Prioritising wetlands for long-term monitoring in Otago under the National Policy Statement for Freshwater Management (2020)

Otago Regional Council

Upper Taieri Scroll Plains, Maniototo, Otago

William G Lee and Peter N Johnson

21 August 2023

Otago Regional Council

Summary

The Otago Regional Council (ORC) has requested a framework for selecting a suite of wetlands for regular monitoring as mandated by the National Policy Statement for Freshwater Management (NPS FM 2020). With over 8000 wetland areas (polygons), representing 15 (total 22 nationally) vegetation types of wetlands (Singers and Rogers 2014) spread across 9 Freshwater Management Units (FMU), the ORC requires a framework that would enable them to regularly monitor and report on extent, state and condition trends of a subset, representative of the diversity of wetland types found in the region at the level of the FMU. In this report, we outline the monitoring and reporting requirements in the NPS FM 2020, summarise attempts elsewhere in New Zealand to select wetlands for monitoring, and present variables that could be used to structure a prioritisation framework for monitoring wetlands. Summary tables are available to provide an estimate of the number and extent of wetlands in the different categories across the Otago region based on the categories of Singers and Rogers (2014). We also provide an equivalence table to facilitate interchange between the categories of Singers and Rogers (2014) and the wetland types of Johnson and Gerbeaux (2004) as the latter have not yet been applied at the FMU level. The selection of the final number of wetlands for monitoring will depend on the following:

- relative number of regionally significant wetlands (currently c. 133) that will automatically require monitoring;
- the distribution and frequency of threatened species in wetlands, that may require regular and independent assessment;
- the identification of significant water bodies, primary contact sites, and sites with cultural values, that will need to be included in any monitoring programme;
- inclusion/exclusion within list of priority sites across Otago that capture its full range of indigenous biodiversity to inform conservation decisions and management efforts to maintain and enhance biodiversity in the region;
- the relative prioritisation of the key threats to sustaining and enhancing wetlands (e.g. relative loss, impacts of adjoining land use, etc.);
- the resources available to maintain the monitoring and reporting system.

In this report we suggest of a total of 300 - 400 representative wetlands across Otago, based on polygons and to be sampled using a restricted randomised approach on a ten-yearly rotation. Approximately half of these would represent wetlands within the special categories mentioned above, and half would be selected on a restricted randomisation basis to cover wetland types, within FMU's and elevation bands. Each year, 40 wetlands would be sampled across the spectrum of FMUs, wetland types, and habitat features, with an emphasis on lowland (60%) and montane (30%) sites reflecting threat levels. This approach should enable the ORC to report on the state and condition of wetlands in the region.

Otago Regional Council

Introduction

This report was compiled at the request of Dr Sami Khan, Otago Regional Council, to assist with the implementation of the recent National Policy Statement for Freshwater Management (NPS FM 2020). The objective was to develop a framework for the identification of a representative subset of wetlands for regular monitoring, reporting and policy assessment.

National Policy Statement Freshwater Management 2020

The National Policy Statement for Freshwater Management 2020 (Ministry for the Environment 2020, revised December 2022) has a primary obligation to prioritise the health and well-being of water bodies and freshwater ecosystems in Aotearoa – New Zealand. To achieve this, a major policy objective is to reduce any further loss of extent of natural inland wetlands, to protect their values, and promote their restoration. Other policies seek to protect freshwater ecosystems, particularly water quality, for human use, and to sustain biodiversity. To assess progress and limit environmental deterioration, Regional Councils and Territorial Authorities are required to systematically monitor the extent and condition of wetlands to provide assurance that the objectives of the NPS-FM are being achieved and trending towards improvement. Section 3.18 specifies that monitoring must address the health of indigenous flora and fauna and include attributes capable of quantitative measure while capturing prescribed environmental outcomes at identified time intervals.

The focus of the NPS-FM is on natural inland wetlands larger than 0.5 hectares, except if habitats contain threatened species, in which case smaller areas may be considered. The initial aim is to document and map sites that are outside of Public Conservation Land, on private land where they currently have little formal protection. The priority is to map those wetlands at risk of loss and those identified in farm plans or in existing or new resource consents, but the further objective is to include all natural inland wetlands over the next decade. This inventory needs to include identifier, location, extent, and classification as to wetland type. A monitoring plan is also specified in the NPS-FM, measuring the wetland condition, values, and extent to assess the effectiveness of council policies. Councils are also required to have methods in place outlining how they will respond to any decline in wetland extent and condition.

The NPS-FM identifies values associated with ecosystem health and threatened species that are relevant to wetlands (Appendix 1). For ecosystem health there is an emphasis on five biophysical components (water quality, water quantity, habitat, aquatic life, and ecological processes) as important functions of wetland ecosystems. An authoritative list of threatened species across biota is maintained by the Department of Conservation. Threatened species in the New Zealand Threat Classification System (NZTCS) and distributions are compiled for all higher risk categories regionally. Other values are identified in the NPS FM 2020 (in their Appendix 1B) and many of these are relevant for wetlands, namely the relative dominance of indigenous flora and fauna, and the position and influence of the ecosystem on sustaining water quality and quantity. The NPS-FM also specifies compulsory attributes requiring limits on resource use (Appendix 2A) and National Targets for human contact with selected rivers and lakes (Appendix 3), but comparable features have not been identified for wetlands.

Monitoring and reporting requirements

The NPS FM 2020 states that *information (including monitoring data) about water bodies and freshwater ecosystems, and the challenges to their health and well-being, is regularly reported on and published* - Policy 14. This is undertaken through a National Objectives Framework (NOF) and is based on identification of community values and set environmental outcomes for wetland ecosystems for each FMU. These may reflect a combination of agreed baseline states and target attributes.

The NPS Freshwater Management (2020) requires monitoring and reporting at the FMU level. This involves (Section 3.8) maintaining a list of natural wetland sites to be monitored, including those with habitats of threatened species, those considered outstanding water bodies, and those identified as primary contact sites with significant human use for recreational and other purposes. The monitoring is also to consider both mātauranga Māori and the indigenous flora and fauna. The methods used must be able to link management and environmental outcomes for the FMU.

In summary, sites selected for monitoring need to be:

- Representative of the natural wetland types within the FMU;
- Include all outstanding water bodies and culturally significant sites;
- Include primary contact sites having significant human use for recreational and other purposes;
- Sufficient in number to show reliable trends for extent and condition of wetlands in the FMU.

Wetland selection at a national level

Wetland typology: The identification of wetlands for ongoing monitoring depends on recognising the full range of wetland types in New Zealand. Johnson and Gerbeaux (2004) established the first national approach to classifying wetland types. They used a wetland classification based on a semi-hierarchical approach recognising nine hydrosystems (nival, riverine, plutonic, geothermal, estuarine, lacustrine, palustrine, inland saline, and marine), and nine wetland classes (swamp, shallow water, marsh, ephemeral wetland, fen, bog, seepage, saltmarsh, pakihi and gumland). Subsequently, these have been widely used in mapping and assessing wetlands and remain the standard classification used by regional councils. More recently Singers & Rogers (2014) developed a classification of all terrestrial ecosystems, and these have also been applied by the Department of Conservation and regional councils. Bellingham et al. (2021) attempted to reduce the 152 terrestrial ecosystems identified by Singers and Rogers (2014), including wetlands, to assist monitoring and reporting. The 21 wetland ecosystems of Singers and Rogers (2014) were merged into a generic "non-forested freshwater wetlands" but in their Appendix 1 there is a full list of both forest (e.g. WF8 Kahikatea/Pukatea forest) and non-forest ecosystems they would include in their generic understanding of wetlands.

Wetland prioritization: Early approaches to identify important wetlands in New Zealand were based on expert opinion (Cromarty and Scott 1996) and this remains a characteristic of many approaches to prioritising ecosystems for management today, especially when information is uneven or sparse for many wetlands and biota. A further factor is that many communities have already selected local wetlands based on historic use. However, Ausseil et al. (2008a) were the first to apply systematic conservation criteria to provide a nationally consistent overview of New Zealand wetlands. They linked databases comparing historic/current extent to calculate loss, utilised a spatial explicit

wetland classification system (Johnson and Gerbeaux 2004) to determine wetland type, and used a new anthropogenic pressure index developed by Stephens et al. (2002) to determine threats. The latter combined six indicators known to degrade ecosystem function and extent, namely natural vegetation cover, human-induced vegetation, introduced fish species, cover of woody weeds, artificial drainage, and nitrate leaching reflecting landuse intensity. These were calculated at three spatial scales (catchment, 30m buffer, and within wetland).

Ausseil et al. (2011) applied principles of systematic conservation planning to remote sensing data within a geographical information system (GIS) to identify nationally important palustrine and inland saline wetlands in New Zealand. They use biogeographic units, subdivided into catchments, and map wetlands using satellite imagery. They field-assessed results in the Otago region and found 60% agreement with remote sensing classifications, mainly because of the misclassification of marshes into swamps. Importance values for wetlands were based on condition estimates determined from measurements of human disturbance (natural cover, human-made impervious cover, introduced fish, woody weeds, artificial drainage and nitrate leaching risk) applied at three spatial scales: the wetland's catchment, a 30-m buffer around the wetland and the wetland itself. Nationally, c. 60% of remaining wetlands had condition indices indicating moderate to severe degradation and loss of native biodiversity. The ranking exercise combined condition and complementarity, the latter to ensure a fully representative set of wetlands in New Zealand. The highest ranked sites in each biogeographic unit were usually the largest remaining wetlands that contained multiple wetland classes. However, the approach did not consider connectivity between wetlands or ecosystem services which may have raised the importance of ecological context in the assessment.

For the Otago region, the physiographic units selected were Otago Peninsula, Taieri and Clutha. The systematic conservation analysis assessed the minimum number of sites required to fully represent wetlands in the region. For all Taieri and Clutha wetlands this involved prioritizing up to 14% of the sites in the catchments but on Otago Peninsula over 60% of the sites were required.

Systematic conservation planning is an important approach when conservation management priorities are required to identify sites for formal protection or special management. However, the NPS FM (2020) includes all wetlands and monitoring is required to represent the full range of types in any FMU and region.

Wetland selection approaches used by other Regional Councils

The following provides an overview of how other Regional Councils have selected wetland sites for monitoring under the NPS FM (2020), compiled from information available in the literature and personal communication with staff.

Northland - Bodmin (2010) assessed Northland wetlands for protection and advocated prioritising wetlands for monitoring where historical loss was greatest and wetland types were under-protected. Only 5.5% of original wetlands remain in Northland and Bodmin (2010) recommends that a more detailed assessment is required to identify all wetlands and evaluate priorities for reporting.

Recently, Clarkson and Price (2022) developed a framework for monitoring ecological state and trend of freshwater wetlands in Northland and provided a representative set of priority monitoring

sites. The region has experienced extreme wetland loss (c. 96.8%) in historical times, with bogs as the least impacted wetland type with only 5.4% remaining. Clarkson and Price (2022) selected 61 wetlands for monitoring to represent the region based on magnitude of loss (rarity), current extent, distribution in Ecological Districts, ecological importance, catchment uses and pressures, and current monitoring programmes. The total includes all wetlands ranked in the Top 30, all wetlands currently being monitored, and wetlands with unique or uncommon features, poorly represented attributes, or rare and threatened species.

It is not clear how the distribution of wetlands will relate to FMU units in Northland, but their use of the Ecological District framework ensures unbiased coverage of the region.

Bay of Plenty - Fitzgerald et al. (2013) developed a framework for assessing regional wetland priorities for monitoring based on representativeness of present-day wetlands compared with historical baselines, regional distribution, ecological significance, and range of vegetation types. The objective in their study in the Bay of Plenty was to ensure that a fully representative range of wetlands are monitored to provide an accurate assessment of both changes in extent and the condition for reporting on the NPS - FM 2020. They list approximately 80 priority wetlands, out of a total of 525, to be monitored over a five-year rotation.

They used rarity, current extent, distribution, Ecological District, ecological significance ranking and adjacent land use to identify 79 wetlands for monitoring and reporting. They considered a total of 525 wetlands, but many (399) had insufficient data available for assessment, and the majority of these (184) were small (<1ha). Later, Clarkson et al. (2014) implemented and tested a monitoring system on three of the selected wetlands.

Hawke's Bay - Clarkson and Bartlam (2017) selected 10 wetlands to represent these habitats in the Tukituki Catchment, Hawke's Bay. They used rarity (at Regional and Ecological District scale), current extent, geographical distribution, ecological significance, and vegetation type to identify 10 (out of a total of c. 94) for regular monitoring, which has subsequently been undertaken (Hashiba and Norris 2017). It is not clear how reporting at the Tukituki catchment level will be integrated with assessments at larger scales or whether the selected 10 wetlands are considered representative of all regional wetlands in the long-term.

Greater Wellington Regional Council - The Greater Wellington Regional Council have one of the longest (now 7 years) regional wetland monitoring programmes in New Zealand and have already completed a five-yearly monitoring and reporting cycle. The following summary of wetland selection procedures is derived from Crisp et al. (2018) and Owen Spearpoint (personal communication 2023).

The Wetland Health monitoring programme surveys 150 wetlands across the Wellington Region, which has been partitioned into five whaitua (super-catchment areas) by Greater Wellington Regional Council (GWRC) for the purposes of freshwater planning. They survey thirty wetlands annually, focussing on a single whaitua each year.

The wetlands were selected from a total of approximately 211 wetlands recognised across the region and scheduled in the proposed Natural Resources Plan. This comprised 14 "Outstanding" and 197 "Significant" wetlands. All "Outstanding" wetlands were included in the monitoring network, 74 "Significant" and a random selection of the remaining, ensuring proportional

representation across whaitua. Annually, a total of 30 wetlands in a single whaitua are randomly selected for monitoring.

This approach clearly fulfils the requirements of the NPS FM 2020, enabling the Greater Wellington Regional Council to report on the extent and condition of representative wetlands in the region, including at the scale of the whaitua. However, selection of wetlands to reflect the range of wetland types is less certain, and restricting annual sampling to a single whaitua is being re-assessed because of the potential impacts of local climate events.

Canterbury – Environment Canterbury (ECAN) is compiling a comprehensive database of wetlands in the region before implementing a NPS FM 2020 compliant monitoring system. Recently it developed an inventory of coastal wetland ecosystems, measuring wetland type and extent (Groove et al. 2012) as a baseline for future monitoring. These wetlands comprise terrestrial and estuarine areas and cover a total area 5744 ha. Compositional analysis recognised 173 groups and 11 vegetation structural classes which were aggregated into 45 broader 'vegetation types'. ECAN have completed more detailed monitoring at Te Waihora/Lake Ellesmere, the largest wetland in Canterbury, primarily to measure wetland response to cessation of stock grazing and vehicle access around much of the margins (Grove and Pompei 2019).

Otago – The project of Ausseil et al. (2008b) to identified wetlands of national importance (WONI) was a major advance, applying new and improved spatial databases, quantitative measures of ecological integrity, and a ranking system based on modern conservation planning incorporating measures of conservation effectiveness and complementarity, based on irreplaceability. Otago was divided into three regions. In their Clutha region 29 wetlands were ranked, the highest associated with mountain ranges in Central Otago. A total of 17 WONI were recognised in the Taieri, with highest rankings to the Upper Taieri wetland complex and the Maungatua and Lammermoor wetland complexes. Their Otago Peninsula supported 11 WONI sites with Swampy Summit and Okia Flat wetlands the top ranked. This gives a total of 57 WONI sites in Otago.

Lloyd et al. (2020) provide a map of potential terrestrial ecosystems across Otago, including an improved map of wetlands, comprising 15 ecosystems (Singers and Rogers 2004) and 8374 polygons, covering an area of 35,703 hectares. The over 8000 polygons comprise a combination of actual and potential wetlands and differentiate wetlands that may be contiguous, and therefore considered as one site. The analysis highlights the importance of WL16 red tussock/*Schoenus pauciflorus* tussockland, WL18 flaxland and WL20 Coprosma/Olearia shrubland in Otago. This study provides an important baseline for wetland identification and extent in Otago, and for more precise calculation of wetland loss in the region.

Recently, Leathwick (2020) undertook a conservation planning approach using the software 'Zonation' to rank all terrestrial and freshwater ecosystems in Otago based on their contribution to protecting the full range of biodiversity in the region. The approach prioritises sites, including rivers and streams, and for the first time uses distributional data for some biotic groups. Overall biodiversity condition is calculated from metrics describing the level of habitat fragmentation, risk of weed invasion, disturbance (mainly logging) and presence of introduced browsers. The assessment also combined gains from recent management actions. This enabled the calculation of biodiversity priorities and the ranking of all ecosystems and sites in terms of their contribution to Otago biodiversity. An important outcome of this exercise is the identification of ecosystem loss within FMU's. For wetlands (Table 5) the greatest loss is in eastern areas (Lower Clutha, Dunedin

Coast) with less than 24% remaining. Further west, the Dunstan, Upper Lakes, have more than 85% of the original wetlands intact.

Leathwick's (2020) analysis also identified sites comprising the top 30% of terrestrial ecosystems of the Otago Region and indicates their distribution across LMUs. Many wetland types (15 are listed in Table 8) are identified amongst the top 30% and most of the 53 priority sites (>1000ha) support wetlands to varying extents. However, The Old Man/Old Woman Ranges (WL17), Dismal Swamp (WL16), Sutton (WL14), Nenthorn (WL14), Lammermoor (WL8), Rock & Pillar Range (WL17), Shepherds Creek Hut (WL16), Maungatua (WL22), Taieri lower/upper scroll plain (WL20), Lammerlaw Top (WL8,16,17), Taieri Ridge (WL8,14), and the Waipori/Waihola wetlands (WL18), are primarily significant for their wetlands.

An advantage of Leathwick's (2020) analysis is that it provides a consistent conservation planning approach across terrestrial and freshwater ecosystems and is an important framework for prioritising management activities. Many regional councils are using 'Zonation', providing a standardised national approach. The differential loss of wetland types and wetland areas between FMUs is extremely useful for considering impacts associated with major development projects and/or agricultural intensification. Recent ORC workshops have explored using 'Zonation' to provide a minimum set of priority zones for the protection of indigenous biodiversity representative of the region, and it would be important to include an equal number of wetlands within and outside of these areas, for comparison based on the monitoring of extent and condition. However, the NPS FM emphasis is on capturing data for a suite of wetlands representative of the region, and for this purpose the full spectrum of types and LMUs needs to be considered. In remote western areas and upper elevation eastern areas, however, it may be useful to reduce the level of wetland representation to recognise the greater loss of wetland types in montane and lowland areas.

Wetland Equivalence

There are currently two classifications being applied to wetlands in Otago, and elsewhere in New Zealand: 1) Johnson and Gerbeaux (2004) wetland types and 2) Singers and Rogers (2014) terrestrial ecosystem classification. Operationally, both are being used and it would be useful to have an equivalence or correspondence framework to enable them to be applied interchangeably by ORC, depending on the purpose. The typology of Johnson and Gerbeaux (2004) focuses on the origin and hydrological context of the wetland, whereas Singers and Rogers (2014) utilise plant species composition as the defining attribute. In this section we summarise the equivalence of these classifications to facilitate the application of both in wetland monitoring.

Some difficulties arise in assessing which Singers and Rogers (2014) ecosystem units occur in Otago. Their units are derived from a hierarchical sequence of ecosystem drivers, primarily temperature, moisture, and landform, (but also fertility for wetlands). However, their units are named principally from floristic composition, which can vary greatly with latitude and locality, and which can make it difficult to decide which dominant plant species might signal the application of an ecosystem unit to Otago situations. In contrast, description of wetland landforms and hydrosystems are useful in cases where floristic information does not correspond fully.

Singers and Rogers (2014) names for units sometimes emphasise a plant name (common, genus, or species, for example *Schoenus, Machaerina* that may not necessarily indicate their presence throughout the geographical range of the ecosystem unit. They also deal primarily with 'terrestrial

ecosystems', and hence there is no coverage of aquatic communities that are part of most wetlands in the region. Finally, Singers and Rogers (2014) do not treat non-indigenous communities, e.g. swamp or riparian willow forest or tall fescue marshes.

In our view, the following Singers and Rogers (2014) units are not applicable to the Otago Region:

WL 1 Gumland, Northland

WL 2 Tall Restiads, Northland, Waikato

WL 3 Bamboo rush Northland, Waikato

WL 4 Pakihi (esp. Westland)

WL 5 Restiad rushland Chatham Is.

WL 7 Tall tussockland, Westland Southland … of local *Chionochloa* spp. dominant

WL 21 Swamp akekake, Chatham Is.

Table: Summary equivalence of Singers and Rogers (2014) wetland units with Johnson and Gerbeaux (2004) types.

Note: Johnson and Gerbeaux (2004) annotations are for hydrosystem/ wetland class/ structural class. We also include some non-wetland types identified by Singers and Rogers (2014) that in our view are found in wetland ecosystems in Otago and should be recognised in mapping and monitoring ecosystem biodiversity values.

Singers and Rogers (2014) wetland units	**Johnson and Gerbeaux (2004) hydrosystem/ wetland class/ structural class**
Wetlands	
WL 6 Lesser wire rush	Palustrine/ bog/ restiad rushland
WL 8 Herbfield/ mossland/sedgeland	Palustrine/ bog, fen, seepage/ herbfield, mossfield
WL 9 Cushionfield	Palustrine/ bog/ cushionfield
WL 10 Oioi restiad rushland reedland	Riverine, Estuarine/ marsh/ rushland
WL 11 *Machaerina* sedgeland	Palustrine, Riverine, Lacustrine/ marsh/ sedgeland
WL 12 Manuka fernland	Palustrine / bog, fen/ scrub, fernland etc.
WL 13 *Sphagnum* mossfield	Lacustrine, Riverine / marsh/ mossfield
WL 14 Ephemeral wetland	Palustrine/ ephemeral wetland/ turf
WL 15 Lakeshore turf	Lacustrine/ marsh, shallow water/ turf
WL 16 Red tussock	Palustrine/ bog, fen/ tussockland

WL 17 *Schoenus* sedgeland	Palustrine/ seepage/ sedgeland
WL 18 Flaxland	Palustrine, Riverine/ swamp/ flaxland, shrubland
WL 19 Raupo reedland	Palustrine, Riverine, Lacustrine/ swamp, shallow water/ reed reedland
WL 20 *Coprosma* etc scrub	Palustrine, Riverine, Estuarine/ swamp
WL 22 *Carex Schoenus* sedgeland	Palustrine, Riverine, Lacustrine/ swamp
Relevant Non-wetland types	
MF4 Kahikatea Forest : Kahikatea-dominant swamp forest on recent, poorly drained alluvium, gley and organic soils.	Palustrine/swamp/forest
CLF 7 (forest) Rimu, kamahi, kahikatea, beech, poorly drained alluvium. Note this may be nearest category for forest on alluvial plains and dune flats in Catlins	Palustrine/ swamp/ forest
CDF 1 (cold forest) Pauhatea (cedar) celery pine; hillcrests "including Catlins". Note this may be best match for low cedar bog forest on Ajax Bog, Catlins tops	Palustrine/ bog/ treeland, scrub
AH 3 (alpine) Gravelfield, Cushionfield, includes snowbanks A unit that embraces many upland communities, including snowbanks, some of which are wet.	Palustrine/ seepage/ herbfield
T 15 (cold) Bog pine, celery pine scrub This may apply to bog pine scrub on Otago range uplands adjacent to stream head wetlands	Palustrine/ bog, fen/ shrubland
DN 5 (dune) Oioi, knobby clubrush ephemeral wet dunelands. Otago sites include Catlins, e.g. False Islet	Estuarine/ ephemeral wetland/ rushland
CL 10 (cliffs) (Kiokio fernland) includes cliff seepages. This broad-spectrum type might include coastal slope marshes and seepages with *Carex* sedgelands	Estuarine/ seepage, marsh/ sedgeland
SA 3 (saline) Glasswort herbfield saltmarsh	Estuarine/ saltmarsh/ herbfield
SA 5 (saline) Herbfield coastal turf	Estuarine/ saltmarsh/ turf
SA 11 (inland saline) 'Cooks scurvy grass herbfield', inland saline pans/ herfield, turf	Inland Saline/ marsh

Issues to be considered in developing a wetland monitoring framework

What is a wetland site?

The NPS FM (2020) refers to freshwater ecosystems which include natural inland wetlands, lakes, rivers, and streams. Apart from FMU's, which are constructed by the territorial authority and are usually on a catchment basis, there is no indication in the NPS FM (2020) of the relevant local scale for either recognising or monitoring freshwater ecosystems other than the term "natural wetland". Currently, the most comprehensive database for wetland ecosystems for Otago, produced by Wildlands Consultants, depicts polygons (Lloyd et al. 2020) which are usually assigned to a single wetland unit using the Singers and Rogers (2014) classification. They used Land Cover Database Version 5, FENZ, soil type, and expert knowledge to identify past and present wetland habitats across Otago. The Table above enables these units to be reclassified following Johnson and Gerbeaux (2004), when and if this is required. However, irrespective of the classification used, there remains the issue of the scale of application as wetlands may be extensive and complex, coupled or decoupled, and often comprising several different types.

Contiguous wetland ecosystem polygons could be aggregated, to recognise individual wetland complexes, and these could become the focal wetland sites. This may be a useful exercise in the future to increase the efficiency of monitoring when several different wetland types can be assessed in a common area.

There are advantages in using the current polygons as the primary wetland units, especially when considering the selection of representative wetlands for monitoring. These units have all been mapped and typed, providing a recognisable, relatively homogenous unit. In contrast, wetland sites may be more extensive, represent multiple wetland types, and have varying levels of internal coherence and interdependence. Therefore, it may be more tractable, especially for developing a representative wetland framework, to retain and utilise these polygons as the primary wetland unit. For other aspects of wetland management however the polygons could be aggregated based on co-location.

We understand (Dr Sami Khan personal communication 2022) that the ORC has used both approaches for wetlands mapping thus far but would prefer to use Johnson and Gerbeaux (2004) for selecting a subset of wetlands for monitoring. This could be achieved using the equivalence table provided above. Using Johnson and Gerbeaux (2004) recognises the primary importance of hydro-system for differentiating wetlands, and the critical roles of geomorphology and climate. While Singers and Rogers (2014) provide a useful classification of current wetland habitats, the composition and structure of these reflects confounding influences of historical disturbance, legacy effects, local hydrology, and surrounding land use intensity and patterns. However, the relevant data for Johnson and Gerbeaux (2004) is not currently available for the latest wetlands dataset completed by Wildlands, and we therefore will use the Singers and Rogers (2014) typology for illustrating wetland type distribution in Otago.

Recognised significant wetland sites

ORC has 171 regionally significant wetlands (RSW) as listed in Schedule 9 of the Regional Plan: Water for Otago (2004) and we assume all these wetlands will be included for monitoring. Additionally, a subset of the RSW listed by the ORC are currently being considered as potential candidates for the Outstanding Water Bodies (OWB) defined within the NPS FM (2020) (Dr Sami Khan personnel communication 2023). Irrespective of the final wetlands selected as OWB, we are assuming these are already included in the RSW and will therefore require monitoring.

The NPS FM (2020) also requires monitoring of culturally significant sites and primary contact sites with significant human use for recreational and other purposes. We are unaware whether these have been identified but are assuming they will be included in the essential monitoring suite of wetlands.

Representative of the natural wetland types within the FMU and sufficient to show reliable trends for extent and condition of wetlands in the FMU

The diversity and number of wetlands in the Otago Region, likely more than 8000 polygons, is exceptional for any region in New Zealand, and these span a large range of environments in most of the five FMUs reflecting the altitudinal range, strong temperature and precipitation gradients, complex landforms, and level of maritime influence.

Using the national classification of Johnson and Gerbeaux (2004) there are 8 (out of a total of 9) hydro-systems based on general landform and hydrological settings combined with distinctive water properties, in Otago (Palustrine, Riverine, Lacustrine, Estuarine, Marine, inland saline, Plutonic, Nival). Each of these potentially could support several of the following 10 wetland classes (Bog, Fen, Swamp, Marsh, Seepage, Shallow Water, Ephemeral wetland, Pakahi and Gumland, Saltmarsh).

The Singers and Rogers (2014) typology for wetlands recognises 22 wetland ecosystem units differentiated by hydro-system, soil nutrient status, climate and landform, and the ones in Otago are identified in the Table above.

The NPS FM (2020) requires monitoring of sufficient natural wetlands to represent wetland type and frequency within the FMU, sufficient in number to show reliable trends for extent and condition.

This indicates that monitoring sites need to reflect the proportionate abundance of wetland types within the FMU and the Otago region. However, the loss of wetlands and threats to wetlands in Otago are greatest in the lowland/montane zones and least in the alpine region. We suggest this risk profile be incorporated in the overall monitoring framework with wetland polygons selected to include lowland (60%), montane (30%) and alpine (10%) sites reflecting threat levels.

Currently the frequency of Singers and Rogers (2014) categories within the FMU's can be used to structure the selection of monitoring sites based on the excess of 8000 polygons including wetland habitats. This information is available in Excel spreadsheets.

Monitoring frequency

We will explore monitoring in a second report but monitoring frequency is relevant for assessing the number of wetlands that can be considered in the framework to provide a representative sample. In our experience, some wetland communities are extremely sensitive to regular tracking which may compact peat and alter composition, especially in small wetlands. We are also aware that structural and compositional changes generally occur slowly and are likely to be detected only over decadal time frames in the Otago region. The exceptions are modifications to hydrology, which can dry wetlands within a few months. We would prefer to see a greater number of wetlands included in the sampling, but over a longer timeframe than is occurring in other regions and therefore suggest that the sampling cycle be completed once every 10 years.

Number of sites in monitoring network

It is unlikely that ORC will be able to regularly monitor all the wetlands in Otago and some process for selecting a representative subset will need to be undertaken. How many wetlands are monitored annually will depend on the resources available for wetland monitoring. Quantitative analyses of sampling representation can be undertaken once decisions have been made around RSW, UWB and culturally significant sites, but these are likely to total between 150-200 polygons. We support the addition of a further 150 sites, randomly allocated in proportion to the frequency and diversity of wetland habitats within each FMU. This may provide a total of between 300 - 400 polygons (c. 5% of total) sites, reflecting number and diversity of wetlands in the southern region.

Fixed or random?

One option is to have a set of monitored wetland sites that are selected to be representative of the types and abundance of wetlands in the area generally. Here, the same wetland sites would be included in the monitoring over the long term. This approach provides consistent data but may bias results as these wetlands become known as “monitoring sites” and therefore receive special management or protection. An alternative approach is to randomly select wetlands for sampling within FMUs every year. This would be unbiased but could create operational challenges because of different ease of accessibility.

Our suggestion is to have a mixed approach with a suite of designated regularly monitored wetlands, comprising those that are outstanding water bodies and those recognised as Nationally Significant, and a similar number selected at random. ORC may also have other wetland categories that should be regularly monitored. These will likely total c. 200 wetland sites, and we suggest that the remaining ca 150-200 comprise a subset randomly selected each sampling period, in proportion to their occurrence at Regional and FMU Level. The sampling cycle for the ca 300 - 400 sites would be 10 years. If the overall sampling programme includes a combination of fixed and random wetland sites, reports on wetland extent/condition should be accurate on an annual basis.

References

Ausseil A-G, Gerbeaux P, Chadderton W, Stephens T, Brown D, Leathwick J 2008a. Wetland ecosystems of national importance for biodiversity. Landcare Research Contract Report LC0708/158, Department of Conservation.

Ausseil A-G, Newsome P, Johnson P 2008b. Wetland mapping in the Otago Region. Landcare Research report LC0608/115.

Ausseil A-E E, Chadderton WL, Gerbeaux P, Stephens RT, Leathwick JR 2011 Applying systematic conservation planning principles to palustrine and inland saline wetlands of New Zealand. Freshwater Biology (2011) 56, 142–16.

Bellingham P, Richardson S, Burge O, Wiser S, Fitzgerald N, Collins K 2021. Standardised methods to report changes in the ecological integrity of sites managed by regional councils. Landcare Research Report LC3903.

Bodmin KA Wetland types of Northland: extent and priorities for protection. 2010. NIWA Client Report HAM2010-121

Clarkson BR, Price RJ 2022. A framework for monitoring Northland wetlands. Manaaki Whenua - Landcare Research Contract Report: LC4180

Clarkson BR, Fitzgerald NB, Overton JM 2014. A methodology for monitoring Bay of Plenty wetlands. Landcare Research Report LC 1779.

Clarkson BR, Bartlam S 2017. State of the Environment monitoring of Hawke's Bay wetlands: Tukituki Catchment. Landcare Research Report.

Crisp P, Uys R, Drummond F 2018 Wetland Health State of the Environment monitoring programme Annual data report, 2017/18, Environmental Science Department, Greater Wellington Regional Council.

Cromarty P, Scott DA 1996 A Directory of Wetlands in New Zealand. Department of Conservation, Wellington, New Zealand.

Fitzgerald NB, Clarkson BR, Price RJ 2013. A priority framework for monitoring Bay of Plenty wetlands. Landcare Research Report LC 1334.

Grove P, Pompei M, Parker M 2012 Coastal wetland vegetation in Canterbury, 2004 – 2011. Report No. R12/24.

Grove P, Pompei M 2019 Monitoring Te Waihora shoreline wetland vegetation, 2007 – 2017. Report No R19/134.

Hashiba K, Norris T 2017 Tukituki Catchment – State of freshwater wetlands 2016. Hawkes Bay Regional Council. Report No RM17-07-4929

Johnson P, Gerbeaux P 2004. Wetland types in New Zealand. Wellington, Department of Conservation.

Leathwick J 2020. Indigenous biodiversity rankings for the Otago Region. Report for the Otago Regional Council.

Lloyd K, Reid A, Vermeulen M, Rate S, Pyatt T 2020. Mapping of potential natural ecosystems and current ecosystems in Otago Region. Contract Report No 5015a, Wildlands

Ministry for the Environment 2020. National Policy Statement for Freshwater Management 2020, Ministry for the Environment, Revised December 2022.

Singers NJD, Rogers GM 2014. A classification of New Zealand's terrestrial ecosystems. Science for Conservation 325. Department of Conservation, Wellington. 91 pages