Mackay-Whitsunday-Isaac Report Card Methods 2025

(reporting on data July 2023 to June 2024)

Technical Report
Mackay-Whitsunday-Isaac Healthy Rivers to Reef Partnership
July 2025

Executive Summary

The Mackay-Whitsunday-Isaac (MWI) Healthy Rivers to Reef Partnership (the Partnership) was established in October 2014 with the primary focus of producing an annual report card on the health of our region's waterways. The 2025 Report Card (reporting on the 2023–2024 financial year) is the Partnership's eleventh Report Card, demonstrating the MWI community's commitment to understanding and caring for the local environment. This commitment is matched outside of regional reporting boundaries as this is one of five regional report cards released annually in the Great Barrier Reef (GBR) World Heritage Area.

The 2025 Report Card contains data relating to freshwater, estuarine, inshore, and offshore marine environments. For each of these waterway types, a series of environmental *indicators* are reported, which are aggregated into *indicator categories* and then into *indices*. Although most indicators are assessed annually, others are updated every three or four years due to differences in the time scales at which notable changes typically occur and/or logistical constraints (Table I).

Table I. Frequency of reporting and latest updates for waterway condition indicators in the 2025 MWI Report Card.

Water type	Index	Indicator Categories	Frequency of Reporting	Most Recent Data
Freshwater	Water Quality	Sediment	Annually	**2024**
		Nutrients	Annually	**2024**
		Pesticides	Annually	**2024**
	Habitat and Hydrology	In-stream habitat modification	4 Yearly	**2023**—Impoundment Length **2023**—Fish Barriers
		Flow	Annually	**2024**
		Riparian ground cover*	Unknown	**2014** (scores revised in 2016)
		Freshwater wetlands	4 Yearly	**2019** (2017 data)
	Fish	Fish	3 Yearly	**2024**
Estuary	Water Quality	Phys-chem	Annually	**2024**
		Nutrients	Annually	**2024**
		Chlorophyll-*a*	Annually	**2024**
		Pesticides	Annually	**2024**
	Habitat and Hydrology	Riparian Vegetation	4-Yearly	**2022** (2019 data)
		Mangrove and Saltmarsh	4-Yearly	**2022** (2019 data)
		Fish Barriers	4-Yearly	**2023**
Marine	Water Quality	Nutrients	Annually	**2024**
		Water Clarity	Annually	**2024**
		Chlorophyll-*a*	Annually	**2024**
		Pesticides	Annually	**2024**
	Coral	Coral	Annually	**2024**
	Seagrass	Seagrass	Annually	**2024**

*Due to methodology changes to riparian ground cover mapping (provided by DETSI), this indicator category has not been updated since 2014.

I. Freshwater Basins

Freshwater monitoring is conducted in five basins in the region, including the Don River (at Bowen), Proserpine River (at Glen Isla), O'Connell River (at O'Connell Caravan Park), Pioneer River (at Dumbleton Weir), and Plane Basin (at both Sandy Creek Homebush and Plane Creek Sucrogen Weir).

Monitoring within freshwater basins is grouped by water quality, habitat and hydrology, and fish indices (Figure I). Within these indices, indicator categories and indicators are updated either every year (water quality), every three years (fish), or between one and four years depending on the specific indicator (habitat and hydrology).

The water quality index includes sediment, nutrients, and pesticides (Pesticide Risk Metric (PRM) based on 22 pesticides). The habitat and hydrology index includes riparian extent, wetland extent, flow, and in-stream habitat modification. The fish index includes the Proportion of Indigenous Species Expected (POISE) and Proportion of Non-Indigenous Fish (PONI) indicator categories (Figure I).

Data are sourced from a range of Partnership-funded and previous existing monitoring projects, including the Great Barrier Reef Catchment Loads Monitoring Program (GBRCLMP), fish barrier monitoring (Catchment Solutions Pty Limited), Aquatic Ecosystem Health monitoring (Department of Environment, Tourism, Science, and Innovation (DETSI)), as well as Regional Ecosystem (RE) mapping data contributed by DETSI and the Department of Resources. Data were collected by remote sensing, automated sampling, grab sampling, on-ground field assessments, and vessel electrofishing surveys.

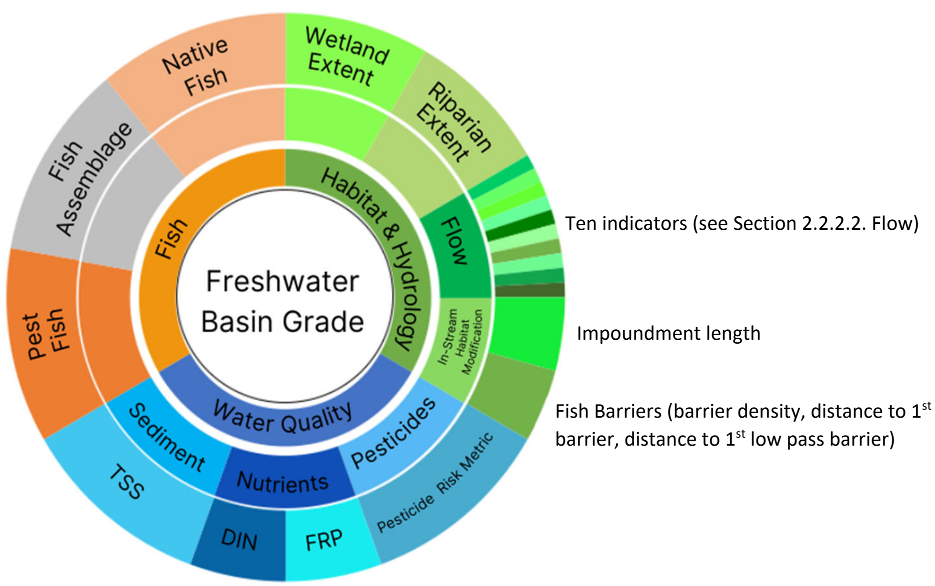

Figure I. Coaster describing freshwater indicator aggregation Indicator/s (outer ring), indicator categories (middle ring), and index/indices (inner ring) that contribute to overall freshwater basin scores/grades. Where no indicator category is listed, this represents that the indicator/s (e.g., native fish) do/does not fit into any specific category below the index level (e.g., fish). Note: TSS = total suspended solids, DIN = dissolved inorganic nitrogen, and FRP = filterable reactive phosphorus.

II. Estuaries

The MWI Report Card reports on eight estuaries within four basins, including Gregory River (Proserpine Basin), O'Connell River Caravan Park and St Helens/Murray Creek (O'Connell Basin), Vines Creek (Pioneer Basin), and Sandy Creek, Plane Creek, Rocky Dam Creek and Carmila Creek (Plane Basin).

Monitoring within estuaries is grouped by water quality, habitat and hydrology, and fish indices (Figure II). Within these indices, indicator categories, and indicators are updated either every year (water quality) or between one and four years depending on the indicator (habitat and hydrology). The fish index and flow indicator category are still under development and therefore are not currently reported.

The water quality index includes physical–chemical, nutrients, and pesticides (PRM based on 22 pesticides) indicator categories. The habitat and hydrology index includes mangrove and saltmarsh extent, riparian extent, flow, and fish barriers indicator categories (Figure II).

Data are sourced from a range of Partnership-funded and previously existing monitoring projects, such as the Regional Estuary Monitoring Program (DETSI), the Estuary Pesticide Monitoring (EPM) Program (the Partnership and Reef Catchments), fish barrier monitoring (Catchment Solutions), as well as RE mapping data contributed by DETSI and the Department of Resources. Data were collected using various techniques, including remote sensing, grab sampling, and on-ground field assessments.

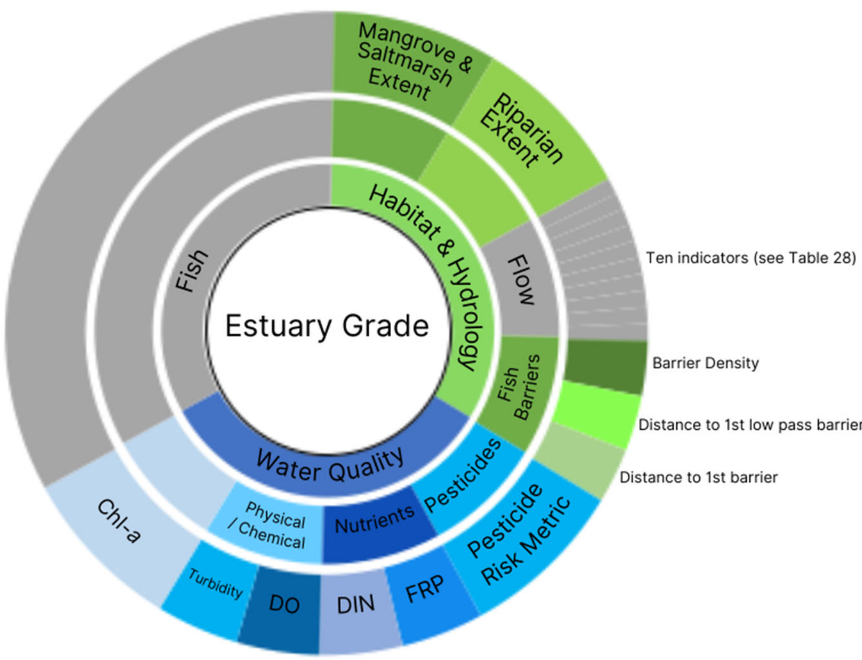

Figure II. Coaster describing estuarine indicator aggregation Indicator/s (outer ring), indicator categories (middle ring), and index/indices (inner ring) that contribute to overall estuary scores/grades. Where no indicator category is listed, this represents that the indicator/s (e.g., riparian extent) do/does not fit into any specific category below the index level (e.g., habitat and hydrology). Dark grey represents no data. Note: chl-*a* = chlorophyll-*a* concentration, DO = dissolved oxygen, DIN = dissolved inorganic nitrogen, and FRP = filterable reactive phosphorus.

III. Inshore and Offshore Marine

Reporting for the MWI marine environment is split into four inshore zones (the Northern, Whitsunday, Central, and Southern Zones) and one Offshore Zone. Monitoring is conducted on coral, water quality, and seagrass indices, with the fish index as an aspirational goal for future report cards (Figure III). All indicators within these indices are updated annually.

In the inshore marine zones, the water quality index includes water clarity, chlorophyll-*a* (chl-*a*), nutrients, and pesticides (Pesticide Risk Metric - PRM based on up to 22 pesticides)[1] (Figure III). The seagrass index includes indicators of area, abundance, species composition, biomass, and resilience. The coral index includes indicators of species composition, cover change (%), macroalgal cover, juvenile density, and coral cover (%) (Figure III). In the Offshore Zone, the coral index includes cover change (%), juvenile density, and total cover (%) (Figure III).

Data are sourced from a range of existing monitoring programs, such as the North Queensland Bulk Ports Corporation Ltd (NQBP) environmental monitoring program, the GBR Marine Monitoring Program (MMP), the Australian Institute of Marine Science (AIMS) Long-term Monitoring Program (LTMP), as well as the Partnership-funded Southern Inshore Monitoring Program (SIP) and citizen science initiatives (ReefCheck Australia and Seagrass Watch). Data were collected using various techniques, including remote sensing, boat, helicopter or shore-based coral and seagrass surveys, and in-situ turbidity loggers and pesticide samplers.

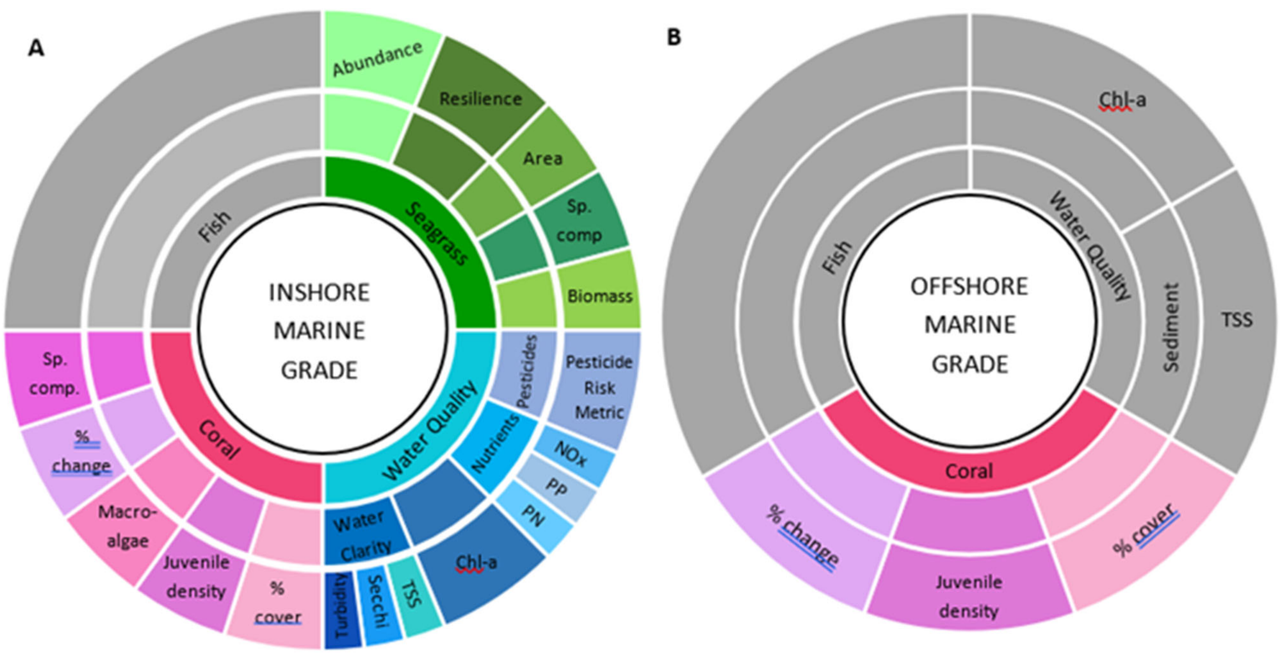

Figure III. Coasters describing marine indicator aggregation Indicator/s (outer ring), indicator categories (middle ring), and index/indices (inner ring) that contribute to overall (A) inshore and (B) offshore marine zone scores/grades. Where no indicator category is listed, this represents that the indicator/s (e.g., juvenile density) do/does not fit into any category below the index level (e.g., coral). Dark grey represents no data. Note: NO_x = oxidised nitrogen, PP = particulate phosphorus, PN = particulate nitrogen, TSS = total suspended solids, chl-*a* = chlorophyll-*a* concentration, and Sp. comp. = species composition, % change = % change in the coral cover during periods without disturbance, % cover = coral cover.

IV. Scoring

A ranking system is applied to classify the condition of indicators, indicator categories, indices, and the overall grade for each reporting zone (e.g., basin, estuary, or marine zone). The aggregation process involves averaging scores from individual indicators to derive category scores, then averaging the category scores to obtain index scores, and finally aggregating index scores to produce the overall condition score for each reporting zone. This system utilizes a five-point scale, based on the GBR Report Card, with the following categories: 'very good' (A), 'good' (B), 'moderate' (C), 'poor' (D), and 'very poor' (E) (Table II). Each category is associated with specific score ranges, or bandwidths, that are unique to each indicator. Table II. Overall scoring range, associated grades, and colour codes as per the GBR Report Card.

Table II. Overall scoring range, associated grades, and colour codes as per the GBR Report Card.

Scoring Range	Condition Grade and Colour Code
81 to 100	A = Very good
61 to <81	B = Good
41 to <61	C = Moderate
21 to <41	D = Poor
0 to <21	E = Very poor

Authorship Statement

The Mackay-Whitsunday-Isaac (MWI) Healthy Rivers to Reef Partnership (the Partnership) 'Mackay-Whitsunday-Isaac 2025 Report Card Methods' technical report was compiled by the Partnership's Lead Technical Officer, Brie Sherow.

Substantial input was received from the Regional Report Card Technical Working Group (TWG) members. Content was also drawn from technical reports from earlier MWI Report Cards.

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The Partnership acknowledges the Traditional Owners from the Land and Sea Country of (or within) the region, including the Yuwibara, Koinmerburra, Barada, Widi, Ngaro, Gia, and Juru Peoples, and pays respect to the ancestors, the Elders both past and present, and to the people.

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Terms and Acronyms

ABS	Absolute (positive) value
Adopted middle thread distance	The distance in kilometres, measured along the middle of a watercourse, that a specific point (in the watercourse) is from the watercourse's mouth.
AIMS	Australian Institute of Marine Science
AM	Annual median (AM) or the mean of a measured indicator.
AMDI	Australian Marine Debris Initiative
Basin	An area of land where surface water runs into smaller channels, creeks, or rivers and discharges into a common point and may include many sub-basins or sub-catchments. Also known as river basin or catchment.
Biodiversity	The variability among living organisms from all sources. It includes diversity within species and between species and the diversity of ecosystems.
Biomass	The total quantity or weight of organisms over a given area or volume.
BoM	Bureau of Meteorology
Chl-*a*	Chlorophyll-*a*: An indicator of overall phytoplankton biomass. It is widely considered a useful proxy for measuring nutrient availability and the productivity of a system.
CI	Confidence interval
COVID-19	Coronavirus Disease 2019—in reference to the worldwide pandemic in 2020–2022
CTF	Cease-to-flow
CV	Coefficient of variation
DDL	Declared downstream limit
DETSI	Department of Environment, Tourism, Science, and Innovation, Queensland Government. Previously known as DESI, DES, DEHP.
DHW	Degree Heating Weeks (DHW) are an accumulated measurement of sea surface temperature (SST) that assesses the instantaneous bleaching heat stress during the prior 12-week period. Significant coral bleaching usually occurs when the DHW value reaches 4 °C-weeks. By the time the DHW value reaches 8 °C-weeks, severe, widespread bleaching and significant mortality are likely. Source: Coral Reef Watch, National Oceanic and Atmospheric Administration (CRW, NOAA)[2]
Diadromous	Diadromous fish are truly migratory species whose distinctive characteristics include that they (i) migrate between freshwaters and the sea; (ii) the movement is usually obligatory; and (iii) migration takes place at fixed seasons or life stages. There are three distinctions within the diadromous category: catadromous, amphidromous, and anadromous.
DIN	Dissolved inorganic nitrogen
DO	Dissolved oxygen

[2] https://coralreefwatch.noaa.gov/product/50km/index.php

Ecosystem	A dynamic complex of plant, animal, and microorganism communities and their non-living environment interacting as a functional unit.
Ecosystem health	"An ecological system is healthy and free from "distress syndrome" if it is stable and sustainable—that is, if it is active and maintains its organisation and autonomy over time and is resilient to stress. Ecosystem health is thus closely linked to the idea of sustainability, which is seen to be a comprehensive, multiscale, dynamic measure of system resilience, organisation, and vigour." (Costanza, 1992).
EC	An enclosed coastal (EC) water body includes shallow, enclosed waters near an estuary mouth and extends seaward towards deeper, more oceanic waters further out. The seaward cut-off of an EC water body is defined by the Great Barrier Reef Marine Park Authority (GBRMPA (Great Barrier Reef Marine Park Authority), 2010).
eReefs	A Commonwealth Scientific and Industrial Research Organisation (CSIRO) program to collate data and new and integrated modelling to produce powerful visualisation, communication, and reporting tools for the Great Barrier Reef.
ESF	Empirical survivor function
Estuary	The aquatic environment at the interface between freshwater and marine ecosystems.
Fish (as an index)	The fish community index, measured by two indicators (the number of indigenous and non-indigenous fish, respectively), is evaluated and included in the ecosystem health assessment (coasters) for basins. Inclusion in the Report Card will contribute to an understanding of the local fish communities.
Fish Barriers (as an indicator)	Fish barriers relate to any man-made barriers that prevent or delay connectivity between key habitats, which has the potential to impact migratory fish populations, decrease the diversity of freshwater fish communities, and reduce the condition of aquatic ecosystems (Moore, 2015a).
Flow (as an indicator)	Flow relates to the degree that the natural river flows have been modified in the region's waterways. This is an important indicator due to its relevance to ecosystem and waterway health.
FRP	Filterable reactive phosphorus
FSS	QLD Health Forensic and Scientific Services Laboratory
GBR	Great Barrier Reef
GBRCLMP	Great Barrier Reef Catchment Loads Monitoring Program
GBR Report Card	Great Barrier Reef Report Card developed under the Reef Water Quality Protection Plan (2013).
GBRMPA	Great Barrier Reef Marine Park Authority
GV	Guideline value—Limits that are defined by experts in their respective fields used to gauge the condition of an indicator/site. If grades/scores do not meet guideline values, this signifies that changes impacting ecosystem health have occurred at a level beyond naturally occurring processes.
HEV	High ecological value: the management intent (level of protection) to achieve an effectively unmodified condition.

Impoundment (also impoundment length)	An indicator used in the 'in-stream habitat modification' indicator for freshwater basins in the region. This index reports on the proportion (%) of the linear length of the main river channel inundated at the Full Supply Level of artificial in-stream structures, such as dams and weirs.
Index	Is generated by indicator categories (e.g., water quality made up of nutrients, water clarity, chlorophyll-*a*, and pesticides).
Indicator	A measure of one component of an environmental dataset (e.g., particulate nitrogen).
Indicator category	Is generated by one or more indicators (e.g., nutrients made up of particulate nitrogen and particulate phosphorus).
Inshore (as a reporting zone)	A reporting zone in the Mackay-Whitsunday-Isaac Report Card that includes enclosed coastal, open coastal, and mid-shelf waters.
In-stream habitat modification (as an indicator)	This basin indicator category is made up of two indicators: fish barriers and impoundment length.
IQQM	Integrated water quantity and quality simulation model—used to model pre-development flow for the flow tool score calculations.
ISP	Independent Science Panel established under the Reef Water Quality Protection Plan (now Reef 2050 Water Quality Improvement Plan), who have independently reviewed the methodologies involved in the report card assessments.
JCU	James Cook University
LAT	Lowest astronomical tide
LGA	Local Government Area
LOR	Limit of reporting
LTMP	Long-Term Monitoring Program—run by the Australian Institute of Marine Science (AIMS).
Macroalgae (cover)	An indicator used in part to assess coral health. Macroalgae is a collective term used for seaweed and other benthic (attached to the bottom) marine algae that are generally visible to the naked eye.
MD	The management intent (level of protection) to achieve a moderately disturbed (MD) condition.
MAG	Management Activity Group—Components of a framework used to calculate scores for urban water stewardship at the local government level.
Measure	A measured value that contributes to an indicator score for indicators that are comprised of multiple measures (e.g., flow, estuary fish barriers).
MERI	Monitoring, evaluation, reporting, and improvement within the context of the Urban Water Stewardship Framework.
Mid-shelf (water body)	Mid-shelf water bodies begin 15 km from the enclosed coastal boundary and extend to 60 km in the Mackay-Whitsunday-Isaac Region (GBRMPA, 2010)
MMP	Great Barrier Reef Marine Monitoring Program. This provides water quality, coral, and seagrass data for the Central and Whitsunday reporting zones in the Report Card.
MoA	The mode of action (MoA) of a pesticide refers to the specific way it exerts toxic effects on target organisms, which helps evaluate its

	potential to harm aquatic ecosystems and impact overall water quality when it enters waterways.
MPA	Management Practice Adoption
MWI	Mackay-Whitsunday-Isaac
n	Sample size
NATA	National Association of Testing Authorities
NB	Negative binomial
NO_x	Oxidised nitrogen (nitrate (NO_3) and nitrite (NO_2))
NQBP	North Queensland Bulk Ports Corporation Ltd
NRM	Natural resource management organisation
Offshore Zone	The Offshore Zone is a reporting zone in the Mackay-Whitsunday-Isaac Report Card that includes mid-shelf and offshore water bodies.
Offshore (water body)	Offshore water bodies begin 60 km from the enclosed coastal boundary and extend to 280 km in the Mackay-Whitsunday-Isaac Region (GBRMPA, 2010).
OC	Open coastal (OC) water bodies are delineated by the seaward boundary of enclosed coastal waters to a defined distance across the continental shelf. For the Mackay-Whitsunday-Isaac Region, open coastal waters extend from enclosed coastal waters to 15 km (GBRMPA, 2010).
Overall Score	The overall scores for each reporting zone used in the Report Card are generated by an index or an aggregation of indices.
P2R	Paddock to Reef Integrated Monitoring, Modelling and Reporting Program
Palustrine Wetlands	Primarily vegetated non-channel environments of less than eight hectares. Examples of palustrine wetlands include billabongs, swamps, bogs, springs, etc.
Pesticides (as an indicator)	Incorporating up to 22 herbicides and insecticides with different modes of action.
Pesticide Risk Metric (PRM)	Refers to the methodology for estimation of ecological risk associated with pesticide pollution.
Phys–chem	The physical–chemical indicator category that includes two indicators: dissolved oxygen (DO) and turbidity.
PN	Particulate nitrogen
POISE	Proportion of indigenous (fish) species expected
PONI	Proportion of non-indigenous fish
Ports	NQBP Port Authority
PP	Particulate phosphorus
Pre-clearing	Pre-clearing vegetation is defined as the vegetation or regional ecosystem present before clearing. This generally equates to terms such as ‘pre-1750’ or ‘pre-European’ used elsewhere (Nelder et al., 2019).
Pre-development Flow	The pattern of water flows, during the simulation period, using the IQQM computer program as if there were no dams or other water

	infrastructure in the plan area and no water was taken under authorisations in the plan area[3].
PSII herbicides	Photosystem II inhibiting herbicides (ametryn, atrazine, diuron, hexazinone, tebuthiuron, bromacil, fluometuron, metribuzin, prometryn, propazine, simazine, terbuthylazine, terbutryn).
PSII-HEq	Photosystem II herbicide equivalent concentrations, derived using relative potency factors for each individual PSII herbicide with respect to a reference PSII herbicide, diuron (Gallen et al., 2014).
QPSMP	Queensland Ports Seagrass Monitoring Program
QLD Government	The Queensland Government includes several departments that provide data sources and support for the MWI Report Card. Key departments for the MWI Report Card are the Department of Environment, Tourism, Science, and Innovation Queensland (includes management of the GBRCLMP); the Department of Local Government, Water and Volunteers (includes management of water monitoring); and the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development (includes management of Queensland Spatial).
RAP	In the context of freshwater flow—river analysis package
RCA	Reef Check Australia
RE	Regional ecosystem
Resilience (as an indicator)	A multivariate metric developed by the MMP to measure the capacity of seagrass to cope with disturbances (Collier et al., 2021). The resilience metric better accommodates differences in recovery strategies between species in comparison to previous indicators.
RIMReP	Reef 2050 Integrated Monitoring and Reporting Program
Riparian extent (as an indicator)	An indicator used in the assessments of both basin and estuarine zones in report cards released to date. This indicator uses mapping resources to determine the extent of the vegetated interface between land and waterways in the region.
SD	The management intent (level of protection) to achieve a slightly disturbed (SD) condition.
Secchi	Secchi depth (m)—a measure of water clarity determined as the depth at which an opaque disc lowered into a water column is no longer visible.
SF	Scaling factor. A value used to set scoring range limits for indicators.
SIP	Southern Inshore Program (Partnership-funded)
SMD	The management intent (level of protection) to achieve a slightly to moderately disturbed condition.
Standardised condition score	The transformation of indicator scores into the MWI Report Card scoring range of 0 to 100.
TSS	Total suspended solids
TWG	Technical Working Group for the Wet Tropics, Dry Tropics, and MWI regional report cards.

[3] Queensland Government 2016. Water Plan (Wet Tropics) 2013. Water Act 2000. https://www.legislation.qld.gov.au/view/pdf/2016-12-06/sl-2013-0282

UQ	University of Queensland
Waterway	All freshwater, estuarine, and marine bodies of water, including storm drains, channels, and other human-made structures in the MWI Region.
Water quality guideline	For the purposes of waterway assessment, the term water quality guideline refers to values for the condition assessment of water quality drawn from a range of sources, including water quality objectives scheduled under the Environmental Protection (Water) Policy 2009, Environmental Protection (Water and Wetland Biodiversity) Policy 2019, and water quality guideline values obtained from the Queensland Water Quality Guidelines (DEHP, 2009) the GBRMPA Guidelines (GBRMPA, 2010), the EPP (Environmental Policy and Planning Division, Department of Environment and Science, 2022a, 2022c, 2022b), and the (ANZG, 2018).
Water quality objective (WQO)	Water quality objective refers to values for condition assessment of water quality scheduled under the Environmental Protection (Water) Policy 2009 and the Environmental Protection (Water and Wetland Biodiversity) Policy 2019.
WWTP	Wastewater Treatment Plant

1. Introduction

1.1. Purpose of this document

This document describes the methods used in the production of the Mackay-Whitsunday-Isaac (MWI) Healthy Rivers to Reef Partnership (the Partnership) 2025 Report Card. This includes the indicator selection process, data collection methods, and scoring methods. Condition assessments and scoring of the environmental indicators are divided by habitat and include freshwater basins, estuaries, and marine environments (both inshore and offshore). Human dimensions, such as Urban Water Stewardship, are assessed alongside the environmental indicators, although are not incorporated into the region's grade.

1.2. Background

The Partnership was established in October 2014 with the primary focus of producing an annual report card on the health of the MWI Region's waterways, including freshwater, estuarine, wetland, and marine ecosystems (Figure 1); and indices including water quality, habitat and hydrology, fish, seagrass, and coral. The MWI reporting region extends from Cape Upstart in the north to Clairview in the south, encompassing the Don, Proserpine, O'Connell, Pioneer, and Plane basins, which contain 33 sub-catchments draining into eight receiving waters. In marine areas it aligns with the boundaries of the Great Barrier Reef Marine Park and includes 335 inshore islands (Figure 2).

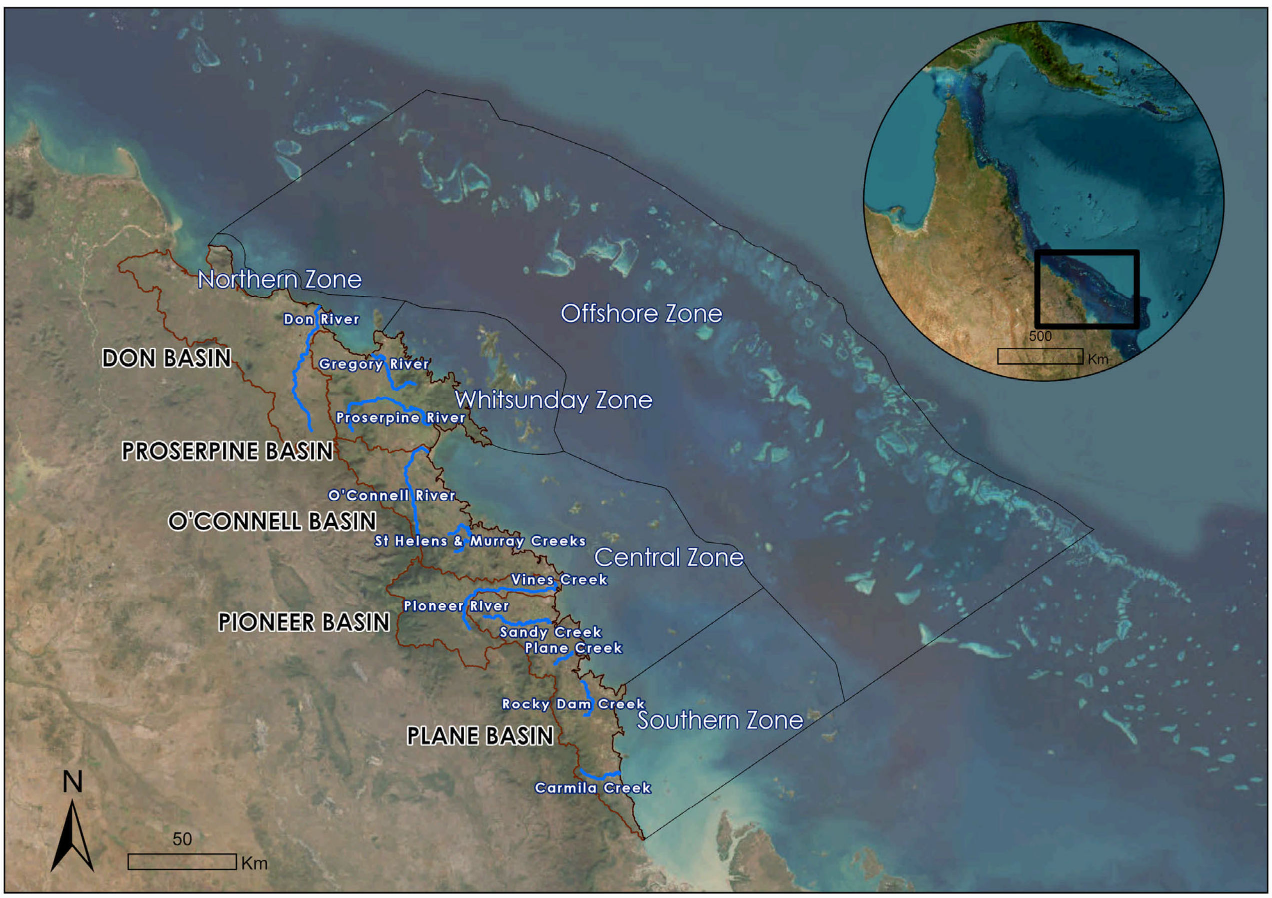

Figure 1. The MWI Healthy Rivers to Reef Partnership reporting region, showing marine zones, freshwater basins, and monitored rivers.

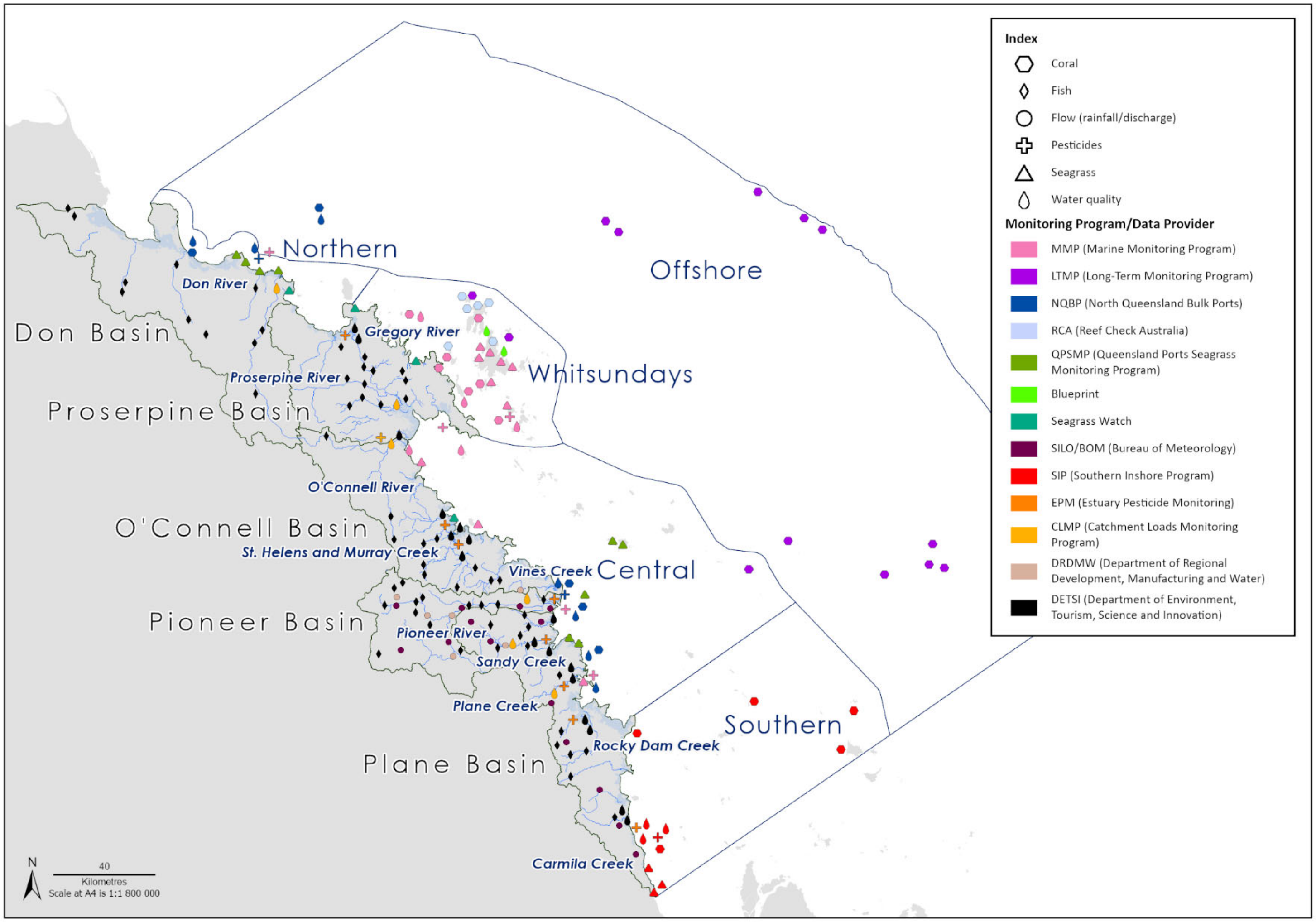

Figure 2. Sampling locations for all indicators in water quality, pesticides, flow, fish, coral, and seagrass monitoring in the MWI Region for the 2025 Report Card. Blue lines in the marine environment delineate inshore and offshore marine zones.

1.3. Program Design Review

Since the release of the Pilot Report Card in 2014, there has been significant review and refinement, with new indices and indicators added as data gaps are identified. Identifying and addressing knowledge gaps is important to the Partnership, and these priorities and opportunities will be revisited and formalised in a program design review that is currently ongoing. For more information on the MWI Report Card and Partnership, refer to the MWI Report Card Program Design 2017 to 2022.[4] The indicator selection process and descriptions of the environmental indicators are described in further detail in the Program Design. The Program Design is currently being updated by Technical Officers in the Regional Report Card network and members of the TWG. Anticipated outputs of the program design review, occurring currently, include:

1. consolidated methods documentation (where possible), to deliver consistency of methods between the Northern 3 Regional Report Cards (RRCs);
2. stream-lined technical reports providing overviews of climate, score and grade tables, trends, and key messages;
3. an outline of the framework that was established in previous Report Cards alongside a plan to improve the Report Cards over the upcoming timeframe;
4. and consolidated priority for ongoing research and development of the RRCs.

[4] https://healthyriverstoreef.org.au/report-card/program-design/

1.4. Terminology

The Report Card assesses different ecosystem (environmental) indicators to report on the overall condition of MWI waterways. Scores for indicators are aggregated depending on the aspect of the environment they are assessing and typically follow three key themes: water quality, habitat, and fish. Report card themes related to human dimensions (e.g., cultural heritage, urban water stewardship, and litter) are presented at the site level rather than rolled up into the regional score.

In the Report Card, overall and index grades/scores are represented in the format of a coaster (Figure 3). Presentation of the coasters differs depending on ecosystem type. Samples are taken to measure indicators (e.g., nitrogen concentration) and are then aggregated into indicator categories (e.g., nutrients). Indicator categories are aggregated into indices (e.g., water quality), which are then aggregated to generate a final score.

Figure 3. Coaster terminology used for defining the level of aggregation of indicators and how they are displayed in coasters in the Report Card.

2. Data Collection Methods

2.1. Regional Setting

The regional setting section of the technical report presents contextual information regarding land use and climate. These data report influences on water quality, habitats, and taxa in the region however are not assessed or aggregated into scores and grades.

2.1.1. Land Use

The land use section of the technical report describes the dominant land use in the region, with nationally consistent descriptions set by the Australian Land Use and Management (ALUM) Classification[5] system. The classification system set by ALUM is a hierarchical structure with primary categories including natural environments, dryland production, irrigated production, and water.

Land use data were sourced from the Queensland Governments data storage platform QSpatial.[6] All land use data were combined into a single dataset and each land use type was grouped into one of

[5] https://www.agriculture.gov.au/abares/aclump/land-use/alum-classification
[6] Queensland Spatial Catalogue : Queensland Government

eight ALUM categories (Table 3). The total area and proportional coverage of each category were calculated for all years of data and a map was created to represent the most recent assessments.[7]

Table 1. Land use categories and examples.

Major Grouping	Examples
Conservation	National Park, habitat or species management, protected landscape
Forestry	Wood production forestry, plantation forests
Grazing	Grazing on native vegetation, modified pastures, and irrigated pastures
Horticulture / Crops	Dryland and irrigated vegetables, fruits, nuts, hay, silage, and other crops
Sugarcane	Irrigated sugarcane
Urban / Industrial	Residential and farm infrastructure, mining, intensive animal production
Marsh / Wetland	Marshes and wetlands
Water	Rivers, lakes, channels, dams, reservoirs, coastal waters

2.1.2. Rainfall

The rainfall section of the technical report presents the monthly and annual rainfall for the period of reporting. Rainfall data were sourced from the Bureau of Meteorology's Australian Water Outlook.[8]

Monthly rainfall data produced at a 5 km resolution was downloaded from 1911 to the current reporting period. Using the historic record, a long-term mean was calculated for each of five basins (Don, Proserpine, O'Connell, Pioneer, and Plane) using the period from 1st July 1990 to 30th June 2020. The total annual rainfall was calculated for the current reporting year by summing the monthly values.

The total annual rainfall for the current reporting year was compared to the long-term mean to determine the rainfall anomaly by month and by year. Maps were made of the total annual rainfall and annual rainfall anomalies for the reporting year.[9]

2.1.3. Air Temperature

The air temperature section of the technical report presents the annual and monthly air temperature for the period of reporting. Air temperature data at a 5 km resolution were obtained via data request to the Bureau of Meteorology[10] for all months from 1911 to the current reporting period.

Monthly mean air temperature values were calculated for all months from 1911 to the current reporting period. A mean was calculated for each month per basin, and an annual mean was calculated as the sum of monthly means per reporting period. An annual long-term mean was calculated using data from 1st July 1910 to 30th June 1940.

The annual mean temperature was calculated for the current reporting year as an average of the monthly values. This annual mean was compared against long-term mean to determine temperature anomalies by month and by year. Maps were made of the total annual temperature and annual temperature anomalies for the reporting year.[11]

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[7] See Mackay-Whitsunday-Isaac Healthy Rivers to Reef 2025 Results Technical Report
[8] https://awo.bom.gov.au/
[9] See Mackay-Whitsunday-Isaac Healthy Rivers to Reef 2025 Results Technical Report
[10] Climate Data Services, Bureau of Meteorology
[11] See Mackay-Whitsunday-Isaac Healthy Rivers to Reef 2025 Results Technical Report

2.1.4. Sea Surface Temperature

The sea surface temperature section of the technical report presents the annual and monthly sea surface temperature for the reporting period. Sea surface temperature data were sourced from the National Oceanic and Atmospheric Administration where data were produced monthly at 5 km resolution.[12]

Monthly data were sourced for all months from 1985 to the current reporting period. Using the historic record, a long-term mean was calculated for the Mackay-Whitsunday-Isaac region from data 1st July 1990 to 30th June 2020. The annual mean sea surface temperature was calculated for the current reporting year by taking the mean of the monthly values. The reporting year sea surface temperatures were compared against the long-term mean to determine anomalies. Maps were made of the mean annual sea surface temperature and annual temperature anomalies for the reporting year.[13]

2.1.5. Degree Heating Weeks

The degree heating week (DHW) section of the technical report presents the annual and monthly degree heating week for the period of reporting. Coral bleaching has been linked to prolonged periods of heat stress (Glynn and D'Croz 1990). NOAA's Coral Reef Watch DHW dataset provides a measure of this heat stress and acts as a proxy to coral bleaching (NOAA, Current Year-to-date Composites 2023). The DHW dataset shows the accumulated heat stress experienced by corals in the prior three months and is a cumulative measure of both intensity and duration of heat stress. Temperatures exceeding 1°C above the usual summertime maximum are sufficient to cause stress, including bleaching, and are the basis of a DHW. A DHW of 2 is equivalent to one week of Hot Spot values persistently at 2°C, or two weeks of Hot Spot values persistently at 1°C above usual summertime maximum temperatures. DHWs over 4 °C have been shown to cause significant coral bleaching, and values over 8°C have caused severe bleaching and significant mortality.[14]

Data were sourced from the National Oceanic and Atmospheric Administration (NOAA) as daily data, an accumulation of the daily heat stress of the most recent 12-week period, for the five years previous to the current reporting period. The number of DHW is then binned into five categories that correlate to the likelihood of coral bleaching (Table 2). Maps were made of the current reporting year and the previous five reporting years.[15]

Table 2. Number of consecutive Degree Heating Weeks (DHW) and likelihood of coral bleaching. Source: National Oceanic and Atmospheric Administration (NOAA).

Consecutive DHW	Likelihood of bleaching
0-2	Low likelihood of bleaching
2-4	Bleaching warning likely
4-6	Bleaching possible
6-8	Bleaching probable
>8	Severe bleaching likely

[12] NOAA Coral Reef Watch Homepage and Near Real-Time Products Portal
[13] See Mackay-Whitsunday-Isaac Healthy Rivers to Reef 2025 Results Technical Report
[14] NOAA Coral Reef Watch 5km Methodology Page
[15] See Mackay-Whitsunday-Isaac Healthy Rivers to Reef 2025 Results Technical Report

2.2. Freshwater Basins

Freshwater basins are assessed using three indices: fish, habitat and hydrology, and water quality (Figure 4). Due to differences in the time scales at which notable changes typically occur and/or logistical constraints, some indicators are assessed annually, while others are updated every three or four years (Table 3). The freshwater basin zones reported in the MWI Report Card are the Don, Proserpine, O'Connell, Pioneer, and Plane basins. The boundaries of these zones are defined as per the Queensland Government.[16]

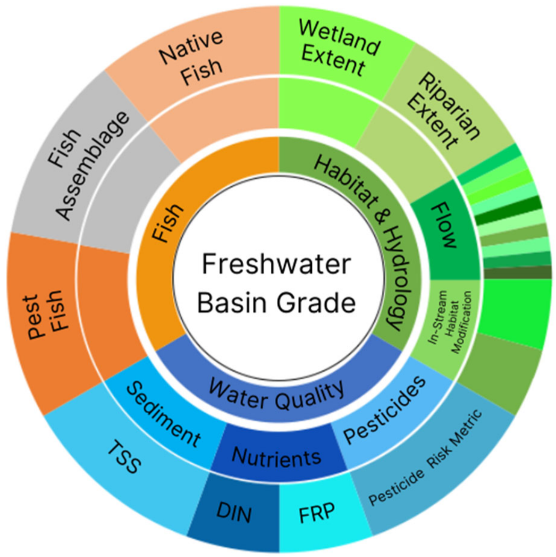

Figure 4. Coaster describing freshwater indicators Indicator/s (outer ring), indicator categories (middle ring), and index/indices (inner ring) that contribute to overall freshwater basin scores/grades. Where no indicator category is listed, this represents that the indicator/s (e.g., native fish) do/does not fit into any specific category below the index level (e.g., fish).

Table 3. Frequency of reporting for freshwater specific indicator categories and their update status for the 2025 Report Card. Note: the reporting frequency is the same for each freshwater basin indicator within an indicator category.

Index	Indicator Categories	Intended Frequency of Reporting	Last Updated
Water Quality	Sediment	Annually	**2024**
	Nutrients	Annually	**2024**
	Pesticides	Annually	**2024**
Habitat and Hydrology	In-stream habitat modification	4 Yearly	**2023**—Impoundment Length **2023**—Fish Barriers
	Flow	Annually	**2024**
	Riparian ground cover	4 Yearly*	**2014** (scores revised in 2016)
	Freshwater wetlands	4 Yearly	**2019**
Fish	Fish	3 Yearly	**2024**
*Due to methodology changes to riparian ground cover mapping (provided by DETSI), this indicator category has not been updated since 2014.			

[16] Department of Resources

2.2.1. Water Quality Index

The water quality index in freshwater basins comprises three different indicator categories and a series of indicators including sediment (total suspended solids – TSS), nutrients (dissolved inorganic nitrogen – DIN and filterable reactive phosphorus - FRP), and pesticides (pesticide risk metric – PRM). TSS was selected as an indicator for sediment over turbidity (NTU) (used for estuary and inshore marine environment) given the availability of data and published guideline values for freshwater systems (Newham et al., 2017). Data were available from five end-of-system GBRCLMP sites within the MWI Region (Figure 5).

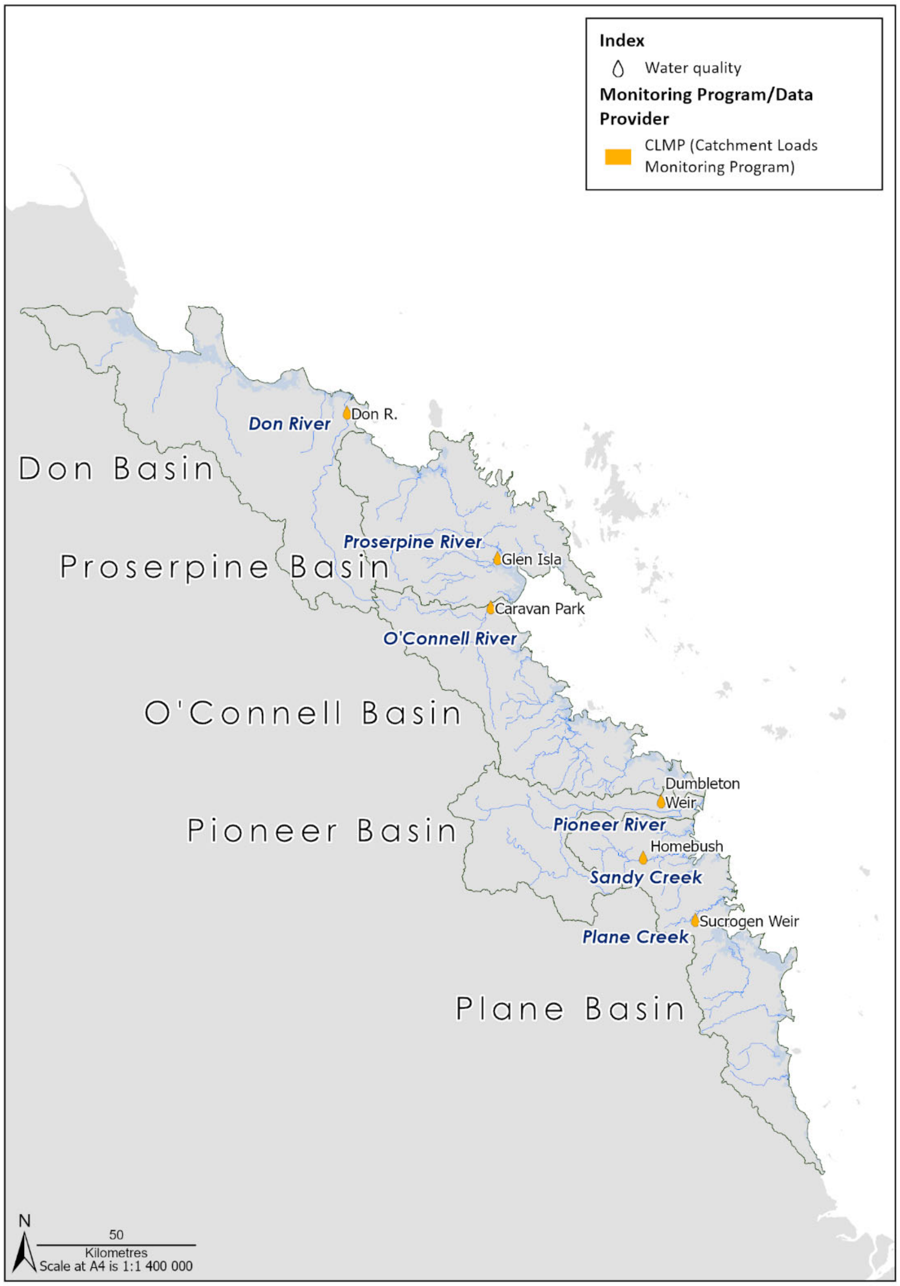

Figure 5. Sampling locations for freshwater water quality monitoring (including pesticides) in the MWI region for the 2025 Report Card (2023-24 data). Data provided by the Catchment Loads Monitoring Program (CLMP) as part of the Queensland Government.

High-frequency sampling (up to hourly) occurred during high flow events, and monthly sampling was undertaken during ambient (low or base-flow) conditions (Table 4). Unlike other water quality parameters, pesticide samples were only taken during a designated six-month period in the wet season (Table 5).

Table 4. Current year water quality sampling record. Water quality monitoring within the MWI basins, where n denotes the sample size analysed for contaminants per month in 2023-24.

Year	Month	Don River (*n*)	Proserpine River (*n*)	O'Connell River (*n*)	Pioneer River (*n*)	Sandy Creek (*n*)	Plane Creek (*n*)
2023	July		1	1	5	5	4
	August		1	1	1	1	1
	September		1	1	2	1	1
	October		1	1	1	1	1
	November		1	1	2	3	2
	December	11	8	11	15	3	13
2024	January	11	4	13	19	16	9
	February	8	16	19	22	7	17
	March	1	7	14	11	4	4
	April		2	2	7	7	9
	May		1	1	1	1	1
	June		1	1	1	1	1
TOTAL		31	44	66	87	50	63

Table 5. Current year pesticide sampling record. Water quality monitoring within the MWI basins, where *n* denotes the number of samples analysed for contaminants. Grey highlighted cells represent where monitoring did not take place (e.g., outside of wet season) or where no data are available.

Year	Month	Don River (*n*)	Proserpine River (*n*)	O'Connell River (*n*)	Pioneer River (*n*)	Plane Creek (*n*)	Sandy Creek (*n*)
2023	July		1	1	4	4	3
	August		1	1	1	1	1
	September		1	1	2	1	1
	October		1	1	1	1	1
	November		1	1	2	2	3
	December	5	8	10	13	13	3
2024	January	9	4	10	16	8	12
	February	6	10	13	11	9	5
	March	1	5	9	6	3	4
	April		2	2	4	5	5
	May			1	1	1	1
	June		1	1	1	1	1
TOTAL		21	36	51	62	49	40

Samples for all water quality indicators were collected concurrently through the Great Barrier Reef Catchment Loads Monitoring Program (GBRCLMP), led by the Queensland Government. Water samples were collected for analysis using manual grab sampling techniques and automatic samplers (DETSI, 2018; Huggins et al., 2017). Daily river flow data (m3/s) for the Don Basin site were sourced from the Queensland Government.[17] These data were used to separate water quality measurements into two categories: high flow periods (likely due to rainfall or runoff) and base-flow periods.

Pesticide indicator scores were developed by the QLD Government's GBRCLMP using the Pesticide Risk Metric (PRM). The aim of this approach is to quantify the ecological risk associated with exposure to a mixture of up to 22 pesticides (herbicides and insecticides) (Table 6) in any given sample. From the 2019 Report Card onwards, the PRM approach has been applied to pesticides with multiple modes of action (MoAs) to better represent pesticide risk. The MoA of a pesticide refers to the specific way it exerts toxic effects on target organisms, which helps evaluate its potential to harm aquatic ecosystems and impact overall water quality when it enters waterways.

Table 6. Pesticides included in Pesticide Risk Metric. Note, not all pesticides listed were necessarily detected in every water sample.

<table>
<tr><th>Pesticide</th><th>Mode of Action</th><th>Pesticide Type</th></tr>
<tr><td>Chlorpyrifos</td><td>Acetylcholine esterase (AChE) inhibitor</td><td rowspan="3">Insecticide</td></tr>
<tr><td>Fipronil</td><td>Gamma-aminobutyric acid (GABA) gated chloride channel blocker</td></tr>
<tr><td>Imidacloprid</td><td>Nicotinic receptor agonist</td></tr>
<tr><td>Haloxyfop</td><td>Acetyl-coenzyme A carboxylase (ACCase) inhibitor</td><td rowspan="10">Non-PSII herbicides</td></tr>
<tr><td>Imazapic</td><td>Group 1 Acetolactate synthase (ALS) inhibitor</td></tr>
<tr><td>Metsulfuron-methyl</td><td>Group 2 Acetolactate synthase (ALS) inhibitor</td></tr>
<tr><td>Pendimethalin</td><td>Microtubule synthesis inhibitor</td></tr>
<tr><td>Metolachlor</td><td>Inhib of VLCFA</td></tr>
<tr><td>2,4-D</td><td rowspan="4">Auxin mimic (Pyridine-carboxylic acid auxins)</td></tr>
<tr><td>MCPA</td></tr>
<tr><td>Fluroxypyr</td></tr>
<tr><td>Triclopyr</td></tr>
<tr><td>Isoxaflutole</td><td>4-hydroxyphenylpyruvate dioxygenase (4-HPPD) inhibitor</td></tr>
<tr><td>Ametryn</td><td rowspan="9">PSII inhibitor</td><td rowspan="9">PSII herbicides</td></tr>
<tr><td>Atrazine</td></tr>
<tr><td>Prometryn</td></tr>
<tr><td>Terbuthylazine</td></tr>
<tr><td>Tebuthiuron</td></tr>
<tr><td>Simazine</td></tr>
<tr><td>Diuron</td></tr>
<tr><td>Hexazinone</td></tr>
<tr><td>Metribuzin</td></tr>
</table>

[17] WMIP: Queensland Government

2.2.1.1. Weighting for multiple sites per catchment

Based on the recommendation provided by the TWG in March 2019, data from different monitoring sites within the same catchment were combined using a weighted average. The weight was based on the size of the catchment area upstream of each site (relative catchment area). In the MWI Region, this method was applied to the Plane Basin, where the Sucrogen Weir site is located on the Plane River and the Homebush site is located on Sandy Creek (Table 7).

Table 7. Plane Basin catchment weighting Calculation of proportional contribution to scores for multiple monitoring sites within the Plane Basin, based on the relative upstream catchment area. Total area refers to the total catchment area upstream of sampling sites on the Plane Creek and Sandy Creek, not to the total area of the Plane Basin.

Sampling sites (Plane Basin)	Relative catchment area (km^2)	Weighting (%)
Sandy Creek catchment upstream from Homebush	326 km^2	78%
Plane Creek catchment upstream from Sucrogen Weir	90 km^2	22%
Total area*	**416 km^2**	**100%**
*Where 100% of the area refers solely to the area of the catchments upstream of the sampling sites rather than the basin as a whole		

2.2.1.2. Proserpine Basin sampling gap

Sediment and nutrient scores have not been reported in the **Proserpine Basin**. In the 2018 review of water quality data, the concentration of TSS at this site was found to be confounded by tidally resuspended sedimentation and therefore not fully representative of the freshwater environment. There was also a strong correlation between TSS and the observed concentration of nutrients (DIN and FRP), suggesting nutrients are similarly confounded at this site. To fill this data gap, the Partnership undertook a pilot monitoring project in the 2020–21 monitoring period using an upstream monitoring location that is largely outside of the range of tidal influence. The pilot project sampled nutrients and suspended solids in the Proserpine Basin monthly, however the results suggested that the new trial site was unsuitable due to a previously unknown illegal sand dam directly upstream of the monitoring site. Further attempts to continue the pilot program at an alternative site were hindered by shipping delays compromising sample integrity. The Partnership discontinued the pilot program in late 2021 in favour of exploring the possibility of an autosampler. Pesticides were reported in the 2025 Report Card using data from the original Proserpine Basin site as it provided a reasonable estimate of pesticide pressures in the freshwater catchment.

2.2.1.3. Don Basin sampling variability

The Don River is ephemeral (seasonal) in nature, characterised by episodic flow and periodic drying. Consequently, monitoring activity is limited to periods where there is sufficient surface flow, often during or shortly after rainfall events. This is different to the other rivers reported in the MWI Region, which are typically permanent in nature. Due to a lack of surface flow in the Don Basin during several months of the monitoring season in 2023-24, samples were only captured in December 2023 and January – March 2024. The dates and times of these samples were compared to discharge data from the Water Monitoring Information Portal (WMIP) to determine whether they should be evaluated using base flow or event flow guideline values (GVs). A total of 28 high flow and 3 low flow samples were used to calculate indicator scores for DIN, FRP, and TSS (Table 8). The result of this reduction in sample size in the recent monitoring periods make these results less temporally representative of the ambient condition of the basin.

Table 8. Don River temporal record. Sampling variability of water quality monitoring within the Don Basin, where n denotes the sample size analysed for contaminants per month. H = High flow, L = Low flow.

Month	Don River (*n*) 2023-24	Don River (*n*) 2022-23	Don River (*n*) 2021-22	Don River (*n*) 2020-21	Don River (*n*) 2019-20	Don River (*n*) 2018-19	Don River (*n*) 2017-18	Don River (*n*) 2016-17
July		H 5, L 1				L 2		
August						L 1	L 1	
September						L 1	L 1	
October		L 3				L 1	L 1	
November						L 1	L 1	
December	H 11	H 1, L 2				L 1	H 3, L 2	
January	H 10, L 1	H 14	H 11, L 1	H 17, L 3		H 14, L 1	L 3	H 3
February	H 7, L 1	H 1, L 1	H 3, L 1	H 2, L 3	H 22	H 16, L 2	H 16	
March	L 1	L 1		H 9, L 2	H 8, L 4	H 4, L 4	H 6, L 3	H 5, L 1
April		L 1		L 2	L 1	L 4	L 4	H 2, L 1
May			H 1, L 2			L 1	L 1	H 9, L 1
June						L 1		L 1
TOTAL	**H 28, L 3**	**H 24, L 6**	**H 15, L 4**	**H 28, L 10**	**H 28, L 7**	**H 34, L 20**	**H 25, L 17**	**H 19, L 4**

2.2.2. Habitat and Hydrology Index

Indicators used to report on the habitat and hydrology index in freshwater basins are impoundment length, fish barriers, riparian extent, wetland extent, and flow. Impoundment length and fish barriers are grouped together as the in-stream habitat modification indicator category.

2.2.2.1. In-stream Habitat Modification

Impoundment Length

This indicator was selected to describe how much 'natural' channel habitat remained in the region compared to artificially ponded channel habitat, which has relatively little diversity in terms of depth (benthic light availability, oxygen availability), flow rate, and natural wetting and drying cycles.

The impoundment length indicator reports on the proportion (%) of the linear length of non-tidal streams (of order three or higher) that are affected by man-made structures such as dams and weirs. The indicator considers how much of the stream is covered by water when these structures are at their full supply level. This value is then compared to the reference condition, considered to be the lack of artificial barriers (0%).

Impoundment locations and estimates of impounded lengths were derived from the QLD Government[16], including 1:100,000 ordered drainage network, Google Earth imagery, QLD Globe spatial layers (Dams, Weirs and Barrages, Referable Dams and Reservoirs), and local knowledge, including from regional hydrographic staff[16]. The proportion of impoundment length was calculated as a percentage of the total linear length of the river channel.

Fish Barriers

The majority of freshwater fish species in the MWI Region migrate between freshwater and estuarine habitats at some stage during their life cycle (Moore, 2015b). Therefore, barriers that prevent or delay connectivity between key habitats have the potential to impact migratory fish populations, decrease the diversity of fish communities in freshwater and estuaries, and reduce the condition of aquatic systems (Moore, 2015b).

The fish barrier index is based on an assessment of three indicators (Figure 6).

1. Barrier Density
2. Proportion of stream length to the first barrier, and
3. Proportion of stream length to the first low/no passability barrier (a barrier that never or rarely drowns out).

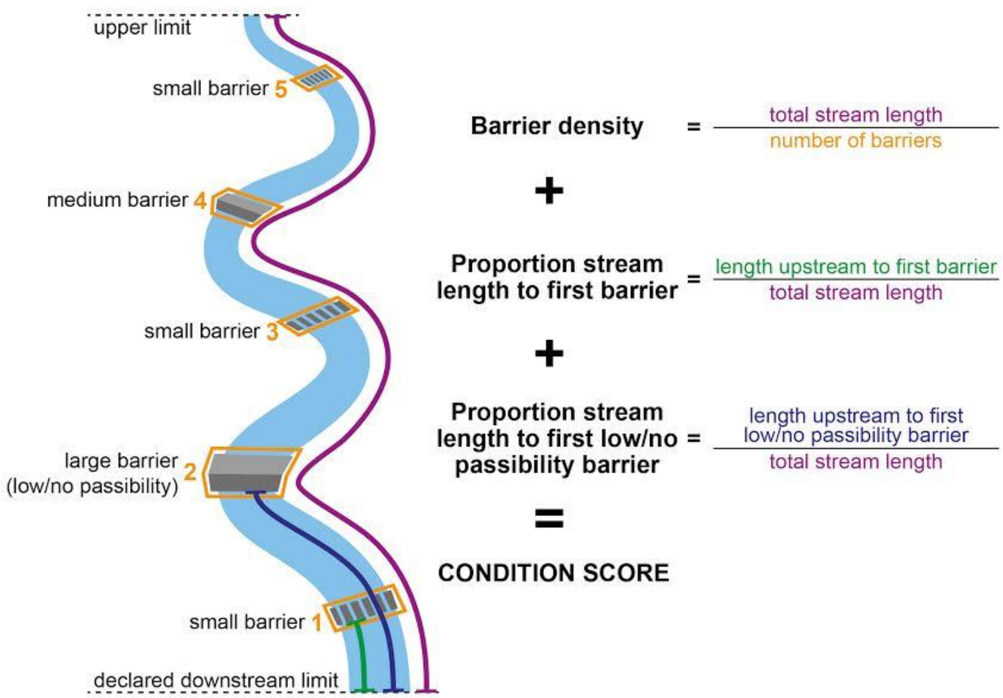

Figure 6. Fish barrier calculation diagram. The declared downstream limit is equivalent to the upper tidal limit for the purposes of this diagram. The fish barriers indicator category comprises three indicators—barrier density, percent of stream length to the first barrier, and percent of stream length to the first impassable barrier. Each indicator is scored separately, and then the scores for these three indicators are summed together to produce the overall score for the fish barriers index.

In freshwater basins, all measurements were taken upstream of the Declared Downstream Limit (DDL), which the Queensland Government defines as the lowest point in a stream that remains freshwater and is not affected by tidal movements. The analysis focused on waterways classified as Major or High risk, as these were deemed most likely to impact fisheries resources (Moore & Power, 2023).

Geographic Information Systems (GIS) software was utilised to prioritise the large number of anthropogenic barriers that prevent, delay, or obstruct fish migration within the region's waterways.

On-ground validation of priority potential barriers was undertaken to determine the authenticity of barriers and collate important barrier characteristics (Power et al., 2022). In the Proserpine, O'Connell, Pioneer, and Plane basins, fish barriers were assessed utilising known barriers that were identified and assessed in the MWI Region Freshwater Fish Barrier Prioritisation report (Moore & Power, 2023).

2.2.2.2. Flow

The flow tool is suited to basins where sufficient flow monitoring data exists and where there are no prolonged low or no-flow scenarios. Since 2019, flow scores have been reported for the Plane and Pioneer Basins, as there are sites with operational stream gauging stations that provide daily flow data, and time series modelled pre-development daily flows exist to provide the reference condition (Figure 7).

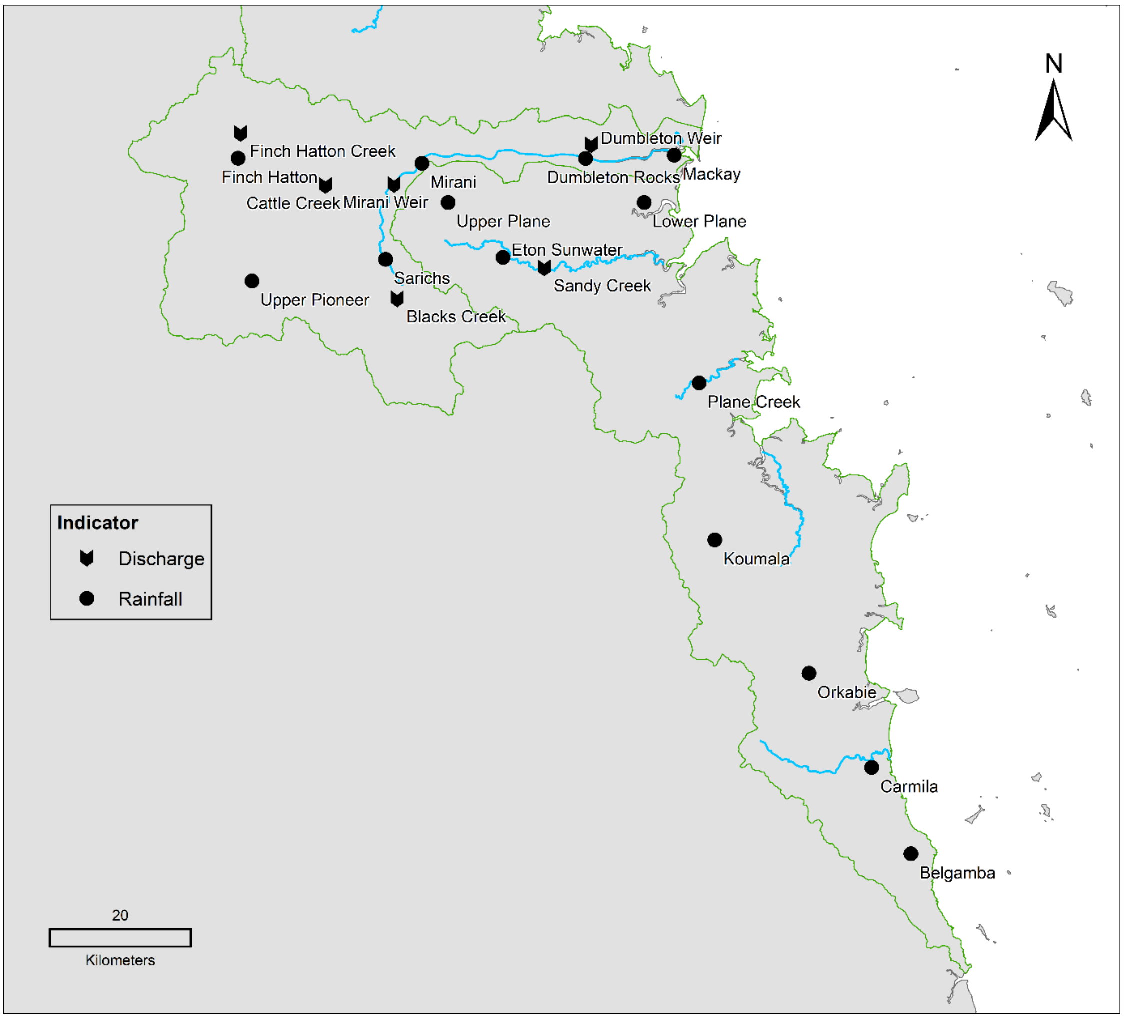

Figure 7. Sampling locations for flow monitoring in the MWI region for the 2025 Report Card. Flow rainfall data provided by the Bureau of Meteorology (BoM) and the QLD SILO database. Flow discharge data provided by the Queensland Government Water Monitoring Information Portal (WMIP).

The flow indicator provides a score for each waterway, based on the modification of the flow regime. A highly modified waterway with large deviations from an unregulated reference condition will score poorly, while a waterway with an unmodified flow regime resulting in a flow regime similar to the reference condition will score well. Observed flow data were assessed for deviations from the reference pre-development flow data (specific to each assessment site and measured against rainfall for each reporting year) to create the flow metrics used for scoring. Observed daily flows (ML/day) were obtained from stream gauging stations managed by the QLD Government and reported via the QLD Government Water Monitoring Information Portal (WMIP)[18] (Table 9).

Table 9. Flow assessment sites with QLD Government gauging stations used for the flow indicator within each basin.

Basin	Flow Monitoring Site	Gauging Station
Pioneer	Cattle Creek at Gargett	125004B
	Blacks Creek at Whitefords	125005A
	Finch Hatton Creek at Gorge Road	125006A
	Pioneer River at Mirani Weir TW	125007A
	Pioneer River at Dumbleton Weir TW	125016A
Plane	Sandy Creek at Homebush	126001A

To account for differences in rainfall between years, catchment historical daily rainfall data (100+ years) were obtained from the QLD SILO program[19] and the Bureau of Meteorology (BoM)[20] (Table 10).

Table 10. Description of rainfall sites used to present catchment rainfall for flow indicator sites for the 2023-24 reporting cycle.

Basin	Site	Station Name / Location	Station Number	Latitude	Longitude	Elevation (m)
Pioneer	PB1 GP	Mackay Alert	N/A	-21.1397	149.1883	11.0
	PB2 GP	Dumbleton Rocks Alert	N/A	-21.1439	149.0753	0.0
	PB3 GP	Mirani Post Office	N/A	-21.1500	148.8667	50.0
	PB4 GP	Finch Hatton Cook St	N/A	-21.1436	148.6322	105.0
	PB5 GP	Sarichs Alert	N/A	-21.2725	148.8203	47.8
	PB6 GP	Upper Pioneer catchment	N/A	-21.3000	148.6500	392.9
Plane	PB1 P	Plane Creek Sugar Milll	33059	-21.4300	149.2200	16.0
	PB2 GP	Eton Sunwater	N/A	-21.2700	148.9700	30.0
	PB3 GP	Koumala Hatfields Road	N/A	-21.6300	149.2400	30.0
	PB4 GP	Carmila Beach Road	N/A	-21.9200	149.4400	23.0
	PB5 P	Orkabie West Hill	33095	-21.8000	149.3600	22.0
	PB6 GP	Belgamba	N/A	-22.0300	149.4900	30.0
	PB7 GP	Upper Plane Catchment	N/A	-21.2000	148.9000	51.7
	PB8 GP	Lower Plane Catchment	N/A	-21.2000	149.1500	7.5

The flow indicator metrics have a reference distribution for each rainfall type at each flow assessment site. Generation of rainfall types and characterisation of the reporting year was conducted using the flow indicator tool (Stewart-Koster et al., 2018). Historical daily rainfall data from all sites within each basin were averaged to define annual rainfall types as follows:

Drought: Years with rainfall equal to or less than 25% of the driest years.

Dry: Years with rainfall between the 25% and 50% of the driest years.

Average: Years with rainfall between 50% and 75% of the average years.

Wet: Years with rainfall greater than 75% of the wettest years.

[18] WMIP: Queensland Government
[19] https://www.longpaddock.qld.gov.au/silo/
[20] http://www.bom.gov.au/

2.2.2.3. Riparian Extent

Riparian extent refers to the amount of vegetation along waterways and its assessment follows the same methodology used for the GBR Report Card. This methodology first defines riparian areas using topographic drainage data and riverine wetlands derived from the 2009 QLD Wetland Mapping Programme data. The present extent of riparian forest is defined by those areas with a foliage projective cover of at least 11% (Folkers et al., 2014) using the 2013 Landsat foliage projective cover data. This is then compared against the pre-development riparian forest extent, based on Regional Ecosystem (RE) mapping (version 9), assuming that these areas were fully forested before clearing. The comparison indicates an estimate of riparian forest remaining in each basin.

The riparian extent indicator is typically updated every four years in line with mapping updates from the Queensland Government Remote Sensing Centre.[21] However, the most recent assessment was based on 2013–14 data, and while an update was planned for the 2018 Report Card, improvements in vegetation mapping methods delayed its release. A revised methodology is currently under review. Wetland Extent.

The assessment of wetland extent uses similar methods to those employed in the GBR Report Card; however, only palustrine systems are reported for the MWI Report Card.

Palustrine systems were defined as wetlands with more than 30% emergent vegetation cover or less than 8 ha. Wetland extent is defined as the aerial extent of a wetland. The condition of wetland extent was determined through a comparison of the current extent against pre-clearing extent of vegetated freshwater swamp (palustrine) systems using the QLD RE mapping version 5. The RE mapping is derived by delineating pre-clearing Res using multiple lines of evidence, including stereo aerial photography, geology and soils mapping, historical survey records, and field survey information.

A combination of automated and manual interpretation of imagery is used to delineate the change in wetland extent due to the clearing of vegetation, destruction of water bodies from draining or earthworks, or the creation of new water bodies through dam or weir construction. Changes in wetland extent due to seasonal wetting and drying are not recorded as wetland loss or gain. Natural wetlands are distinguished from hydrologically modified wetlands (i.e., human-made inputs, such as levees or bunds) within this analysis, and artificial or highly modified wetlands are not reported (Australian and Queensland Governments, 2018).

The wetland extent indicator is updated every four years and was last updated in the 2019 Report Card (2017–18 mapping). Due to refinements such as error correction and remapping to a finer scale compared to the previous 2013–14 assessment, scores are not directly comparable between years. To rectify this, wetland extent scores were back-calculated for the 2013 assessment using the updated mapping. The current Report Card scores are therefore directly comparable only to the back-calculated scores, with results represented in Report Cards prior to 2019 all superseded.

[21] https://www.qld.gov.au/environment/land/management/mapping

2.2.3. Fish Index

The fish community index is based on the species composition of native and pest fish, with field monitoring surveys, data collection, and analysis conducted by the QLD Government in each basin in the MWI Region (Figure 8).

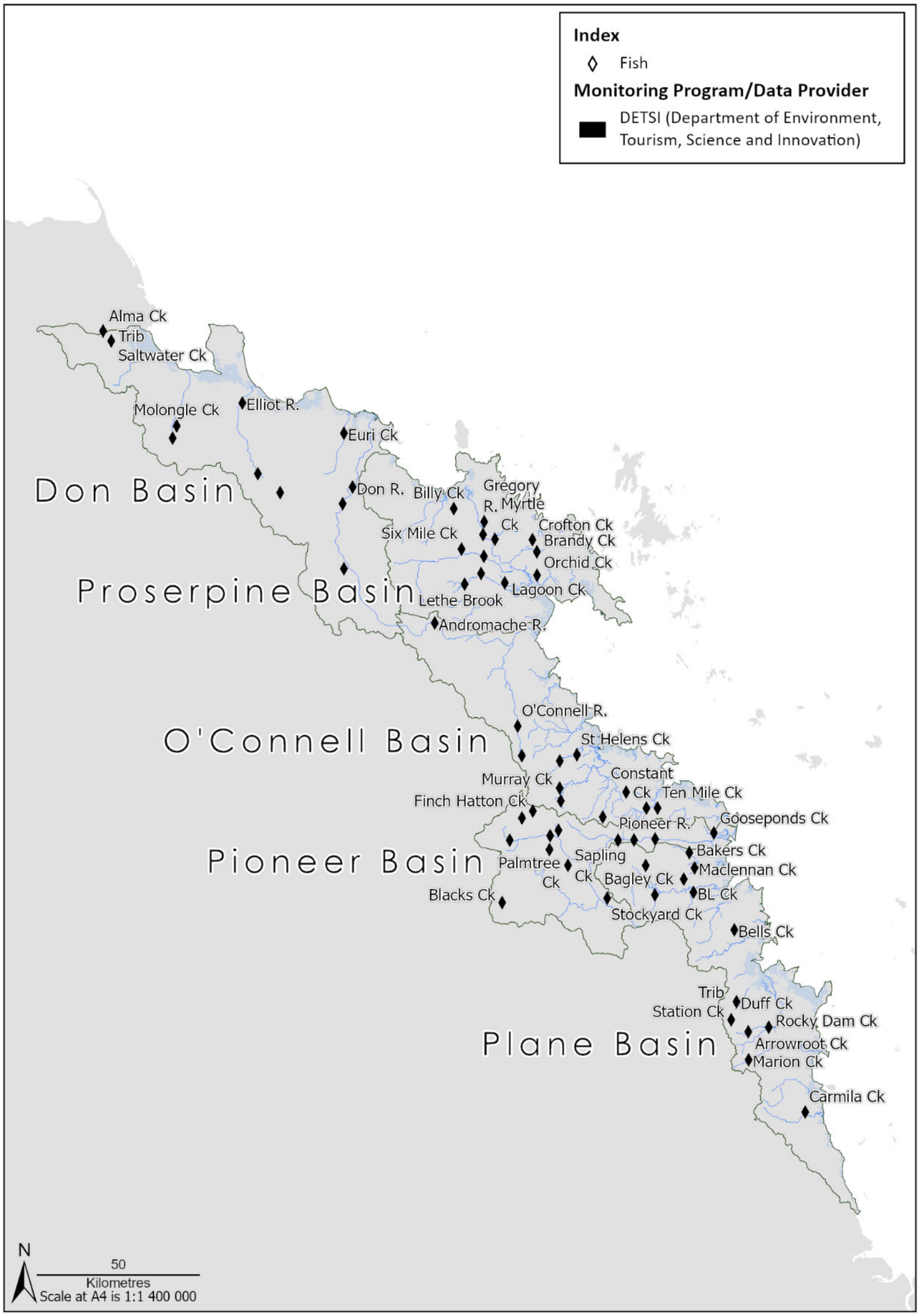

Figure 8. Freshwater fish survey locations. Sampling sites for freshwater fish assessments by DETSI during the 2023-24 reporting period.

The indicators for fish community condition in freshwater basins are assessed by comparing observed data to modelled data and include:

Proportion of Indigenous Species Expected (POISE):
The number of naturally occurring native Australian fish species caught as a proportion to the number predicted to occur at the site (in a single sample, using a standardised method) by a quantitative statistical model.

Proportion of Non-Indigenous Fish (PONI)
The number of non-Australian and translocated native Australian fish caught, expressed as a proportion of the total fish catch at the site. Sub-indices include:

- ***Proportion of Alien Fish*** The number of non-Australian fish caught, expressed as a proportion of the total fish catch at the site.
- ***Proportion Translocated Fish*** The number of translocated native Australian fish caught, expressed as a proportion of the total fish catch at the site.

Fish survey sites were randomly selected using Generalised Random-Tessellation Stratified (GRTS) methods, weighted by stream order. An ordered list of sites was generated and reviewed to identify limitations to sampling, including dense vegetation, which may restrict access and safety risks (e.g., presence of crocodiles). If a site was rejected on this basis, the next listed site was used. The most recent fish surveys were conducted from September to October 2020, predominantly using backpack electrofishing techniques. Boat-mounted electrofishing techniques were used to assess sites unsuitable for wading (e.g., deeper water).

2.3. Estuaries

The eight estuaries reported on in the MWI Report Card are associated with the Gregory River, O'Connell River, St Helens/Murray Creeks, Vines Creek, Sandy Creek, Plane Creek, Rocky Dam Creek, and Carmila Creek. Indicator categories and indicators within two indices, habitat and hydrology and water quality, are reported annually or on four-year cycles (Figure 9, Table 11).

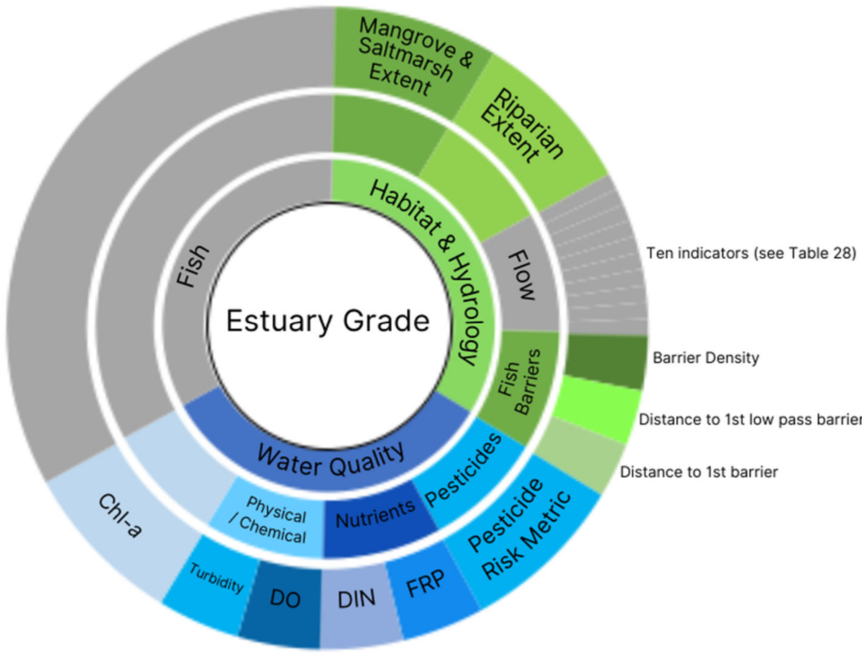

Figure 9. Description of estuarine indicators (outer ring), indicator categories (middle ring), and indices (inner ring) that contribute to overall estuary scores/grades. Where no indicator category is listed, this represents that the indicator/s (e.g., riparian extent) do/does not fit into any specific category below the index level (e.g., habitat & hydrology). Dark grey represents no data.

2.3.1. Water Quality Index

The Estuary Water Quality grade is comprised of Nutrients (DIN and FRP), Physical-chemical (turbidity and dissolved oxygen (DO)), Pesticides (Pesticide Risk Metric (PRM)), and Chlorophyll-*a* (Chl-*a*). While chl-*a* concentration is considered a useful proxy for nutrient availability, it was not grouped into the nutrients category, given its linkages to measures of turbidity; instead, it is considered as an indicator as a representative of the productivity of a system.

Table 11. Estuarine indicator frequency of reporting for specific indicator categories and their update status for the 2025 Report Card, including data up to 30th June 2024.

Index	Indicator Categories	Intended Frequency of Reporting	Last Updated
Water Quality	Phys–chem	Annually	**2024**
	Nutrients	Annually	**2024**
	Chlorophyll-*a*	Annually	**2024**
	Pesticides	Annually	**2024**
Habitat and Hydrology	Flow		
	Riparian Vegetation	4 Yearly	**2022 (2019 data)**
	Mangrove and Saltmarsh	4 Yearly	**2022 (2019 data)**
	Fish Barriers	4 Yearly	**2023**
Fish			

2.3.1.1. Indicator Category Details (Nutrients, Chl-a, Phys–chem, and Pesticides)

Water quality data used to report the condition of the eight estuaries were obtained through the Estuary Monitoring Program led by the QLD Government, with supplementary data added through the GBRCLMP and a Partnership-led Estuary Pesticide Monitoring Program. The Estuary Monitoring Program commenced in 2014 and is conducted once per month at between one and three sites in each estuary (Table 11). Sampling sites are located at varying distances upstream of the mouth of each estuary (Table 11, Figure 10) and the distance is reported as the adopted middle thread distance[22] and are referred to as 'mid-river' sites.

To increase the temporal representation of pesticide data, the Partnership-led Estuary Pesticide Monitoring Program was established in November 2018. Monitoring was conducted twice per month during the wet season (November–April) from a single site in each estuary. Sites were selected based on their proximity to existing mid-river sites, site accessibility, and safety risks. Hereafter, monitoring sites associated with this program will be referred to as 'land-based sites'. The result of this program is increased confidence in estuary pesticide scores for the Report Card.

Given the Murray and St Helens Creeks are reported as one estuary (St Helens/Murray Creek Estuary), the inclusion of sites upstream of both creeks collectively results in a greater representation for this large area. For the O'Connell River estuary only, pesticide and nutrients data were reported using the freshwater basin GBRCLMP water quality monitoring site (Table 5). As a result, estuary pesticide monitoring is not conducted in the O'Connell River at mid-river or corresponding land-based sites, and estuary monitoring O'Connell data are only used for dissolved oxygen and chl-*a* indicators.

Table 12. Estuaries monitored for water quality, the location of sampling sites upstream of the estuary mouth reported as 'middle thread distance', and number of monthly samples (n) for each indicator in 2023-24. Monitoring data for Murray Creek and St Helens Creek are combined to produce one score.

Monitoring Sites	Sites (km from estuary mouth)	Nutrients (n)	Phys–chem (n)	Chl-*a* (n)
Gregory River	3.6	12	12	12
	8.4	12	12	12
St Helens Creek	7.5	0	12	0
	8.9	12	12	12
Murray Creek	10.0	0	12	0
	12.5	12	12	12
	16.5	12	12	12
Vines Creek	2.0	12	12	12
Sandy Creek	4.5	12	12	12
	13.5	12	12	12
Plane Creek	6.0	11	12	11
	9.0	12	12	12
Rocky Dam Creek	8.9	12	12	12
	12.9	12	12	12
Carmila Creek	0.9	0	12	12
	2.9	12	12	12

Data samples collected between 1st July 2023 and 30th June 2024 were used to calculate water quality condition scores for estuaries in the 2025 Report Card. Pesticide monitoring routinely occurs across

[22] Denotes the distance in kilometres, measured along the middle of a watercourse that a specific point in the watercourse is from the mouth or junction from the main watercourse. Australian Bureau of Meteorology. Australian Water Information Directory. http://www.bom.gov.au/water/awid/id-771.shtml

the wet season for a period of six months (Table 13). This contrasts to the monitoring program for water quality, where ambient sampling activity occurs once per month for the duration of the monitoring year. Sampling was conducted on the ebb of neap tides to minimise the effect of tidal variation and ensure that conditions at monitoring events were comparable. All water quality samples were collected, stored, and transported in accordance with the QLD Government's Monitoring and Sampling Manual (DESI, 2018).

Laboratory analyses for chl-*a* and nutrients were conducted in-house at the QLD Government Science Division Chemistry Centre (Ecoscience Precinct, Dutton Park, QLD). The laboratory is accredited by the National Association of Testing Authorities (NATA) for the chemical and physical analysis of water and soil, including for the assessment of chl-*a* and dissolved nutrients. This is to ensure compliance with relevant international and Australian standards and competency in providing consistent quality of results. As done for freshwater basins, to derive DIN from estuary data, oxidised nitrogen (NO_x) is summed with ammonia nitrogen.

To maintain consistency in the quality of results, pesticide samples across the ambient and supplementary monitoring program were both submitted to the QLD Health Forensic and Scientific Services Laboratory (FSS) for analysis. This laboratory is also accredited by NATA for the chemical and physical analysis of water, including for the assessment of toxicants, such as pesticides.

Table 13. Water quality monitoring for pesticides within the MWI estuaries. Where no monitoring data was available, cells have been highlighted in grey.

Year	Month	Gregory River	OConnell River*	St Helens Creek	Murray Creek	Vines Creek	Sandy Creek	Plane Creek	Rocky Dam Creek	Carmila Creek
2023	July		1							
	August		1							
	September		1							
	October		1							
	November	3	1	3	3	3	3	3	3	3
	December	3	10	3	2^	3	3	3	3	3
2024	January	3	10	3	3	3	3	3	3	3
	February	3	13	3	3	3	3	3	3	3
	March	2**	9	2^^	3	3	3	3	3	3
	April	3	2	3	3	3	3	3	3	3
	May		1							
	June		1							
	TOTAL	17	51	51	17	18	18	18	18	18

*Pesticide data (and nutrients) in the O'Connell River estuary are derived from samples collected through the GBRCLMP (Table 4, Table 5). Changes in sample numbers across years for this site are due to the nature of event sampling.
^EPM sample missing due to broken bottle in transit
**DETSI sample missing due to inaccessible site
^^DETSI sample missing due to staff illness

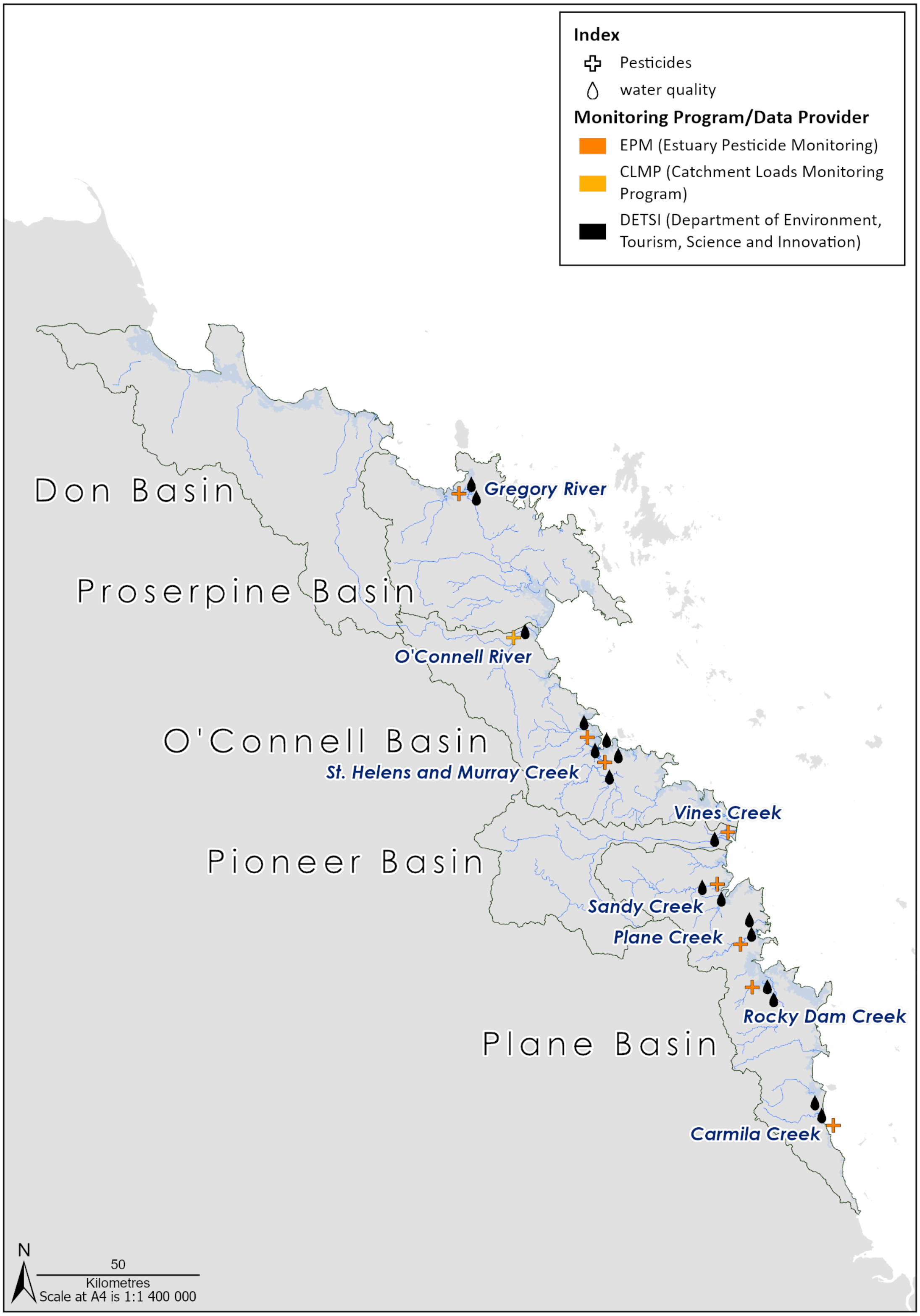

Figure 10. Estuarine water quality and pesticides sample locations for the MWI region for the 2025 Report Card (2023-24 data). Water quality data (including pesticides) provided by the QLD Government (DETSI AEH); additional pesticide data provided by a Partnership-funded initiative (EPM) and the QLD Government (DETSI CLMP).

2.3.2. Habitat and Hydrology Index

Indicators used to report on the habitat and hydrology index in estuaries are riparian extent, mangrove/saltmarsh extent, and fish barriers. There was not sufficient information available to report on the condition of flow within estuaries.

2.3.2.1. Riparian Extent

The assessment of riparian vegetation extent in the estuarine environment was conducted by reviewing the proportion of riparian area that had been cleared of natural vegetation. The riparian area was determined to be any vegetation within 50 metres (m) of the bank of the estuarine environment. The area assessed was from the estuary mouth, upstream to the tidal limit. The tidal limit was determined based on vegetation species distribution observed in situ and expert opinion relating to these species. The actual spatial area assessed along the length of each estuary was recorded so that the same spatial layer for each assessment could be used in subsequent assessments, allowing for the comparison of report cards over time. The data prepared by the QLD Government were obtained through Google Earth and the QLD Herbarium's RE (version 9) mapping.

The procedure for the spatial estimation of the proportion of the estuary area where natural vegetation (of any sort) has been cleared within 50 m of the water's edge was:

1. Start from the upstream point that was considered by signs (vegetation) to be the tidal limit.
2. Construct lines from the tidal limit downstream, following the outermost waterline for both sides of the stream.
3. Construct areas 50 m wide as 'buffer strips' on the edge of the constructed lines.
4. Select all data within these defined areas to extract the latest Herbarium data (2013 Remnant REs of QLD, version 9 (April 2015)).
5. Using the non-ocean data within the selected area, calculate the proportional area of non-remnant vegetation as the estimated result of the proportional area of natural vegetation (of any sort) that has been cleared within 50 m of the water's edge.

Data for riparian extent were initially assessed in 2013–14 and again for the 2019 Report Card based on mapping which depicts condition in 2017 as per its four-year assessment cycle. The 2017 updates to this source mapping, including refinements such as changes in source data, error correction, and mapping to a finer scale, were substantial. Therefore, the resulting data are not directly comparable to those previously reported, inhibiting any interpretation in change between years. To rectify this, riparian extent results have been back-calculated for the 2013 assessment using updated mapping.

2.3.2.2. Mangrove/Saltmarsh Extent

To assess the condition of mangrove/saltmarsh extent in the estuaries, the aerial extent of intertidal habitat categories (listed below) was compared to the same habitat areas in their pre-clearing condition. The spatial data were prepared by the QLD Government and derived from the QLD Herbarium's RE (version 7.1.1, 7.1.2, 7.1.3, and 7.1.5) data[23]. The pre-clearing data layers were compared to aerial extents for target years (2013, 2017, and 2019), and the proportion of loss since pre-clearing was presented.

The procedure for the spatial estimation of the percentage loss (pre-clearing to target years) of the four important dominant vegetation categories from the RE mapping data were as follows:

[23] https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/about

1. Start with the defined area of each estuary.
2. Select all areas within the estuary that contain the RE groups 8.1.1-8.1.5, regardless of whether the target groups are the dominant vegetation.
3. Weight the area within the estuary that contains the target RE groups by the proportion of the area that is classified as the target RE group.
   3.1. E.g. if the area is 10 km^2 and the RE groups contain 60% of 8.6.1 and 40% of 8.1.1, total area of the target RE group would be 10*0.4 = 4 km^2.
4. Calculate the total area of each target RE group for all years of data.
5. Use the proportion of each of the selected REs of mangrove (8.1.1), samphire (8.1.2), tussock (8.1.3), sedgeland (8.1.4), and melaleuca (8.1.5) within these defined areas used as a "cookie cutter" to extract from the Herbarium datasets of pre-development, 1997, 2013, 2017, and 2019 Remnant REs of QLD.
6. Calculate the percentage loss from the difference in pre-development to the 2019 combined area of mangrove, samphire, tussock, sedeland, and melaleuca in the RE data, and again for the most recent changes (2017 to 2019).

All data for mangrove/saltmarsh extent results were assessed for the 2022 Report Card (bar Murray / St Helens) based on mapping, which depicts the condition in 2019 (as per its four-year assessment cycle).

2.3.2.3. Fish Barriers

Assessment of fish barriers in the estuarine environment was updated in 2022-23, using the same indicators and scoring ranges described for freshwater basins. All barriers on 'major' or 'high' impact tributaries were included in the analysis, up to the threshold of 18.5 m above DDL. Barriers were assessed on waterways that intersected the Fisheries QLD 'Estuary Extent' Layer, regardless of the size of the waterway (Figure 11).

The elevation threshold (18.5 m above the DDL) was selected based on Fisheries QLD fish community monitoring data and local expert knowledge.[24] This was determined based on the highest known upstream location where diadromous and/or marine vagrant estuarine fish species were known to occur and were known to be important to estuarine fish habitat, particularly for QLD's most iconic estuarine fish species, barramundi. The minimum elevation was selected as the threshold value that would incorporate all upstream sites across the estuaries where such occurrence was known.

[24] Fisheries biologists Matt Moore and Trent Power from Catchment Solutions Pty Limited.

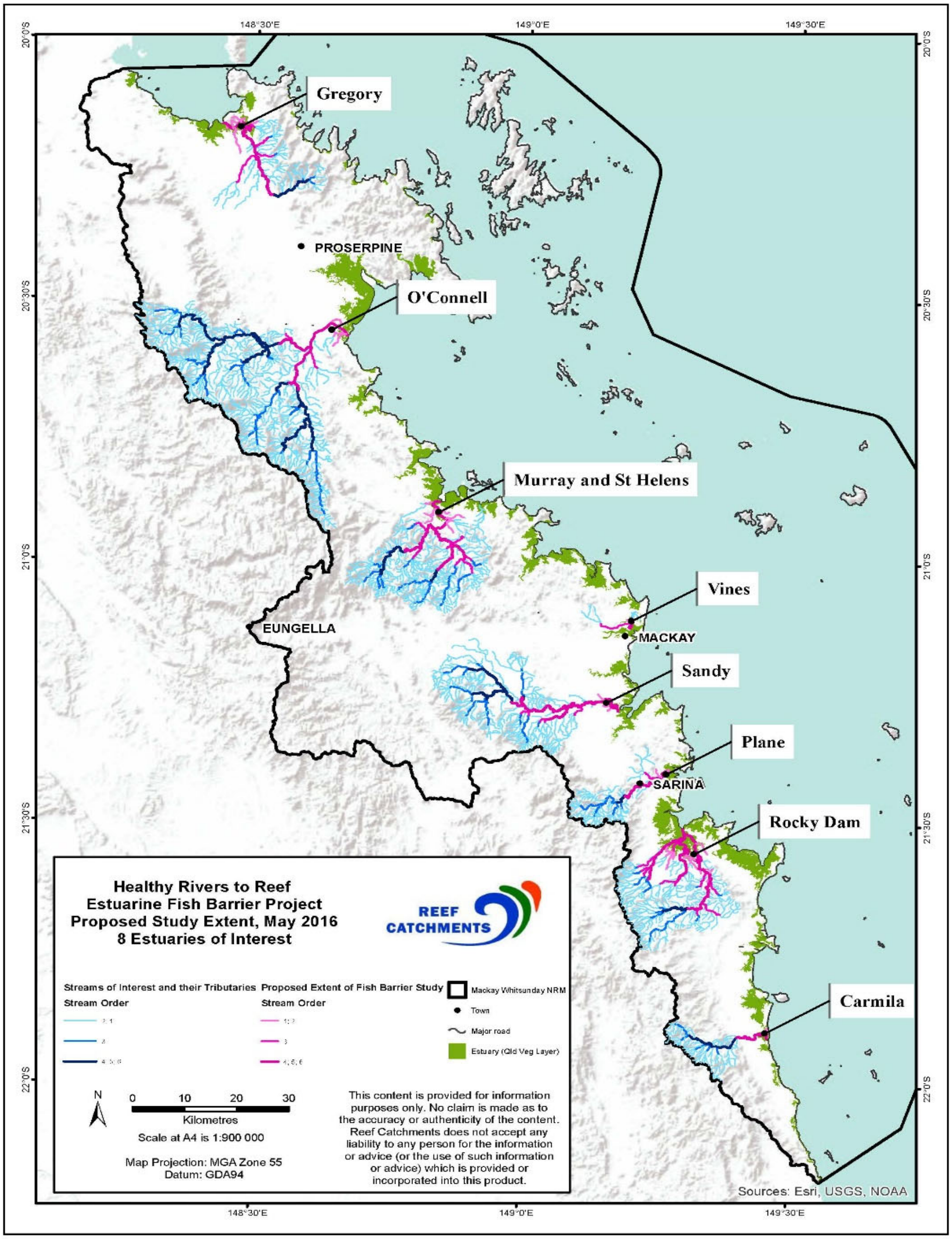

Figure 11. Extent of estuary assessment of fish barriers. Only pink/magenta waterways are included in the estuary barrier assessment; blue waterways are excluded, as they do not intersect the estuary layer, are not 'Major' or 'High' impact tributaries and/or are higher than 18.5m above DDL. Note: the major river near Mackay is the Pioneer River; however, it is not assessed for estuary condition and thus does not feature on this map.

2.4. Inshore and Offshore Marine Zones

The inshore and offshore marine environments, separated by the state jurisdiction boundary, are reported separately in the MWI Report Card. The inshore environment is further divided into four zones: Northern, Whitsunday, Central, and Southern inshore marine zones. Holbourne Island falls within the Midshelf Zone, however, is included in the Northern Inshore Zone for both water quality and coral assessments as it includes conditions typical of inshore reefs. The Offshore marine zone extends from the state jurisdiction boundary to the eastern boundary of the GBR Marine Park (Figure 1). The indicators, indicator categories, and indices assessed for the inshore and offshore zones are shown in Figure 12. Assessment frequency of indicators is annual unless stated otherwise. Marine fish scores are currently in development for future reporting cycles, and offshore water quality will not be reported in the 2025 report card due to changes in the data availability (see Section 2.3.1.2).

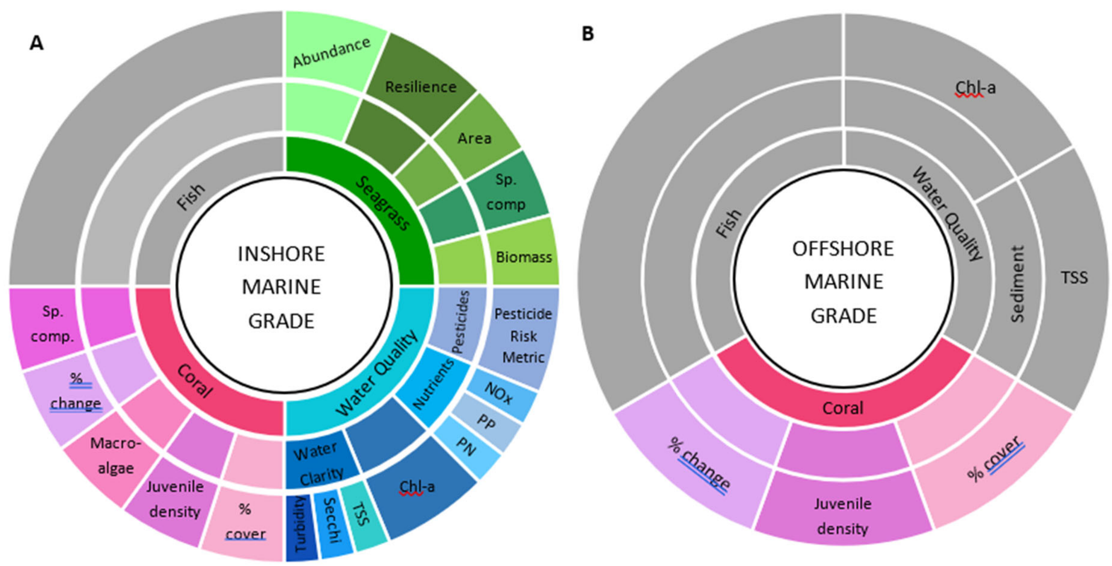

Figure 12. Description of marine Indicators (outer ring), indicator categories (middle ring), and indices (inner ring) that contribute to overall inshore (A) and offshore (B) marine zone scores/grades. Where no indicator category is listed (e.g., within the coral index), the indicator does not fit into any category below the index level. Dark grey represents no data.

2.4.1. Water Quality Index

2.4.1.1. Inshore Water Quality

Water quality in the inshore marine environment was monitored using eight indicators across four indicator categories (Figure 12A, Table 14). Data for these indicators are sourced from four existing marine water quality monitoring programs (Appendix A):

1) The Inshore Marine Water Quality Monitoring program led by the Australian Institute of Marine Science (AIMS) as part of the GBR Marine Monitoring Program (MMP)
2) The North QLD Bulk Ports Corporation Ltd (NQBP) Abbot Point Ambient Marine Water Quality Monitoring Program with TropWATER monitoring,
3) The NQBP Mackay and Hay Point Ambient Marine Water Quality Monitoring Program with TropWATER monitoring,
4) The Partnership-funded Southern Inshore Program (SIP) with TropWATER monitoring, and
5) The Partnership-funded Blueprint Project with TropWATER monitoring.

Table 14. Marine water quality sampling frequency conducted in each of the four inshore zones. Closed circles in green cells (●) represent data that are included in report card scores, and open circles in orange cells (o) show data that are collected at these sites, but no score is calculated due to the lack of relevant guideline values. Grey indicates no data. Note: AP = Abbot Point Ambient Water Quality Monitoring Program, MMP = Marine Monitoring Program, MHP = Mackay and Hay Point Ambient Water Quality Monitoring Program, SIP = Southern Inshore Monitoring Program, OC = open coastal, EC = enclosed coastal.

Inshore Zone	Site Name	Program	# Grab Samples	Water Type	Grab Samples						Passive Polar	Logger
					PN	PP	NO_x	Chl-*a*	TSS	Secchi	Pesticides	Turbidity
Northern	Euri Creek#	Abbott Point (NQBP)	8	OC	●	●		●	●	●	●#	●
	Camp Island		8	OC	●	●		●	●	●		●
	Holbourne Island		8	OC	●	●		●	●	●		●
Whitsunday	Double Cone	MMP	5	OC	●	●	●	●	●	●		●
	Pine Island		5	OC	●	●	●	●	●	●		●
	Seaforth Island		5	OC	●	●	●	●	●	●		●
	Whitsunday Channel			OC							●	
	Tongue Bay	Blueprint	17	OC	●	●	●	●	●	●		●
	Cairn Beach		17	OC	●	●	●	●	●	●		●
Central	Freshwater Point	Hay Point (NQBP)	8	OC	●	●		●	●	●		●
	Round Top Island		8	OC	●	●		●	●	●		●
	Slade Island		8	OC	●	●		●	●	●	●	●
	Victor Island		8	OC	●	●		●	●	●		●
	Repulse Bay	MMP	5	OC	●	●	●	●	●	●	●	
	Sarina Inlet			OC							●	
	Flat Top Island			OC							●	
	O'Connell River mouth		5	EC	o	o	●	●	●	●		●
Southern	Aquila Island	SIP	8	OC	●	●	●	●	●	●	●	●
	Morning Cay		8	OC	●	●	●	●	●	●		
	Fanning Shoal		8	OC	●	●	●	●	●	●		
# Pesticide sampling at Euri Creek shared between NQBP and MMP												

The MMP program documents ecosystem health in the GBR to inform the management cycle.[25] Depth-weighted average (DWA) sample data from MMP were used instead of surface sample only from 2020-21 onwards, and previous scores were back-calculated to reflect this change. Differences observed in previously reported scores are due to stratification between different water depths. DWA samples are commonly used to account for variability within the water column.

The NQBP programs were commissioned to establish a long-term understanding of the natural variability in key marine water quality characteristics for the region and to facilitate effective management of Port activities (Waltham et al., 2021a, 2021b). Aligning closely with the data collected under the NQBP programs, water quality monitoring in the Southern Zone is part of the SIP (Cartwright, Johns, et al., 2024). This program is Partnership-funded and highlights our commitment

[25] https://www.gbrmpa.gov.au/our-work/our-programs-and-projects/marine-monitoring-program

to improving our understanding of the region's waterways. The Blueprint Project water quality monitoring program is another Partnership-funded initiative and aligns with NQBP and SIP methods (Cartwright, Iles, et al., 2024) . It targets two key tourism sites in the Whitsunday Zone (Tongue Bay and Cairn Beach) to fill a water quality data gap and enhance understanding of the impacts of the Fitzroy, Pioneer, and O'Connell rivers. Blueprint data has been included in the MWI Report Card since 2025.

Pesticide condition was calculated using the Pesticide Risk Metric (PRM) based on the monitored concentrations of up to 22 pesticides (Table 15) in passive sampler devices (Warne et al., 2020, 2023). This method differs from pesticide condition in basins and estuaries which are based on multiple grab samples over the wet season. Passive samplers provide a single time-integrated concentration for each sampler, representing the entire deployment time (typically six to eight weeks). Grab samples have the potential to identify acute, rapid, irregular peaks in pesticide concentration only if taken at the opportune time. As a result, only pesticide data collected by passive polar samplers were used to calculate the scores for the inshore marine zones.

Table 15. Chemicals included in the PRM that were sampled in each zone during the 2023–24 reporting cycle. All chemicals were sampled with passive polar samplers deployed from between four to eight weeks. Blue shaded indicates chemicals sampled, filled circles (●) indicate chemicals analysed with known sampling rate, empty circles (○) indicate chemicals sampled where no calibration data were available and the sampling rate of Atrazine was assumed. Light red shaded indicates chemicals that cannot be sampled using empore disc passive samplers. Grey indicates no data.

Name of Pesticide	Mode of Action	Pesticide Type	NQBP	MMP	SIP
Chlorpyrifos	Acetylcholine esterase (AChE) inhibitor				
Fipronil	Gamma-aminobutyric acid (GABA) gated chloride channel blocker	Insecticide	●		
Imidacloprid	Nicotinic receptor agonist		○	○	○
Haloxyfop	Acetyl-coenzyme A carboxylase (ACCase) inhibitor		●	●	●
Imazapic	Group 1 Acetolactate synthase (ALS) inhibitor		○	○	○
Metsulfuron-methyl	Group 2 Acetolactate synthase (ALS) inhibitor		○	○	○
Pendimethalin	Microtubule synthesis inhibitor				
Metolachlor	Inhib of VLCFA	Non-PSII herbicides	●	●	●
2,4-D			●	●	●
MCPA			●	●	●
Fluroxypyr	Pyridine-carboxylic acid auxin		○	○	○
Triclopyr			●		
Isoxaflutole	4-hydroxyphenylpyruvate dioxygenase (4-HPPD) inhibitor				
Ametryn			●	●	●
Atrazine			●	●	●
Prometryn			●	●	●
Terbuthylazine			●	●	●
Tebuthiuron	PSII inhibitors	PSII herbicides	●	●	●
Simazine			●	●	●
Diuron			●	●	●
Hexazinone			●	●	●
Metribuzin			○	○	○

All water quality data were collected in accordance with the QLD Water Quality Monitoring and Sampling Manual (DESI, 2018). The water type at each monitoring location is defined by the Environmental Protection (Water) Policy 2009 for Central QLD.

All sample sites are detailed in Table 14 and Figure 13. Details on sample sites, sampling methodology, and laboratory analysis can be found in the relevant reports for Abbot Point (Waltham et al., 2021a), Mackay and Hay Point (Waltham et al., 2021b), and Southern Inshore (Cartwright et al., 2023) water quality monitoring programs (Appendix A).

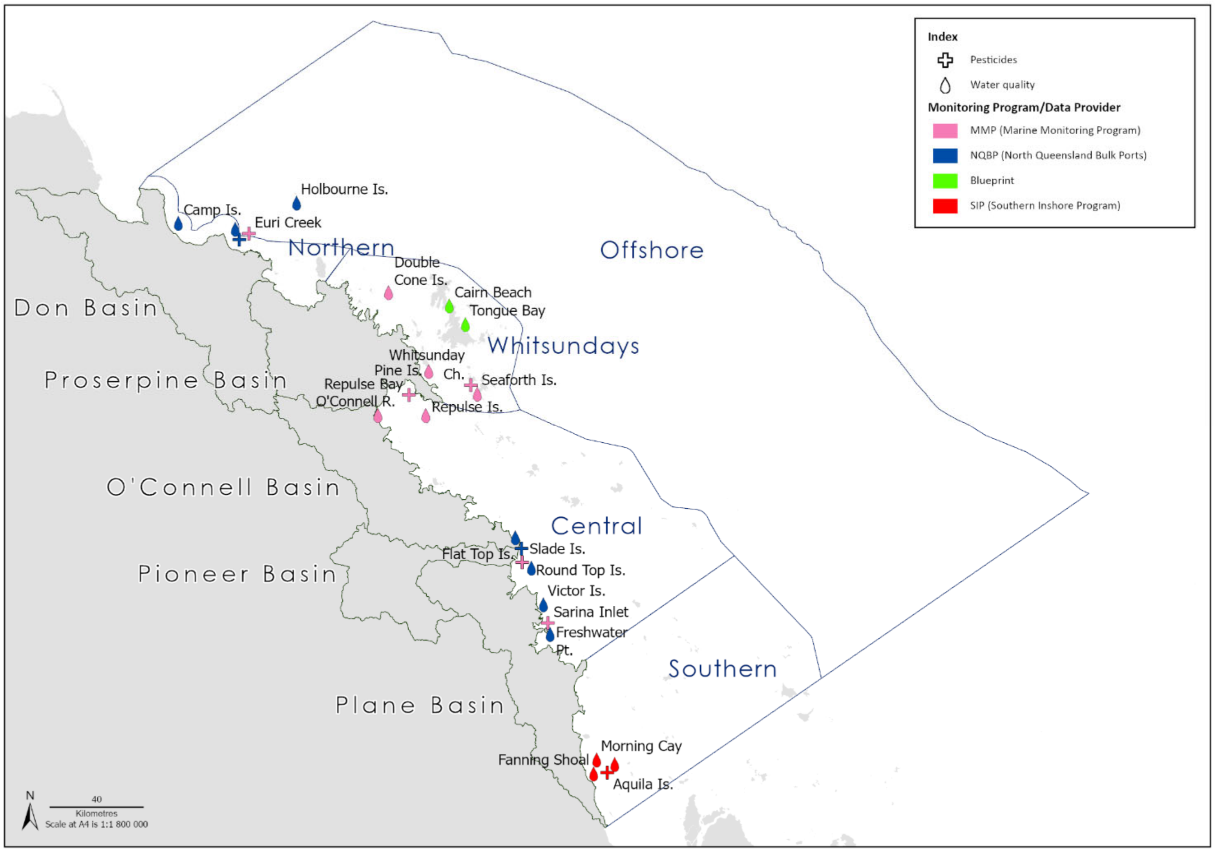

Figure 13. Marine inshore water quality monitoring sites during the 2023-24 reporting year. Sites in each zone are shown according to data provider. Marine Monitoring Program as pink, North Queensland Bulk Ports as blue, and two Partnership-funded programs including Blueprint as green and Southern Inshore Program as red.

2.4.1.2. Offshore Water Quality

The Offshore Zone extends from the State jurisdictional boundary to the eastern boundary of the GBR Marine Park; however, mid-shelf waters within this zone were excluded from condition assessments. In previous years, offshore water quality data was extracted from the BoM marine water quality dashboard. However, as the dashboard was recently decommissioned, alternative data sources are being investigated to address this gap. Options under consideration include the CSIRO Sentinel-3 remote sensing program and CSIRO eReefs marine modelling system. Regional Report Card technical officers are working with the TWG to resolve this data gap.

2.4.2. Coral Index

Coral data were sourced from five different programs, covering five marine zones (Table 16, Figure 14). In the Whitsunday Zone, coral data are drawn from the Marine Monitoring Program – MMP, the Long-Term Monitoring Program - LTMP (both also used by the GBR Report Card), and Reef Check Australia – RCA citizen science data. In the Northern and Central Zones, data are collected by the NQBP coral monitoring program, and in the Southern Zone data are collected by the Partnership-funded Southern Inshore Program (SIP). Both the NQBP and the SIP report indicators align with those used in the MMP and LTMP (Appendix A). Indicators used in inshore zones include coral cover, composition (in Whitsunday Zone only), cover change, macroalgae, and juvenile density. Coral condition scores for the Offshore Zone use LTMP data, and report on coral cover, cover change, and juvenile density.

Table 16. Inshore coral monitoring frequency, displaying survey occurrence (●) for each site and program. The LTMP program previously surveyed reefs across a two-year period; however, in response to thermal stress and acute disturbance from TC Debbie some reefs were sampled out of schedule (+). Although surveys were undertaken, RCA data were not included in the MWI Report Card prior to 2019–20.

Zone	Program	Reef	Most Recent Survey	2023-24	2022-23	2021–22	2020–21	2019–20	2018–19	2017–18	2016–17
Northern	NQBP	Camp Is.	June 2024	●	●	●	●	●	●	●	●
		Holbourne Is.		●	●	●	●	●	●	●	●
Whitsunday	LTMP	Hayman Is. Reef	May 2024	●	●	●	●		●		●
		Border Is. Reef		●	●	●	●		●		●
	MMP	Double Cone Is.	May 2024	●	●	●	●	●	●	●	+
		Hook Is.		●	●	●	●	●		●	
		Daydream Is.		●	●	●	●	●		●	+
		Shute Harbour		●	●	●	●	●		●	+
		Dent Is.		●	●	●	●	+	●		●
		Pine Is.		●	●	●	●	+	●	+	●
		Seaforth Is.		●	●	●	●	+	●		●
	RCA	Blue Pearl Bay	Oct-Nov 2023	●	●	●	●	●	●		
		Butterfly Bay		●	●		●	●			
		Black Is.		●	●						
		Luncheon Bay		●	●	●	●	●			
		Mermaids Cove		●	●		●	●			
		Peter's Bay		●	●		●	●			
Central	NQBP	Round Top Is.	June 2024	●	●	●	●	●	●	●	●
		Slade Islet		●	●	●	●	●	●	●	●
		Victor Islet		●	●	●	●	●	●	●	●
Southern	SIP	Pine Peak	June-July 2024	●	●	●	●	●	●		
		Pine Islets		●	●	●	●	●	●		
		Henderson Is.		●	●	●	●	●	●	●	
		Temple Is.		●	●	●	●	●	●		
		Aquila Is.		●	●	●	●	●	●		

2.4.2.1. Survey Methods

Only data from the most recent survey were used to calculate scores, the exception being the change indicator that is based on mean changes in hard coral cover over the preceding four years. The MMP, LTMP, NQBP, and the SIP employ the photo point intercept method to record percentage cover estimates of the benthic communities (Table 17).

Table 17. Survey methods for coral monitoring programs reporting in the MWI Region.

Zone	Program	Survey Method	No. of Reefs and Sites	Depths Sampled per Site	Transects per Site
Northern	NQBP (Abbot Point)	Photo point intercept transect	2 reefs (4 sites per reef)	1 survey at either 2 m or 5 m depth*	5 x 20 m
		Belt transect			
Whitsunday	MMP	Photo point intercept transect	7 reefs (2 sites per reef)	1 survey at both 2 m and 5 m depths	5 x 20 m
		Belt transect			
	LTMP	Photo point intercept transect	2 reefs (3 sites per reef)	1 survey at 5 m depth	5 x 50 m
		Belt transect			5 x 5 m
Central	NQBP (Mackay & Hay Point)	Photo point intercept transect	3 reefs (4 sites per reef)	1 survey from 0.5 m to 7 m depth depending on reef structure	4 x 20 m
		Belt transect			
Southern	SIP	Photo point intercept transect	5 reefs (2 sites per reef)	1 survey at both 2 m and 5 m depths^	5 x 20 m
		Belt transect			
Offshore	LTMP	Photo point intercept transect	9 reefs (3 sites per reef)	1 survey at 6–9 m depth	5 x 50 m
		Belt transect			5 x 5 m

*Camp Island is surveyed at a single depth of ~2 m and Holbourne Island at 5 m.
^Due to the reef structure, Temple and Aquila Islands are surveyed at a single depth of 1 m only.

All programs record juvenile abundance within narrow belt transects from which the density of juvenile corals can be estimated (Table 16). These transects are 34 cm wide for MMP and LTMP surveys, while NQBP programs are 30 cm. Juvenile coral surveys aim to provide an estimate of the number of hard coral colonies that are successfully recruiting and surviving early post-settlement pressures. Importantly, this method aims to record only those small juvenile colonies (<5 cm), which result from the settlement and subsequent survival and growth of coral larvae. It does not include small coral colonies that result from fragmentation or partial mortality of larger colonies. Both this method and the photo point intercept method closely follow the AIMS Standard operational procedure number 10 of the LTMP (Jonker et al., 2008). Despite some differences in survey methodology and transect dimensions, comparable data were collected across the various monitoring programs (Table 15). For further detail on the MMP and LTMP methods (also used by the SIP program), refer to Thompson et. al (2021), and the AIMS Reef Monitoring website standard operating procedures[26], respectively. NQBP monitoring closely follow AIMS methods and can be found online.[27]

Northern Zone

Coral data for the Northern Zone are collected under the NQBP Abbot Point Coral Monitoring Program from reefs around two island locations (Chartrand et al., 2022a). At each island (reef), four sites are surveyed. For each site at Holbourne Island, surveys were conducted at 5 m below the lowest

[26] https://www.aims.gov.au/docs/research/monitoring/reef/sops.html
[27] https://nqbp.com.au/sustainability/coral-monitoring

astronomical tide (LAT), while at Camp Island, sampling could only be conducted at 2 m depths due to reef structure.

Whitsunday Zone

Photo point intercept or belt transect data were collected from MMP, LTMP, and RCA sites in the Whitsunday Zone. The MMP stratify survey efforts at 2 m and 5 m, while LTMP sample at 5 m depth. RCA surveys are conducted at a range of depths to accommodate for the location of coral communities at the monitored sites.

Central Zone

Coral community health data for the Central Zone was collected from three island (reef) locations under the NQBP Mackay and Hay Point Coral Monitoring Program (Chartrand et al., 2022b). At each island, four sites were surveyed. At each site, the cover of benthic reef organisms was assessed along transects between 0.5 m and 0.7 m below LAT.

Southern Zone

Inshore coral data for the SIP were collected from five island locations. Transects were replicated at both 2 m and 5 m depths below LAT at Pine Peak Island, Pine Islets, and Henderson Island. At Temple Island and Aquila Island, however, the reef slope transitioned to sand at 1.0 – 1.5 m below LAT, and therefore, transects were set at 1 m below LAT only (Davidson et al., 2023).

Offshore Zone

Offshore Zone coral data were collected from 11 reefs surveyed by the LTMP (Figure 14). Several sites were decommissioned from the LTMP program, and the remaining sites are now surveyed annually rather than bi-annually (Table 18).

The intensive survey sites are located in the first stretch of continuous reef encountered when following the perimeter from the back-reef zone towards the front-reef in a clockwise direction, usually on the north-east flank of the reef. Where possible, sample sites were a minimum of 250 m apart, and five 50 m transects were completed at each site. Transects follow depth contours on the reef slope parallel to the reef crest (at approximately 6–9m depth).

Technically, Penrith Island falls within the Central Zone for the MWI Report Card, but the Penrith Island reef is characterised as 'mid-shelf' and as such is included with the offshore reefs for the Report Card. All coral reef sites included for assessment were selected based on expert advice and to meet the purposes of each specific coral monitoring program.

Table 18. Offshore coral monitoring frequency, displaying survey occurrence (●) for each site and program. The LTMP program previously surveyed reefs across a two-year period however sites are now surveyed annually.

Zone	Program	Reef	2023-24	2022-23	2021–22	2020–21	2019–20	2018–19	2017–18	2016–17
Offshore	LTMP	Slate Reef	●	●	●	●		●		●
		Hyde Reef	●	●	●	●		●		●
		Rebe Reef	●	●	●	●		●		●
		19-131S	●	●	●	●		●		●
		19-138S	●	●	●	●		●		●
		Pompey Reef 1	●	●	●		●		●	
		Pompey Reef 2	●	●	●		●		●	
		21-060S	●	●	●		●		●	
		21-591S	●	●	●		●		●	
		Tern Reef (20-309)	●	●	●		●		●	
		Penrith Reef	●	●	●		●		●	

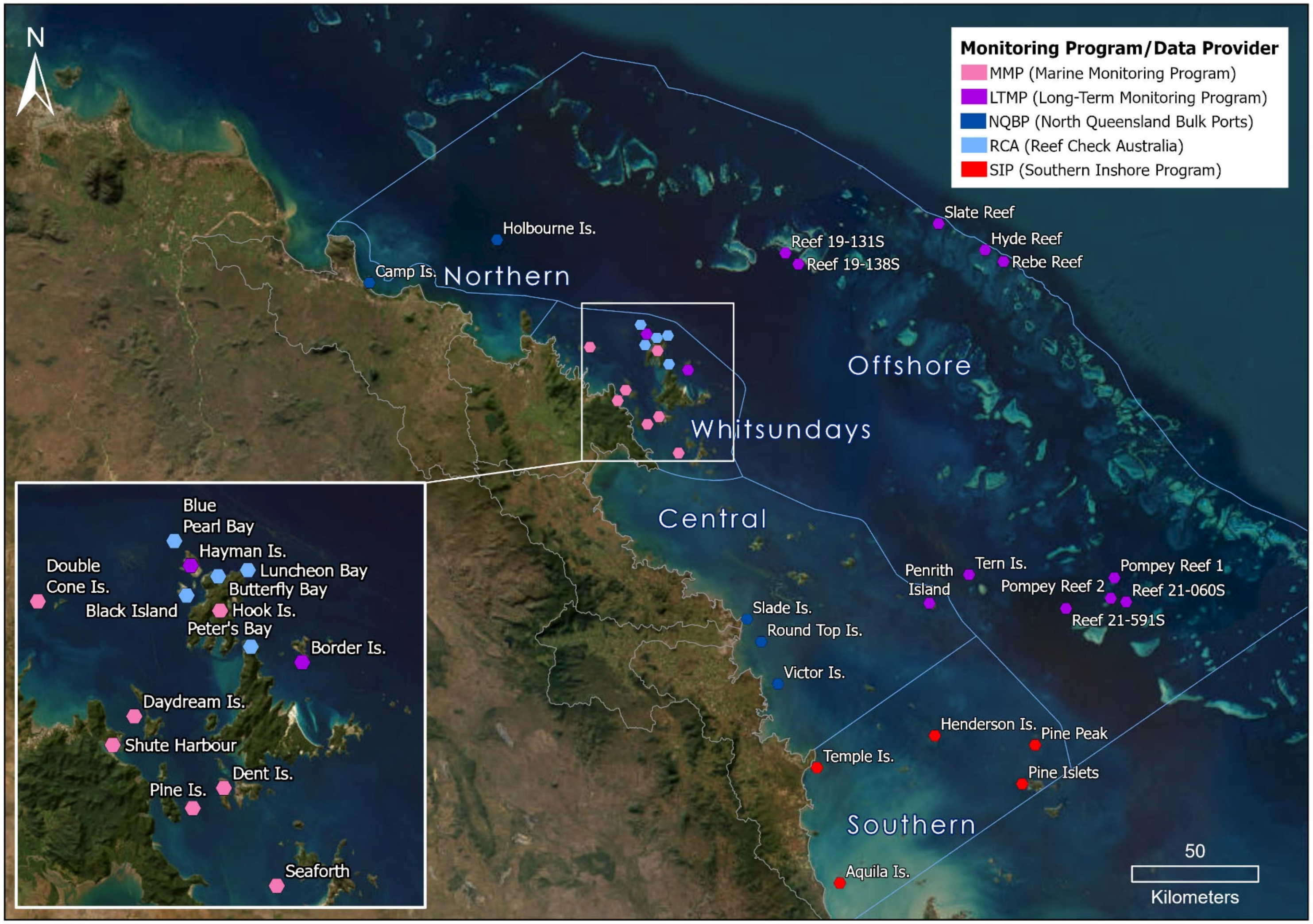

Figure 14. Coral monitoring sites for inshore and offshore zones during the 2023-24 reporting year. Sites in each zone are colour symbolised according to data provider.

2.4.3. Seagrass Index

The seagrass indicators used in the MWI Report Card are based on those used in two existing monitoring programs (Figure 15, Table 19). The MMP, used in the GBR Report Card, provides data in the Whitsunday and Central Zones and includes data from the citizen science monitoring program Seagrass Watch (McKenzie et al., 2003). The QLD Ports Seagrass Monitoring Program (QPSMP) provides data in the Northern and Central Zones. A Partnership-funded seagrass monitoring program was established in the Southern Zone in 2017 and follows the methods in the QPSMP. Seagrass scores in the Southern Zone were reported for the first time in the 2021 Report Card, following the initial five years of monitoring needed to establish a baseline condition (van de Wetering & Rasheed, 2024).

2.4.3.1. Marine Monitoring Program

The MMP seagrass sampling design was developed to detect change in inshore seagrass meadows in response to improvements in water quality parameters associated with specific catchments or regions and in the context of disturbance events (McKenzie et al., 2024). Historically, this program monitored the percentage cover of seagrass (McKenzie, 2009), tissue nutrient status (carbon:nitrogen ratio) (McKenzie & Collier, 2015), and reproductive effort (production of spathes, flowers, and fruits per unit area) (McKenzie & Collier, 2015). From 2021, both nutrient status and reproductive effort were replaced with a multivariate resilience metric, measuring the capacity of seagrass to cope with disturbances (Collier et al., 2021). The resilience metric better accommodates differences in recovery strategies between species. Species differ in their abilities to resist disturbances through physiological processes and modifications to morphology as well as recover following loss by regeneration from seed and through plant growth.

Monitoring occurred during the late dry (growing) season and late wet season to obtain information on the seagrass communities' status pre- and post-wet season. The meadows monitored within the MMP were selected by GBRMPA using expert advice (McKenzie, 2009; McKenzie et al., 2010; McKenzie & Collier, 2015). This was performed using mapping surveys to select representative meadows, which had a greater extent of seagrass. They were also generally the dominant community type and within GBR average abundances. Meadows in both lower littoral (rarely exposed to air) and sub littoral (permanently covered with water) zones were sampled. Two sites (transect blocks) were selected at each location to account for spatial heterogeneity. Additionally, the minimum detectable difference between sites had to be below 20%. Where both transect blocks occur within the same meadow and at the same depth, they are treated as replicates, and the two scores are averaged to provide a location score.

Seagrass Watch citizen science surveys contribute data to the Whitsunday, Central, and Northern Zones.

2.4.3.2. Queensland Ports Seagrass Monitoring Program (QPSMP)

The objective of the QPSMP is to report on the condition of seagrass in the highest risk areas of QLD and use this information to assist in the planning and management of anthropogenic activities (Carter et al., 2023). The QPSMP monitors and reports on seagrass condition for entire meadows, and sampling occurs annually during the peak of the seagrass growing season in late spring/early summer at the end of the dry season. Meadow selection is based on the representation of the range of meadow types found in each location. The indicators surveyed by this program are mean above-ground biomass, meadow area, and species composition.

The QPSMP report card approach was developed in consultation with the Gladstone Healthy Harbour Partnership (GHHP) to report on seagrass condition for the Gladstone region and was implemented in 2014. The methods for setting baseline conditions, score calculation, and indicator assessment received independent analysis and review through the GHHP Independent Science Panel (ISP), and the wider program's results are published in peer-reviewed journals (Carter et al., 2023). For further information on site selection and methods in the MWI Region, refer to previous QPSMP reports for Abbot Point (McKenna et al., 2024) and Mackay and Hay Point (Rasheed et al., 2024) and the Southern Inshore Program report for Clairview and Flock Pigeon Island (van de Wetering & Rasheed, 2024).

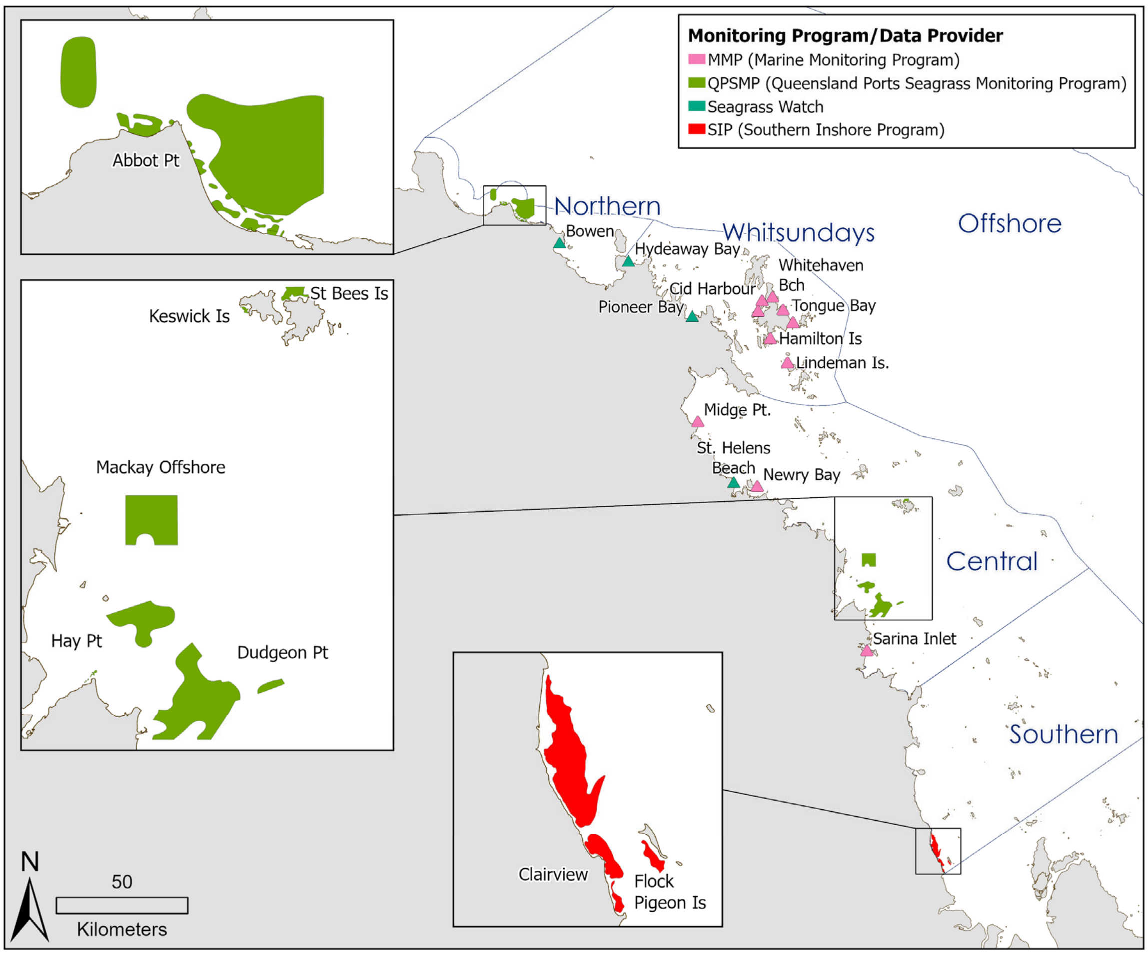

Figure 15. Seagrass monitoring sites for the inshore zones. Colours represent each data provider with MMP data from James Cook University (JCU) shown as pink, NQBP as green, Seagrass Watch citizen science data as teal, and Partnership-funded data from the Southern Inshore Program as red. Sites following the QPSMP methodology are shown as polygon extents of the meadow survey area, while sites following the MMP methodology are shown as a triangle point feature. Seagrass is not currently reported in the Offshore Zone.

Table 19. Seagrass monitoring for programs and indicators in the MWI 2025 Report Card (2023-24 monitoring). A circle marks an indicator that is measured at that site and green background indicates data that are used in scoring.

Zone	Habitat	Depth	Location	Site	MMP		NQBP/SIP		
					Abundance	Resilience	Biomass	Area	Species Comp.
Northern	Coastal	Intertidal	Bowen	BW2-3*	●				
		Subtidal	Abbot Point	API3			●	●	●
				API5			●	●	●
				API9			●	●	●
				APD1-4			●	●	●
Whitsunday	Reef	Intertidal	Hydeaway Bay	HB1-2*	●				
			Hamilton Is.	HM1	●	●			
				HM3	●	●			
			Lindeman Is.	LN3	●	●			
		Subtidal	Lindeman Is.	LN1	●	●			
			Tongue Bay	TO1-2^	●				
			Cid Harbour~	CH4^	●				
				CH5^	●				
			Whitehaven Beach~	WB1^	●				
				WB3^	●				
	Coastal	Intertidal	Pioneer Bay	PI2-3*	●				
Central	Coastal	Intertidal	Midge Point	MP2-3	●	●			
			St. Helens Beach	SH1*#	●				
		Subtidal	Newry Bay	NB1-2^	●				
			St. Bees Is.	SB10			●	●	●
			Keswick Is.	KW14			●	●	●
			Hay Point	HPD1			●	●	●
		Intertidal/Subtidal	Dudgeon Point	DP1			●	●	●
	Estuarine	Intertidal	Sarina Inlet	SI1-2	●	●			
	Offshore	Subtidal	Mackay Offshore	MO5			●	●	●
Southern	Coastal	Intertidal	Clairview	CV1-2*	●				
				CVH2			●	●	●
				CVH6			●	●	●
				CVH7			●	●	●

*Seagrass Watch
^QLD Parks and Wildlife Service (QPWS) drop-camera
#Not used in GBR wide MMP

2.4.4. Fish Index

There is currently no score for marine fish in the Report Card. Identification of appropriate indicators and methodology development is currently under investigation in inshore and offshore zones. The suitability of citizen science and/or engagement of recreational fishers was investigated by Regional Report Card Partnerships, however, was ultimately found unsuitable due to the complexities of merging datasets with differing methods, and representativeness (spatial and temporal) that was not sufficient for Regional Report Card indicator development.[28]

2.5. Agricultural Stewardship

The MWI Report Card aligns its agricultural stewardship reporting with the GBR Report Card, which is reported through the Paddock to Reef (P2R) program.[29] Through P2R, the QLD state and federal governments direct investment towards the adoption of best practice farm management systems, with the aim of achieving the Reef 2050 Water Quality Improvement Plan's targets and improving the quality of water flowing into the GBR.[30] Farm management practice benchmarks are reviewed every five years, and annual change is based on data reported each year. The 2016–17 year is the current benchmark from which improvements are measured and aligns to the GBR Report Card. P2R program management practice and benchmarks were developed for each agricultural industry sector and in each of the five major river basins within the region.

Available environmental management practice frameworks are used to provide the basis for stewardship reporting. In agriculture, frameworks that have been developed, reviewed, and endorsed by industry are currently available for grazing, sugarcane, and horticulture. These are based on P2R reporting that uses "Water Quality Risk Frameworks" (previously "ABCD Frameworks").[16]

As mentioned above, due to a review of Agricultural Management Practice (AMP) targets, agricultural stewardship results were not available for the MWI Region prior to the release of this report. It is anticipated that results will be updated again following the current Program Design Review.

2.6. Urban Water Stewardship Framework

The Urban Water Stewardship Framework (UWSF) is a tool for assessing and reporting on the level of practice applied by local government and industry to manage sediment and nutrient loads. Several activities are measured, including erosion during the construction phase (categorised as developing urban), stormwater run-off during the post-construction phase (established urban), and sewage wastewater treatment plant releases (point source). These activities contribute to sediment and nutrient loads entering the Great Barrier Reef (GBR).

To assess this indicator, data were collected and analysed according to methods outlined in the UWSF Implementation Manual version 2.1 (Department of Environment and Science (DES), 2022). As per the framework methodology, the primary mode of data collection was via a facilitated workshop and consensus opinion rating process, with direct reference to primary information sources for activity rating done where possible. In November 2024 separate workshops were held for each of the three participating local government areas. The workshops were attended by a diverse range of personnel from within each council, including land-use planners, compliance, catchment management, development approvals, civil engineers, asset managers, and wastewater treatment plant (WWTP) operators. The workshops were held in-person and were facilitated by staff from Water by Design.

[28] https://healthyriverstoreef.org.au/projects/reef-fish-citizen-science-data-assessment/
[29] https://www.reefplan.qld.gov.au/tracking-progress/reef-report-card/2020
[30] https://www.reefplan.qld.gov.au/tracking-progress/paddock-to-reef/management-practices

Notably, due to the nature of natural resource management (NRM) versus Local Government Area (LGA) boundaries, grades resulting from the UWSF means that the MWI Report Card represents different area extents than that reported for other indicators (e.g., the Isaac LGA is shared by both Fitzroy and MWI Report Cards). This indicator is updated every two years and results in the 2025 Report Card represent 2024-25 data.

There were three workshops undertaken, split into three reporting components (Figure 16):

1. Activities that may contribute to diffuse pollution associated with **Developing Urban** areas.
2. Activities that may contribute to diffuse pollution associated with **Established Urban** areas.
3. Activities that may contribute to **Point Source** pollution (associated with sewage treatment and management).

Figure 16. Coaster describing UWSF Indicators (outer ring), indicator categories (middle ring), and overall index grade (inner ring) that contribute to the overall UWSF score. The indicator codes are as follows: PS = Point Source, DU = Developing Urban, EU = Established Urban.

A total of 66 activities, linked to the Developing Urban, Established Urban, and Point Source framework components, were assessed at each workshop via a consensus-based rating method (Figure 17). Separate assessment sessions were held for each framework component to allow focussed discussions among the relevant experts and to reduce local government time and resources for participating in the framework assessment process.

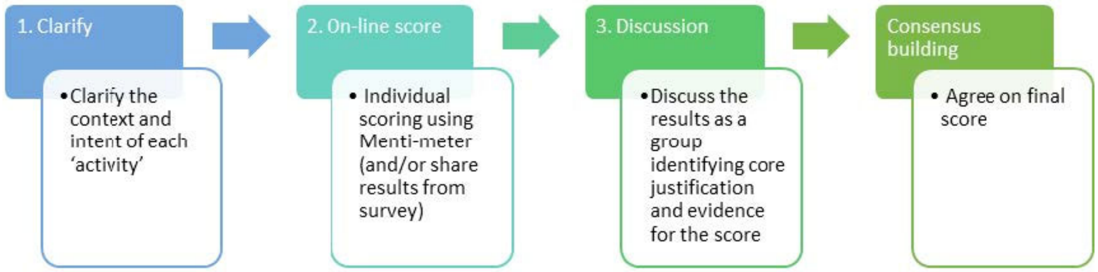

Figure 17. Process diagram for UWSF consensus-building in MWI workshops.

Following the workshops, report card-level results were derived by grouping activity questions into the following framework components:

- **Policy, planning, and governance** (relates to policy setting, planning document, and procedure document content).
- **Infrastructure management and maintenance** (relates to on-ground management activities).
- **Social approaches** (relates to capacity, training, collaboration, and research and development).
- **MERI** (monitoring, evaluation, reporting, and improvement; relates to monitoring and evaluation and how information is used to improve aspects of the above three elements).

Scores for these components (referred to as Management Activity Groups, or MAGs) were derived based on activity responses for each council, which were subsequently used to calculate an overall 'Urban Water Stewardship' grade for each LGA. For reporting purposes, these were averaged across councils and reported as a single UWSF grade.

2.7. Indigenous Cultural Heritage

Indigenous Cultural Heritage assessments are a collaborative set of indicators, led by the MWI Traditional Owner Reference Group (TORG) with support from Reef Catchments, HR2RP, and archaeological consultants. The TORG include representatives from Yuwibara, Koinjmal/Koinmerburra, Barada/Widi, and Ngaro/Gia/Juru Traditional Owners of the Mackay-Whitsunday-Isaac region.

The most recent cultural heritage scores (2020-21 data) are based on assessments of 17 sites from four zones: Islands of the Whitsundays, Proserpine and Airlie Beach, St Lawrence, and Lake Elphinstone and Mt Britton) (Figure 18). The assessments took place on the traditional country of Juru, Ngaro, Gia, Koinjmal/Koinmerburra, Barada and Widi peoples in October 2020. Further information about the indicators and grades are available in our Cultural Heritage Executive Summary.[31]

Figure 18. Cultural Heritage Zones assessed in the 2020-21 surveys. Islands of the Whitsundays (4 sites), Airlie Beach & Proserpine (4 sites), Lake Elphinstone & Mt Britton (7 sites), St Lawrence (2 sites).

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[31] https://healthyriverstoreef.org.au/wp-content/uploads/2022/07/hr2rp-cultural-heritage-exec-summary-2021.pdf

Sites were prioritised in each assessment based on member recommendations and logistical factors as guided by the TORG. As such, not all sites and regions are visited in each assessment (Table 20).

Table 20. Cultural heritage assessment frequency. Green shading indicates visitation during the assessment, while dotted shading indicates that the site was not visited.

Zone #	Zone Name	2014–15	2017–18	2020–21
1	St. Helens			
2	Islands of the Whitsundays			
3	Cape Hillsborough			
4	Cape Palmerston			
5	Proserpine-Airlie Beach			
6	Lake Elphinstone / Mount Britton			
7	St. Lawrence Zone			

3. Development of Condition Scoring Methods

Ordinal categories are used to describe scores for the condition of indicators, indicator categories, indices, and the overall basin/estuary/zone grade. This follows a five-point grading system: 'very good' (A), 'good' (B), 'moderate' (C), 'poor' (D), and 'very poor' (E).

Numerical scores are aggregated (rolled up by calculating an average) from the indicator level to an overall score for an individual reporting zone in an environment as per Figure 2 (i.e., indicators > indicator categories > index > overall zone score).

The minimum information required to generate scores is as follows:

- ≥ 50% of measured indicators to generate the indicator category score (where relevant), and
- ≥ 60% of indicator categories to generate an index score.
- Overall scores for reporting zones are presented in the Report Card, even if not all indicator categories are available. However, the coaster visualises only components that contribute to the overall grade.

All indicators have specific scoring ranges and bandwidths, described in the following sections, which correspond to the five-point system. Results for indicators that have divergent scoring ranges and bandwidths must be translated into a common scoring range before aggregating. The common scoring range used for reporting is based on that used by the GBR Report Card (Table 21). Where required, indicator scores were standardised into the GBR scoring range by linear interpolation (scaling) within bandwidths. In the following sections, individual indicator scoring and associated formulas for scaling are presented. Once standardised, relevant scores are averaged to aggregate into the higher category.

For presentation purposes in the technical documents and online, scores are shown as integers. The exception to this rule is for coral and seagrass scores, which are presented as rounded scores to ensure alignment with the MMP and QPSMP. Importantly, all significant figures are retained when creating overall scores at each level of aggregation.

Table 21. Description of standardised grading. Overall scoring range, associated grades, and colour codes.

Scoring Range	Condition Grade and Colour Code
81 to 100	Very good
61 to <81	Good
41 to <61	Moderate
21 to <41	Poor
0 to <21	Very poor

3.1. Freshwater Basins and Estuaries

Indicators in freshwater basins and estuaries have closely aligned approaches to determine their condition. The following section describes indicator scoring approaches and associated formulas for indicators in these waterway types.

3.1.1. Water Quality Index

3.1.1.1. Nutrients, Sediments, and Phys–chem

To calculate a condition score for water quality indicators, annual median concentrations of TSS, DIN, FRP, DO, and/or NTU are compared to guideline values. Annual median concentrations are calculated from monthly median concentrations to remove bias towards event concentrations. Annual medians concentrations that are less than or equal to the guideline value achieve a 'good' or a 'very good' score. Medians that exceed the guidelines achieve a 'moderate', 'poor', or 'very poor' grade, depending on where the median falls between the guideline value and a scaling factor (SF). This approach is very similar to the MMP system used in the marine inshore waters, where the cut-off between 'good' and 'moderate' grades is where the indicator's annual median concentration (or mean) is equal to or less than the guideline value. The approach to calculating a condition score (from 1 to 100) and translating this to the report card five-point grading is:

1. If the measured concentration of an indicator is less than the limit of reporting (LOR), then use a value of 0.5 × LOR,
2. Calculate monthly median concentrations (where relevant),
3. Calculate annual median from monthly medians (where relevant),
4. Compare annual median to the relevant local guideline value,
5. Calculate condition score (0–100) following rules and formulas in Table 22, Table 23, and Figure 19, and
6. Aggregate indicator scores into indicator category scores (where relevant) and the water quality index (following decision rules for minimum information).

Table 22. Rules, formulas, and scoring ranges for associated water quality grades for TSS, DIN, FRP, chl-*a*, Turbidity, and DO (when comparing to the upper guideline value) in freshwater basins and estuaries of the MWI Report Card.

Rule	Formula	Scoring Range	Grade
Median meets GV and ≥80% of data meets GV	Assigned 90[32]	81 to 100	Very good
Median meets GV, but 80% of data does not meet GV	80.9 – (19.9 × (((80th – GV) / (80th – median))))	61 to <81	Good
Median does not meet GV	60.9 – (60.9 × (ABS((median – GV) / (SF – GV))))	41 to <61	Moderate
		21 to <41	Poor
		0 to <21	Very poor
Where: 80th = 80th percentile of the data; median = annual median; SF = scaling factor based on 90th percentile[33] of available data.			

[32] QLD water quality guidelines 2009 recommend protocols for testing against 20th, 50th (median), and 80th percentiles. There is no *a priori* knowledge or guidelines regarding the entire distribution of water quality parameters in our systems; therefore, assumptions/decisions regarding the other 20% of the data (between 80–100%) and how it should be distributed around the GV cannot be made. Thus, a discrete value within the 'very good' range to systems if the 80th percentile meets the GV was assigned. The middle (i.e., 90) of the 'very good' range (Table 22) is used to assign a score for 'very good'.

[33] Scaling Factor for DO is varied to be based on the 99th percentile of all values—further discussion below under 'Scaling Factors (SF)'.

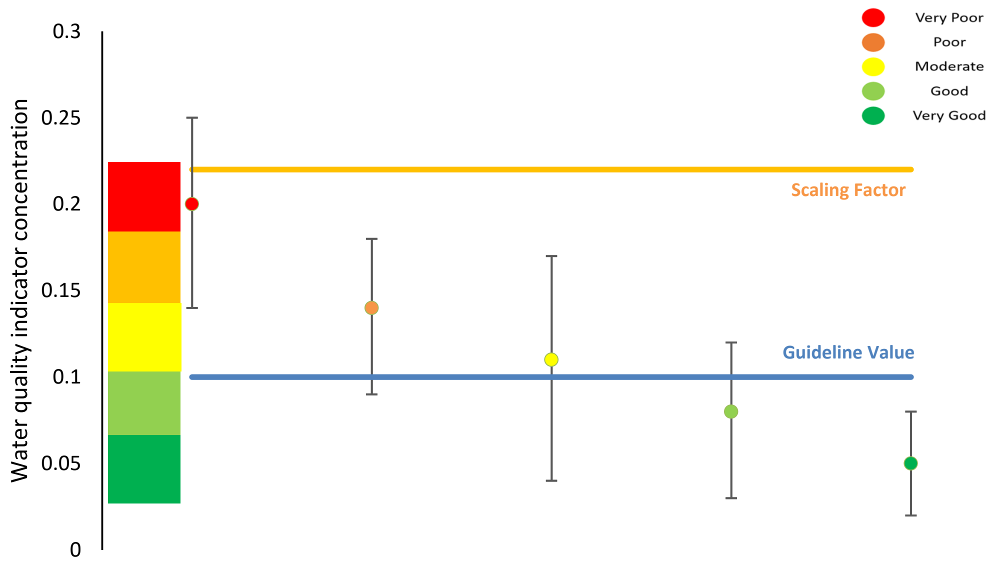

Figure 19. An example of how water quality grades are assigned. Where the middle point represents the annual median, the top whisker—the 80th percentile, and the bottom whisker—the 20th percentile of the data. Only when the median meets or is better than the guideline (in this case, meeting the guideline means the value must be at or below the guideline) can 'good' or 'very good' be scored. Scores for 'moderate', 'poor', and 'very poor' are equally scaled between the guideline and scaling factor.

Table 23. Rules, formulas, and scoring ranges for associated water quality grades for DO (when comparing to the lower guideline value (GV)*) in estuaries of the MWI Report Card.

Rule	Formula	Scoring Range	Grade
Median is less than or equal to the GV and the 80th percentile is less than or equal to the GV	Assigned 90	81 to 100	Very good
Median is less than or equal to the GV, but 80th percentile exceeds the GV	80.9 – (19.9 × (((GV – 20th) / (median – 20th))))	61 to <81	Good
Median exceeds the GV	60.9 – (60.9 × (ABS((median – GV) / (SF – GV))))	41 to <61	Moderate
		21 to <41	Poor
		0 to <21	Very poor
Where: 20th = 20th percentile of the data; median = annual median; SF = scaling factor based on 90th percentile of available data. * To meet the lower DO guideline value, % saturation must be higher than the GV. This is inverse to how other indicators meet the GV; thus, the formula to calculate grade must also be the inverse.			

Guideline Values

Guideline values used for most freshwater basins are based on the QLD Water Quality Guidelines 2009 (DEHP, 2009) and are related to the individual river or creek (Table 24). For the Don River, guideline values used are based on the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 Don River Basin Environmental Values and Water Quality Objectives Don River water quality data are separated into high (event) flow and low (base) flow periods using daily discharge data from the time nearest when the sample was taken. This allowed the separate scheduled guideline values for event flows and base flows to be applied for calculation of the water quality scores. Monthly medians for basin water quality were calculated separately for high (event) flow and low (base) flow conditions, and medians for high (event) flow and low (base) flow periods were calculated from the monthly medians.

Draft guidelines for DIN for the Don Basin and monitored estuaries were not available. Therefore, guideline values were created by summing ammonia nitrogen and NO_x draft guideline values. There is a precedent for this approach in the EPP 2009 'Proserpine River, Whitsunday Island and O'Connell River Basins environmental values and water quality objectives'[34] which, in reference to DIN guideline values, states: "DIN = ammonia nitrogen + NO_x" (page 47). This is reflected in the additive nature of the scheduled water quality objectives for the middle and lower estuaries in this document.

Table 24. Freshwater Basin guideline values. Water quality indicator categories, associated indicators, and guideline values for freshwater basins in the MWI Report Card. Sources include (DEHP, 2009; Environmental Policy and Planning Division, Department of Environment and Science, 2022a)

Source	Site	Flow	DIN mg/L	FRP mg/L	TSS mg/L
EPP 2019	Don @ Bowen	Low	0.024	0.025	4
		High	0.14	0.095	65
DEHP 2009	O'Connell @ Caravan	All	0.03	0.006	2
	Pioneer @ Dumbleton	All	0.008	0.005	5
	Plane @ Sandy Creek Homebush	All	0.03	0.015	5
	Plane @ Plane Creek Sucrogen Weir	All	0.008	0.008	3

Table 25. Estuarine guideline values. Water quality indicator categories, associated indicators, and guideline values for estuaries in the MWI Report Card. DO guideline values are presented as lower and upper limits. Sources include (Environmental Policy and Planning Division, Department of Environment and Science, 2022c, 2022b).

Source	Site	DIN mg/L	FRP mg/L	Chl-*a* µg/L	DO % sat	Turb NTU
EPP WQO 2019 Proserpine River, Whitsunday Island and O'Connell River Basins	Gregory River	0.012	0.015	1.1	70-105	5
	O'Connell River	0.04	0.03	2	70-105	10
	Murray / St Helens Creek	0.012	0.015	1.1	70-105	5
EPP WQO 2019 Pioneer River Plane Creek Basins	Vines Creek	0.04	0.03	1.1	70-105	10
	Sandy Creek	0.04	0.06	5	70-105	Too variable to derive GV
	Plane Creek	0.04	0.06	5	70-105	
	Rocky Dam Creek	0.04	0.06	5	70-105	
	Carmila Creek	0.04	0.06	5	70-105	

Scaling Factors (SF)

To set an SF for freshwater nutrient and sediment indicators (DIN, FRP, and TSS), the historical GBRCLMP data were pooled for each basin, and the 90th percentile was used as the SF. The advantage of this approach is that the SFs were derived from the largest sample size available. For new sites, including the Don and Proserpine GBRCLMP sites, the same SF used for existing sites will be applied to new sites. This will mean the number of SF values across the Report Card will be minimised, making the assessments between basins more consistent.

For the estuarine indicators of turbidity, DIN, FRP, and chl-*a*, the SF is based on the 90th percentile of all values of the relevant indicator collected from estuarine monitoring in the MWI Region. The SF for DO is based on the 99th percentile of all values for DO collected from estuarine monitoring in the MWI

[34] https://ehp.qld.gov.au/water/policy/pdf/plans/proserpine-river-ev-wqo.pdf

Region. This is because the adoption of the 90th percentile would have resulted in the adoption of an SF value of 70% saturation. Most significantly, this is the same as the lower guideline value for DO. This value was unsuitable, as the SF needs to be some distance from the guideline value to provide a scoring range that will determine the grade of annual medians that do not meet guidelines. Further, values below 70% saturation occur reasonably frequently in the reference estuary, the Gregory, and therefore, the use of a 90th percentile SF value would put the least impacted estuary in a poor category. Therefore, the SF that was adopted to DO was the 99th percentile (~60% saturation), which avoids giving the Gregory a poor score and still provides a reasonable scoring range.

The Sandy, Rocky Dam, and Carmila Creeks estuaries are strongly tidal-influenced, and this may be apparent in the results. This could affect turbidity values through the increased suspension of sediments by tidal currents. Additionally, at the time of setting SF values, estuarine monitoring in the MWI Region was a newly commenced program, and therefore, only one year of data were available for calculation of the SF. SF values will be re-visited in the future as more data are collected.

Limits of Reporting (LOR)

Rules have been set around how to deal with samples where concentrations of an indicator are below the LOR (Table 26):

- Where a monitoring program reports a LOR that is greater than the guideline value, data from that program where a concentration was reported as <LOR is not used (because this does not allow for valid interpretation of whether guidelines are met within the State of QLD); and
- Where a monitoring program reports a LOR that is less than the guideline value, a value of 0.5 × LOR is applied to data where <LOR is reported in a sample.

When a monitoring program reports a LOR where the magnitude of difference between the guideline value and the LOR is less than two-fold, applying a value of 0.5 × LOR may have the impact of biasing results towards better scores than is true in the field. Therefore, the number of samples where data are reported as <LOR should be considered when reporting confidence of the results when the magnitude of difference between the guideline value and the LOR is less than two-fold.

Table 26. LOR values for estuary water quality indicator categories and associated indicators in the MWI Report Card. DO guideline values are presented as lower and upper limits.

Indicator Category	Indicator	LOR
Nutrients	Ammonium Nitrogen (NH_4) mg/L	0.002
	NOx mg/L	0.001
	FRP mg/L	0.002
Phys–chem	DO % sat	-
	Turbidity NTU	-
Chl-*a*	Chl-*a* µg/L	0.100
Sediment	TSS mg/L	1.000

Aggregation of Scores

Multiple monitoring sites were used to inform water quality scores within the O'Connell and Plane basins. The addition of these sites into the Report Card assessment occurred for the first time in 2018. The following steps were applied for the aggregation of scores in the Plane Basin:

1. The total catchment area upstream of the monitoring site was obtained from the QLD Government;
2. The adjusted upstream catchment area for each monitoring site was determined. Where multiple monitoring sites are present along the same system, the adjusted catchment area reflects:
    a. The total upstream catchment area from the start of the system, or
    b. The total upstream catchment area as measured from the (first) upstream monitoring station to the next monitoring station;
3. The proportion of total catchment area for each monitoring site was determined and multiplied by the standardised score for each monitoring site;
4. All scores were summed to provide the final basin score.

3.1.1.2. Pesticides

Pesticide indicator scores were developed by the QLD Government's GBRCLMP using the Pesticide Risk Metric (PRM). The aim of this approach is to quantify the ecological risk associated with exposure to a mixture of pesticides. Measured concentrations of up to 22 pesticides in each sample are converted to a PRM that expresses risk as the percentage of aquatic species that may be adversely affected by the mixture of pesticides. From the 2019 Report Card onwards, the PRM approach has been applied to pesticides with multiple Modes of Action (MoAs). This was calculated using the independent action model of joint action (Plackett & Hewlett, 1952; Warne et al., 2020, 2023).

The pesticide mixture toxicity was calculated for all samples collected over the principal pesticide exposure period (i.e., the wet season period between 1st November and 30th April). Where there was more than one sample per day, a daily mean concentration was calculated. The mixture toxicity data (i.e., PRM values) for all water samples collected over the wet season were then summarised as a single value. A multiple imputation technique was used to the daily average PRM for days that were not monitored during the wet season (Donders et al., 2006; Patrician, 2002; Rubin, 1996). This involved fitting a statistical distribution to the observed data for the wet season for the site. Values were then imputed to fill in the missing days in the 182-day period. The resultant data were then divided to obtain the daily PRM and ranked into five risk categories (Table 27). These categories are consistent with the ecological condition categories used in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality[35]. All values were rounded to the nearest whole number.

Table 27. Standardised grading for freshwater pesticides in the freshwater basin assessments.

Risk Categories (% species affected)	% Species Protected	Risk Level	Pesticides Assessment	Scaling of Scores for Aggregation
≤1.0 %	≥99%	Very low risk	Very good	= 81 + ABS((19 − ((score − 0) × (19 / 1))))
>1 to <5%	>95 to <99%	Low risk	Good	= 61 + ABS((19.9 − ((score − 1.01) × (19.9 / 3.99))))
5 to <10%	>90 to 95%	Moderate risk	Moderate	= 41 + ABS((19.9 − ((score − 5.00) × (19.9 / 4.99))))
10 to <20%	>80 to 90%	High risk	Poor	= 21 + ABS((19.9 − ((score − 10.00) × (19.9 / 9.99))))
≥20.0%	≤80%	Very high risk	Very poor	= 0 + ABS((20.9 − ((score − 20.00) × (20.9 / 79.99))))

35 https://www.waterquality.gov.au/anz-guidelines

3.1.2. Habitat and Hydrology

3.1.2.1. In-stream Habitat Modification

The two in-stream habitat modification indicators, impoundment length and fish barriers, were equally weighted to generate the in-stream habitat modification score for freshwater basins (only the fish barriers indicator is used in this category for estuaries). Scoring for each indicator is described below. Final impoundment length and fish barrier scores were standardised within appropriate bandwidths before an average score was generated to describe the overall condition of the in-stream habitat modification indicator.

Impoundment Length (Freshwater Basins only)

The scoring range in Table 28 was derived from work on Murray–Darling Basin rivers, which involved benchmarking the ecological condition of multiple rivers in relation to several ecological indicators, one of which was the proportion of river impounded by dams and weirs. The ecological condition of streams was assessed during benchmarking and was based on existing studies and the expert opinion of a panel of experienced aquatic ecologists.[16] An assumption of the status quo is implied in the scoring for impoundment length (rather than cause-and-effect with ecological function), with additional impoundments lowering subsequent report card scores.

Table 28. Impoundment length grading. Description of the grading breaks for the impoundment length indicator in the freshwater basin assessments.

% of Waterway Impounded	Condition Grade	Scaling of Scores for Aggregation
<1.0%	Very good	= 81 + ABS((19 − ((score − 0) × (19 / 0.99))))
1.0–3.99%	Good	= 61 + ABS((19.9 − ((score − 1) × (19.9 / 2.99))))
4.0–6.99%	Moderate	= 41 + ABS((19.9 − ((score − 4) × (19.9 / 2.99))))
7.0–9.99%	Poor	= 21 + ABS((19.9 − ((score − 7) × (19.9 / 2.99))))
≥10.0%	Very poor	= 0 + ABS((20.9 − ((score − 10) × (20.9 / 90))))

Fish Barriers

To score the condition of fish barriers in freshwater basins and estuaries, a scoring range and subsequent score was developed for each of the three indicators (Table 29, Table 30, Table 31). Each basin and estuary were allocated a score for each indicator based on these scoring ranges. The final aggregated fish barriers indicator score for each basin and estuary was derived by adding these three scores together (Table 32).

Table 29. Barrier density scoring range and subsequent score assigned for the barrier density indicator. Assessed on Stream Order (SO) as indicated.[36]

Scoring Range (km/barrier) Freshwater Basins and Estuaries (SO ≥ 3)	Score	Condition Grade
≥16.1	5	Very good
8.1–16	4	Good
4.1–8	3	Moderate
2.1–4	2	Poor
0–2	1	Very poor

[36] In estuaries only, barriers were assessed on waterways that intersected the Fisheries Queensland 'Estuary Extent' Layer, regardless of Stream Order.

Table 30. Stream length to 1st barrier scoring ranges in freshwater basins and estuaries, and subsequent score assigned for 'stream length to the first barrier as a proportion (%) of total stream length'. Assessed on Stream Order (SO) as indicated.

Scoring Range (%) Freshwater Basins (SO ≥ 3)	Scoring Range (%) Estuaries (SO ≥ 3)	Score	Condition Grade
No Barriers	No Barriers	5	Very good
50%–99.9%	80%–99.9%	4	Good
30%–49%	60%–79%	3	Moderate
10%–29.9%	40%–59.9%	2	Poor
0%–9.9%	0%–39.9%	1	Very poor

Table 31. Stream length to 1st low passability barrier scoring ranges in freshwater basins and estuaries, and subsequent score assigned for 'stream length to the first low/no passability barrier as a proportion (%) of total stream length'. Assessed on Stream Order (SO) as indicated.

Scoring Range (%) Freshwater Basins (SO ≥ 4)	Scoring Range (%) Estuaries (SO ≥ 4)	Score	Condition Grade
≥95.1%	No low pass barriers (100%)	5	Very good
70.1%–95%	90.1%–99.9%	4	Good
60.1%–70%	80.1%–90%	3	Moderate
50.1%–60%	60.1%–80%	2	Poor
0%–50%	0%–60%	1	Very poor

Table 32. Overall fish barrier scoring range and fish barrier condition rating.

Scoring Range	Overall Fish Barrier Condition Rating	Scaling of Scores for Aggregation
14–15	Very good	= 81 + ABS((19 + ((score − 15) × (19 / 1))))
11–13	Good	= 61 + ABS((19.9 + ((score − 13) × (19.9 / 2))))
8–10	Moderate	= 41 + ABS((19.9 + ((score − 10) × (19.9 / 2))))
5–7	Poor	= 21 + ABS((19.9 + ((score − 7) × (19.9 / 2))))
3–4	Very poor	= ABS((20.9 + ((score − 4) × (20.9 / 1))))

3.1.2.2. Flow

There are ten measures that contribute to the flow score (Table 33). Each measure assesses observed flow data against the reference distribution from pre-development modelled flow for each flow assessment site. The reference distributions are selected for one of the four rainfall types (drought, dry, average, or wet) to match the rainfall type of the reporting year. The ten flow measures were selected to represent key components of the natural flow regime that are required by a range of ecological assets, with links to water resources that are sensitive to changed water allocation and management conditions. The key flow components and associated ecological assets are cease-to-flow (CTF) (amphibians, riffles, and waterholes), low flows (some spawning fish, reptile and amphibian species, and riffles and waterholes), medium flows (riffles), and high flows (fisheries production in estuaries). Details of the flow requirements of the assets (including seasonal flow requirements), their links to the flow measures, and a description of the flow measures are presented in the Report Card Flow Indicator Project report (Stewart-Koster et al., 2018).

Table 33. Metrics used in the flow indicator, the season to which they apply, and the hydrologic definition of the measure. CV = coefficient of variation.

Flow Measure	Season	Hydrologic Definition
Low flow duration	July–Jan	Total duration of flows that remain equal to or below the 10th percentile threshold for the reporting period (annual).
Low flow frequency	July–Jan	Count of the number of occurrences during which the magnitude of flow falls to or below the 10th percentile threshold during the reporting period (annual).
Low flow variability (CV dry season)	July–Dec	CV (standard deviation/mean) of daily flow for dry season.
Driest six months (ratio dry/total)	July–Dec	Proportion of annual discharge contributed during the months of July–December.
CTF duration	All year	Total duration of where flow ceases during the reporting period (annual).
CTF frequency	All year	Count of the number of occurrences during which flow ceases during the reporting period (annual).
Medium flow duration	All year	Total duration of flows that remain equal to or above the 50th percentile threshold for the reporting period (annual).
Medium flow frequency	All year	Count of the number of occurrences during which the magnitude of flow passes from below to equal or above the 50th percentile threshold during the reporting period (annual).
High flow duration	All year	Total duration of flows that remain equal to or above the 90th percentile threshold for the reporting period (annual)
High flow frequency	All year	Total count of flows that remain equal to or above the 90th percentile threshold for the reporting period (annual)

Landscape changes resulting from human activities, including vegetation clearing, removal of wetlands, levelling, modification of channel morphology, and removal or addition of waterway channels, may affect the characteristics of flood waters, including their duration, extent, and frequency. Consequently, whilst flow volumes during flood events may be similar to pre-development levels, the actual hydrological characteristics of the flood and inundation events, and hence their ecological functioning, may be altered.

The scoring for each flow measure is based upon the percentile range representative of standard deviations from the mean (Table 34).

Table 34. Benchmark measures for flow metrics, expressed as standard deviations from the mean and approximate percentiles.

Score	Target Standard Deviations from Mean	Rationale	Percentile Range
5	1	Within 68.27% observed range	15.87–84.13
4	2	Within 95.37% observed range	2.28–15.87, 84.13–97.72
3	3	Within 99.73% observed range	0.13–2.28, 97.72–99.87
2	4	Within 99.99% observed range	0–0.13, 99.87–100
1	5	Outside the observed range	<0, >100

The 30th percentile value was selected as the most appropriate summary statistic for representing the range of the ten flow measures and reporting a score for each site. The other summary statistics were the mean, mode, and minimum score. The procedures required for producing flow measure scores and summary scores were conducted using the flow indicator tool developed for the Report Card Flow Indicator Project (Stewart-Koster et al., 2018). The summary scores from the flow assessment sites were converted from the 1 to 5 scale to the standardised scale of 0 to 100 for aggregation with other report card indicators. For each flow assessment site, the following steps were applied to provide a standardised score from 0 to 100 from the output score of the flow assessment tool (1 to 5 scale):

1. Determine the 30th percentile value from the ten flow measures (each scores from 1 to 5) for each flow assessment site.
2. Apply the following formula for scores of <2: (20.9 + ((30th percentile − 1.9) × (23.2))).

To provide a value of 0 to 20.9 for scores of <2 graded 'very poor'.

3. Apply the following formula for scores of 2 to <5: ((30th percentile × 20) − 19).

To provide a value between 21 and 80 for scores 2 to <5 and are graded 'poor', 'moderate', or 'good'.

4. Apply the following formula for scores of 5: 80 + ((M_{min} − 1) × 5) where M_{min} is the lowest scoring measure (1 to 5) for the flow assessment site.

To provide a value of between 80 to 100 for scores of 5, using the lowest contributing flow measure score as a scale. This also prevents a flow assessment site for which a flow measure is scored 1 (outside of the observed distribution) from receiving a grade of 'very good'.

The 30th percentile score, standardisation formula, and standardised scoring range with grade colour code are presented in Table 35.

Table 35. Flow assessment standardisation formula for 30th percentile scores of flow assessment sites.

Scoring Range 30th Percentile Score	Grade	Scaling of Scores for Aggregation
5	Very good	= 80 + ((minimum flow measure score − 1) x 5)
4 to <5	Good	= (score x 20) − 19
3 to <4	Moderate	= (score x 20) − 19
2 to <3	Poor	= (score x 20) − 19
1 to <2	Very poor	= 20.9 + ((score − 1.9) x (23.2°))
°23.2 is a scaling factor to convert the 30th percentile score to within the very poor standardised scoring range (0–20.9).		

For basins or estuaries with more than one flow assessment site, the following steps were applied for aggregating scores:

- The total catchment area upstream of the gauged flow assessment sites were determined.
- The adjusted upstream catchment for each assessment site (stream gauge) was determined, which is the total catchment area up until the next upstream assessment site(s), if present.
- The proportion of total catchment for each assessment site was determined and multiplied by the standardised score for the assessment site.
- All contributing scores were summed to provide the final basin score.

Flow Indicator Example:

The 2019 to 2020 rainfall for the Pioneer Basin and the annual flow records for Finch Hatton Creek and Dumbleton Weir Tailwater are presented in Figure 20. Finch Hatton is located upstream in the upper catchment, whilst Dumbleton Weir Tailwater (TW) is downstream in the lower catchment of the Pioneer River. Differences in the flow records between the sites include the effect of impoundments on river flow of three weirs: Dumbleton, Marian, and Mirani. A major dam, Teemburra, is also located on this watercourse. This example visually presents how the assessment of flow records using the indicator differ between a site that has minimal alteration from pre-development flows (Finch Hatton) and one that has substantial alteration from flows (Dumbleton Weir TW) for the 2019–20 reporting period.

The flow at Finch Hatton Creek for 2020–21 reporting period scored a five or four (out of five) for nine of the ten flow measures, determining that much of the flow was not substantially altered from pre-development flow. The overall freshwater flow score at Finch Hatton Creek was four, calculated from the 30th percentile of the ten flow measures. The standardised report card value of this score was 61 ('good'). The flows at Dumbleton Weir TW were substantially altered from pre-development flows (i.e., a score of one out of five) for the following four measures: cease to flow duration and frequency, low flow duration, and coefficient of variation for the dry season. The flow record at Dumbleton Weir TW shows abrupt changes to flow as a result of the in-stream habitat modifications, including weir impoundments and water releases for consumption purposes. The overall Dumbleton Weir TW score was one, with the standardised report card value of this score of zero ('very poor'). The example demonstrates how the flow indicator assesses the degree of change from reference for different characteristics of the flow regime.

The example includes alterations to flow that are easy to visualise from an annual flow record. However, the ten flow measures can assess and score aspects of the flow regime that may not be as clearly visualised from the flow record but may still be important to waterway health. The potential impacts upon waterway health attributes linked to low flows include low flow spawning fish, critical hydraulic habitat, longitudinal connectivity, and water quality; those linked to medium flows include riffle habitats and macrophyte beds; and those linked to high flows include fishery productivity (Stewart-Koster et al., 2018). The results of the flow indicator for Dumbleton Weir TW identify that alteration of flows may be impacting waterway health for the attributes linked to low and medium flows.

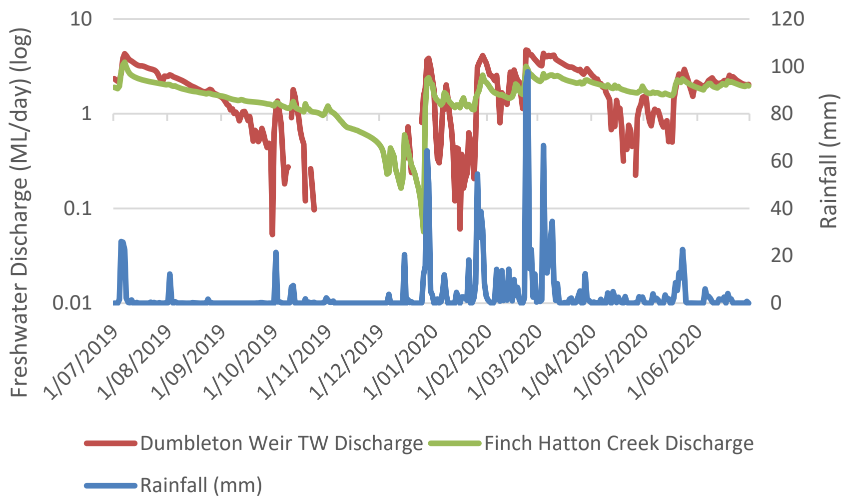

Figure 20. Observed daily discharge (ML/day) for the Dumbleton Weir Tailwater (TW) and Finch Hatton Creek sites in the Pioneer Basin, presented on a log scale. This is plotted against daily rainfall (mm) for the Pioneer Basin. Missing data represent periods of no flow at Dumbleton Weir TW.

3.1.2.3. Riparian, Wetland, and Mangrove/Saltmarsh Extent

The condition score for the extent of riparian, wetland, and mangrove/saltmarsh extent vegetation was determined by calculating the percentage of vegetation loss since pre-clearing to 2013–14 (freshwater riparian extent), 2016–2017 (freshwater wetland extent), and (2018-19) (estuarine vegetation extent indicators) for each basin or estuary and assigning the result a grade (Table 36).

Table 36. Standardised grading for riparian, wetland, and mangrove/saltmarsh extent indicators in freshwater basin and estuary assessments.

Scoring Range	Grade	Scaling of Scores for Aggregation
≤5.0%	Very good	= 81 + ABS((19 − ((score − 0) × (19 / 4.99))))
>5.0–15.0%	Good	= 61 + ABS((19.9 − ((score − 5.01) × (19.9 / 9.99))))
>15–30.0%	Moderate	= 41 + ABS((19.9 − ((score − 15.01) × (19.9 / 14.99))))
>30–50%	Poor	= 21 + ABS((19.9 − ((score − 30.01) × (19.9 / 19.99))))
>50%	Very poor	= ABS((20.9 − ((score − 50.01) × (20.9 / 49.99))))

3.1.3. Fish (Freshwater Basins only)

The model developed for the calculation of indigenous species richness was reviewed by local experts to ensure validity. The model provides a means to compare fish species richness across basins to a reference. This reference was based on species richness at the 'least disturbed' site that had recent available data, which in the MWI Region was Repulse Creek. This approach does not compare to a pre-development baseline, so it can only be considered as a comparison of current fish community condition between basins.

The primary baseline for assessing the species richness of sites within the MWI region was a regression line describing the relationship between the species richness of the 10% most specious samples, primarily in relation to variables describing the natural variation in fish species richness across the MWI region (D. Moffatt, pers. comm. 19/04/2022).

The regression line was derived using 90th percentile quantile regression, and the variables used to characterise streams were (1) stream size (accumulated run-off weighted catchment area), (2) stream slope, (3) maximum stream slope downstream, and (4) annual temperature range as inputs. The regression line was derived from the fish catch from 370 samples at 252 different locations and explained about 50% of the observed variation. In areas where there were insufficient data to derive a reliable regression line, e.g., the Don Basin, a line was fitted by eye using the single environmental variable explaining the greatest proportion of variation in species richness (D. Moffatt, pers. comm. 19/04/2022).

Based on ongoing indicator development and feedback from a variety of fish experts (both local and QLD Government), several methodological updates were made to the 2021 freshwater fish assessments, including:

- The Don Basin was included in the assessment for the first time.
- The indicator categories were changed from 'Native' and 'Pest' fish to 'Indigenous' and 'Non-indigenous' fish.
- Derived updated or new (Maximum Species Richness) baselines to accommodate new data and assessment areas.

Fish communities are assessed every three years, reflecting the lifespan of many local freshwater fish species and budgetary constraints. Although the method updates in the 2022 Report Card reflect the third round of fish assessments, the fish assemblage indicator is still under development. Future updates will include species distribution models (currently being developed by the QLD Government in collaboration with local experts), ecological integrity insights, and greater detection of individual species present.

A qualitative rating scheme for indigenous species richness (POISE) was developed (Table 37), where the 'very good' category was based on available data for the Repulse Creek sites ('minimally disturbed' site with available data) and the 'poor' was based on the 90th percentile of the results for recent times. Anything less than the 90th percentile is considered 'very poor'. The rating scheme for the non-indigenous fish model output (PONI) differs slightly to that for indigenous species richness (Table 38).

Species distribution models are currently being developed by the QLD Government to complete development of the fish assemblage indicator.

Table 37. Standardised grading for POISE (modelled indigenous species richness) for freshwater fish communities.

Native Species Richness	Grade	Scaling of Scores for Aggregation
0.80 to 1	Very good	= 81 + ABS((19 + ((score − 1) × (19 / 0.2))))
0.67 to <0.80	Good	= 61 + ABS((19.9 + ((score − 0.7999) × (19.9 / 0.1329))))
0.53 to <0.67	Moderate	= 41+ ABS((19.9 + ((score − 0.6669) × (19.9 / 0.1339))))
0.40 to <0.53	Poor	= 21 + ABS((19.9 + ((score − 0.5329) × (19.9 / 0.1329))))
0 to <0.40	Very poor	= ABS((20.9 + ((score − 0.3999) × (20.9 / 0.3999))))

Table 38. Standardised grading for PONI (modelled non-indigenous fish condition indicator) for freshwater fish communities.

Non-indigenous Fish	Grade	Scaling of Scores for Aggregation
0 to 0.03	Very good	= 81 + ABS((19 − ((score − 0) × (19 / 0.025))))
>0.03 to 0.05	Good	= 61 + ABS((19.9 − ((score − 0.0251) × (19.9 / 0.0249))))
>0.05 to 0.1	Moderate	= 41 + ABS((19.9 − ((score − 0.051) × (19.9 / 0.049))))
>0.1 to 0.2	Poor	= 21 + ABS((19.9 − ((score − 0.101) × (19.9 / 0.099))))
>0.20 to 1	Very poor	= ABS((20.9 − ((score − 0.201) × (20.9 / 0.799))))

3.2. Inshore and Offshore Marine Zones

3.2.1. Inshore Water Quality

3.2.1.1. Nutrients, Chlorophyll-a, and Water Clarity

For indicators in the nutrients, chl-*a*, and water clarity categories, annual medians or means were calculated (as per the guidelines of the relevant zone) for each site, and condition scores were calculated using the relevant guideline value and the procedure below.

Guideline values were obtained from the Queensland Government (Environmental Policy and Planning Division, Department of Environment and Science, 2022a, 2022c, 2022b), and from the Great Barrier Reef Marine Park Authority (Moran et al., 2023) (Table 39).

The first two Report Cards (2014 and 2015) used only the relevant guidelines from (GBRMPA (Great Barrier Reef Marine Park Authority), 2010). The shift towards using locally relevant QLD guidelines (where available) reflects a move toward reporting on the 'interim site-specific water quality index', based on guideline values refined using site-specific, long-term water quality data collected at MMP sites (Waterhouse et al., 2017a) rather than GBR-wide (GBRMPA (Great Barrier Reef Marine Park Authority), 2010) guidelines. While the MWI Report Card has not employed the same guideline values as the MMP, the adopted guideline values sourced from the EPP refer to GBRMPA guideline values where appropriate.

Prior to calculating annual medians or means and comparing them to the guidelines, the LOR (or limit of detection (LOD) was explored as per Table 40, and the same rules applied as described for freshwater basins and estuaries.

Table 39. Inshore marine water quality guideline values for relevant indicators at monitoring sites in the MWI Report Card. Also listed are the programs associated with each site, source documents for the guideline values listed, associated basin/region/water area, water type (OC = open coastal, EC = enclosed coastal), and management intent (SMD = slightly to moderately disturbed, HEV = high ecological value, MD = moderately disturbed) outlined in the source documents. Bold and underlined values are compared to means; other guidelines are compared to medians.

Zone	Water Type	Mgmt. Intent	Basin/region/water area	Site	NO_x (µg/L)	PN (µg/L)	PP (µg/L)	Chl-*a* (µg/L)	TSS (mg/L)	Secchi (m)	Turb (NTU)
Northern	OC	SMD	ABBOT BAY Open coastal waters in GBR Marine Park outside core port waters: landward of GBR plume line, shown in WQ1222	AP_AMB1 Euri Creek (NQBP)* AP_AMB4 Camp Island (NQBP)*	0.42	13	2.1	**0.45**	1	**10**	2
			MIDSHELF WATERS HEV waters around Holbourne Island	AP_AMB5 Holbourne Island (NQBP)*	0.25	14	2	0.33	0.8	11	0.5
Whitsunday	OC	HEV	HEV2381 open coastal waters (Whitsundays – south to Thomas island) seaward of Plume line shown in WQ1222)	WHI1 Double Cone Island (MMP)**	0.36	14	2.3	0.36	1.4	**10**	1.1
				WHI4 Pine Island (MMP)**(WHI5 Seaforth Island (MMP)**	0.49						
Central	EC	HEV	SD2381S Site-specific Guideline Values for MMP sites Table C - 9: Site-specific Guideline Values (GVs) used for comparison with water quality monitoring data. (Great Barrier Reef Marine Park Authority, 2010. GBRMPA Group 16	WHI6 O'Connell River mouth (MMP)	4			1.3	5	1.6	4
	OC	HEV	SD2381S Repulse Bay south open coastal waters, landward of the plume line	WHI7 Repulse Is. dive mooring (MMP)**	0.21	18	2.1	**0.45**	1.6	**10**	**2**
	OC	HEV	SD2382 open coastal waters, landward of the plume line, shown in WQ1222	MKY_AMB1 Freshwater Point (NQBP)^	0.21	18	**2.1**	**0.45**	1.6	**10**	2
	OC	MD	Ports: MD2343 Hay Point sub-zone open coastal waters (including approved dredge spoil grounds) Ports: MD2341: Mackay Port open coastal waters (including approved dredge spoil grounds)	MKY_AMB2 Hay Reef (NQBP) ^ MKY_AMB5 Slade Island (NQBP) ^	1	**20**	**2.8**	**0.45**	**2.0**	**10**	D = 2 W =12
	OC	SMD	Open coastal waters landward of the plume line, shown in WQ1222 [Includes OC waters outside of port sub-zones and not identified as SD or HEV]	MKY_AMB3B Round Top Is. (NQBP) ^ MKY_AMB10 Victor Island (NQBP) ^	1	**20**	**2.8**	**0.45**	**2.0**	**10**	**2**
Southern	OC	HEV	SD2383 and SD2384 open coastal waters (including macro tidal) landward of the plume line, shown in WQ1222	CAM1 Aquila Island (SIP) ^ CAM2 Morning Cay (SIP) ^ CAM3 Fanning Shoal (SIP) ^	0.25	**20**	**2.8**	**0.45**	**2.4**	**8**	2.4

References:

* Environmental Protection (Water and Wetland Biodiversity) Policy 2019. Don River Basins Environmental Values and Water Quality Objectives.

**Environmental Protection (Water and Wetland Biodiversity) Policy 2019. Proserpine River, Whitsunday Island and O'Connell River Basins Environmental Values and Water Quality Objectives

^Environmental Protection (Water and Wetland Biodiversity) Policy 2019. Pioneer River and Plane Creek Basins Environmental Values and Water Quality Objectives.

Table 40. Marine inshore LORs and LODs for different marine water quality indicators and monitoring programs used by the MWI Report Card.

Indicator Category	Indicator	LOR: SIP and NQBP (JCU)	LOD: MMP (AIMS)
Nutrients	Particulate nitrogen (PN) *(= TN − TDN)*	NA	<1.0 µg/filter
	Particulate phosphorus (PP) *(= TP − TDP)*	NA	<0.09 µg/L
	Oxidised nitrogen (NO_x) *(= NO_2 + NO_3)*	<1 µg/L	<0.28 µg/L (NO_x)
Chl-*a*	Chl-*a*	<0.2 µg/L	<0.004 µg/L
Water Clarity	TSS	<0.2 mg/L	<0.15mg/filter
	Secchi disk depth	NA	NA
	Turbidity	0.005 NTU	

The following steps were used to calculate indicator scores (see Lønborg et al., 2016; Waterhouse et al., 2017b).

1. For indicators where failure to meet a guideline is defined as the annual (mean or median) concentration being *higher* than a guideline value:

$$\text{Condition score} = \log_2 (GV/AM)$$

For indicators where failure to meet a guideline is defined as the annual (mean or median) concentration being *lower* than a guideline value (e.g., secchi disk depth):

$$\text{Condition score} = \log_2 (AM/GV)$$

Where:
AM is the annual median or mean of the measured indicator
GV is the guideline value

2. Ratios were capped to bind the water quality index to the range of −1 to 1 to ensure all indicators were on the same scale.
3. For turbidity, where a wet and dry season score is calculated, these scores were averaged to give an annual turbidity score.
4. The nutrients indicator category score was calculated as the average of NO_x, particulate phosphorus (PP), and particulate nitrogen (PN) scores (where available and following rules for minimum information).
5. The water clarity indicator category was calculated as the average of secchi, TSS, and turbidity scores (where available and following rules for minimum information).
6. Nutrients, water clarity, and chl-*a* scores were translated to the report card five-point grading scale (Table 41).

Table 41. Standardised grading for Inshore water quality, scoring ranges, and scaling for aggregation.

Score Range	Condition Grade and Colour Code	Scaling of Scores for Aggregation
>0.5 to 1	Very good	= 100 − (19 − ((score − 0.51) × (19 / 0.49)))
0 to 0.5	Good	= 80.9 − (19.9 − ((score − 0.01) × (19.9 / 0.49)))
<0 to −0.33	Moderate	= 60.9 − (19.9 − ((score − (−0.33)) × (19.9 / 0.32)))
<−0.33 to −0.66	Poor	= 40.9 − (19.9 − ((score − (−0.66)) × (19.9 / 0.32)))
<−0.66 to −1	Very poor	= 20.9 − (20.9 − ((score − (−1)) × (20.9 / 0.34)))

3.2.1.2. Pesticides

Pesticides in the inshore marine zone have been reported using the PRM since 2017-18, and align with the method for freshwater basins, the Reef 2050 Water Quality Improvement Plan pesticide targets, and the Australian and New Zealand Water Quality Guidelines (ANZG, 2018). The Pesticide Risk Metric (PRM) approach considers pesticides with different Modes of Action (MoAs), which exert their toxicity by different means, increasing the number of chemicals that can be incorporated to inform water quality assessments. As a result, the impacts to the marine environment through land-based run-off are captured for a greater number of pollutants.

Concentration data was converted into a single number that represents the toxicity of the mixture of pesticides in each passive sampler deployment period. This was done to express the overall risk to aquatic ecosystems in simple numeric terms (given as a percentage of species affected). The PRM for pesticides with different MoAs was calculated using the independent action model of joint action (Plackett & Hewlett, 1952). Further details on how the PRM calculations were made are provided in (Warne et al., 2020, 2023).

Corresponding to the percentage of species affected calculated for each passive sampler, the percentage of species protected were allocated to given risk categories as done for freshwater basins and estuaries. These categories are consistent with the ecological condition categories used in the Australian and New Zealand Water Quality Guidelines ANZG 2018.[37] The average maximum PRM concentration recorded within the zone was used as the pesticide result. All values were rounded to the nearest whole number.

3.2.2. Offshore Water Quality

Offshore water quality is not currently reported while technical staff and the TWG work towards finding new data sources for this region.

[37] https://www.waterquality.gov.au/anz-guidelines/resources/key-concepts/level-of-protection

3.2.3. Coral

Condition assessment of the coral indicators for the inshore zones followed the MMP method (Table 41):

Coral cover: This indicator simply scores reefs based on the level of coral cover, with high coral cover being the desirable state for coral reefs. For each reef, the proportional cover of all genera of hard (order Scleractinia) and soft (subclass Octocorallia) corals are combined.

Macroalgae cover: This indicator is the percentage cover of macroalgae as a proportion of the total cover of all algal forms (inshore regions only) as a representation of these opportunistic colonisers outcompeting corals.

Density of juvenile hard corals: Counts of juvenile hard corals were converted to density per m^2 of space available for settlement. The genus *Fungia* (mushroom/disc corals) were excluded.

Cover change (change in coral cover): This is derived from the comparison of the observed change in coral cover between two visits and the predicted change in cover derived from a multi-species form of a Gompertz growth equation (Thompson et al., 2021). Due to differences in growth rates, GBR reefs were divided into eight groups based on community types. Models were developed for each group of reefs and separately for fast growing corals of the family Acroporidae, as well as the combined grouping of all other slower growing hard coral taxa. Some reefs are surveyed in alternate years. The coral change index is based on the mean of available estimates of change over the previous four-year period.

Community composition: The basis of the indicator is the scaling of cover for constituent hard coral genera (subset of life forms for the abundant genera *Acropora* and *Porites*) by genus weightings that correspond to the distribution of each genus along a gradient of turbidity and chl-*a*. Composition is scored relative to a baseline observed over the first years that a site was monitored.

Benthic cover and density of juvenile hard coral data collected under the NQBP monitoring programs in the Central and Northern zones were analysed using the MMP approach. This involved aggregating site-level juvenile density and benthic cover estimates, up to the reef level mean. Mean hard coral and soft coral cover for each reef are summed to produce the overall ‘coral cover’. Mean total algae cover at each site was used to convert juvenile abundance to the indicator juvenile density. Inshore zone scores are the mean of reef-level scores for each indicator.

Coral indicators for the inshore and offshore zones were scored in a similar way. Observations for each indicator were scored on a continuous scale following (Thompson et al., 2016) (Table 42). The approach involves selecting bounding values for each indicator based on biology. These bounds become zero (‘very poor’) and 1.0 (‘very good’) on an approximately linear scale (see Section 6 of (Thompson et al., 2016)). The values for the reefs in each reporting zone are then averaged and converted to a scale of 0 to 100 (Table 43).

Table 42. Coral assessment thresholds for the condition assessment of coral, where indicators that are reported in inshore zones only are identified. CI = confidence interval.

Community Attribute	Score	Thresholds
Cover—Combined hard and soft coral cover	Continuous between 0.0 and 1.0	1 at 75% cover or greater 0 at zero cover
Cover Change—Rate of increase in hard coral cover (preceding four years)	1.0	Change > 2x upper 95% CI of predicted change
	Continuous between 0.6 and 0.9	Change between upper 95% CI and 2x upper 95% CI
	Continuous between 0.4 and 0.6	Change within 95% CI of the predicted change
	Continuous between 0.1 and 0.4	Change between lower 95% CI and 2x lower 95% CI
	0.0	change < 2x lower 95% CI of predicted change
Macroalgae—Proportion of algae cover classified as macroalgae (inshore only)	Continuous between 0.0 and 1.0	≤ reef specific lower bound and ≥ reef specific upper bound
Juvenile—Density of hard coral juveniles (<5 cm diameter)	1.0	> 13 juveniles per m^2 of available substrate
	Continuous between 0.4 and 1.0	4.6 to 13 juveniles per m^2 of available substrate
	Continuous between 0 and 0.4	0 to 4.6 juveniles per m^2 of available substrate
Composition—Composition of hard coral community (inshore only)	1.0	Beyond 95% CI of baseline condition in the direction of improved water quality
	0.5	Within 95% Confidence intervals of baseline composition
	0.0	Beyond 95% CI of baseline condition in the direction of declined water quality

Table 43. Standardized grading for coral results including scoring ranges for aggregated coral results and scaling formula to aggregate coral index with other indices to produce overall score.

Condition Grade and Colour Code	Score Range	Scaling of Scores Aggregation
Very good	>0.8	= score × 100
Good	>0.6–0.8	= score × 100
Moderate	>0.4–0.6	= score × 100
Poor	>0.2–0.4	= score × 100
Very poor	0–0.2	= score × 100

3.2.4. Inshore Seagrass

3.2.4.1. Marine Monitoring Program

The MMP seagrass monitoring data are rolled up into the GBR Report Card scoring range (McKenzie & Collier, 2015). The scoring thresholds and their relation to the GBR Report Card scoring ranges are provided for the two MMP seagrass indicators in Table 44 and Table 45. An overall score for each site is then calculated by averaging the two seagrass indicator scores, where all indicators are equally weighted.

Table 44. Standardised grading for seagrass 'abundance' scoring thresholds in relation to condition grades (low = 10th or 20th percentile guideline). Source: (McKenzie et al., 2015).

Category	Score	Score Range	Condition Grade
75–100	100	80 to 100	Very good
50–75	75	60 to <80	Good
Low–50	50	40 to <60	Moderate
<Low	25	20 to <40	Poor
<Low by >20%	0	0 to <20	Very poor

Table 45. Standardised grading for seagrass 'resilience' where sites grouped and graded according to resistance and reproductive qualities of resilience and the corresponding standardised scoring ranges and grades. Source: Collier *et al*. 2021

<table>
<tr><th>Resilience group</th><th>Scoring range</th><th>Resilience group grade</th><th>Scoring range</th><th>Standardised scoring range</th><th>Condition grade</th></tr>
<tr><td rowspan="3">Reproductive high resistance</td><td rowspan="3">70–100</td><td>Persistent reproductive and high resistance</td><td>85–100</td><td rowspan="2">81–100</td><td rowspan="2">Very Good</td></tr>
<tr><td rowspan="2">Reproductive high resistance</td><td rowspan="2">70–100</td></tr>
<tr><td rowspan="2">61–80</td><td rowspan="2">Good</td></tr>
<tr><td rowspan="4">Non-reproductive high resistance</td><td rowspan="4">30–70</td><td rowspan="2">Reproductive history and high resistance</td><td rowspan="2">50–70</td></tr>
<tr><td rowspan="2">41–60</td><td rowspan="2">Moderate</td></tr>
<tr><td rowspan="2">Non-reproductive history and high resistance</td><td rowspan="2">30–50</td></tr>
<tr><td rowspan="2">21–40</td><td rowspan="2">Poor</td></tr>
<tr><td rowspan="3">Low resistance sites</td><td rowspan="3">0–30</td><td rowspan="2">Reproductive and low resistance</td><td rowspan="2">5–30</td></tr>
<tr><td rowspan="2">1–20</td><td rowspan="2">Very Poor</td></tr>
<tr><td>Non-reproductive, low resistance</td><td>0–15</td></tr>
</table>

3.2.4.2. Queensland Ports Seagrass Monitoring Program and Southern Inshore Program

The QPSMP and the SIP use a condition index developed for seagrass monitoring meadows based on changes in mean above-ground biomass, total meadow area, and species composition relative to a baseline (Table 46). The baseline is ideally calculated using a ten-year average. Seagrass meadows near Abbot Point have been monitored since 2008, and meadows near Mackay and Hay Point have been monitored since 2005 (although no surveys were conducted in 2008 or 2013). Baseline conditions were therefore calculated using all data available and are updated annually until the full 10 years is reached. Seagrass meadows in the Southern Inshore have been monitored since 2017 (Van De Wetering & Rasheed, 2023).

The index provides a means of assessing current meadow condition and likely resilience to disturbance. Seagrass condition for each indicator is scored from zero to one and assigned an A–E grade (Carter et al., 2019). Scores are multiplied by 100 to align to the MMP and regional report card scale.

To derive a condition score, a meadow classification system defines threshold ranges for the three indicators, in recognition that for some seagrass meadows, these measures are historically stable, while in other meadows, they are relatively variable. Baseline conditions for species composition were determined based on the annual per cent contribution of each species to average meadow biomass of the baseline years. Meadows are classified as either single species dominated (one species comprising ≥80% of baseline species) or mixed species (no one species comprises ≥80% of baseline species composition). Where species composition was determined to be anything less than in 'perfect' condition (i.e., a score <1), a decision tree was used to determine whether equivalent and/or more persistent species were driving this grade/score (Carter et al., 2019).

Each meadow/site score is defined as the lowest grade/score of the three indicators within that meadow where this is driven by biomass or area. Where species composition is the lowest score, it contributed 50% of the overall meadow score, with the next lowest indicator (area or biomass) contributed the remaining 50%.

Table 46. Standardised grading for QPSMP seagrass meadows Threshold levels for grading seagrass indicators for various meadow classes relative to the baseline. Upwards/ downwards arrows are included where a change in condition has occurred in any of the three condition indicators (biomass, area, species composition) from the previous year (Source: Carter *et al.* 2016).

Seagrass grade

Indicators	Meadow class	A Very good	B Good	C Satisfactory	D Poor	E Very Poor
Biomass	Stable	>20 % above	20 % above– 20 % below	20–50 % below	50–80 % below	>80 % below
	Variable	>40 % above	40 % above– 40 % below	40–70 % below	70–90 % below	>90 % below
Area	Highly stable	>5 % above	5 % above– 10 % below	10–20 % below	20–40 % below	>40 % below
	Stable	>10 % above	10 % above– 10 % below	10–30 % below	30–50 % below	>50 % below
	Variable	>20 % above	20 % above– 20 % below	20–50 % below	50–80 %	>80 % below
	Highly variable	> 40 % above	40 % above– 40 % below	40–70 % below	70–90 % below	>90 % below
Species composition	Stable and variable; Single species dominated	>0 % above	0–20 % below	20–50 % below	50–80 % below	>80 % below
	Stable; Mixed species	>20 % above	20 % above– 20 % below	20–50 % below	50–80 % below	>80 % below
	Variable; Mixed species	>20 % above	20 % above– 40 % below	40–70 % below	70–90 % below	>90 % below
			Increase above threshold from previous year (BIOMASS ↑)		Decrease below threshold from previous year (BIOMASS ↓)	

3.2.4.3. Combined Display Approach for MMP and QPSMP Seagrass Indicators

The combined display approach for seagrass indicators maintains the score calculation methods from each program. This ensures that the scores given in the regional report cards for a meadow/site remain consistent with MMP and QPSMP reporting. There is no overlap between QPSMP and MMP locations in the Whitsunday Zone, but both programs have seagrass monitoring in the Central and Northern Zones.

Overall scores for each monitoring site/meadow are averaged to generate an overall score for each reporting zone. Final zone scores are graded based on the regional report card scoring ranges previously described, regardless of the program. Final scores were calculated in this way (compared to taking an average of the overall indicator scores for each zone) due to the score calculation differences between programs. For a full description and worked example of the combined display approach refer to (Carter et al., 2016).

3.3. Urban Water Stewardship Framework

For the UWSF, activities were rated using unique assessment criteria, accompanied by guidance notes to explain the intended basis for activity evaluation and any relevant indication or information sources. All activities were rated on a four-point 'ABCD' scale, with score ranges given for each rating category (Table 47). That same system was used for evaluating the practice level when 'rolling up' the scores from individual activities to Management Activity Groups (MAGs) to components and the overall regional grade.

The process of aggregating scores to each MAG level was as per DES 2022 guidelines (Department of Environment and Science (DES), 2022). It involved averaging across relevant activities and/or activity groups. Where a 'non-applicable' answer was given for an activity, this was accounted for by adjusting the weightings of the remaining activities in the MAG.

Table 47. Standardised grading for UWSF Test Score and rating categories for the Urban Water Stewardship Framework.

Terminology	Practice standard			
Practice level rating	A	B	C	D
Practice level description	Innovative and/or aspirational	Current best practice	Minimum standard	Superseded
Water quality risk framework	Lowest risk	Moderate–low risk	Moderate risk	High risk
Score range	>17.5	12.5–17.4	5.0–12.4	<5.0

3.4. Indigenous Cultural Heritage

3.4.1. Scoring and Assessment Grade Development

Cultural heritage surveys in the Mackay-Whitsunday-Isaac region were reported by the Partnership in the 2015, 2018 and 2021 Report Cards. A five-point scale was developed as part of the 2015 assessment and was also used for the 2018 and 2021 results (Table 48). The cultural values indicators, measures and scoring system were further refined during the 2018 program to provide a more balanced and culturally appropriate picture, with greater emphasis placed on Traditional Owner values. This refined methodology was used in the 2021 assessment.

The revised approach aligned to the emerging Indigenous Heritage program design forming under the Reef 2050 Integrated Monitoring and Reporting Program (RIMReP) and had the intention to increase the focus of Traditional Owner perspective (stories, significance, and associations) of their heritage. TORG members defined expanded definitions of Aboriginal heritage and values (sites/places/landscapes) throughout the project. The quantity of sites assessed, and the number of zones visited was expanded, and baseline data was established for the sites; including GPS locations, physical condition of the site, threats to the site, and management options to preserve and protect the cultural values of the site, location, and landscape.

The 2021 grades were based on assessments of 17 sites from four zones, which took place on the traditional country of the Juru, Ngaro, Gia, Koinmerburra, Barada and Widi peoples in October 2020. Broad grade/value ranges (A to E and very high to very low) in this scoring system matched those used in 2015, but the attribution of + or – to letter grades was better defined in the 2018 assessments, and again refined in 2021 (Table 47). The assessment was not purely quantitative and incorporated qualitative data obtained from first-hand observations, interviews with participants, field recordings of sites and artefacts, scientific data, and online resources, such as the Queensland Department of Aboriginal and Torres Strait Islander Partnerships (DATSIP) register.

Table 48. Standardised grading for Cultural Heritage 2021 scoring system for indigenous cultural heritage assessments.

Score	Grade	Value
5	A	Very High
4.6 – 4.9	A-	
4.1–4.5	B+	High
4	B	
3.6-3.9	B–	
3–3.5	C+	Medium
3	C	
2.6 – 2.9	C–	
2.1–2.5	D+	Low
2	D	
1.6-1.9	D–	
1-1.5	E+	Very low
1	E	
0-0.09	E-	

3.4.2. Indicator Development

For the purposes of this assessment, indicators were developed at the zone level and enable a holistic assessment of the heritage values, sites, cultural landscape, and management activities within each zone. For the purposes of this assessment, indigenous cultural heritage for each zone was assessed as a combination of five indicators included in Table 49 below.

Table 49. Cultural heritage indicators in the Mackay-Whitsunday-Isaac report card and what was measured to assess them.

Indicator	Measure
Spiritual/Social Value	How healthy a site is in a spiritual and social sense, as determined by the relevant Traditional Owner(s) representatives for a given site. This metric is qualitative and holistic.
	This indicator was assessed retroactively at a zone level following the most recent assessment by members of the Traditional Owner Reference Group.
Archaeological Value	Representativeness—how well sites represent or support the story of traditional land use
	Uniqueness—how rare or distinct identified sites are
	Potential to answer research questions for Traditional Owners and archaeologists
Physical Condition	Visible impact of threats from: • Environment, e.g., storm surges; inundation and erosion; for art sites—fading of motifs, insect nests, water flow across art, mineral staining, etc. • Animals, e.g., burrowing, trampling, animal waste • Humans, e.g., tracks, vehicles, paths, trampling, boating activities
	Impact of threats on cultural values—stability or deterioration as a result of visible impact of threats from environment, animals, and humans
Protection of Sites	Registration of sites with the Queensland Department of Aboriginal and Torres Strait Islander Partnerships (DATSIP)
	Management of threats to sites
	Control of access to sites (e.g., through boardwalks, information signage, and fencing)
	No obvious threats (physical protection not needed)
Cultural Maintenance	Documented on-going management arrangements (e.g., Management Plans, Council MOUs, and QPWS MOUs, etc.)
	Engaging and collaborating with stakeholders to fulfil joint cultural values aims (e.g., regular meetings, committees, etc.)

4. Development of Progress to Targets Scoring Methods

Progress to pre-defined targets may be presented in future report cards and associated documentation. This would enable regional progress to be assessed and allow comparison across years and establishment of trends.

4.1. Calculating Progress to Targets

In order to provide a score on how the region is progressing toward meeting its targets, the following information will be required:

- Baseline condition (i.e., a starting point),
- Current condition; and
- Target condition.

The calculation of the results of the progress to targets in each report card will use the following equation:

$$\text{Progress to target} = ((X-Z) / (X-Y)) \times 100$$

Where:
X is the baseline
Z is the current condition
Y is the target

Determining appropriate targets requires a specific body of work to identify which indicators should have targets and what the targets (and associated timeframes) should be. Where possible, the targets established for the Report Card will align with available targets used in the GBR Report Card and other relevant programs to provide consistency.

5. Confidence, Limitations, and Recommendations

5.1. Confidence Associated with Results

The regional report cards use the 2015 GBR Report Card as the basis for communicating confidence (Australian and Queensland Governments, 2015). This is based on a multi-criteria analysis approach to qualitatively score the confidence for each key indicator used in the Report Card (Table 49). The approach enables the use of expert opinion and measured data.

The multi-criteria analysis identifies the key components (criteria) that contribute to confidence. Each criterion is then scored using a defined set of scoring attributes. The attributes are ranked from those that contribute weakly to the criteria to those that have a strong influence. If the criteria are seen to have different levels of importance for the problem being addressed, they can be weighted accordingly. The strengths of this approach are that it is repeatable, transparent, and can include contributions from a range of sources. The weaknesses are that it can be subjective and open to manipulation.

The key difference in how the regional report cards use the 2015 GBR Report Card method for communicating confidence is how confidence criteria are weighted. Criteria that are seen to have more importance for the MWI Region have been given a higher weighting when determining the overall confidence.

5.1.1. Methods

Report card confidence levels are determined using the five criteria explained below (Table 50).

Maturity of Methodology

The purpose of this criterion is to show the confidence that the method/s being used are tested and accepted broadly by the scientific community. Methods must be repeatable and well-documented. Maturity of methodology is not a representation of the age of the method, but the stage of development. It is expected that all methods used would be robust, repeatable, and defendable. This criterion is weighted 0.36 so as not to outweigh the importance of the other criteria.

Validation

The purpose of this criterion is to show the proximity of the indicator being measured to the indicators reported. The use of proxies is scored lower than direct measures. This criterion minimises compounded errors. The score is weighted 0.71 for this criterion so as not to outweigh the importance of the representativeness criterion.

Representativeness

This criterion shows the confidence in the representativeness of monitoring/data to adequately report against relevant indicators. It takes into consideration the spatial and temporal resolution of the data as well as the sample size. This criterion is considered the most important when considering confidence in the MWI Report Card and as such is given a weighting of 2.

Directness

This criterion is similar to validation, but instead of looking at the proximity of the indicator, it looks at the confidence in the relationship between the monitoring and respective indicators being reported against. The score is weighted 0.71 for this criterion so as not to outweigh the importance of the representativeness criterion.

Measured Error

The purpose of this criterion is to incorporate an estimate of uncertainty when an indicator is measured. This score is weighted 0.71 for this criterion so as not to outweigh the importance of the representativeness criterion.

Table 50. Confidence scoring assessment criteria.

Maturity of methodology (weighting 0.36)	**Validation** (weighting 0.71)	**Representativeness** (weighting 2)	**Directness** (weighting 0.71)	**Measured error** (weighting 0.71)
Score = 1 **New** or experimental methodology	**Score = 1** **Limited** Remote sensed data with no or limited ground truthing or Modelling with no ground truthing or Survey with no ground truthing	**Score = 1** **Low** 1:1,000,000 or Less than 10% of population survey data	**Score = 1** **Conceptual** Measurement of data that have conceptual relationship to reported indicator	**Score = 1** Greater than 25% error or limited to no measurement of error or error not able to be quantified
Score = 2 **Developed** Peer-reviewed method	**Score = 2** **Not comprehensive** Remote sensed data with regular ground truthing (not comprehensive) or Modelling with documented validation (not comprehensive) or Survey with ground truthing (not comprehensive)	**Score = 2** **Moderate** 1:100,000 or 10%–30% of population survey data	**Score = 2** **Indirect** Measurement of data that have a quantifiable relationship to reported indicators	**Score = 2** Less than 25% error or some components do not have error quantified
Score = 3 **Established** methodology in published paper	**Score = 3** **Comprehensive** Remote sensed data with comprehensive validation program supporting (statistical error measured) or Modelling with comprehensive validation and supporting documentation or Survey with extensive on ground validation or directly measured data	**Score = 3** **High** 1:10,000 or 30–50% of population	**Score = 3** **Direct** Direct measurement of reported indicator with error	**Score = 3** 10% error and all components have errors quantified

5.1.2. Scoring

For all indicators where a condition score was reported, each criterion is scored 1 (lowest) to 3 (highest). The score of each criterion is weighted accordingly, and the total confidence score is calculated by adding all weighted scores of the five criteria. The final score is assessed against a 1 to 5 qualitative confidence ranking. The final scores and the associated confidence rankings have been adjusted from the previous report cards to reflect the MWI specific weightings applied to the criteria. The confidence ranking (out of 5) is then presented in the Report Cards (Table 51).

5.1.2.1. Scoring Confidence Criteria in the MWI Report Card

When scoring confidence for indicators in the MWI Region, confidence of an indicator was considered separately for the different reporting zones to accommodate different sample sizes, programs, or divergent methods contributing to the condition scores of an indicator depending on the zone.

The representativeness criterion was considered at a spatial and temporal scale. Where confidence was lower at one scale, the conservative (lowest) score was applied to this criterion for that indicator. For example, if spatial representativeness was moderate (i.e., 2) but the temporal scale representativeness was low (i.e., 1), the score used for representativeness was low (i.e., 1).

Occasionally, data from different programs were used to derive condition scores for an indicator in the same reporting zone. For example, in the Central Zone, NQBP and MMP programs provided water quality data, but there was a difference in confidence in the data provided by the two programs. To score confidence in such a situation, where two or more methods/programs/datasets contribute to an overall indicator score in the same reporting zone, the following decision rule was applied:

- When data are partitioned equally between the two methods/programs/datasets, confidence is scored conservatively (i.e., the lower of two scores is applied where relevant),
- When data are not partitioned equally between the methods/programs/datasets, confidence is scored by using the score for the dominant method/program/dataset.

Based on these rules, in the Central Zone, confidence is scored by considering the Ports program because it has nine sampling sites compared to the MMP's two sampling sites.

5.1.2.2. Final Confidence Scores for Presentation in the MWI Report Card

Once each criterion is scored, the appropriate weighting is applied, and these scores are added together to give a final score. An overall ranking for confidence for each indicator in each zone was applied based on the final score. For presentation purposes, confidence scores were aggregated into a single score for freshwater basin, estuarine, and inshore and offshore marine indices.

Indicator Level

When confidence scores for an indicator are different across only two reporting zones, confidence was scored conservatively (i.e., the lowest total score of the pair is used) to determine the overall rank of the indicator.

When confidence scores for an indicator were different across three or more zones, the median of all the total confidence scores between the reporting zones was used to apply the overall rank of the indicator.

For example, in the Don Basin, confidence in the fish barrier indicator was lower than confidence in this indicator across the other four basins because there were differences in ground truthing between the Don and the other basins. Therefore, the freshwater fish barriers indicator score used was the median of the final confidence score and associated ranking.

Indicator Category and Index Level

When confidence scores for an indicator or indicator category were different, the median of all the total confidence scores between the indicator or indicator category was used to apply the overall rank of the indicator category or index.

Table 51. Overall confidence score, associated ranking, and ranking display in the Report Card.

Final Confidence Score Range	Ranking	Display in Report Card
>11.7 to 13.5	Five	VERY HIGH ●●●●●
>9.9 to 11.7	Four	HIGH ●●●●○
>8.1 to 9.9	Three	MODERATE ●●●○○
>6.3 to 8.1	Two	LOW ●●○○○
4.5 to 6.3	One	VERY LOW ●○○○○
<4.5	Zero	NO DATA ○○○○○

5.1.2.3. Confidence in Human Dimensions Indicators

The results for Urban Water Stewardship (Table 52) were rated in terms of the confidence based on the same methods used for other report card indicators.

Table 52. UWSF confidence associated with Urban Water Stewardship Results for the 2022–23 monitoring period. Confidence criteria are scored 1 to 3 and then weighted by the value identified in parentheses as per the UWSF implementation manual (DES, 2020). Final scores (6–18) are additive across weighted confidence criteria. Summary rationales are given below each criterion.

Maturity of methodology (weighting 0.4)	**Validation** (weighting 0.7)	**Representativeness** (weighting 4.0)	**Directness** (weighting 0.7)	**Measured error** (weighting 0.7)
Score = 1 **New** or experimental methodology	**Score = 1** **Limited** < 20% of activities are rated using direct reference to quantitative data or primary source information **and/or** More than 20% of activities are rated without relevant subject matter experts being present at the workshop **and** No review of workshop ratings based on other evidence	**Score = 1** **Low** **Spatial** 50% of the LGAs in the report card region participate in the assessment process **or** < 3 of 5 the Report Card Partnerships participate in the assessment process **Temporal** Duration and the frequency over which the assessment process has been run is too limited to determine if the scores and ratings derived are typical of management practice pattern, or merely an aberration. **and/or** Temporal extent of data linked to quantitative metrics supporting activity ratings is insufficient to determine if available information is typical of a longer term pattern	**Score = 1** **Conceptual** Measurement used only have a conceptual relationship to reported indicator	**Score = 1** **High** Measured error > 25% **or** Limited to no measurement of error **or** Error not able to be quantified
Score = 2 **Developed** Peer-reviewed method	**Score = 2** **Not comprehensive** 20-50% of activities are rated using direct reference to quantitative data or primary source information	**Score = 2** **Moderate** **Spatial** 50-90% of the LGAs in the reporting region participate in the assessment process	**Score = 2** **Indirect** Measurements used have a quantifiable	**Score = 2** **Moderate** 11-25% measure error or where only some components

Maturity of methodology (weighting 0.4)	Validation (weighting 0.7)	Representativeness (weighting 4.0)	Directness (weighting 0.7)	Measured error (weighting 0.7)
	and/or No more than 10% of activities are rated without relevant subject matter experts being present at the workshop **and** Post-workshop validation review of up to 10% of workshop ratings based on other evidence (e.g. remote sensed data, modelling, surveys or information provided by capacity building extension officers) is carried out before results are published	**or** Most, but not all Report Card Partnerships participate in the assessment process (i.e. 3 or 4 participate) **Temporal** Duration and the frequency at which the assessment process has been run is sufficient to derive scores and ratings that are indicative of a longer term pattern of management practice **and/or** Temporal extent of data linked to quantitative metrics supporting activity ratings sufficient for available information to provide an indication of what the longer term pattern is.	relationship to reported indicators	of the indicator do not have error quantified
Score = 3 **Established** methodology in published paper	**Score = 3** **Comprehensive** >50% of activities are rated using direct reference to quantitative data or primary source information **and/or** No activities are rated without relevant subject matter experts being present at the workshop **and** Post-workshop validation review of > 10% of workshop ratings based on other evidence (e.g. remote sensed data, modelling, surveys or information provided by capacity building extension officers)	**Score = 3** **High** **Spatial** All LGAs in the reporting region participate in the assessment process **or** All 5 Report Card Partnerships participate in the assessment process **Temporal** Duration and frequency at which the assessment process has been run is sufficient to derive scores and ratings that reliably represent a longer term pattern of management practice **and/or** Temporal extent of data linked to quantitative metrics supporting activity ratings sufficient for available information to provide a reliable representation of the longer term pattern	**Score = 3** **Direct** Direct measurement of indicator	**Score = 3** **Low** Error margin of 10% or less and all components of the indicator have errors quantified

5.2. Limitations and Recommendations

The quality and accuracy of report card results have improved since the pilot release in 2014. However, it is important to highlight and acknowledge the limitations of our existing approach.

Current Limitations / Future Improvements

Spatial representativeness of freshwater basins is still low, with only one or two sites per basin. Additional monitoring throughout all basins is a critical step to improving confidence in basin scale reporting.

The **Proserpine Basin was not given a water quality score** in the Report Card following a review of the available water quality data that suggested the monitoring site was influenced by tidal action and therefore was not fully representative of the freshwater environment. It is anticipated that this tidal action may also impact the observed concentration of nutrients (DIN and FRP). As a result, sediment and nutrient condition were not reported for the Proserpine Basin in the current Report Card. HR2RP is investigating alternative sites in the Proserpine Basin that could be used for future water quality monitoring. Potential to use estuarine water quality data in the Proserpine Basin is also being investigated.

Considerable work has been undertaken to explore opportunities to fill flow data gaps in basins and estuaries with additional sites and pre-development data currently under investigation. Questions remain on the validity of the model in response to the data available, especially during periods of low or now flow. **A review of the flow indicator tool** was recommended first at the 2020 ISP and TWG meetings and is intended to be progressed as part of the current Program Design Review.

A knowledge gap was identified in previous Report Cards for the Southern Zone. Baseline water quality, seagrass, and coral monitoring was commissioned by the Partnership in 2017, and a long-term monitoring program has been established for these indicators. The 2018 Report Card saw the release of a water quality score for the Southern Zone for the first time. The 2019 Report Card reported on pesticides and coral for the first time. With the release of seagrass scores in the 2021 Report Card, the **Partnership continues to fill knowledge gaps in the Southern Zone**, **including advocating for a review of guideline values appropriate for assessing this zone considering its unique geo-physical characteristics.**

There are limitations around the **understanding of riparian, wetland, and mangrove/saltmarsh habitats**. The Partnership is currently working with the TWG and riparian and wetland data providers/experts to improve report card indicators for wetland and riparian extent and ensure comparability over time.

Estuarine and marine fish continue to be gaps in reporting, while existing citizen science data was deemed not suitable for development of an indicator[38], alternative sources such as fisheries data and use of eDNA are being investigated.

Offshore water quality remains a reporting gap, and the option to use eReefs modelling is being investigated as part of Program Design Review.

[38] https://healthyriverstoreef.org.au/projects/reef-fish-citizen-science-data-assessment/

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7. Appendices

Appendix A—Data Sources

Table A1. Data sources for each index reported in the 2025 MWI Healthy Rivers to Reef Report Card.

Environment	Basin/Estuary/ Marine Zone	Index (Indicator Category)	Program	Data Source
Freshwater Basins	Don Basin Proserpine Basin O'Connell Basin Pioneer Basin Plane Basin	Water Quality (including pesticides)	GBRCLMP	Pesticide data available through the Water Quality & Investigations Pesticide Reporting Portal Data available for download from Queensland Government Water Quality Data Portal – Tahbil Current Contact: Dr Reinier Mann—Science Leader, DESI (reinier.mann@des.qld.gov.au)
		Riparian Extent	Built-for-purpose	Current contact: Partnership Staff (technical@healthyriverstoreef.org.au)
		Fish Barriers		
		Impoundment Length		
		Wetland Extent		
		Fish	Regional Report Card Monitoring Program	Current Contact: David Moffatt—Principal Environment Officer, DESI (david.moffatt@des.qld.gov.au)
		Flow	Streamflow data—Water Monitoring Information Portal (QLD Government) Rainfall data—SILO (QLD Government) and BoM	Streamflow Online Database Rainfall Online Databases for SILO and BoM
Estuarine	Gregory River O'Connell River St Helens/Murray Creek Vines Creek Sandy Creek Plane Creek Rocky Dam Creek Carmila Creek	Water Quality (including pesticides)	DESI Estuary Monitoring Program	Data Request: water.data@qld.gov.au
		Pesticides (additional monitoring)	Regional Report Card Monitoring Program	Current contact: Partnership Staff (technical@healthyriverstoreef.org.au)
		Riparian Extent	Built-for-purpose	
		Mangrove and Saltmarsh Extent		
		Fish Barriers		

Table A1. Data sources for each index reported in the 2025 MWI Healthy Rivers to Reef Report Card.

Environment	Basin/Estuary/ Marine Zone	Index (Indicator Category)	Program	Data Source
Inshore Marine	Northern	Water Quality (including pesticides)	NQBP Abbot Point Ambient Water Quality Monitoring Program	Annual Reports Current contact: Nicola Stokes—Senior Environmental Advisor, NQBP (environment@nqbp.com.au)
		Coral	NQBP Abbot Point Coral Monitoring Program	Online Database
		Seagrass	NQBP Abbot Point Seagrass Monitoring Program	Online Database
			Seagrass Watch	Online Database
	Whitsunday	Water Quality	GBR MMP for Inshore Water Quality	Annual Reports Turbidity and Chlorophyll-*a* Online Database Current contact: Dr Renee Gruber—Biological-Chemical Oceanographer, AIMS (r.gruber@aims.gov.au)
		Coral	GBR MMP for Inshore Coral Reefs	Annual Reports Online Database Current contact: Angus Thompson—Coordinator Inshore Reef Benthic Monitoring, AIMS (a.thompson@aims.gov.au)
			RCA	Annual Reports Current contact: Jenni Calcraft—Great Barrier Reef Project Coordinator, RCA (jenni@reefcheckaustralia.com)
		Seagrass	GBR MMP for Inshore Seagrass (including Seagrass Watch)	Annual Reports Seagrass Watch Online Database Current contact: Len McKenzie—Principal Research Officer, JCU (len.mckenzie@jcu.edu.au)
	Central	Water Quality — Pesticides	GBR MMP for Inshore Pesticides	Annual Reports Current Contact: Dr Reinier Mann—Science Leader, DESI (reinier.mann@des.qld.gov.au)

Table A1. Data sources for each index reported in the 2025 MWI Healthy Rivers to Reef Report Card.

Environment	Basin/Estuary/ Marine Zone	Index (Indicator Category)	Program	Data Source
		Nutrients, Water Clarity, Chlorophyll-*a*	GBR MMP for Inshore Water Quality	Annual Reports Turbidity and Chlorophyll-*a* Online Database Current contact: Dr Renee Gruber—Biological–Chemical Oceanographer, AIMS (r.gruber@aims.gov.au)
			NQBP Mackay and Hay Point Ambient Water Quality Monitoring Program	Annual Reports Current contact: Nicola Stokes—Senior Environmental Advisor, NQBP (environment@nqbp.com.au)
		Coral	NQBP Mackay and Hay Point Coral Monitoring Program	Online Database
		Seagrass	NQBP Mackay and Hay Point Seagrass Monitoring Program	Online Database
			GBR MMP for Inshore Seagrass (including Seagrass Watch)	Annual Reports Seagrass Watch Online Database Current contact: Len McKenzie—Principal Research Officer, JCU (len.mckenzie@jcu.edu.au)
	Southern	All indices	Partnership-funded SIP	Current contact: Partnership Staff (technical@healthyriverstoreef.org.au)
		Seagrass	Seagrass Watch	Online Database
	All inshore and urban sites	Litter	AMDI Database	Online Database
Offshore Marine	Offshore	Coral	AIMS LTMP	LTMP Annual Reports and Database Current contact: Angus Thompson—Coordinator Inshore Reef Benthic Monitoring, AIMS (a.thompson@aims.gov.au)

GBRCLMP = Great Barrier Reef Catchment Loads Monitoring Program, DESI = Department of Environment, Science, and Innovation, NQBP = North Queensland Bulk Ports, MMP = Great Barrier Reef Marine Monitoring Program, RCA = Reef Check Australia, UQ = University of Queensland, SIP = Southern Inshore Monitoring Project, BoM = Bureau of Meteorology, AMDI = Australian Marine Debris Initiative, AIMS = Australian Institute of Marine Science, JCU = James Cook University, LTMP = AIMS Long-term Monitoring Program, Great Barrier Reef Marine Park Authority = GBRMPA, RAP = Representative Areas Program.

Appendix B—Changes Log

Table B1. Summary of changes included in the 2023-24 Report Card methods.

Section	Page (section start)	Summary of Updates
Data Collection Methods		
2.1 Regional Setting		Land use (including change between 2016-2021) Rainfall Air temperature Sea surface temperature Degree heating weeks
2.2 Freshwater Basins	27	Frequency of reporting table updated Site maps updated for freshwater water quality due to decommission of Staffords Crossing site. Water quality sampling records updated, including pesticides. Table added to record high and low flow sample numbers at Don River site. Fish index sample map updated to reflect most recent sample sites.
2.3 Estuaries	41	Frequency of reporting table updated Water quality sampling records updated, including pesticides.
2.4.1 Marine inshore water quality	48	Water quality sampling records updated, including pesticides. Site maps updated for marine water quality due to addition of Project Blueprint sites at Cairn Beach and Tongue Bay in the Whitsunday Zone. Text added to describe Project Blueprint site selection and methods (aligning with JCU / NQBP monitoring).
2.4.2 Coral	53	Coral sampling records updated for inshore and offshore.
2.4.3 Seagrass	58	Seagrass sampling records updated.
Development of Scoring Methods		
3.1.1 Freshwater and estuary water quality	67	Freshwater and estuary guideline values updated (see summary below).
3.2.1 Inshore water quality	81	Marine inshore guideline values updated (see summary below).
Confidence		

5.1.2.3 Confidence for human dimensions	96	Updated confidence table for UWSF
References		
6 Reference List		Added citations for: van de Wetering et al 2024 Davidson et al 2024 Rasheed et al 2024 Cartwright et al 2024 McKenzie et al 2024

Table 53. Changes in Don River freshwater guideline values, updates shown highlighted yellow, based on low flow cutoff value at < 4.1 m^3/s (cumecs) at gauge 121003A – Don River at Reeves. Median summary statistic is used for all indicators.

	DIN mg.L		FRP mg.L		TSS mg.L	
Don River	High	Low	High	Low	High	Low
EPP 2019	0.14	0.024	0.095	0.025	65	4
Former MWI	0.03		0.045		5	

Table 54. Changes in estuarine guideline values, updates shown highlighted in yellow. Median summary statistic is used for all indicators.

	Chl-a ug.L	DIN mg.L	FRP mg.L	TSS mg.L
Gregory River, Murray Creek, St Helens Creek estuaries				
EPP 2019	1.1	0.012	0.015	5
Former MWI	2	0.018	0.03	10
O'Connell River Estuary				
EPP 2019	2	0.04	0.03	10
Former MWI	2	0.018	0.03	10
Vines Creek Estuary				
EPP 2019	1.1	0.04	0.03	10
Former MWI	2	0.018	0.03	10
Sandy Creek, Plane Creek, Rocky Dam Creek, and Carmila Creek estuaries				
EPP 2019	5	0.04	0.06	NA
Former MWI	5	0.018	0.06	NA

Table 55. Changes in marine guideline values, updates shown highlighted in yellow. Mean summary statistic shown by bold and underlined value, otherwise Median summary statistic is used.

	Chl-a ug.L	Nox ug.L	Turb (NTU)	PN ug.L	PP ug.L	Secchi m	TSS mg.L
Camp Island and Euri Creek (NQBP Northern)							
EPP 2019	**<u>0.45</u>**	0.42	2	13	2.1	**<u>10</u>**	1
Former MWI	**<u>0.45</u>**	**<u>3</u>**	1	**<u>20</u>**	**<u>2.8</u>**	**<u>10</u>**	**<u>2</u>**
Holbourne Island (NQBP Northern)							
EPP 2019	0.33	0.25	0.5	14	2	11	0.8
Former MWI	**<u>0.45</u>**	**<u>3</u>**	1	**<u>20</u>**	**<u>2.8</u>**	**<u>10</u>**	**<u>2</u>**
Double Cone Island (MMP Whitsunday)							
EPP 2019	0.36	0.36	1.1	14	2.3	**<u>10</u>**	1.4

	Chl-a ug.L	Nox ug.L	Turb (NTU)	PN ug.L	PP ug.L	Secchi m	TSS mg.L
Former MWI	0.36	1	1.1	13	2.4	**10**	1.4
Pine Island and Seaforth Island (MMP Whitsunday)							
EPP 2019	0.36	0.49	1.1	14	2.3	**10**	1.4
Former MWI	0.36	1	1.1	13	2.4	**10**	1.4
Repulse Islands dive mooring (MMP Central)							
EPP 2019	**0.45**	0.21	**2**	18	2.1	**10**	1.6
Former MWI	0.36	1	1.1	13	2.4	**10**	1.4
Freshwater Point (NQBP Central)							
EPP 2019	**0.45**	0.21	2	18	2.1	**10**	1.6
Former MWI	**0.45**	NA	1	**20**	**2.8**	**10**	**2**
Slade Island and Hay Reef (NQBP Central)							
EPP 2019	**0.45**	1	Dry 2 / Wet 12	**20**	**2.8**	**10**	**2**
Former MWI	**0.45**	NA	Dry 2 / Wet 12	**20**	**2.8**	**10**	**2**
Round Top Island and Victor Island (NQBP Central)							
EPP 2019	**0.45**	1	**2**	**20**	**2.8**	**10**	**2**
Former MWI	**0.45**	NA	1	**20**	**2.8**	**10**	**2**
Aquila Island, Morning Cay, Fanning Shoal (SIP Southern)*							
EPP 2019	**0.45**	0.25	ID	**20**	**2.8**	**8**	**2.4**
Former MWI	**0.45**	3	**2****	**20**	**2.8**	**10**	**2**

*The Partnership is currently advocating for a review of water clarity guideline values in the southern inshore zone due to the geophysical differences separating this inshore zone from others in the region.

**The Partnership is currently using a guideline value of 2 NTU with a median summary statistic based on values used by nearby sites.