To: All interested providers.
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Request for Quote: Development of report card flow indicators

Purpose

The Mackay Whitsunday Healthy Rivers to Reef Partnership and the Wet Tropics Healthy Waterways Partnership are seeking providers to further develop and complete waterway health indicators for flow in freshwater and estuarine environments as required for reporting in annual report cards. Preliminary work has already been completed to develop the flow indicators from a conceptual context. Further refinement of this preliminary work is required to complete the development of flow indicators for their inclusion in future report cards.

Background information

The Mackay-Whitsunday Healthy Rivers to Reef Partnership (http://healthyriverstoreef.org.au/) and the Wet Tropics Healthy Waterways Partnership (http://wettropicswaterways.org.au/) produce annual report cards which include regional assessments of waterway health for freshwater, estuarine and marine environments. Both partnerships have selected flow in freshwater basin and estuary environments as an indicator for waterway health for their annual report cards. Currently the flow indicator is not reported due to the requirement for effective methods and metrics of measuring and scoring annual flows in relation to ecosystem health outcomes.

Status of flow indicator development

Regional experts from the Mackay-Whitsunday and Wet Tropics regions came together twice in 2016 as the Flow Working Group to undertake preliminary work in identifying and recommend appropriate flow indicators for use in future report cards. As part of this working group a Pressure State Response (PSR) framework was developed in relation to hydrological function in the Mackay-Whitsunday's environment as a case study, to assist in forming a conceptual basis for development of suitable indicators. The Wet Tropics Water Resource Plan Environmental Assessment (DSITIA 2013) was used to identify equivalent PSR information for the Wet Tropics.

The following main pressures relating to hydrological function were identified.

- Water infrastructure: dams and weirs;
- Water extraction: cease to flow and low flows;
- Water extraction: low flows to medium flows; and
- Water extraction: event flows (high flows and floods).

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The most appropriate preliminary indicators for the pressures were determined. The indicators were considered equally important and when combined would represent the flow indictor category.

- Baseflow variability;
- Change in cease to flow - low flows;
- Change in low flow-medium flows; and
- Change in event flows.

The indicators were proposed to assess change from pre-development flows and require linkages to ecological condition and function to be identified and integrated. These indicators now require development for use in future report cards for Mackay-Whitsunday and Wet Tropics.

Scope of works

The scope of works outlines the steps for further development of the indicators.

1. Indicator review

The first stage of this work is a review of the proposed indicators. The objective of the indicators is to assess flows in relation to waterway health. Indicators will assess flow in five freshwater basins and eight estuaries in the Mackay-Whitsunday and nine freshwater basins and eight estuaries in the Wet Tropics region.

The proposed indicators (baseflow variability, change in cease to flow/low flows, change in low flows-medium flows, change in event flows) are to be reviewed for their suitability for reporting in accordance with the following criteria.

- Include flow metrics that have demonstrated links to ecosystem flow requirements;
- Include the range of flow requirements provided by the natural flow regime;
- Assess ecological responses that are linked to measurable flow characteristics such as magnitude, duration, timing, frequency, and rate of change of flows.
- Be appropriate for reporting in both the Mackay-Whitsunday and Wet Tropics region.
- Be appropriate for reporting freshwater basins and estuaries (may require different indicator sets).
- Be suitable for annual reporting.

The review may also propose additional or alternative indicators for consideration. This review will be assessed by the Flow Working Group in consultation with the provider, where the most appropriate indicator/s will be selected.

2. Review and selection of methodologies

Following the review of indicators, the methodologies for assessing the selected indicators are to be determined. A review of potential metrics and methods used to calculate the selected indicators will be undertaken by the provider (see later section on *existing resources*). Once potential metrics for indicators are evaluated and deemed suitable for reporting flow in both regions, the methodology for measuring and assessing the metrics needs to be determined.

The Flow Working Group has identified potential approaches for measuring the proposed indicators (see later section on *potential methods*) and these methods should be considered as part of this review.

The advantages and disadvantages for different methods and flow metrics will be tabled for review by the Flow Working Group. Consideration will need to be given to the following.

a) Linkages between the flow metrics and ecosystem requirements.
b) Availability of data.
c) Influence and incorporation of rainfall.
d) Availability of appropriate benchmarks (for example modelled predevelopment flows).
e) Appropriate scoring and aggregation.

a) Linkages between the flow metrics and ecosystem requirements

The approach must be consistent with the driver, pressure, state, impact, response (DPSIR) framework. Similar frameworks that are used for environmental flow assessments, for example the pressure, stressor, response (PSR) framework can be adapted to align with DPSIR.

Consideration must be given to specific flow requirements for aspects of ecosystem health and ecological responses (e.g. minimum flows for function) for provision of the natural state of both Mackay-Whitsunday and Wet Tropics reporting zones.

Examples of linking flow metrics to ecosystem requirements are provided in the Wet Tropics Water Resource Plan Environmental Assessment (DSITIA 2013) where an assessment of risk relating to occurrence of important flow types for ecological condition and function was applied. Thresholds of Concern were defined to represent the minimum frequency of flow related opportunities required to maintain an ecological asset's viability. For example a cease to flow/low-flow metric could be the number and duration of no flow spells longer than the 80th percentile duration of pre-development that are required to maintain the viability of an ecological asset with critical links to low flows.

b) Availability of data

Availability of existing data and annual data will need to be considered for each reporting zone in the Mackay-Whitsunday and Wet Tropics regions.

Annual flow data must be available and accessible for condition reporting. Where required, current, available models and ability to use these to report flow in all listed basins and estuaries must be considered.

Flow may be assessed from discharge and height data recorded at gauging stations within each basin and from end of system gauging stations for each estuary and compared to predicted natural flows. Where recorded flow data is not available the options of using alternative assessments of river discharge and heights can be assessed (e.g. modelling or temporary depth loggers).

Because the report cards provide annual reporting it is expected that indicators of flow will be developed as an assessment of the flows that were recorded during the reporting year in

comparison to predevelopment modelled flows predicted to occur under the same rainfall conditions.

Tables 1 and 2 list the basin and estuary reporting zones for each region and identify the presence of DNRM gauging stations and Catchment Loads Monitoring Program (CLMP) sites for each reporting zone. For the estuary reporting zones the CLMP sites and DNRM gauging stations that are within or in close proximity to the estuary are differentiated from those that are some distance upstream of the estuary.

Table 1 Mackay-Whitsunday freshwater basin and estuary reporting zones and associated Catchment Loads Monitoring Program (CLMP) monitoring sites and DNRM gauging stations.

Basin	CLMP site	DNRM gauging stations*	Estuary	Estuary CLMP site or DNRM gauging station.	Upstream CLMP site or DNRM gauging station
Don	Proposed	4	Gregory	No	Yes
Proserpine	Proposed	1	O'Connell	Yes	Yes
O'Connell	Yes	5	St Helens / Murray	No	Yes
Pioneer	Yes	7	Vines	No	No
Plane	Yes	2	Sandy	Yes	Yes
			Plane	Yes	No
			Rocky Dam	No	No
			Carmila	No	Yes

* includes CLMP sites

Table 2 Wet Tropics freshwater basin and estuary reporting zones and associated Catchment Loads Monitoring Program (CLMP) monitoring sites and DNRM gauging stations.

Basin	CLMP site	DNRM gauging stations*	Estuary	Estuary CLMP site or DNRM gauging station.	Upstream CLMP site or DNRM gauging station
Daintree	Proposed	3	Daintree	Proposed	Yes
Mossman	No	1	Dickson Inlet	No	Yes
Barron	Yes	13	Barron	No	Yes
Mulgrave	Yes	4	Trinity Inlet	No	Yes
Russell	Yes	3	Russell-Mulgrave	Yes	Yes
Johnstone	Yes	9	Johnstone Basin	Yes	Yes
Tully	Yes	3	Moresby	No	No
Murray	Proposed	2	Hinchinbrook	No	No
Herbert	Yes	12			

* includes CLMP sites

c) Influence and incorporation of rainfall

Rainfall is a driver of flows, thus indicator development needs to consider rainfall as a driver and how rainfall data can be incorporated into indicator calculations.

d) Availability of appropriate benchmarks

The indicators may incorporate measures of the extent to which provision of critical flows for ecological responses are provided, and measures of alteration of specific characteristics of the flow regime, relative to predicted natural flows.

e) Appropriate scoring and aggregation

Ultimately, indicators will be developed so that flow can be reported on a five-point scale from Very Good to Very Poor, aligning with reporting for other indicators in the report card and allowing for aggregation with existing indicators for basins and estuaries specified in the Mackay-Whitsunday and Wet Tropics regions.

For integration into the report card scoring system flow indicators will require the following.

- Grading of measured flow values into five bandwidths within the scaled range (very good, good, moderate, poor, very poor).
- Consideration of weighting for different flow indicators that may be required prior to aggregation.

Conversion of values to standardised scores will allow aggregation of flow indicators and will allow aggregation with other report card indicators. This will be aligned with methods applied to freshwater and estuary indicators for the Mackay-Whitsunday and Wet Tropics report cards (HR2RP 2016; WTHWP 2016).

f) Estimates of error, confidence and uncertainty

The metrics, modelling and scoring procedures for the flow indicators will require estimates of error, confidence and uncertainty. Estimates of error will be particularly relevant for modelled predevelopment flows and will require consideration of the modelling methodology, influence of climate change, rainfall intensity, and run off variability. The approach for estimating confidence and uncertainty for report card indicators is based upon the Paddock to Reef Integrated Monitoring, Modelling and Reporting Program and are provided in the methods documents for Mackay-Whitsunday and Wet Tropics report cards (HR2RP 2016; WTHWP 2016).

The Flow Working Group will assess the review in consultation with the provider to determine the most appropriate metrics and methods for measuring the indicators and calculating indicator scores.

3. Data collection and analysis

Upon agreement on the appropriate metrics and methods for reporting on the most suitable flow indicators, the procedure for data collection and analysis for annual reporting of flow indicators need to developed and require the following.

- Establishment of procedures for annual data acquisition for Wet Tropics and Mackay-Whitsunday (including the Don basin) regions.
- Setting of procedures for undertaking data analysis to produce annual flow scores.

- Worked examples of the analyses and indicator reporting using actual data for freshwater basins and estuaries for all metrics selected for the Mackay Whitsunday and Wet Tropics regions.

The Flow Working Group will review and approve the data collection and analysis procedures in consultation with the provider.

The final approved indicators, methods and analysis approach will be reviewed and approved by the Technical Working Group (June/July) and the Reef Plan Independent Science Panel (July). Any recommendations made by these groups must be incorporated into the final report.

Existing potential resources for flow indicator development

There are a range of resources available that can contribute to the development of flow indicators within each region, some of which are specific to reporting zones within the Mackay Whitsunday or Wet Tropics regions. Some potential resources are described below.

- Hydrologic models for example IQQM, used to provide modelled flows for predevelopment scenarios, water resource plan (WRP) implementation scenarios, and assessment of historical recorded flow data for WRP nodes (select gauging station sites) that are specific to basins in both regions.
- River and water resource analysis tools including the eWater River Assessment Package (http://www.toolkit.net.au/rap) which can be used for hydraulic and time series analysis for flow assessments.
- Water Resource Plans (WRPs) environmental investigations and reviews for river basins within the Wet Tropics and Mackay-Whitsunday regions
- Environmental Flow Assessment Program reports including assessments of Resource Operations Plans (ROPs) and WRP ecological outcomes and environmental flow objectives within the Wet Tropics and Mackay-Whitsunday regions.

Resources specific to the Mackay Whitsunday region

A pressure, stressor, response framework used for determination of pressures on key flows for the Mackay-Whitsunday region has been drafted (refer to Supporting Documentation section below).

Resources specific to the Wet Tropics region

The Wet Tropics has recently had the Environmental Assessment of the Wet Tropics WRP (DSITIA 2013) completed in addition to the review of the Barron WRP. It is expected that these reports and assessments can assist to identify the main pressures on flow and appropriate indicators for flow. For example the Wet Tropics WRP Environmental Assessment has identified eco-hydraulic rules of several fish and frog species for baseflows, riffle habitat for low and medium flows, and fish and prawn production for event flows. Refer to Supporting Documentation section for the DSITIA (2013) reference.

The following key objectives of the Wet Tropics WRP Environmental Assessment have application relevant to development of flow indicators for basins in the Wet Tropics.

1. identify ecological assets in the plan area that are linked to both the ecological values of the area and to its surface water resources and that are potentially sensitive to changed water allocation and management conditions;
2. identify the critical water requirements of assets (magnitude, duration, timing, frequency, rate of change, quality of flow exposure) which, provide opportunities for key ecological responses and/or geomorphologic processes that support the viability of the assets;
3. identify flow requirements (frequency of flow conditions) that provide appropriate opportunities for key ecological responses and/or geomorphologic processes to maintain (or to restore where appropriate) the long term viability of the ecological assets; and
4. assess the effectiveness of flows delivered during the reporting period to provide the flow requirements of ecological assets in comparison to an appropriate benchmark, for example predevelopment flow scenarios.

Potential methods

For consideration during the review of methodologies process.

- Baseflow variability: a variability statistic (to be confirmed) to demonstrate change in baseflow compared to expected flow without water infrastructure.
- Change in low flows (% change from natural): change in low flows based on minimum flows needed to sustain ecological function (**not** 'no flow'). For example, some sites like Cattle creek require 4 mega litres per day to maintain ecological function; this is their minimum flow. If known/applicable, low flow figures applicable for each basin could be used. Rainfall is required to be incorporated in this metric; this could be accounted for by comparing low flow in average years, wet (70^{th} percentile) or dry (30^{th} percentile) years.
- Change in event flows: volume of entitled water extraction compared to end of system volume based on gauged flow. This will need a starting threshold (look at curve of increase in cumulative volume of entitlements). This may not be an appropriate measure for the Wet Tropics given water harvesting is not extensive in the region.

Consultation during process

Review of indicators, review of methodologies and the data collection/analysis approach will be completed in sequence and will be provided in a document to the Flow Working Group at the completion of each stage. This will provide the Flow Working Group the opportunity to review, comment and make recommendations at each stage which will inform the next output.

- Outcomes and recommendations of the Flow Working Group consultation must be recorded in writing and circulated to members and partnership Technical Officers after each consultation, including actions.

Deliverables and Timeframes

The proposed project schedule for key deliverables and milestones is provided in Table 3. The proposed month for commencing the project is April 2017.

Table 3. Proposed project schedule for 2017: key deliverables and milestones (within or by the end of each month).

Deliverables (Project Stage)	Commencement date	Flow Working Group Review	Completion date
Stage 1: Indicator review	Month 1	Month 2	Month 2
Stage 2: Review and selection of methodologies	Month 2	Month 3	Month 3
Stage 3: Data collection and analysis procedures	Month 3	Month 4	Month 4
Stage 4: Report	Month 4	Month 5	Month 6

Outcomes and recommendations of the flow working group consultation must be recorded in writing and circulated to members within one week after each consultation. Each review meeting with the Flow Working Group will be conducted using conference calls.

At the conclusion of each stage of work the provider must provide a written summary of the indicators/methodologies/data analysis approaches that were reviewed/recommended, the selected indicators/methodologies/data analysis approaches as recommended by the Flow Working Group and reasons behind the selection or dismissal of the summarised indicators/methodologies/data analysis approaches. The Technical Officers will provide these three summaries to the Technical Working Group (June, assuming project commencement in March) and the Reef Plan Independent Science Panel (July, assuming project commencement in March) for their final review and endorsement. Any recommendations made by Technical Working Group and the Reef Plan Independent Science Panel groups must be incorporated into the final report.

Each stage of work is to be incorporated within the final report including introduction, methods, results/discussion and conclusion. In addition to recording the project stages the Final Report will constitute a document that can be used to calculate annual flow indicators from available flow data for waterway health reporting in the Mackay Whitsunday and Wet Tropics report cards.

Draft Report due: August 31st assuming project commencement in April.

Final Report due: September 30th assuming project commencement in April.

All deliverables are to be provided electronically and in hard copy. Electronic versions are to be provided in both PDF and Microsoft Word with numerical methods and assessments provided in Microsoft Excel in addition to any other formats.

Contract Value

This project will be conducted on a fixed fee basis based on the value of the successful tender. The proponent must cover the costs of all expenses incurred during execution of the project including but not limited to the following.

- Tender preparation costs
- Travel and accommodation
- Meeting costs
- Operation costs
- Provision of written and electronic reports and mapping products
- Any external professional advice required.

Contractual Terms and Conditions

A standard consultancy agreement will form the basis of the terms of engagement for this project.

Requirements for the Proposal Preparation

Proposals must be submitted for all parts of the project and are to be submitted electronically in either PDF or Microsoft Word. Proposals must include the following.

- A clear statement of the methods and activities to be used to fulfil the Scope of Works.
- Proposed milestones and delivery dates.
- Identification of any other tender partners with which the proponents is planning to collaborate.
- An all-inclusive fee for the project.
- Resumes of all staff working on the project including their work experience on similar projects.
- Details of public liability, workers compensation and professional indemnity insurance
- Details of the proponent's primary contact.

Evaluation and Award Process

Proposals will be assessed on how closely they meet the objectives of the project, total cost and experience of staff working on the project. The Executive Officers of the Mackay-Whitsunday Healthy Rivers to Reef Partnership and the Wet Tropics Healthy Waterways Partnership will be responsible for assessing submissions and awarding the tender.

Process schedule

Proponents should submit a letter of intent by 3rd March 2017 with the final proposal due by 17 March 2017 to the Science Technical Officers. The Science Technical Officers Richard Hunt (Wet Tropics) and Emma Carlos (Mackay Whitsunday) will be available during this time to answer questions to assist with proposal submission.

A decision of the successful application will be made within two weeks after the last proposal is received. All applicants will be notified of the outcome of the assessment of their application.

Supporting Documentation

Electronic copies of the following documents can be provided by the Science Technical Officers upon request to assist with proposal and project development.

- Wet Tropics Healthy Waterways Partnership Pilot Report Card technical publications (Program Design, Methods and Results). Also available for download at http://wettropicswaterways.org.au
- Mackay Whitsunday Healthy Rivers to Reef Partnership 2015 Report Card technical publications (Program Design, Methods and Results). Also available for download at http://healthyriverstoreef.org.au
- Pressure, stressor, response framework used for determination of pressures on key flows for the Mackay-Whitsunday region
- Details of basin-specific pressures in the Mackay-Whitsunday region.-
- Environmental Assessment of the Wet Tropics Water Resource Plan
    - DSITIA 2013, Wet Tropics Water Resource Plan: Environmental assessment report. Department of Science, Information Technology, Innovation and the Arts, Brisbane.
    - DSITIA 2013, Wet Tropics Water Resource Plan: Environmental Assessment– Appendix A Ecological asset selection report. Department of Science, Information Technology, Innovation and the Arts, Brisbane
    - DSITIA 2013, Wet Tropics Water Resource Plan: Environmental Assessment– Appendix B Defining critical water requirements for selected ecological assets. Department of Science, Information Technology, Innovation and the Arts, Brisbane.
    - DSITIA 2013, Wet Tropics Water Resource Plan: Environmental Assessment– Appendix C Risk assessment for selected ecological assets. Department of Science, Information Technology, Innovation and the Arts, Brisbane.

Additional supporting information and documents held by the Mackay Whitsunday Healthy Rivers to Reef Partnership and the Wet Tropics Healthy Waterways Partnership relevant to development of the flow indicators will be made available to the successful provider for the purpose of the project. Additional supporting information and documents includes outcomes and recommendations recorded from the Flow Working Group meetings.

References

DSITIA 2013, Wet Tropics Water Resource Plan: Environmental Assessment–Appendix B Defining critical water requirements for selected ecological assets. Department of Science, Information Technology, Innovation and the Arts, Brisbane.

HR2R 2016. Mackay-Whitsunday Healthy Rivers to Reef Partnership Report Card Development of Methods: Environmental Indicators. http://healthyriverstoreef.org.au/wp-content/uploads/2016/12/Development-of-Methods-for-Environmental-Indicators-2015.pdf

WTHWP (Wet Tropics Healthy Waterways Partnership) 2016a. Wet Tropics Pilot Report Card Methods. Waterway environments. http://wettropicswaterways.org.au/wp-content/uploads/2016/12/WT_Methods_2016_V8-1.pdf