index.html> accessed 19 November 2010; OECD, 1993. OECD core set of indicators for environmental performance reviews. A synthesis report by the Group on the State of the Environment. Paris, OECD. 39p

¹⁴ Froude (2011)

& freshwater)	species for freshwater environments
Level of protection/ naturalness mobile biota (marine)	Score representing the level of freedom/protection from human harvesting pressure
Progress towards present-potential-cover ¹	Score for <i>progress to present-potential cover</i> for each natural cover type
Hydrological and geomorphological naturalness index (HGNI) HGNI=1-HGIS (Hydrological and Geomorphological Impact Score)	
Indicator	Parameter(s)
Hydrological and geomorphic impacts	<ul style="list-style-type: none"> Score representing the magnitude of each human-mediated change to the hydrology, hydraulics, water quality and/or geomorphology/landform compared to the <i>present-potential natural state</i> % of unit area affected by each human-mediated hydrological and/or geomorphological change
Freedom from buildings and structures index (FBSI) FBSI=1-BSIS (Buildings and Structures Impact Score)	
Indicator	Parameters
Building, structure, paved or surfaced cover	% area/100 in buildings % area/100 in structures % cover in paved/surfaced areas/100 ²
Building & structure height/volume	Score for maximum height (terrestrial or intertidal) of buildings; structures; paved Score for structure volume (subtidal)
Building colour naturalness, reflectivity and prominence (terrestrial & intertidal and water surface)	Score for colour naturalness and reflectivity of buildings; structures; paved/surfaced areas Score for prominence (from public places) of buildings, structures and paved/surfaced areas
Alien cover on structures (subtidal)	Score representing the level of alien cover on structures only

¹ Descriptions of special purpose terms are in Box 2

² Paved or surfaced areas include sealed and unsealed roads as well as hard surfaced areas which may or may not be sealed

Box 2: Special purpose terms used in the QINCCE methodology

Cover type (CT): This includes different types of land and benthic biological cover. It includes natural areas, natural surfaces and biological artefacts (e.g. garden, plantation)

Natural areas (NA) have vegetation or benthic cover (including marine encrusting fauna) and are where natural processes predominate. The species are not necessarily native and may include ecological pest plants and/or alien encrusting fauna.

Natural surface (NS) do not have a readily visible biotic cover (e.g. very steep cliffs, highly mobile sands) and are where natural processes predominate and the biota might be cryptic (eg. lichen) or subsurface (e.g. the invertebrate infauna of intertidal flats).

Present potential state (PPS) is the state or condition that would be present today had humans, their tools and technology and the introduced species they brought with them not arrived in New Zealand. This can apply to hydrology, geomorphology, and cover (including vegetation and encrusting fauna). It can also be used for fauna (e.g. fish and birds). When used for biological components extinct species are not included as the return of such species is not possible.

Present-potential cover (Progress to PPC). Present-potential cover for a site is the cover that would be present had humans and the introduced species they brought with them not arrived in New Zealand. It differs from historical vegetation /cover in that it incorporates the effects of geological, climatic disturbances and other natural changes that have occurred since human arrival and so is not necessarily the “climax” cover, particularly for areas where there are high levels of natural disturbance.

The concepts of *present-potential natural state* (and *present-potential cover*) have been developed to facilitate comparisons of levels of natural character present in different environment types and contexts. *Present potential state* (PPS) is the state or condition that would be present today had humans, their tools and technology and the introduced species they brought with them not arrived in New Zealand. This can apply to hydrology, geomorphology, and cover (including vegetation and encrusting fauna).

The reason for comparing present day state with the *present-potential natural state* is that this provides a standard reference condition that can be applied to all environment types and contexts. It allows natural character levels in different types of environment to be aggregated or compared as appropriate. In some situations it can be difficult to determine the appropriate *present-potential natural state* (including *present-potential cover*). Examples of such situations include environments subject to frequent natural disturbance (e.g. coastal cliffs, estuarine environments, wetlands and dunes with their associated swales). In these types of situation, determining *present-potential natural state* requires a good understanding of hydrological, geomorphological and ecological processes for the area being assessed.

Ecological naturalness index

The key parameters for this index are the percentage of the unit having each cover type; and the score for *progress to present-potential cover* for each natural cover type. Present-potential cover is a special form of *present-potential natural state*. Earlier work had prepared scoring tables for

determining the score that represents *progress to present-potential cover* for a variety of Northland terrestrial environments (Froude 2011). As part of this project scoring tables were developed and refined for other environments (e.g. dunelands and steep and/or exposed locations with skeletal soils, dry alluvial plains and wet alluvial plains). The compilation of these scoring tables drew on experience with applying the methodology elsewhere in New Zealand including the Waikato and the northern South Island. Additional tables have been since been developed to cover a wider range of environments and “succession” pathways (including those involving non-native species). The theory underpinning the concept of present-potential cover, and scoring progress towards this, is described in Froude (2011).

Present-potential cover is typically described in relatively general terms as often the precise species composition (especially on land) would be the product of the characteristics of the site, broad scale environment patterns and processes (e.g. factors affecting broad-scale distribution patterns for individual species) and stochastic factors (e.g. which colonising species arrived first after a disturbance event).

The steps for determining *progress to present-potential cover* are as follows:

- Describe the current cover or covers in a unit (e.g. low mixed broadleaved scrub, intertidal flats with dense sea grass)
- Determine the *present-potential cover* based on the environment type, known natural processes and location-specific environment conditions
- Use the scoring tables to determine the score for *progress to present-potential cover* for each described cover category in the unit

Tables for scoring progress to present-potential cover address wet and dry alluvial flats; erosional surfaces generally and where there are steep slopes, skeletal soils and/or highly exposed sites, dunelands (foredunes, intermediate and back dunes and dune swales); sheltered waters (areas with mangroves and/or saltmarsh, intertidal flats, subtidal reefs and soft-sediment. These tables address the scoring for different levels of alien species invasion in natural areas of any type. They also address the scoring for human-managed biological systems (e.g. plantation forests, pastoral farming).

The third component of the ecological naturalness index is a parameter that represents the level of naturalness of the fauna (or animal communities). This has less impact on the index than the cover parameters. A different parameter is used in each of terrestrial, freshwater and marine coastal environments. This reflects the different pressures on faunal naturalness and the practicalities of assessment for a regional scale project. As it is not practical to obtain *state* or condition information for the fauna in a regional scale assessment, *pressure* indicators and parameters were used. Froude (2011) provided the rationale and scoring protocols for the following *pressure* parameters¹⁵:

- Score for freedom from alien mammalian species as represented by the long-term pest eradication/control strategy (terrestrial)

¹⁵ As in the OECD pressure-state-response model for indicators Organisation for Economic Co-operation and Development 1993. OECD core set of indicators for environmental performance reviews. Environmental Monographs No 83. Paris. 39 p.

- Score for freedom from alien freshwater fish species as represented by the known absence of alien fish species (freshwater)
- Score representing the level of protection from human harvesting pressure (marine)

Subsequent experience has shown that the scoring protocols initially used for terrestrial environments had too large an impact on the overall scores at the regional or sub-regional assessment scale. The scoring range has been modified to address this problem and is now 0.8-1 with the same four options as set out in Table 6.2 in Froude (2011). For marine environments the score representing the level of protection from human harvest pressure is as set out in Table 6.3 in Froude (2011) although this table has now been expanded to incorporate different levels of fishing restrictions using information from Froude & Smith (2004) and elsewhere. The scoring range used for this parameter ranges from 0.7-1.

Hydrological and geomorphological naturalness index

The parameters for human-induced hydrological and geomorphological change address the magnitude of each impact and the proportion of a unit affected by that impact. Hydraulic changes are also addressed as are aspects of water quality (from the perspective of the environment rather than human health). Table 6.4 in Froude (2011) contains the scoring system for on-site changes while Table 6.5 addresses the protocols for scoring off-site impacts. Some additional matters have been added to these tables. The proportion of the unit affected by each change is estimated using ortho-rectified aerial images or marine charts, field inspection as required and other sources of information where these are available.

Hydrological and geomorphological naturalness is assessed relative to the equivalent *present-potential natural state*. Scoring tables have been developed to measure the magnitude of different human-mediated hydrological and geomorphological changes (Froude 2011). A special category of these changes is those that result from off-site human activities. Such changes include:

- Increased levels of or changes in the type of sediment reaching aquatic environments from human activities in the catchment;
- Increased nutrients and/or contaminants reaching aquatic environments from human activities in the catchment;
- Changes in sedimentation patterns resulting changed hydraulics (especially scour velocity and fetch-limited resuspension) caused by causeways and similar structures

Scoring tables have been developed in Froude (2011) and since expanded. This expansion drew on experience with applying the methodology elsewhere in New Zealand including the Waikato and the northern South Island.

Protocols for addressing interactions between the hydrological (including hydraulics and water quality), geomorphological (including the characteristics of sediment), and cover parameters have been developed. This includes distinguishing between natural versus human-induced disturbance, and on-site versus off-site sources of disturbance. These protocols are particularly important for assessing natural character in areas where there has been an especially wide range of human impacts on hydrological, water quality and sediment characteristics that have a major impact on land/benthic cover. Protocols have been developed to avoid double-counting of impacts.

To avoid inappropriate double counting of impacts caused by off-site human activities, Table 7.1 in Froude (2011) sets out the protocols for addressing different types of disturbance. This is particularly relevant to aquatic environments where up-catchment activities can result in changes in the types and amounts of sediment and nutrients reaching downstream or down-current aquatic environments. There can be a long period of off-site adjustment following hydrological, hydraulic and geomorphological disturbance at a site that is typically up-stream or up-current.

For example, in the Firth of Thames, an area that was previously intertidal sand flat was transformed into mangrove forest by the deposition of millions of cubic metres of mud following catchment deforestation and later floodplain isolation. Deforestation largely occurred from the 1850's to the 1920's. Floodplain isolation was developed from the 1920s to the 1970s. Mangrove colonisation began in the 1950's when the surface elevation reached 0.5m above mean sea level. Mangroves now extend 1km seaward of their 1952 seaward boundary and in places more than one metre of fine mud has accumulated on top of former sand flat (Swales & Bentley 2008).

In the context of the QINCCE methodology, the impacts of the changed hydrology and geomorphology resulting from human actions at another location are addressed directly in the hydrological and geomorphological naturalness parameters for the off-site location(s). To avoid double counting the impacts, the *present-potential cover* for the biotic or surface cover is *reset* to that which is appropriate for the changed hydrology and geomorphology. This *reset* only applies where the human actions that led to the changes are off-site ones (Table 7.1 in Froude 2011).

Freedom from buildings and structures index

The rationale and assessment protocols for the relevant parameters are addressed in Chapter 6 of Froude (2011). This includes the scoring protocols for:

- building and structure height
- building and structure colour naturalness and reflectivity scores for terrestrial and intertidal environments

Subsequently, building and structure colour naturalness and reflectivity scores have been combined and averaged, with a new score given for building prominence. This was in response to feedback and experience obtained applying the methodology elsewhere in New Zealand including the Waikato and the northern South Island as well as in Northland. These parameters do not have a large impact on the score and are so are scored over a small range. The building prominence score uses the same scoring range as building reflectivity and colour naturalness (0.8 when there is a low level of prominence from public places to 1 when prominence is high). Public places include reserves and other public space and the coastal marine area.

In subtidal environments the colour naturalness and reflectivity of structures are not especially relevant since structures are rapidly covered by encrusting organisms unless antifouling paints are used and regularly reapplied. A major potential impact of structures in subtidal environments is that they provide a new surface that can be colonised by alien invasive flora and fauna. This specific impact is not addressed in the ENI and is therefore included in the BSIS for subtidal environments. Apart from the wreck of the Canterbury which was deliberately sunk in Maunganui Bay, Bay of

Islands after all alien species had been removed, it was not necessary to use this parameter for this project. This is because areas with significant marine structures were excluded from measurement using the initial screening criteria.

Defining natural character units

Criteria for defining unit boundaries were developed to address environment type (see Table 3), management regime (e.g. management for conservation versus production purposes), cover including density of alien species, and relative natural character homogeneity at the scale of mapping. Units were delineated manually on printed aerial imagery and on bathymetric charts for the marine environment away from the near shore. A scale of 1:25,000 was used for the initial delineation of units. Units were subsequently digitised as polygons with geo-referencing. Each geo-referenced unit has a unique identifier that links it electronically to a database containing that unit's description and a variety of parameter data.

The size of units varied depending on the complexity of environment types in an area and the variability in natural character at scales appropriate to the scale of the project. For example, there were large units covering extensive areas of indigenous forest at a similar stage of maturity or extensive areas used for a similar intensity of agriculture. Conversely, small units were used where the environment type was limited in extent in a particular location or a small feature (e.g. quarry, mature forest remnant, marine farm) was significantly different from its surrounding matrix. In some areas the complexity of the local environment meant that a unit had to contain more than one environment type.

The “environment type” was used to assist in the assigning the appropriate *present-potential cover*. For some environment types there are different *present-potential covers* that reflect a gradient in environmental conditions and/or age of formation. For example there would be different present-potential covers for each of the foredune, intermediate and back dunes, and dune swales/wetlands within a broad environment type of dunelands. Table 1 sets out the coastal environment types used at a 1:10,000-1:25,000 scale of terrestrial and near-shore natural character measurement. This typology is applicable throughout New Zealand (although *present-potential cover* will vary to address local bioclimatic and geological differences and species distributions). The classification covers both terrestrial and aquatic coastal environments.

Table 3: Environment types used in assessing natural character

Environment type	Definition	Code
Alluvial	Where sediment has been moved by water. This includes some coastal features (e.g. chenier plains) as well as river features	AL
Aeolian (dunelands and associated features)	Where sediment has generally been moved by wind. While supratidal sands are usually initially transported by water, supratidal sediments are generally included as part of the inland adjoining duneland environment	DU
Erosional Erosional steep	These are surfaces formed by erosional processes. A sub-group of “steep” erosional surfaces that includes areas such as coastal cliffs and faces where a different <i>present-potential cover</i> is used because of the steepness of the site	ER ER-s

Environment type	Definition	Code
Erosional open coast	and skeletal soils A further subgroup of “open coast” erosional surfaces includes those directly exposed to the impacts of oceanic swells and open ocean climate and sea conditions (and the associated winds and salt-spray). A different <i>present-potential cover</i> is used to recognise the impacts of natural disturbance processes.	ER-o
Erosional steep open coast	Some areas are both steep/have skeletal soils and are subject to the effects of oceanic swells, sea conditions and climatic conditions. <i>Present-potential cover</i> is adjusted to recognise these combined impacts.	Er-s-o
Island	This is a secondary environment sub-type used in addition to the core environment type (e.g. erosional). Islands on the open coast can be isolated from seed sources and pest reinvasion and are often exposed to extreme disturbance regimes.	IS
Lake	This includes lakes and lagoons – where the later may have brackish rather than fresh water.	LA
Lava	This is where the surface is a relatively recent lava flow. In this project it is mainly used in the Kerikeri Inlet and nearby environs. There are also a few lava outcrops on the open coast	L
Sheltered waters	These are marine units where the waters are protected from open ocean swells	SW
Marine- near shore	Marine areas less than 30 metres in depth that are not sheltered waters	MN
Marine -offshore	Marine areas deeper than 30 metres out to the Regional Council coastal marine area boundary	MO
Reclamation	Reclamations. No high or outstanding areas are reclamations	R

Calculating the scores

Froude (2011) contains a detailed evaluation of the rationale and the approach used to construct the natural character indices. There are three primary sub-indices:

- Ecological naturalness index (ENI)
- Hydrological and geomorphological naturalness index (HGI)
- Freedom from buildings and structures index (FBSI)

The formulae for each of these sub-indices is constructed so that their calculated value lies between 0 and 1, and when multiplied together, the natural character index calculated value also lies between 0 and 1. Figure 2 provides a diagrammatic representation of the indices (ENI (ecological naturalness index); HGNI (hydrological and geomorphological naturalness index); FBSI (freedom from buildings and structures index)) for several units.

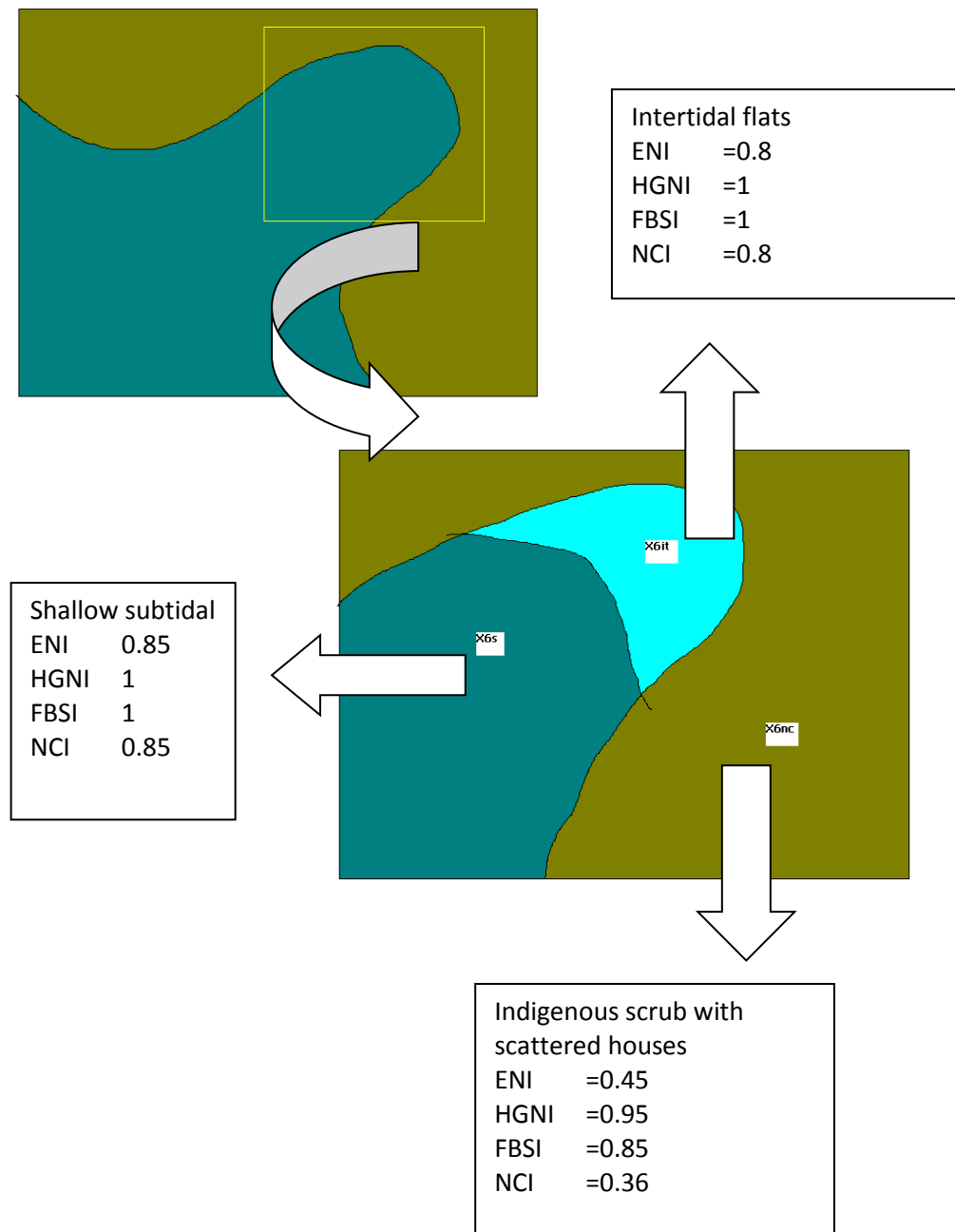


Figure 2: Diagrammatic representation of the QINCCE methodology. Source Froude (2011)

Detailed description of the process used for determining areas of high and outstanding coastal natural character for the Northland proposed RPS

Defining the coastal environment

The first stage in this process was to define the inland extent of the coastal environment. The coastal marine area (part of the coastal environment) had been previously defined by the Resource

Management Act¹⁶ and as part of preparing the earlier operative Northland regional coastal plan. The inland coastal environment boundary was defined by Glenn Mortimer (Mortimer Consulting) as part of the current Northland Mapping Project. It was necessary for the inland coastal environment to be defined before we assessed the coastal natural character of an area. There were changes to this boundary over the course of the project requiring adjustments in the assessments of natural character in some areas.

Trialling

The natural character assessment methodology used in this project was tested in trials covering the Waitangi area in the Bay of Islands and the Whangarei Heads. These trials were discussed with some stakeholder groups and reported to Council prior to the full natural character assessment of the region beginning in 2012. Refinements were made to the methodology to address various issues raised by stakeholders, including a desire to see larger (and therefore more heterogenous) units used for assessing and reporting natural character.

Defining and digitising units for assessing natural character

Unit boundaries were digitised from scanned hand-marked-up imagery at a scale of 1:25,000. The early feedback received from those consulted on the methodology was that they preferred that there be larger units. This seemed appropriate given the scale of the total project (more than 3000km of coastline). Accordingly some initial units included several patches of high natural character connected by smaller areas that were of less than high natural character. The initial criteria for defining units (especially having a single environment type) led to the creation of some relatively small units even though they may have been part of a larger continuum.

The initial marking up was done on 1: 25,000 A3 laminated paper prints of the most recent satellite imagery owned by Council at that time. The quality of these prints was often poor with only older SPOT imagery being available for some locations at the time the mapping was undertaken. Some of the older, as well as the most recent images, were of poor quality with high levels of cloud cover and shadow. Accordingly some of the digitising of the marked up imagery was generalised and did not follow detailed vegetation or other appropriate boundaries as had been intended.

Assessing the natural character of units

A comprehensive set of criteria (see Box 3) was used to determine which areas of the defined coastal environment were definitely not of high natural character. Those areas were grouped into units (largely based on environment type), briefly described, assigned a unique identifier and mapped (firstly on aerial image mosaics and then digitised). This was a conservative assessment and so a number of locations that proceeded to the next stage of assessment did not make the final proposed RPS maps of high or outstanding natural character

¹⁶ Under the Resource Management Act s2 the coastal marine area is the foreshore, seabed, coastal water, and the air space above the water:

- (a) Of which the seaward boundary is the outer limits of the territorial sea (12 nautical miles)
- (b) Of which the landward boundary is the line of mean high water springs, except for a more detailed formula for river mouths

Box 3: Screening criteria used to assess whether areas may be of at least high natural character

- **FBSI (all required)**
- Absence of a moderate density or bulk of structures and/or buildings unless part of a mature predominantly indigenous forest unit
- Absence of a large paved or surfaced area
- Absence of moderate intensity of roads or vehicle tracks
-
- **ENI (1 required)**
- The cover is predominantly indigenous OR this can't be determined for initial assessment
- AND/OR There is intensive predator control OR There are major restrictions on harvest
-
- **HGNI: (required)**
- Absence of quarries, open cast mines, landfills, reclamations, stop-banking, major drainage, dredging, dumping, major land re-contouring
-
- **Experiential (all required)**
- Absence of regular significant industrial, commercial, residential, or recreation/entertainment sounds and odours
- Absence of regular intensive artificial night light

Areas that met these criteria were then assessed using the QINCCE methodology (as previously described)

1. To do this relevant descriptive and other evaluative information was collected for each unit. The primary methods for doing this were field evaluations and assessments of remote (satellite) imagery. The field assessments were made from water craft in the coastal marine area and other water bodies with public access, walking intertidal areas, driving along roadways and walking in other areas of public land (especially Department of Conservation and Council managed lands). Where-ever possible dunelands were visited to ensure that there was an accurate assessment of the levels of weed invasion in different locations. Forest canopy weed levels were usually able to be assessed from a distance using binoculars and for those locations where there was a reasonable quality of available satellite imagery (from Council, or Google and Bing). Existing technical documents and other sources of information (e.g. Council website for water quality, Oceans 20/20 survey data, lake assessment and PNA programme reports) were also used in the assessment process, and were particularly important for inaccessible areas.
2. Descriptive information and data were entered into Excel spreadsheets and the natural character indices were calculated.
3. Indicative numerical thresholds based on work in several regions of New Zealand were used to create an indicative schedule of units of high and outstanding natural character. Each unit was then reviewed to determine whether it should be downgraded a rank. Reasons for such a downgrade included: very small size; high levels of anthropogenic sound and (night) light

4. The thresholds were adjusted upwards several times by Council and the unit boundaries were revised following informal landowner consultation. Step 3 was repeated before the revised maps were included in the proposed RPS

Draft maps used for consultation

Once the draft maps were sent out for landowner comment it became clear that the digitising needed to be at a finer scale. In response to Council requests and landowner submissions the boundaries of the units were refined considerably and the outcome re-digitised. The new units no longer contained the connecting areas of less than high natural character. In many case larger units were split into a number of small units. The new boundaries were more accurate at detailed assessment scales with buildings, roads, pasture, plantations, blocks of introduced trees and areas with plant pest species excluded wherever practicable.

Setting numerical thresholds for natural character

Based on indicative work in Northland and elsewhere in New Zealand, the initial Natural Character Index thresholds for high and outstanding were initially set at 0.40 for *high* and 0.60 for *outstanding*. After several reviews Council selected the following thresholds used to generate the Proposed RPS natural character maps: 0.43 and above for *high* and 0.62 and above for *outstanding*. As a result a number of units were reassigned from either *outstanding* to *high*, or from *high* to *not high*. This, along with the boundary revisions reduced the extent of the terrestrial and marine areas within the coastal environment with a ranking of either *high* or *outstanding*. Boundary changes and exclusions for some units also led to higher scores in some instances.

Preparing the maps for the proposed RPS

The re-digitising process included refinements to the LINZ (Land Information New Zealand) coastline that had been used previously. This led to the inclusion of some intertidal rock platforms and beaches in adjoining land units in some locations.

The re-digitising and review process changed the boundaries and therefore the attributes of many units. In some cases units were combined. Every effort was made to update the original descriptions and scoring in the time available following this process.

As part of the review process Council decided that it would only include high and outstanding ranking for areas of the open coast where there was sufficient information to draw precise boundaries. In other parts of the open coast the ranking would be *Unclassified*. The estuaries and harbours were all assessed and have been mapped for natural character.

Proposed RPS mapped areas

Areas of high and outstanding natural character in the coastal environment are shown in the proposed regional policy statement maps. A depicted area may include several different natural character units with distinctive attributes. The natural character indices for these units may be similar or they may differ within the numerical range for each of high and outstanding.

The RPS natural character maps are supported by a series of worksheets. These worksheets include an A4 map of the same area showing the unit number, unit boundaries and a table with summary

information for each unit. The worksheet tables contain a summary description, a summary of the values contributing to the ranking, the ranking, the natural character index, as well as locality and environment type for each unit. The data used to calculate the natural character index are in a master spreadsheet.

Changes arising from Council decisions on the proposed RPS

After considering submissions on the Proposed RPS, the Council made a number of changes to the natural character mapping. The main change made by the Council was to raise the threshold for HNC from a NCI score of 0.43 to 0.44. This removed a number of HNC units. These units were scored at the lower end of the HNC rank although some units included small areas of higher natural character (often moderately mature native forest). The Council decisions also resulted in a number of site specific changes to natural character maps in response to submissions. A number of these decisions followed the s42A report recommendations – many of which were based on new field inspections and subsequent analyses leading to boundary revisions, description and scoring changes.

Following the Council decisions the RPS maps, the master spreadsheet, and the associated A4 unit maps and tables were amended to reflect the decisions made.

Natural character restoration priorities

Policy 14 of the New Zealand Coastal Policy Statement 2010 requires that restoration or rehabilitation of the natural character of the coastal environment be promoted by:

- Identifying areas and opportunities for restoration or rehabilitation
- Providing appropriate policies, rules and other methods in regional policy statements and plans
- Imposing or reviewing (where practical) restoration or rehabilitation conditions on resource consents and designations

The assessment of coastal natural character made in this project has identified key restoration and rehabilitation priorities. These priorities are not linked with specific sites as it is recommended that landowners and administering agencies be actively involved in any process which might do this.

The following restoration and rehabilitation priorities for the coast are divided into marine, freshwater and terrestrial environments. They address matters that could be directly influenced by Resource Management Act related processes as well as those that fall outside the influence of that Act and the direct responsibilities of Council.

Terrestrial restoration priorities

The loss of natural character has not been spread evenly across different terrestrial coastal environments. Like much of New Zealand Northland's terrestrial natural character (especially the ecological component) has been considerably modified in many locations. However, Northland is fortunate in retaining a variety of terrestrial coastal areas that have a very high or outstanding level of natural character (e.g. mature native forest patches in the Kaipara Harbour tributaries, Maungonui Bluff forest, coastal forest patches in between Whangaruru and Bream Head, dunelands around North Cape. Very little indigenous vegetation approximating the state prior to human impact

still remains. In addition, in many areas there has been considerable hydrological and/or geomorphological/landform change. Stop-banking of rivers, drainage of wetlands (using drains and flapgates) has led to considerable change in soil moisture levels (i.e. from wet to drained). This, and the loss of the periodic flooding from the river, has led to other changes in soil properties. Those few floodplain forest remnants that remain can be vulnerable to weed invasion and stock grazing.

Dunelands have also been considerably modified in many parts of Northland with the area of active dunes contracting significantly since the time of the first aerial photography (Hilton et al. 2000; Hilton 2006). However a number of highly natural areas still remain. Northland is fortunate, from a natural character perspective, in that non-native marram appears to be less competitive than in the South Island and the native sand binders (e.g. *Spinifex*) seem to be more competitive. Consequently there are still duneland areas with largely indigenous vegetation. Weed species are a major threat, especially pampas, gorse, wilding conifers and wattles. A variety of other weed species are present in specific locations.

Northland has a long length of coast with coastal cliffs and faces. While these areas can be refugia for important native species (e.g. Surville Cliffs) they can also be vulnerable to weed invasion, especially after disturbance. Weed management in such areas can be hazardous and expensive.

In those areas of Northland with poorer soil a number of previously farmed areas have been left to regenerate following early clearance of indigenous forest (in many areas). In many cases the current regeneration is largely towards indigenous vegetation. Weed invasion is a major problem generally with the amount and number of species of weeds increasing significantly near areas that have long been settled by Europeans. Older remnant areas can be vulnerable to stock grazing if they are not fenced and nearby land use is pastoral farming. Fire is a significant risk in some locations. As with much of New Zealand animal pests have a major impact on indigenous birds and other wild life. In Northland a number of local communities have established sustained animal pest control programmes, in addition to those managed by public agencies

The first key restoration priority for terrestrial coastal environments is the effective management of plant and animal pest species. Particular priorities include:

- Eradicating key pest species where they are present at low levels, especially in sites that otherwise display a relatively high level of naturalness. An example would be marram in the dunes south of Kauri Mountain,
- Investigate more effective and economical methods for controlling important pest plant species in terrestrial coastal environments including pampas and Sydney Golden wattle.
- Maintaining and enhancing the areas subject to animal pest control
- Development of a strategy for weed management in coastal Northland as effective long-term control often involves landowners working together to manage existing populations and reduce reinvasion and spread
- Expand the assistance available to landowners for (environmental) weed management in coastal natural areas

In many areas the fencing of forest remnants and other indigenous vegetation from stock browsing is the most important restoration action. Finance for fencing can be a major impediment and so the

continuation and expansion of various funding sources to assist landowners would be a priority. It is suggested that priority areas for fencing (from a natural character perspective) would be native forest remnants on alluvial plains; mature native forest patches elsewhere (where grazing is a threat); wetlands and indigenous vegetation on dunes.

Marine restoration priorities

Estuaries and harbours

Human impacts on Northland estuarine and harbour natural character have been more diverse than for the open coast. These impacts include:

- Dredging (to make and maintain channels) and the associated spoil dumping;
- Introduction of alien species either deliberately (e.g. *Spartina*) or accidentally (e.g. Pacific oyster initially)
- Increases in the amount of (especially fine) sediment transported from the catchment to estuaries/harbours (resulting from vegetation clearance, earthworks, floodplain isolation etc)
- Increases in the amount of nutrients and contaminants transported from the catchment to estuaries/harbours (from both point source discharges and diffuse source discharges resulting from land use practices) is the most widespread impact)
- Reduction in water clarity and the associated loss of intertidal sea grass beds and reduction in range for various marine algae species
- Creation of causeways leading to changes in the hydraulic attributes of flows and therefore sediment deposition rates
- Reclamations and other causes of reduction in tidal prisms (the intertidal volume) of inlets
- Construction of ports, marinas, sea walls etc.
- Placement of structures
- Channelisation of rivers and construction of stopbanks thereby increasing the scouring effect, velocities and sediment-transporting capacities of river floods reaching estuaries
- Drainage of catchment wetlands

Depending on location, some of the key estuary/harbour restoration priorities include:

- Continuation and expansion of the sea grass restoration trials to bring back sea grass beds to areas of previously damaged habitat in mid-outer Whangarei Harbour. If this is successful this could be extended to other estuaries where there has been recent sea grass loss. This would be conditional on the causes of that loss being addressed first (e.g. improvement in water clarity and reduction in turbidity)
- Removal of all infestations of the invasive cord grass *Spartina* (e.g. parts of Bay of Islands, Hokianga). This is a high risk species that is still present in a few confined locations
- Extending controls on fishing activities that damage benthic communities. Shell fish dredging can significantly damage benthic communities and habitats. Preventing dredging of areas where there are vulnerable habitats/ benthic communities could give those habitats/ communities a chance to recover to a more natural state

- Managing the catchment and especially riparian margins in a way that reduces the amount of sediment, contaminants and nutrients reaching estuarine and other near shore waters to more closely match the natural state. This recognises that different estuaries naturally have different nutrient regimes dependent on the nature of the catchment (geology, wetlands, catchment size etc.)
- Providing opportunities for upper estuarine ecological communities (e.g. saltmarsh) to migrate inland as a response to sea level rise and other environment changes. Upper estuaries have shallow gradients and very small increases in sea level can lead to noticeable changes in these areas. Where the estuarine margins have been drained and/or stopbanked there is little opportunity for these ecological communities to move inland. Mangroves can migrate inland into saltmarsh, but where the inland margin of saltmarsh is constrained by drains, stop-banks etc. the extent of saltmarsh will gradually reduce over time.
- Allow the full re-flooding of partly drained coastal wetlands. In a number of areas drainage attempts have led to the abandonment of areas that are not able to be profitably used for agriculture but are at the same time highly vulnerable to weed invasion. In the eastern Far North (e.g. Rangaunu Harbour margins) there are a number of partly drained wetlands that have been invaded by weed species that would not survive in a fully re-flooded area. Sydney golden wattle and pampas are examples of such weeds.

Open coast

A noticeable feature of the open coast out to the 12 nautical mile limit is the low proportion of the area where a ranking of outstanding could be confidently assigned. This is primarily because only a few areas of open coast in Northland are closed to potentially damaging fishing activities and/or are effectively protected from high levels of harvest of key species of marine biota. Key species are those where changes in their abundance and mean size can lead to a cascade of effects throughout the marine ecosystem. For example the removal of large snapper and rock lobster has been shown to have a major impact on the naturalness of near-shore rocky reef ecosystems in north-east New Zealand. Where snapper and rock lobster populations are able to recover over time following the establishment of a no-take marine reserve, their predation of sea urchins can lead to a dramatic recovery in shallow benthic communities from ones dominated by kina barrens to ones dominated by macro-algae (Shears & Babcock 2003).

In locations close to population centres recreational fishing can significantly affect marine ecosystems even where commercial fishing is not allowed. For example, at Mimiwhangata the no-commercial-fishing marine park status has not led to the recovery of a more natural marine ecosystem compared to that found in nearby areas without such restrictions (Shears et al. 2006). In areas that are more remote and difficult to access by recreational fishers, such status would be likely to lead to improved recovery towards a more natural state.

The first restoration priority for the Northland open coast is to restrict the extent of locations where fishing practices can damage benthic habitats and ecological communities. This is particularly important for those benthic communities and habitats that are most vulnerable to physical trauma and for which the recovery period is extremely lengthy, if at all. An area to the north of Tom Bowling

Bay is an example of an area where the key damaging activities (in this case dredging, seining and netting) have been prohibited.

The second restoration priority for the marine open coast is to set aside more of the Northland Coast as either marine reserves (“no-take areas”) or locations where only a few species (e.g. Kina and other urchins) can be harvested using restricted methods. At present the only area on the open coast that has such a fully protected status on a long-term basis is the waters around the Poor Knights Islands.

Freshwater priorities

Coastal lakes and lagoons

The ecological condition of most of Northland’s lakes is monitored using Lake SPI methodology (Wells et al. 2006; Wells & Champion 2010). This resource can be used to identify specific priorities for particular lakes. Key threats to coastal lakes are nutrient enrichment, grazing of margins, weed species and pest fish.

Restoration priorities would be:

- Containment or preferably removal of pest fish species in lakes where infestation is recent and/or there is risk of spread to other lakes that are free from those species
- Containment of pest plant species and removal in locations where there is risk of spread to lakes of particularly high levels of natural character (i.e. only native plants (or at least no significant pest plants) & only native fish species)
- Fencing off a buffer zone around lakes that are vulnerable to grazing to allow natural emergent vegetation and lake shallow-zone herbfield to regenerate
- Managing catchment land use practices to reduce nutrients reaching the lake to levels more closely matching the natural state. This recognises that lakes can naturally have different nutrient regimes.

Rivers

Restoration priorities for the estuarine components of rivers have been addressed under marine environments. For those tidal rivers that have not been extensively modified by stop-banking and channelization the key threats to natural character include: invasive species (e.g. alligator weed); increased sediment and nutrients from the catchment land use activities (especially riparian and seep management). Restoration priorities would be:

- Managing catchment land use practices to reduce levels of sediment and nutrients reaching the river to more closely match the natural state. This recognises that river can naturally have different sediment and nutrient regimes
- Fencing riparian margins in areas where there is stock grazing. Priority areas would be those where indigenous vegetation, especially in wetlands and seeps, already directly provide natural character benefits and where it helps to reduce nutrient inputs to the river
- Investigate how to more effectively control alligator weed in a cost effective way

- Planting (fencing and maintaining) indigenous riparian vegetation in those locations that contribute proportionally larger amounts of sediment and nutrients to the river

Priority rivers for action would be those that still have high levels of natural character and those that flow directly into estuaries and harbours that have outstanding or very high levels of natural character

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