Australian Government

BIOREGIONAL ASSESSMENTS

PROVIDING SCIENTIFIC WATER RESOURCE INFORMATION ASSOCIATED WITH COAL SEAM GAS AND LARGE COAL MINES

Description of the water-dependent asset register for the Maranoa-Balonne-Condamine subregion

Product 1.3 for the Maranoa-Balonne-Condamine subregion from the Northern Inland Catchments Bioregional Assessment

11 September 2015

A scientific collaboration between the Department of the Environment, Bureau of Meteorology, CSIRO and Geoscience Australia

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The Bioregional Assessment Programme is a transparent and accessible programme of baseline assessments that increase the available science for decision making associated with coal seam gas and large coal mines. A bioregional assessment is a scientific analysis of the ecology, hydrology, geology and hydrogeology of a bioregion with explicit assessment of the potential direct, indirect and cumulative impacts of coal seam gas and large coal mining development on water resources. This Programme draws on the best available scientific information and knowledge from many sources, including government, industry and regional communities, to produce bioregional assessments that are independent, scientifically robust, and relevant and meaningful at a regional scale.

The Programme is funded by the Australian Government Department of the Environment. The Department of the Environment, Bureau of Meteorology, CSIRO and Geoscience Australia are collaborating to undertake bioregional assessments. For more information, visit http://www.bioregionalassessments.gov.au.

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Cover photograph

Condamine river weir on Darling Downs in Queensland, 2005

Credit: Arthur Mostead © Commonwealth of Australia (Murray–Darling Basin Authority)

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Contributors to the Technical Programme

The following individuals have contributed to the Technical Programme, the part of the Bioregional Assessment Programme that undertakes bioregional assessments. Leaders are underlined.

Assistant Secretary	Department of the Environment: Matthew Whitfort
Programme Director	Department of the Environment: Anthony Swirepik
Technical Programme Director	Bureau of Meteorology: Bronwyn Ray
Projects Director	CSIRO: David Post
Principal Science Advisor	Department of the Environment: Peter Baker
Science Directors	CSIRO: Brent Henderson
	Geoscience Australia: Steven Lewis
Integration Lead	Bureau of Meteorology: Richard Mount
Programme management	Bureau of Meteorology: Graham Hawke, Louise Minty
	CSIRO: Paul Hardisty, Warwick McDonald
	Geoscience Australia: Stuart Minchin
Project Leaders	CSIRO: Alexander Herr, Tim McVicar, David Rassam
	Geoscience Australia: Hashim Carey, Kriton Glenn, Tim Evans, Martin Smith
	Bureau of Meteorology: Natasha Herron
Assets and receptors	Bureau of Meteorology: Richard Mount, Eliane Prideaux
	Department of the Environment: Larry Guo, Glenn Johnstone, Brad Moore, Wasantha Perera, Jin Wang
Bioregional Assessment Information Platform	Bureau of Meteorology: Derek Chen, Trevor Christie-Taylor, Melita Dahl, Lakshmi Devanathan, Angus MacAulay, Christine Panton, Paul Sheahan, Kellie Stuart
	CSIRO: Peter Fitch
	Department of the Environment: Geraldine Cusack
	Geoscience Australia: Neal Evans
Communications	Bureau of Meteorology: Karen de Plater
	CSIRO: Chris Gerbing
	Department of the Environment: Lea Locke, Milica Milanja
	Geoscience Australia: Chris Thompson

Assistant Secretary	Department of the Environment: Matthew Whitfort
Coordination	Bureau of Meteorology: Julie Burke, Sarah van Rooyen
	CSIRO: Ruth Palmer
	Department of the Environment: James Hill, Angela Kaplish, Megan Stanford, Craig Watson
	Geoscience Australia: Tenai Luttrell
Ecology	CSIRO: Tanya Doody, Brendan Ebner, Kate Holland, Craig MacFarlane, Patrick Mitchell, Justine Murray, Anthony O'Grady, Chris Pavey, Jodie Pritchard, Nat Raisbeck-Brown, Ashley Sparrow, Georg Wiehl
Geology	CSIRO: Deepak Adhikary, Luke Connell, Emanuelle Frery, Jane Hodgkinson, James Kear, Manoj Khanal, Zhejun Pan, Kaydy Pinetown, Matthias Raiber, Hayley Rohead-O'Brien, Regina Sander, Peter Schaubs, Garth Warren, Paul Wilkes, Andrew Wilkins, Yanhua Zhang
	Geoscience Australia: Stephen Hostetler, Steven Lewis, Bruce Radke
Geographic information systems	CSIRO: Caroline Bruce, Jody Bruce, Steve Marvanek, Arthur Read
	Geoscience Australia: Adrian Dehelean
Groundwater modelling	CSIRO: Olga Barron, Russell Crosbie, Tao Cui, Warrick Dawes, Lei Gao, Sreekanth Janardhanan, Luk Peeters, Praveen Kumar Rachakonda, Wolfgang Schmid, Saeed Torkzaban, Chris Turnadge, Binzhong Zhou
Hydrogeology	CSIRO: Konrad Miotlinski
	Geoscience Australia: Rebecca Cassel, Steven Hostetler, Jim Kellett, Jessica Northey, Tim Ransley, Baskaran Sundaram, Gabrielle Yates
Information management	Bureau of Meteorology: Belinda Allison, Jill McNamara, Brendan Moran, Suzanne Slegers
	CSIRO: Nick Car, Phil Davies, Andrew Freebairn, Mick Hartcher, Geoff Hodgson, Brad Lane, Ben Leighton, Trevor Pickett, Ramneek Singh, Matt Stenson
	Geoscience Australia: Luke Caruana, Matti Peljo
Products	CSIRO: Maryam Ahmad, Daniel Aramini, Heinz Buettikofer, Simon Gallant, Karin Hosking, Frances Marston, Linda Merrin, Becky Schmidt, Sally Tetreault-Campbell, Catherine Ticehurst
	Geoscience Australia: Penny Kilgour, Kathryn Owen
Risk and uncertainty	CSIRO: Simon Barry, Jeffery Dambacher, Jess Ford, Keith Hayes, Geoff Hosack, Yang Liu, Warren Jin, Dan Pagendam, Carmel Pollino
Surface water hydrology	CSIRO: Santosh Aryal, Mat Gilfedder, Fazlul Karim, Lingtao Li, Dave McJannet, Jorge Luis Peña-Arancibia, Xiaogang Shi, Tom Van Niel, Neil Viney, Bill Wang, Ang Yang, Yongqiang Zhang

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This technical product was reviewed by several groups:

- Discipline Leaders: Anthony O'Grady (ecology), Richard Mount (assets)
- Senior Science Leaders: David Post (Projects Director), Steven Lewis (Science Director, Geoscience Australia), Brent Henderson (Science Director, CSIRO), Becky Schmidt (Products Manager, CSIRO)
- Technical Assurance Reference Group: Chaired by Peter Baker (Principal Science Advisor, Department of the Environment), this group comprises officials from the NSW, Queensland, South Australian and Victorian governments.

Introduction

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) was established to provide advice to the federal Minister for the Environment on potential water-related impacts of coal seam gas (CSG) and large coal mining developments.

Bioregional assessments (BAs) are one of the key mechanisms to assist the IESC in developing this advice so that it is based on best available science and independent expert knowledge. Importantly, technical products from BAs are also expected to be made available to the public, providing the opportunity for all other interested parties, including government regulators, industry, community and the general public, to draw from a single set of accessible information. A BA is a scientific analysis, providing a baseline level of information on the ecology, hydrology, geology and hydrogeology of a bioregion with explicit assessment of the potential direct, indirect and cumulative impacts of CSG and coal mining development on water resources.

The IESC has been involved in the development of *Methodology for bioregional assessments of the impacts of coal seam gas and coal mining development on water resources* (the BA methodology; Barrett et al., 2013) and has endorsed it. The BA methodology specifies how BAs should be undertaken. Broadly, a BA comprises five components of activity, as illustrated in Figure 1. Each BA will be different, due in part to regional differences, but also in response to the availability of data, information and fit-for-purpose models. Where differences occur, these are recorded, judgments exercised on what can be achieved, and an explicit record is made of the confidence in the scientific advice produced from the BA.

The Bioregional Assessment Programme

The Bioregional Assessment Programme is a collaboration between the Department of the Environment, the Bureau of Meteorology, CSIRO and Geoscience Australia. Other technical expertise, such as from state governments or universities, is also drawn on as required. For example, natural resource management groups and catchment management authorities identify assets that the community values by providing the list of water-dependent assets, a key input.

The Technical Programme, part of the Bioregional Assessment Programme, will undertake BAs for the following bioregions and subregions:

- the Galilee, Cooper, Pedirka and Arckaringa subregions, within the Lake Eyre Basin bioregion
- the Maranoa-Balonne-Condamine, Gwydir, Namoi and Central West subregions, within the Northern Inland Catchments bioregion
- the Clarence-Moreton bioregion
- the Hunter and Gloucester subregions, within the Northern Sydney Basin bioregion
- the Sydney Basin bioregion
- the Gippsland Basin bioregion.

Technical products (described in a later section) will progressively be delivered throughout the Programme.

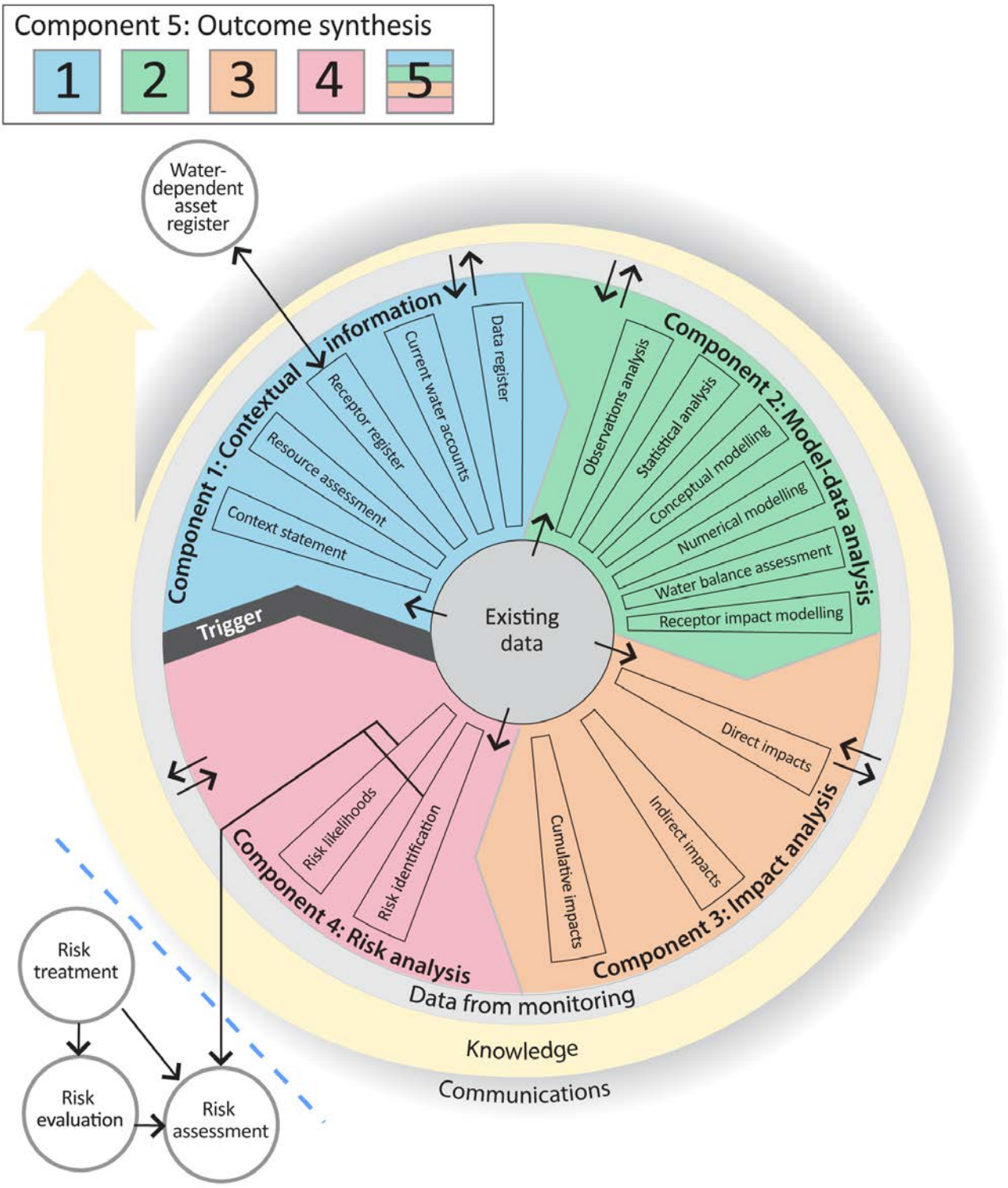

Figure 1 Schematic diagram of the bioregional assessment methodology

The methodology comprises five components, each delivering information into the bioregional assessment and building on prior components, thereby contributing to the accumulation of scientific knowledge. The small grey circles indicate activities external to the bioregional assessment. Risk identification and risk likelihoods are conducted within a bioregional assessment (as part of Component 4) and may contribute activities undertaken externally, such as risk evaluation, risk assessment and risk treatment. Source: Figure 1 in Barrett et al. (2013), © Commonwealth of Australia

Methodologies

For transparency and to ensure consistency across all BAs, submethodologies have been developed to supplement the key approaches outlined in the *Methodology for bioregional assessments of the impact of coal seam gas and coal mining development on water resources* (Barrett et al., 2013). This series of submethodologies aligns with technical products as presented in Table 1. The submethodologies are not intended to be 'recipe books' nor to provide step-by-step instructions; rather they provide an overview of the approach to be taken. In some instances, methods applied for a particular BA may need to differ from what is proposed in the submethodologies – in this case an explanation will be supplied. Overall, the submethodologies are intended to provide a rigorously defined foundation describing how BAs are undertaken.

Table 1 Methodologies and associated technical products listed in Table 2

Code	Proposed title	Summary of content	Associated technical product
M01	*Methodology for bioregional assessments of the impacts of coal seam gas and coal mining development on water resources*	A high-level description of the scientific and intellectual basis for a consistent approach to all bioregional assessments	All
M02	*Compiling water-dependent assets*	Describes the approach for determining water-dependent assets	1.3 Description of the water-dependent asset register
M03	*Assigning receptors and impact variables to water-dependent assets*	Describes the approach for determining receptors associated with water-dependent assets	1.4 Description of the receptor register
M04	*Developing a coal resource development pathway*	Specifies the information that needs to be collected and reported in product 1.2 (i.e. known coal and coal seam gas resources as well as current and potential resource developments). Describes the process for determining the coal resource development pathway (reported in product 2.3)	1.2 Coal and coal seam gas resource assessment 2.3 Conceptual modelling
M05	*Developing the conceptual model for causal pathways*	Describes the development of the conceptual model for causal pathways, which summarises how the 'system' operates and articulates the links between coal resource developments and impacts on receptors	2.3 Conceptual modelling
M06	*Surface water modelling*	Describes the approach taken for surface water modelling across all of the bioregions and subregions. It covers the model(s) used, as well as whether modelling will be quantitative or qualitative.	2.6.1 Surface water numerical modelling
M07	*Groundwater modelling*	Describes the approach taken for groundwater modelling across all of the bioregions and subregions. It covers the model(s) used, as well as whether modelling will be quantitative or qualitative. It also considers surface water – groundwater interactions, as well as how the groundwater modelling is constrained by geology.	2.6.2 Groundwater numerical modelling

Code	Proposed title	Summary of content	Associated technical product
M08	*Receptor impact modelling*	Describes how to develop the receptor impact models that are required to assess the potential impacts from coal seam gas and large coal mining on receptors. Conceptual, semi-quantitative and quantitative numerical models are described.	2.7 Receptor impact modelling
M09	*Propagating uncertainty through models*	Describes the approach to sensitivity analysis and quantifying uncertainty in the modelled hydrological response to coal and coal seam gas development	2.3 Conceptual modelling 2.6.1 Surface water numerical modelling 2.6.2 Groundwater numerical modelling 2.7 Receptor impact modelling
M10	*Risk and cumulative impacts on receptors*	Describes the process to identify and analyse risk	3 Impact analysis 4 Risk analysis
M11	*Hazard identification*	Describes the process to identify potential water-related hazards from coal and coal seam gas development	2 Model-data analysis 3 Impact analysis 4 Risk analysis
M12	*Fracture propagation and chemical concentrations*	Describes the likely extent of both vertical and horizontal fractures due to hydraulic stimulation and the likely concentration of chemicals after production of coal seam gas	2 Model-data analysis 3 Impact analysis 4 Risk analysis

Each submethodology is available online at http://www.bioregionalassessments.gov.au. Submethodologies might be added in the future.

Technical products

The outputs of the BAs include a suite of technical products variously presenting information about the ecology, hydrology, hydrogeology and geology of a bioregion and the potential direct, indirect and cumulative impacts of CSG and coal mining developments on water resources, both above and below ground. Importantly, these technical products are available to the public, providing the opportunity for all interested parties, including community, industry and government regulators, to draw from a single set of accessible information when considering CSG and large coal mining developments in a particular area.

The information included in the technical products is specified in the BA methodology. Figure 2 shows the information flow within a BA. Table 2 lists the content provided in the technical products, with cross-references to the part of the BA methodology that specifies it. The red rectangles in both Figure 2 and Table 2 indicate the information included in this technical product.

This technical product is delivered as a report (PDF). Additional material is also provided, as specified by the BA methodology:

- all unencumbered data syntheses and databases
- unencumbered tools, model code, procedures, routines and algorithms
- unencumbered forcing, boundary condition, parameter and initial condition datasets
- the workflow, comprising a record of all decision points along the pathway towards completion of the BA, gaps in data and modelling capability, and provenance of data.

The PDF of this technical product, and the additional material, are available online at http://www.bioregionalassessments.gov.au.

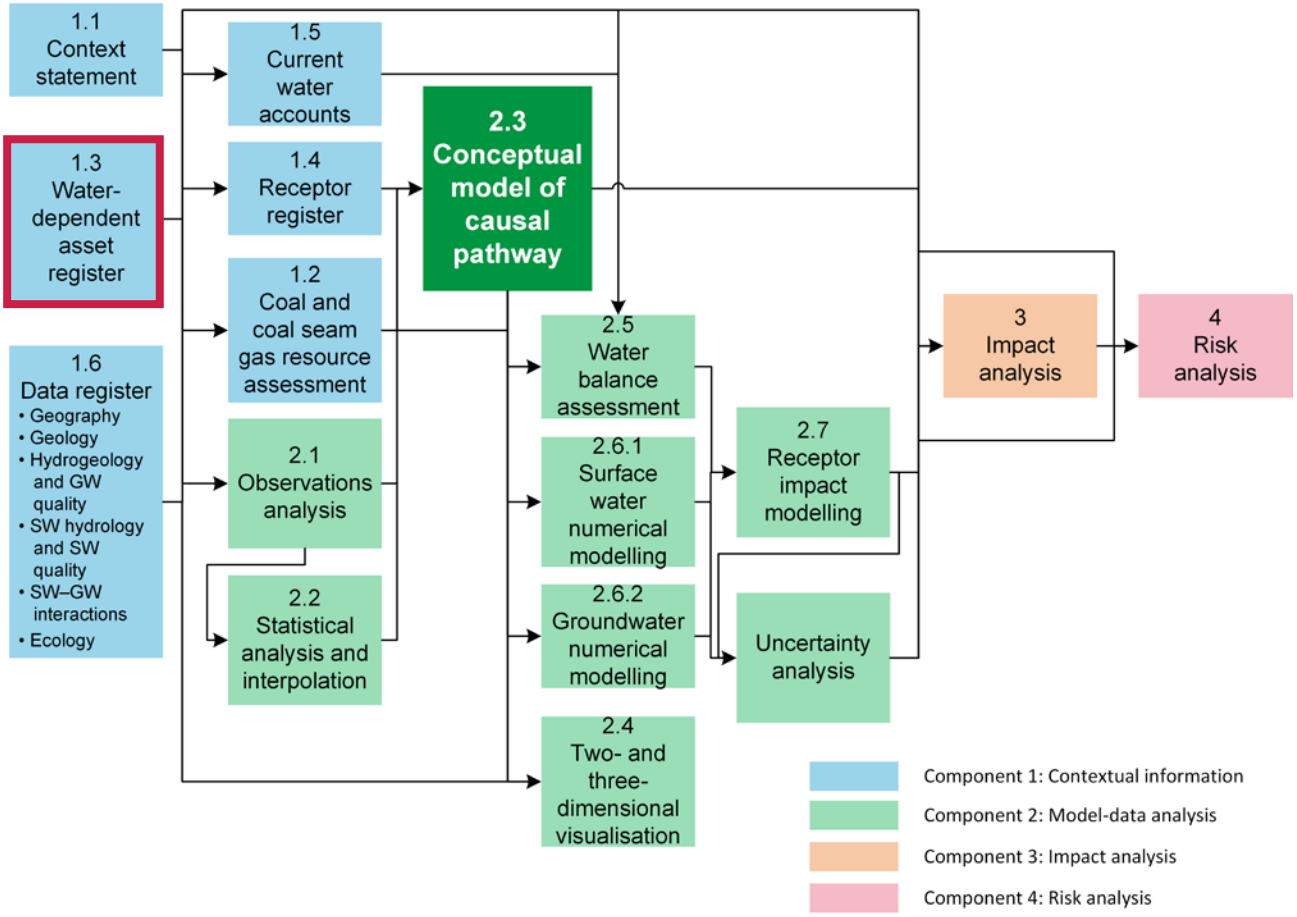

Figure 2 The simple decision tree indicates the flow of information through a bioregional assessment

The red rectangle indicates the information included in this technical product.

Table 2 Technical products delivered by the Northern Inland Catchments Bioregional Assessment

For each subregion in the Northern Inland Catchments Bioregional Assessment, technical products are delivered online at http://www.bioregionalassessments.gov.au, as indicated in the 'Type' column[a]. Other products – such as datasets, metadata, data visualisation and factsheets – are provided online.

Component	Product code	Title	Section in the BA methodology[b]	Type[a]
Component 1: Contextual information for the Maranoa-Balonne-Condamine subregion	1.1	Context statement	2.5.1.1, 3.2	PDF, HTML
	1.2	Coal and coal seam gas resource assessment	2.5.1.2, 3.3	PDF, HTML
	1.3	Description of the water-dependent asset register	2.5.1.3, 3.4	PDF, HTML, register
	1.4	Description of the receptor register	2.5.1.4, 3.5	PDF, HTML, register
	1.5	Current water accounts and water quality	2.5.1.5	PDF, HTML
	1.6	Data register	2.5.1.6	Register
Component 2: Model-data analysis for the Maranoa-Balonne-Condamine subregion	2.1-2.2	Observations analysis, statistical analysis and interpolation	2.5.2.1, 2.5.2.2	Not produced
	2.3	Conceptual modelling	2.5.2.3, 4.3	PDF, HTML
	2.5	Water balance assessment	2.5.2.4	Not produced
	2.6.1	Surface water numerical modelling	4.4	Not produced
	2.6.2	Groundwater numerical modelling	4.4	PDF, HTML
	2.7	Receptor impact modelling	2.5.2.6, 4.5	Not produced
Component 3: Impact analysis for the Maranoa-Balonne-Condamine subregion	3-4	Impact analysis	5.2.1	PDF, HTML
Component 4: Risk analysis for the Maranoa-Balonne-Condamine subregion		Risk analysis	2.5.4, 5.3	
Component 5: Outcome synthesis for Northern Inland Catchments bioregion	5	Outcome synthesis	2.5.5	PDF, HTML

[a]The types of products are as follows:

- 'PDF' indicates a PDF document that is developed by the Northern Inland Catchments Bioregional Assessment using the structure, standards, and look and feel specified by the programme.
- 'HTML' indicates the same content as in the PDF document, but delivered as webpages.
- 'Register' indicates controlled lists that are delivered using a variety of formats as appropriate.
- 'Cross-reference' indicates material that does not use the same structure, standards, and look and feel specified by the programme. This material is typically developed externally or through aligned research projects funded by the Department of the Environment. A webpage links to this material and explain how it fits into the Assessment.
- 'Not produced' indicates that the product was not developed. A webpage explains why and points to relevant submethodologies (Table 1).

[b]*Methodology for bioregional assessments of the impacts of coal seam gas and coal mining development on water resources* (Barrett et al., 2013)

About this technical product

The following notes are relevant only for this technical product.

- All reasonable efforts were made to provide all material under a Creative Commons Attribution 3.0 Australia Licence.
- All maps created as part of this BA for inclusion in this product used the Albers equal area projection with a central meridian of 151.0° East for the Northern Inland Catchments bioregion and two standard parallels of –18.0° and –36.0°.
- Contact bioregionalassessments@bom.gov.au to access metadata (including copyright, attribution and licensing information) for all datasets cited or used to make figures in this product. At a later date, this information, as well as all unencumbered datasets, will be published online.
- The citation details of datasets are correct to the best of the knowledge of the Bioregional Assessment Programme at the publication date of this product. Readers should use the hyperlinks provided to access the most up-to-date information about these data; where there are discrepancies, the information provided online should be considered correct. The dates used to identify Bioregional Assessment Source Datasets are the dataset's published date. Where the published date is not available, the last updated date or created date is used. For Bioregional Assessment Derived datasets, the created date is used.

References

Barrett DJ, Couch CA, Metcalfe DJ, Lytton L, Adhikary DP and Schmidt RK (2013) Methodology for bioregional assessments of the impacts of coal seam gas and coal mining development on water resources. A report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of the Environment. Department of the Environment, Australia. Viewed 11 September 2015, http://www.iesc.environment.gov.au/publications/methodology-bioregional-assessments-impacts-coal-seam-gas-and-coal-mining-development-water.

1.3 Description of the water-dependent asset register for the Maranoa-Balonne-Condamine subregion

A water-dependent asset has a particular meaning for bioregional assessments; it is an asset potentially impacted by changes in groundwater and/or surface water due to coal or coal seam gas development. Some ecological assets solely depend on incident rainfall and will not be considered as water dependent if evidence does not support a linkage to groundwater or surface water.

This product describes water-dependent assets that have been identified in the bioregional assessment and are listed in the water-dependent asset register (available at http://www.bioregionalassessments.gov.au).

1.3.1 Methods

Summary

The water-dependent asset register is a list of water-dependent assets identified for the bioregional assessment (BA) of the Maranoa-Balonne-Condamine subregion. This section details the specific application to the Maranoa-Balonne-Condamine subregion of methods described in the companion submethodology M02 (as listed in Table 1) for compiling water-dependent assets (Mount et al., 2015), outlining how the register was compiled. Key concepts and terminology are also explained.

The methods covered include: the process of collecting different groups of assets and determining their water dependency, the development and compilation of the water-dependent asset register, and the determination of the preliminary assessment extent (PAE) of the Maranoa-Balonne-Condamine subregion.

1.3.1.1 Background and context

This product presents information about the water-dependent asset register for the Maranoa-Balonne-Condamine subregion. The name of the dated snapshot of the asset register this description refers to is 'water-dependent asset register and asset list for Maranoa-Balonne-Condamine subregion on 26 June 2015'. Development of the register used methods and processes defined and outlined in the companion submethodology M02 (as listed in Table 1) for compiling water-dependent assets (Mount et al., 2015); their specific application to the Maranoa-Balonne-Condamine subregion is described in the following sections.

An *asset* is an entity having value to the community and, for BA purposes, is associated with a bioregion or subregion. Technically, an asset is a store of value and may be managed and/or used to maintain and/or produce further value. Each asset will have many values associated with it and they can be measured from a range of perspectives; for example, the values of a wetland can be measured from ecological, sociocultural and economic perspectives. A *bioregion* is a geographic land area within which coal seam gas (CSG) and/or coal mining developments are, or could, take place and for which BAs are conducted. A *subregion* is an identified area wholly contained within a bioregion.

A *water-dependent asset* has a particular meaning for BAs; it is an asset potentially impacted, either positively or negatively, by changes in the groundwater and/or surface water regime due to coal resource development. Some assets are solely dependent on incident rainfall and will not be considered as water dependent if evidence does not support a linkage to groundwater or surface water.

The *water-dependent asset register* is a simple and authoritative listing of the assets within the *preliminary assessment extent* (PAE) (discussed in Section 1.3.1.3) that are potentially subject to water-related impacts. A PAE is the geographic area associated with a bioregion or subregion in which the potential water-related impact of coal resource development on assets is assessed. The

compiling of the asset register is the first step to identifying and analysing potentially impacted assets, which is the goal of the overall BA.

The asset source data are compiled into an *asset database*, including the geographic location, which are designated as *elements* (individual spatial features – points, lines and polygons) and *assets* (combinations of one or more elements). During the compilation process, assets are classified into three groups: (i) ecological, (ii) economic and (iii) sociocultural. Many assets are obtained from state and national databases and an important group of assets is provided by natural resource management organisations (NRMs). The Office of Water Science liaised with Indigenous knowledge holders about Indigenous sociocultural water-dependent assets (further discussed in Section 1.3.4.1).

The *asset list* is created through selection of assets in the asset database that occur within the PAE. The assets in the asset list that pass the BA water-dependency test are then 'registered' in the water-dependent asset register. A preliminary version of the asset register is presented to experts and organisations with local knowledge at organised workshops. Feedback is sought about whether the asset register is complete and correct; appropriate amendments are then made. It is at this stage – when assets have been selected using the PAE and the amended water-dependent assets have been recorded in the database – that the water-dependent asset register is complete for the purposes of producing product 1.3. Note, however, that the addition of new assets to the asset database, or a review of the status of existing assets in the database will mean that the asset register may be updated. As this has implications for other BA components, any updates must be documented. The product 1.3 will not be updated or republished as part of BAs but an updated version of the asset register (derived from the asset database) may be published at the same time as other products, for example, those associated with Component 3: Impact analysis (Figure 1 and Figure 2).

Following development of the asset register, the connection of the registered assets to coal resource development is assessed using 'materiality' tests and, if potentially subject to water-related impacts, assigned *receptors* (after Barrett et al., 2013). A receptor is a point in the landscape where water-related impacts on assets are measured and/or estimated. The approach to assigning receptors and impact variables to water-dependent assets is described in the companion submethodology M03 (as listed in Table 1) for assigning receptors to water-dependent assets (O'Grady et al., 2015).

1.3.1.2 Compiling assets and developing the water-dependent asset register

Seven natural resource management organisations (NRMs) contributed data to the Water Asset Information Tool (WAIT) database for the Maranoa-Balonne-Condamine subregion (Table 3). These NRM-nominated assets were added to the asset database. The Maranoa-Balonne-Condamine subregion falls predominantly within Queensland. This is consistent with the source of the NRM datasets, with six of the seven NRMs being from Queensland and only one from NSW.

Table 3 Natural resource management organisations that contributed data to the Water Asset Information Tool database

Organisation	Description in asset register
Border Rivers-Gwydir Catchment Management Authority (prepared by Ecological Australia)	WAIT_Border Rivers Gwydir
Burnett Mary Regional Group	WAIT_Burnett Mary
Condamine Alliance	WAIT_Condamine
Fitzroy Basin Association	WAIT_Fitzroy
Queensland Murray-Darling Committee	WAIT_Border Rivers Maranoa-Balonne
South West Natural Resource Management Ltd	WAIT_South East Queensland
Western Catchment Management Authority Natural Resource Management Region	WAIT_Western

In addition to data provided by the NRM organisations, data were obtained from national, state and regional databases to complement the coverage of assets for the subregion.

Within the asset database, each surface water, groundwater and vegetation polygon, line or point is an element and elements are grouped according to class and spatial location to create assets. Each asset has a unique asset identifier (AID). A detailed description of the process for aggregating and classifying elements to assets is presented in the companion submethodology M02 (as listed in Table 1) for compiling water-dependent assets (Mount et al., 2015).

1.3.1.2.1 Ecological assets

The majority of the datasets used in compiling the ecological assets for the Maranoa-Balonne-Condamine subregion (Dataset 1) are shown in Table 4.

Table 4 Data sources for ecological assets for the Maranoa-Balonne Condamine subregion

Dataset[a]	Organisation	Dataset citation	Elements	Assets (asset list)
Collaborative Australian Protected Areas Database (CAPAD)	Department of the Environment	Australian Government Department of the Environment (Dataset 2)	61	61
A directory of important wetlands in Australia (DIWA)	Department of the Environment	Australian Government Department of the Environment (Dataset 3)	13	6
Environmental Assets Database (EAD; Commonwealth Environmental Water Holder)	Department of the Environment (restricted access)	Australian Government Department of the Environment (Dataset 4)	6	6
Great Artesian Basin groundwater recharge	Geoscience Australia	Geoscience Australia (Dataset 5)	90	5

Dataset[a]	Organisation	Dataset citation	Elements	Assets (asset list)
National atlas of groundwater dependent ecosystems	Bureau of Meteorology	Bureau of Meteorology (Dataset 6)	Surface: 10,528 Subsurface: 32,751	Surface: 209 Subsurface: 66
Important Bird Areas (IBA)	Birds Australia	Birds Australia (Dataset 7)	3	3
Key Environmental Assets of the Murray-Darling Basin (KEA)	Murray-Darling Basin Authority	Murray-Darling Basin Authority (Dataset 8)	Streams: 7,308 Waterbodies: 521	Streams 324 Waterbodies: 521
Threatened ecological communities listed under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)	Department of the Environment	Australian Government Department of the Environment (Dataset 9)	16,284	8
Threatened species listed under the EPBC Act	Department of the Environment	Bioregional Assessment Programme (Dataset 10)	2,286	99
Threatened species listed under Queensland's *Nature Conservation Act 1992* (Nature Conservation Act)	Department of Environment and Heritage Protection, Queensland Government	QLD Department of Environment and Heritage Protection (Dataset 11)	168,394	66
Threatened regional ecosystems listed under Queensland's *Nature Conservation Act 1992* (Nature Conservation Act)	Department of Environment and Heritage Protection, Queensland Government	Queensland Herbarium, Department of Science, Information Technology, Innovation and the Arts (Dataset 12)	12,551	42
Queensland wetland mapping	Department of Science, Information Technology, Innovation and the Arts, Queensland Government	Department of Science, Information Technology, Innovation and the Arts (Dataset 13, Dataset 14, Dataset 15)	Springs: 187 Streams: 102,548 Wetlands: 12,514	Springs: 56 Streams: 1 Wetlands: 83
Queensland groundwater-dependent ecosystem mapping and classification	Department of Science, Information Technology, Innovation and the Arts, Queensland Government	Queensland Department of Science, Information Technology, Innovation and the Arts (Dataset 16)	Surface areas: 4,993 Surface lines: 63,171 Terrestrial areas: 27,106	Surface areas: 17 Surface lines: 23 Terrestrial areas: 33

Dataset[a]	Organisation	Dataset citation	Elements	Assets (asset list)
Permanent and Semi-Permanent Waterbodies of the Lake Eyre Basin (Queensland and South Australia) (DRAFT)	Department of Environment and Heritage Protection, Queensland Government	Queensland Department of Environment and Resource Management (Dataset 17)	30	26
Total			**461,345**	**1,655**

[a]The asset database (Bioregional Assessment Programme, Dataset 1) is a collation of all these source datasets. Some assets may be captured in multiple databases. These replicates are retained in the asset register as boundaries may differ between databases.

In addition to the datasets listed above, 56,220 elements (757 assets) were added to the MBC asset list sourced from the NRM WAIT databases (Dataset 18, Dataset 19). In total there were 517,565 elements grouped into 2412 assets in the asset list. These were then subjected to the water-dependency test to produce the 2200 assets in the water-dependent asset register. A preliminary version of the water-dependent asset register, along with associated maps and data, was presented to experts and organisations with local knowledge at a workshop in Toowoomba in December 2014 for comment and feedback. The attendees were given two weeks to review the preliminary water-dependent asset register and return comments and suggestions. This consultation identified four additional datasets that were added to the asset database:

- Queensland threatened regional ecosystems listed under the *Nature Conservation Act 1992* (Nature Conservation Act) (Queensland Herbarium, Department of Science, Information Technology, Innovation and the Arts, Dataset 12)
- Queensland wetland mapping (Department of Science, Information Technology, Innovation and the Arts, Dataset 13, Dataset 14, Dataset 15)
- Queensland groundwater-dependent ecosystem mapping and classification (Queensland Department of Science, Information Technology, Innovation and the Arts, Dataset 16)
- Queensland permanent and semi-permanent waterbodies of the Lake Eyre Basin (Queensland and South Australia) (DRAFT) (Queensland Department of Environment and Resource Management, Dataset 17).

1.3.1.2.2 Economic assets

The datasets used in compiling the economic assets for the Maranoa-Balonne-Condamine subregion are shown in Table 5.

Table 5 Data sources for economic assets in the Maranoa-Balonne-Condamine subregion

Dataset[a]	Organisation	Dataset citation	Elements	Assets (asset list)
Queensland groundwater access entitlements linked to bores and NGIS	Bioregional Assessment Programme	Bioregional Assessment Programme (Dataset 20)	9,968	104
Queensland surface water access entitlements linked to spatial locations	Bioregional Assessment Programme	Bioregional Assessment Programme (Dataset 21)	811	168
Queensland regulated rivers	Bioregional Assessment Programme, NSW Office of Water, Department of Primary Industries	Bioregional Assessment Programme (Dataset 21), NSW Office of Water (Dataset 22)	1	1
NSW groundwater licensing linked to spatial locations	Bioregional Assessment Programme	Bioregional Assessment Programme (Dataset 23)	1	1
NSW surface water licensing linked to spatial locations	Bioregional Assessment Programme	Bioregional Assessment Programme (Dataset 24)	10	2
NSW surface water sharing plans	NSW Office of Water, Department of Primary Industries	NSW Office of Water (Dataset 22)	6	6
NSW groundwater macro plans	NSW Office of Water, Department of Primary Industries	NSW Office of Water (Dataset 22)	8	8
NSW regulated rivers	NSW Office of Water, Department of Primary Industries	NSW Office of Water (Dataset 22)	1	1
WAIT_Border Rivers Maranoa-Balonne	Queensland Murray-Darling Committee	Australian Government Department of the Environment (Dataset 18)	3	3
WAIT_South East Queensland	South West Natural Resource Management Ltd	Australian Government Department of the Environment (Dataset 18)	16	16
Total			**10,825**	**310**

[a]The asset database (Bioregional Assessment Programme, Dataset 1) is a collation of all these source datasets. Some assets may be captured in multiple databases. These replicates are retained in the asset register as boundaries may differ between databases.

As described in the companion submethodology M02 (as listed in Table 1) for compiling water-dependent assets (Mount et al., 2015), all economic assets in the Maranoa-Balonne-Condamine subregion are a form of water access entitlement and are classed either as a ‘water access right’ (referred to as ‘water access licences’ in NSW or 'Water Allocation' in Queensland), or a ‘basic water right’ (stock and domestic):

- water access right – this requires a licence both for the works and the extraction of the water. The extraction of the water can be for a range of purposes including irrigation, commercial, industrial, farming, dewatering, mining, intensive agriculture, etc.
- basic water right (stock and domestic) – this is the right to take water for domestic and stock purposes only. A basic right for 'take of groundwater' requires approval for the works (bore) but does not require a licence for the extraction of groundwater. A basic right for 'take of surface water' does not require an approval for the works or approval for the extraction of surface water.

Basic landholder rights (i.e. a type of basic water right), including riparian rights, maintain the right of those adjacent to rivers, estuaries, lakes or aquifers underlying the land to extract water for domestic and stock use without a water access licence. Basic landholder rights are defined by the jurisdiction based on the location of the water source and include an estimated volume of use based on the number of landholders with adjacent water sources.

As the Maranoa-Balonne-Condamine subregion spans the Queensland–NSW border, data from both states have been included in the Maranoa-Balonne-Condamine economic asset list, however it is important to note that due to the location of the subregion, predominantly the data are from Queensland. Water access entitlements for Queensland are described in different units of measure, depending on the purpose. Some licences specify water access entitlements in hectares per year (an area unit of measure) for irrigation and other licences specify an amount in megalitres per year (a volume unit of measure) for extraction. Consequently, the data for water access entitlements have not been able to be standardised and contain variable volume information. The WAIT database for Queensland 2013 has been included in the analysis separately (Table 11). The 13 elements in the 'Groundwater management zone or area (surface area)' subgroup are from borefields providing information on the class 'Water supply and monitoring infrastructure' rather than individual licences. A further six elements from the 'Surface water management zone or area (surface area)' subgroup and the class 'Water supply and monitoring infrastructure' were also incorporated. Although they do not include volume they show the location of water dependent infrastructure.

In NSW, water access entitlements from groundwater management plans and water sharing plans were also included in the total volumes.

Licensing data were sourced from the NSW Office of Water 2013 and from the Queensland Department of Natural Resources and Mines 2013 to determine economic assets. These datasets are currently not publicly available and were obtained by special request. Consistent with how water licensing information is published under the Commonwealth's *Water Act 2007*, these data will be published in an aggregated form.

Data were obtained for groundwater and surface water access licences, and their corresponding works locations. Data about basic landholder rights were sourced online from the publicly available water sharing plans in NSW (DPI, 2014). No equivalent for basic landholder rights was obtained for Queensland as volumes were either not published or not currently available at the time of obtaining the data.

In Queensland, the Queensland *Water Act 2000* provides the legislative framework for the allocation and management of Queensland's water resources (NWC, 2014). This legislation has the following implications for the data:

- take of surface water does not require an entitlement for stock and domestic purposes and other low-risk activities prescribed in the *Water Regulation 2002*
- take of groundwater does not require an entitlement unless it is in a water resource plan, Wild River Declaration, moratorium area or the *Water Regulation 2002* states that there is one.

This means that there may be many economic elements without an entitlement volume attached and there may be many not included in the analysis.

In collating the economic elements, surface water and groundwater access entitlements that were not 'current' or 'active' as at 2013 were disregarded. As basic water rights do not have to be renewed on a frequent basis, it is unknown if all the basic water rights are in use. Consequently volumes of basic water rights may be overestimated. The works (locations) data were linked to the particular surface water or groundwater access entitlements. A count was added to show how many works are associated with each water access entitlement. The volume of the water access entitlement was then equally split among the works to ensure that the entitlement volumes were not double-counted. A geographic information system (GIS) layer was derived using the spatial coordinates provided with the licensed work approvals. This spatial layer was clipped with the PAE for the Maranoa-Balonne-Condamine subregion so that only works and associated licences within the PAE were included

The class of asset (as described in the companion submethodology M02 (as listed in Table 1) for compiling water-dependent assets (Mount et al., 2015)) was aggregated using the NSW Office of Water 'purpose' field, which records the purpose for which water is used. For Queensland, an equivalent field 'AuthorisedPurposeList' was used. Any purpose that was listed as 'Domestic' and/or 'Stock' was included in the class 'Basic water right'. Where 'Stock' and/or 'Domestic' was listed with another licensed purpose, it was listed as a 'Water access right'. 'Water access right' was based on anything that had an extractive use purpose such as, for example, commercial, irrigation, farming, industrial or dewatering.

Each water access entitlement can have one or multiple works associated with it, where the works is the location where the water is extracted through a bore or pump. It was assumed that each of the works associated with a licence extracts an equal share of the volume. For example, if there is one groundwater access entitlement of 80 ML/year that has four works (bores) associated with it, then 20 ML/year is assigned to each of those works. It is not possible to validate this assumption. It is possible that most extraction could occur at a single works location and is not evenly distributed across all works associated with the licence. However, entitlement data does not allow us to resolve volume down to discrete location.

Groundwater elements that were not classified as a basic water right or a water access right were classed as 'null'. These include test bores, bores installed for groundwater remediation, exploratory bores, exploratory research and monitoring bores. These elements are 'flagged' in the asset database and are not included in the water-dependent asset register.

1.3.1.2.3 Sociocultural assets

Sociocultural assets were sourced from the Australian Heritage Database (Department of the Environment, 2013), which includes assets sourced from the World Heritage List, National Heritage List and the Register of the National Estate (Table 6). Meetings have been held with Indigenous knowledge holders in the Maranoa-Balonne-Condamine subregion to gain further understanding of Indigenous cultural water-dependent assets. Where possible and appropriate, and with the agreement of Indigenous knowledge holders, these additional Indigenous water-related values will be published in a separate report. Identified assets will be incorporated into an updated water-dependent asset register and/or incorporated into later technical products.

Table 6 Data sources for sociocultural assets in the Maranoa-Balonne-Condamine subregion

Dataset[a]	Organisation	Dataset citation	Elements	Assets (asset list)
World Heritage List (WHL)	Department of the Environment	Australian Government Department of the Environment (Dataset 25)	1	1
National Heritage List (NHL)	Department of the Environment	Australian Government Department of the Environment (Dataset 26)	2	2
Commonwealth Heritage List (CHL)	Department of the Environment	Australian Government Department of the Environment (Dataset 27)	0	0
Register of the National Estate (RNE)	Department of the Environment	Australian Government Department of the Environment (Dataset 28)	124	124
Total			**127**	**127**

[a]The asset database (Bioregional Assessment Programme, Dataset 1) is a collation of all these source datasets. Some assets may be captured in multiple databases. These replicates are retained in the asset register as boundaries may differ between databases.

1.3.1.3 Determining the preliminary assessment extent

The impacts of coal resource development in the Maranoa-Balonne-Condamine subregion could either extend beyond the subregion boundary, or not extend as far as the subregion boundary due to remoteness from development. Defining the preliminary assessment extent (PAE) allows the asset register to be compiled in parallel with the assessment of the resource (Sander et al., 2014) and the development of the coal resource development pathway (see pending companion product 2.3 for the Maranoa-Balonne-Condamine subregion as listed in Table 2) for the Maranoa-Balonne-Condamine subregion.

The following were considered in developing the PAE for the Maranoa-Balonne-Condamine subregion:

- the location of CSG and large coal mining developments
- modelling results from the Office of Groundwater Impact Assessment (OGIA; Queensland Water Commission, 2012)
- groundwater management units
- streamflow characteristics.

The Maranoa-Balonne-Condamine PAE (Figure 3) is the extent of groundwater and surface water systems that may potentially be impacted by coal resource developments in the subregion.

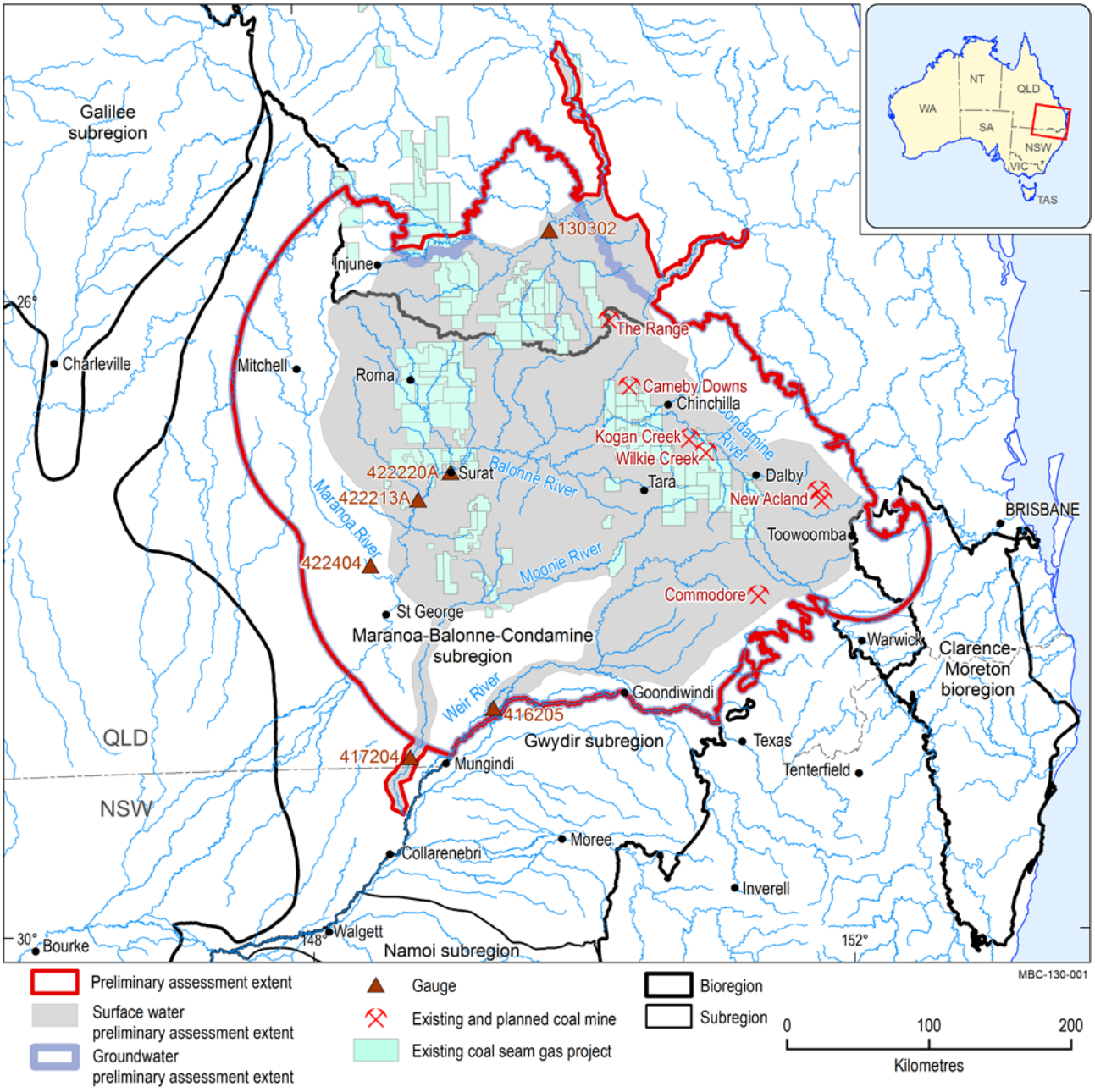

Figure 3 Preliminary assessment extent (PAE) of the Maranoa-Balonne-Condamine subregion

Data: Department of Natural Resources and Mines (Dataset 29 and Dataset 30)

1.3.1.3.1 Groundwater considerations

Predicted water level impacts, reported in the Underground Water Impact Report (UWIR) for the Surat Cumulative Management Area (Queensland Water Commission, 2012), were considered in developing the groundwater PAE. The predicted water level impacts were calculated using a regional groundwater flow model (MODFLOW 2005, Queensland Water Commission, 2012) designed to predict the impacts of groundwater extraction by the petroleum and gas extraction industries within the Queensland portion of the Surat and Bowen basins.

The 95th percentile maximum groundwater drawdown areas for the Walloon Coal Measures, Hutton Sandstone, Precipice Sandstone and Clematis Sandstone hydrogeological units (Queensland Water Commission, 2012) were used to determine the lateral extent of the 1 m drawdown boundary for each geological unit (refer to Figure 21 in companion product 1.1 for the Maranoa-Balonne-Condamine subregion (Welsh et al., 2014)). To ensure all potentially affected assets were included within the PAE, a 100 km buffer was applied to the 1 m drawdown boundary for each hydrogeological unit. The resulting 100 km buffer boundaries were combined and the most laterally extensive boundaries were incorporated into the PAE boundary. The eastern PAE boundary, where it extends into the Clarence-Moreton Basin, was a combination of a 50 km buffer of the 1 m drawdown extent and the outer boundary of the Marburg Sandstone (a lateral equivalent of the Hutton Sandstone).

Significantly, a portion of the 1 m drawdown boundary for both the Walloon Coal Measures and Hutton Sandstone extends north, beyond the Maranoa-Balonne-Condamine subregion boundary toward the Hutton Sandstone recharge areas. The PAE boundary in this area follows the northern extent of the Hutton Sandstone geologic unit, which encompasses the northern extent of the Walloon Coal Measures. Drawdown in both the Hutton Sandstone and the Walloon Coal Measures is a result of extraction within the Maranoa-Balonne-Condamine subregion.

It is unlikely that the units underlying the Hutton Sandstone will be impacted by extraction of groundwater from within the Maranoa-Balonne-Condamine subregion. For example, north of Roma, the modelled impact to water levels in both the Precipice and Clematis sandstones is a result of CSG extraction from the Bandanna Formation of the Bowen Basin in the Fairview and Spring Gully gas fields, which are located outside the subregion. Therefore the 1 m drawdown extents for the Precipice and Clematis sandstones north of Roma were not considered in developing the PAE.

The PAE allows full assessment of impacts to the Hutton Sandstone and shallower aquifers as well as those areas of the Clematis and Precipice sandstones that may be impacted by CSG-related groundwater extraction from within the Maranoa-Balonne-Condamine subregion. Furthermore, in the east, the PAE encompasses current operating (Commodore, New Acland, Kogan Creek and Cameby Downs) and proposed (The Range) coal mines.

1.3.1.3.2 Surface water considerations

The CSG and large coal mining developments in the Maranoa-Balonne-Condamine subregion are mostly at upstream and headwater areas of the Condamine-Balonne, Maranoa, Moonie and Weir rivers. To examine their flow volume and seasonal patterns, data from the following stream gauging stations were analysed: Balonne River at Surat (422220A) and at Weribone (422213A); Maranoa River at Cashmere (422404); Moonie River at Fenton (417204), Weir River at Jericho (416205) and Dawson River at Taroom (130302) (Figure 3). These stations are at the most downstream location in the rivers within the Maranoa-Balonne-Condamine subregion. The following summarises their flow characteristics:

- The Maranoa River at Cashmere on average flows for less than 30% of the time, mostly during November to March. On average, river flow is less than 0.080 m^3/second (6.9 ML/day) for 80% of days.
- The Condamine-Balonne River at Weribone and Surat gauging stations on average flows for about 75% and 60% of the time, respectively. The median daily flow is about 1 m^3/second (86.4 ML/day) and 0.35 m^3/second (30.24 ML/day) respectively.
- The Moonie River at Fenton is an ephemeral river flowing for about 40% of the time on average. For some years (e.g. 1971 to 1972, 1974 to 1975, 1990 to 1991) the gauging station recorded zero flow for nine or more months in the year.
- The Weir River is also highly ephemeral, flowing for 32% of the time on average.
- The Dawson River at Taroom flows for more than 95% of the time with median flows of 0.3 m^3/second (226 ML/day). This indicates a baseflow contribution to the flow resulting in a sustained dilution capacity throughout the year (DNRM, 2014).

Most rivers in the Maranoa-Balonne-Condamine subregion are ephemeral, with temporary or intermittent surface water flow that varies between seasons and years. Apart from a few wet months (the wet season in this region is October to April), river flow is zero or close to zero, except for the Dawson River. Therefore any potential discharge from developments to these rivers could have a significant impact on the riparian environment. Since there will be little or no natural streamflow for most days of the year, the quality of released water could potentially be changed by evapoconcentration and mixing with remnant water in the river bed or remnant pools. Current regulations on co-produced water from CSG activities in Queensland aim to strategically manage water and saline waste so that it is used beneficially for new or existing water users, water-dependent industries and/or the environment and firstly avoids, and then minimises and mitigates impacts on environmental values (EHP, 2012).

Dilution, evaporation, seepage, chemical transformation or a combination of these make it difficult to predict how far any effluent water could travel in natural watercourses. Influential factors include the quality and quantity of the release or spillage, existing flow in the receiving waters and the prevailing weather conditions.

A buffer of between 5 and 7 km based on the extent of riparian vegetation from the Dawson, Moonie and Weir rivers was used in defining the spatial extent of possible surface water related impacts.

1.3.1.4 Assessing water dependence

Once assets were compiled into the asset database and checked for inclusion in the PAE, they were assessed for water dependence. While most assets are clearly 'water dependent' (e.g. groundwater bores, rivers and wetlands), there are a number of assets that could be affected but are not as readily identified as being 'water dependent'. Examples of these assets include historical buildings that may be potentially subject to inundation or salinity impacts, or Indigenous sociocultural water-dependent assets that may be more difficult to access.

The water dependency of threatened species habitats, including threatened ecological communities and species listed under the Commonwealth's *Environment and Biodiversity Conservation Act 1999* (EPBC Act) and species and regional ecosystems listed under Queensland's *Nature Conservation Act 1992* (Nature Conservation Act) was assessed by a review of the habitat requirements for each species. It is important to emphasise that BAs consider the potential impact to the habitat of species not the individual species per se. However, it is necessary to present species-based information to best reflect the available data, but implicit in this is the focus on habitat. In most cases, profiles from the Species Profile and Threats Database (SPRAT) (Department of the Environment, 2012; Bioregional Assessment Programme, Dataset 10), the Queensland Government's *WetlandInfo* website (Department of Environment and Heritage Protection, 2015) or Queensland's Department of Environment and Heritage Protection Regional Ecosystem Description Database (Queensland Herbarium, 2014; Department of Science, Information Technology, Innovation and the Arts, Dataset 13) were examined. The paucity of detailed descriptions of regional ecosystems listed under the Nature Conservation Act required additional spatial information for determining their water dependence. This was done by spatially intersecting the regional ecosystems' habitat with the groundwater-dependent ecosystems' (GDE) habitat derived from the *National atlas of groundwater dependent ecosystems* (Bureau of Meteorology, 2012; Bureau of Meteorology, Dataset 6). Only those GDEs (including those that rely on both surface and subsurface expression of groundwater) derived from previous field work or possessing a high or moderate potential for groundwater dependency were used in this analysis (Bureau of Meteorology, Dataset 6). If the spatial overlap of the habitat with the GDE was less than 10 % and there was no additional evidence for water dependency of the habitat the asset was not included in the asset register. The water dependence of each species-related asset was ranked as being 'likely', 'possible', 'unlikely' or 'unsure'. Assets listed as 'likely' are those with a clear and demonstrated link to aquatic ecosystems (e.g. aquatic species). Assets listed as 'possible' may have some overlap with habitats that may be water dependent (e.g. species that may visit riparian areas). Assets listed as 'unlikely' show no evidence of surface water or groundwater dependence in habitat requirements. Where assets were recorded as 'unsure', the precautionary principle was applied and the asset retained for inclusion in the water-dependent asset register.

Assets classed as 'Surface water features' or 'Groundwater features', or assets with names that include the terms waterhole, lake, lagoon, soak, etc., were assumed to be water dependent. Similarly, assets sourced from the *National atlas of groundwater dependent ecosystems* (Bureau of Meteorology, 2012; Bureau of Meteorology, Dataset 6) with a known groundwater dependency (derived from previous field work or possessing a high or moderate potential for groundwater dependency) were assumed to be water dependent (attributed as 'likely'). Assets with a moderate potential for groundwater dependency were attributed as 'possible' and also included in the

register. Where assets were identified as having a low probability for groundwater dependence, it was assumed that these assets were unlikely to be groundwater dependent and were not included in the water-dependent asset register. The mapping of GDEs done by the Queensland Government (DSITIA, 2012) used more extensive data sources and validation than the *National atlas of groundwater dependent ecosystems*, thus all groundwater-dependent ecosystem assets provided from the Queensland Government (Queensland Department of Science, Information Technology, Innovation and the Arts, Dataset 16) are included in the water-dependent asset register.

For many assets, water dependency is not obvious, such as national parks, nature reserves or historical buildings. Therefore, a preliminary assessment of the water dependency was made using multiple lines of evidence. Water-dependent assets were those that met at least one or more of the following criteria:

- intersected with existing Queensland floodplain mapping (Geoscience Australia, Dataset 31; Office of Environment and Heritage, Department of Premier and Cabinet, Dataset 32)
- contained wetlands or other surface water features identified in existing Queensland wetland mapping (Queensland Department of Environment and Heritage Protection, Dataset 33; NSW Department of Environment, Climate Change and Water, Dataset 34; Department of Sustainability, Environment, Water, Population and Communities, Dataset 35)
- occurred over shallow groundwater, where shallow groundwater is defined as regions where depth to groundwater is less than 10 m (Geoscience Australia, Dataset 36)
- occurred in regions where depth to groundwater ranged between 10 to 20 m. This second criterion considered those assets that may access groundwater intermittently (Geoscience Australia, Dataset 36)
- contained water-dependent assets already listed in the water-dependent asset register.

Each of these criteria were assessed by inspecting assets against the existing data sources. In some cases, assets extended beyond the boundary of the PAE. If assets intersected with floodplains, wetlands or the depth-to-groundwater criteria outside of the PAE, then this was noted and these assets were deemed not to be water dependent for the purposes of the BA. Assets attributed as 'likely' or 'possible' were included in the BA and flagged as 'On' with respect to water dependency in the asset database. Assets attributed as 'unlikely' were flagged as 'Off' in the asset database and are not included in the preliminary water-dependent asset register.

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Dataset 13 Department of Science, Information Technology, Innovation and the Arts (2012) Queensland wetland data version 3 - wetland points. Bioregional Assessment Source Dataset. Viewed 19 April 2015, http://data.bioregionalassessments.gov.au/dataset/83653fbd-ed5a-4ead-95fe-166038e620af.

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Dataset 23 Bioregional Assessment Programme (2014) NSW Office of Water Groundwater licences extract linked to spatial locations NIC v3 20140313. Bioregional Assessment Derived Dataset. Viewed 27 April 2015, http://data.bioregionalassessments.gov.au/dataset/b0ea1363-4603-463a-b82e-fc586db6b967.

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Dataset 25 Australian Government Department of the Environment (2013) Australia World Heritage Areas. Bioregional Assessment Source Dataset. Viewed 19 April 2015, http://data.bioregionalassessments.gov.au/dataset/4927789b-7ba7-4a77-b6fc-be1b29b6590c.

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Dataset 33 Queensland Department of Environment and Heritage Protection (2014) Wetland protection area - high ecological significance wetland. Bioregional Assessment Source Dataset. Viewed 6 March 2015, http://data.bioregionalassessments.gov.au/dataset/3ea44427-c4c5-440e-87d7-9393ba7c33fb.

Dataset 34 NSW Department of Environment, Climate Change and Water (DECCW) (2010) NSW Wetlands. Bioregional Assessment Source Dataset. Viewed 6 March 2015, http://data.bioregionalassessments.gov.au/dataset/90476e12-77a2-4970-a0be-942eeb84e95e.

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1.3.2 Ecological assets

Summary

The water-dependent asset register for the preliminary assessment extent (PAE) of the Maranoa-Balonne-Condamine subregion contains 2200 individual ecological assets. These assets were selected from a total of 2412 ecological assets listed in the assets database. The register consists of 489 assets within the 'Vegetation' subgroup, 23 within the 'Groundwater feature (subsurface)' subgroup and 1688 within the 'Surface water feature' subgroup. All surface water features located within the PAE (1688) are included in the register including several spring complexes, wetlands and lagoons. A total of 23 alluvial aquifers, geological formations, recharge areas and groundwater management areas are included in the water-dependent asset register. The asset register includes the potential spatial habitat distribution of eight threatened ecological communities and 45 species listed under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and 23 species listed under Queensland's *Nature Conservation Act 1992* (Nature Conservation Act). Six wetlands listed in *A directory of important wetlands in Australia* (Environment Australia, 2001; Australian Government of the Environment, Dataset 2), including the Balonne River Floodplain, are also included in the register. Among the 73 water-dependent assets derived from protected and riparian areas, 17 are national parks and three are *Important Bird Areas* (IBAs) (Birdlife Australia, 2014; Birds Australia, Dataset 3). The register contains 313 assets classed as 'Groundwater-dependent ecosystems' of which 46 rely on the subsurface expression of groundwater and 267 rely on the surface expression of groundwater (Bureau of Meteorology, 2012; DSITIA, 2012; Bureau of Meteorology, Dataset 4).

1.3.2.1 Description

The total number of registered ecological water-dependent assets in the PAE of the Maranoa-Balonne-Condamine subregion is 2200 (from a total of 2412 assets listed in the database), including 23 in the 'Groundwater feature' subgroup, 1688 in the 'Surface water feature subgroup' and 489 in the 'Vegetation' subgroup (Table 7). A total of 1688 surface water features (including assets classed as 'River or stream reach, tributary, anabranch or bend', 'Lake, reservoir, lagoon or estuary', 'Waterhole, pool, rock pool or billabong', 'Wetland, wetland complex or swamp' and 'Floodplain') and all 23 groundwater features (including 'Aquifer', 'Geological feature' and 'Alluvium or stratum') are assumed to be water dependent and are included in the water-dependent asset register. The total assets assessed for water dependency in the 'Vegetation' subgroup consist of 290 habitats (potential species distributions and protected areas), 348 groundwater-dependent ecosystems (GDEs) and 20 riparian vegetation assets. Overall, 90% of the GDEs and 54% of the habitat assets are classified as water dependent. Table 7 provides a breakdown of the relevant subgroups and classes of assets and their inclusion in the water-dependent asset register.

Table 7 Summary of ecological assets within the preliminary assessment extent (PAE) of the Maranoa-Balonne-Condamine subregion

Subgroup	Class	Not in water-dependent asset register	In water-dependent asset register	Total assets (asset list)
Groundwater feature (subsurface)	Aquifer, geological feature, alluvium or stratum	3	23	26
	Groundwater total	**3**	**23**	**26**
Surface water feature	Floodplain	0	6	6
	Lake, reservoir, lagoon or estuary	0	55	55
	Marsh, sedgeland, bog, spring or soak	0	267	267
	River or stream reach, tributary, anabranch or bend	39	695	734
	Waterhole, pool, rock pool or billabong	1	554	555
	Wetland, wetland complex or swamp	0	111	111
	Surface water total	**40**	**1688**	**1728**
Vegetation	Groundwater-dependent ecosystem	35	313	348
	Habitat (potential species distribution)	134	156	290
	Riparian vegetation	0	20	20
	Vegetation total	**169**	**489**	**658**
Total		**212**	**2200**	**2412**

Data: Bioregional Assessment Programme (Dataset 1)

1.3.2.1.1 Groundwater features

The 23 groundwater features in the water-dependent asset register consist of geological features, alluvium and aquifers (Table 7). All aquifers are assumed to be water dependent and geological features and alluvium are deemed to be water dependent based on their spatial overlap with one or more criteria (see Section 1.3.1.4). These include five Great Artesian Basin recharge areas, the Riverine Plain and upland alluvium groundwater flow systems, the Mulgildie and Stuart River groundwater management areas and several sandstone, alluvial and volcanic geological features including the Walloon Coal Measures and Wandoan formation. Three groundwater features are not included in the register because on closer inspection they did not occur within the PAE of the Maranoa-Balonne-Condamine subregion (Table 7).

1.3.2.1.2 Surface water features

The number of ecological assets associated with the 'Surface water feature' subgroup, occurring in the PAE of the Maranoa-Balonne-Condamine subregion, is listed in Table 7. Forty surface water features are excluded from the register because on closer inspection they did not occur within the PAE of the Maranoa-Balonne-Condamine subregion (Table 7). All assets that occur in the PAE are assumed to be water dependent. There is a higher density of stream networks and therefore surface water features and 'Marsh, sedgeland, bog, Spring or soak' clustered around the northern and eastern portions of the PAE compared to other parts of the PAE (Figure 4). Among the 111

assets within the 'Wetland, wetland complex or swamp' class, six wetlands are listed in *A directory of important wetlands in Australia* (DIWA) (Environment Australia, 2001; Australian Government Department of the Environment, Dataset 2) and include the Balonne River Floodplain, Boggomoss Springs, Dalrymple and Blackfellow Creeks, Lake Broadwater, Palm Tree and Robinson Creeks and The Gums Lagoon (Figure 4).

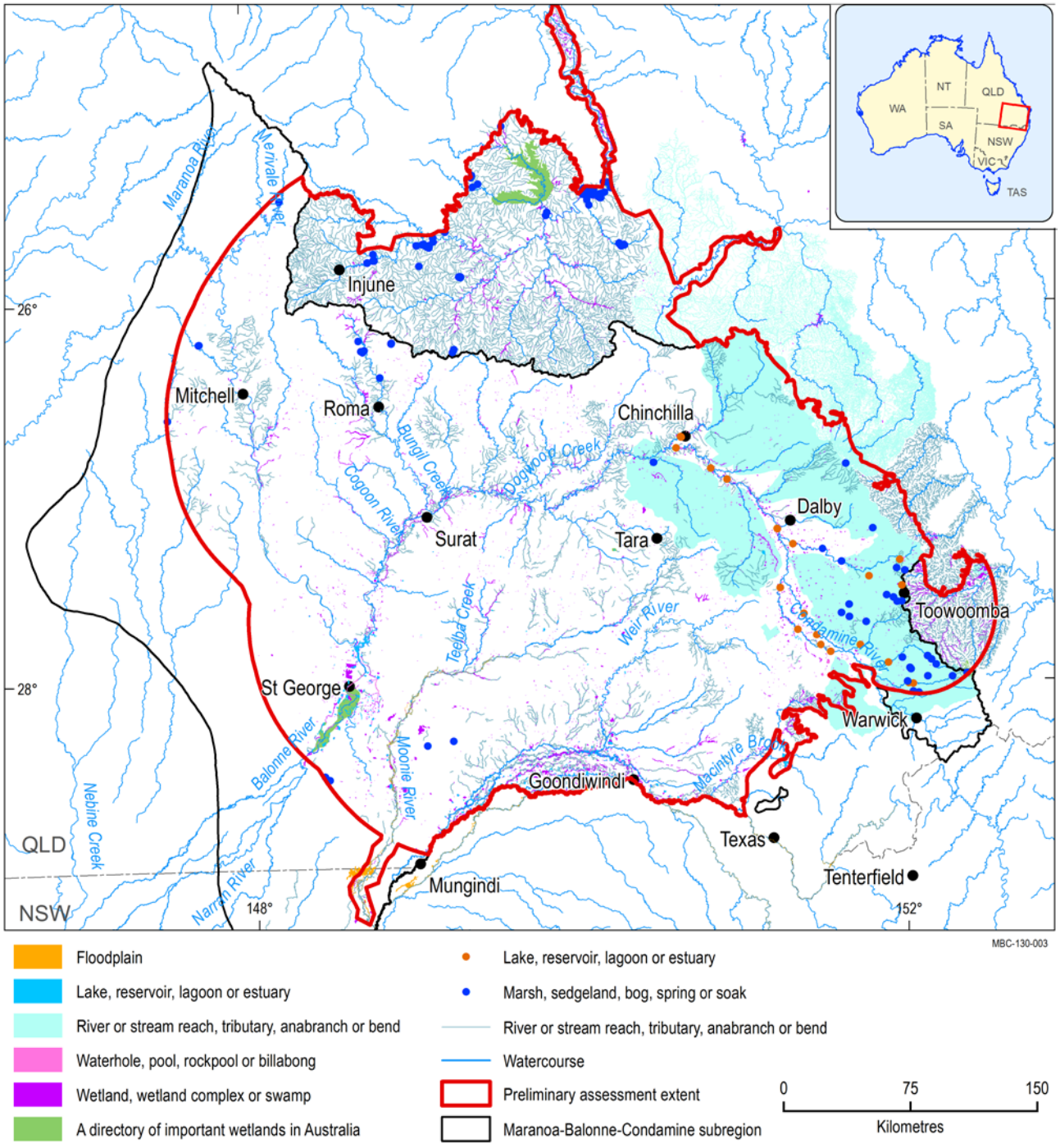

Figure 4 Surface water features in Maranoa-Balonne-Condamine subregion preliminary asset extent (PAE)

A directory of important wetlands in Australia is a subset of the 'Wetland, wetland complex or swamp' class

Data: Bioregional Assessment Programme (Dataset 1), Australian Government Department of the Environment (Dataset 2)

1.3.2.1.3 Vegetation

The asset database for the PAE of the Maranoa-Balonne-Condamine subregion contains a total of 658 assets within the 'Vegetation' subgroup of which a total of 489 assets are identified as water dependent.

Ecological communities

The PAE for the Maranoa-Balonne-Condamine subregion includes the potential habitat distribution of eight threatened ecological communities listed under the EPBC Act (Table 8). All eight of these communities demonstrate water dependency, in most cases are associated with alluvium (river and creek flats) as well as upland sites or are a dominant floodplain community (Figure 5 and Table 8). Furthermore, the community of native species dependent on natural discharge of groundwater from the Great Artesian Basin clearly demonstrates water dependency as it occurs in groundwater discharge areas within the PAE (Table 8).

There are 42 regional ecosystems listed as threatened under the Nature Conservation Act including several classified within those threatened ecological communities listed in the EPBC Act (e.g. Brigalow *Acacia harpophylla* dominant and co-dominant). The proportion of spatial overlap between the regional ecosystem and the surface and subsurface GDE layers (Bureau of Meteorology, 2012; Bureau of Meteorology, Dataset 4) was used to characterise the water dependency of many communities because of the lack of sufficient detail on habitat requirements for many of the regional ecosystems (see Section 1.3.1.4 for further details). Of the 42 regional ecosystems identified within the PAE, 27 are included in the water-dependent asset register including several communities dominated by or in association with Brigalow (*Acacia harpophylla*).

Table 8 Threatened ecological communities listed under the Commonwealth's Environment Protection and Biodiversity Conservation Act 1999 within the preliminary assessment extent (PAE) of the Maranoa-Balonne-Condamine subregion

The name of the threatened ecological community in the figure legend has been shortened (Interim Biogeographic Regionalisation of Australia (IBRA) subregion reference removed).

Community	Status	Decision
Brigalow (*Acacia harpophylla* dominant and co-dominant)	Endangered	Community demonstrates water dependency, associated with alluvium (river and creek flats) as well as upland sites
Coolibah-black box woodlands	Endangered	Community demonstrates water dependency, is a dominant floodplain vegetation community
Natural grasslands on basalt and fine-textured alluvial plains	Critically endangered	Community demonstrates water dependency, associated with alluvium (river and creek flats) as well as upland sites
Semi-evergreen vine thickets	Endangered	Community demonstrates water dependency, associated with alluvium (river and creek flats) as well as upland sites
Swamp Tea-tree (*Melaleuca irbyana*)	Critically endangered	Community demonstrates water dependency, associated with alluvium (river and creek flats) as well as upland sites
The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin	Endangered	Community demonstrates water dependency, associated with groundwater discharge areas
Weeping Myall Woodlands	Endangered	Community demonstrates water dependency, associated with alluvium (river and creek flats) as well as upland sites
White box-Yellow box-Blakely's red gum grassy woodland and derived native grassland	Critically endangered	Community demonstrates water dependency, associated with alluvium (river and creek flats) as well as upland sites

Data: Australian Government Department of the Environment (Dataset 5)

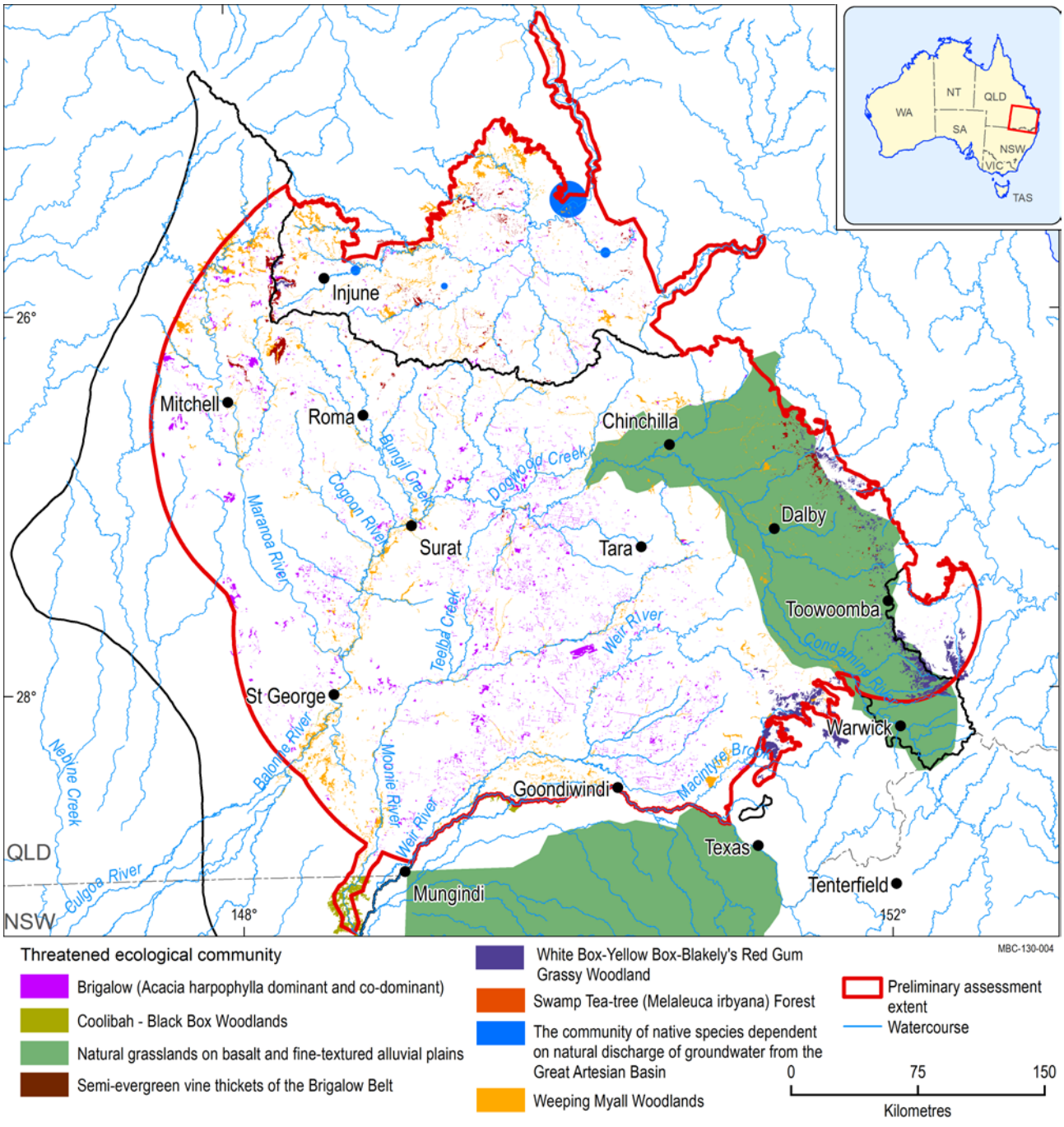

Figure 5 The eight threatened ecological communities listed in the Commonwealth's Environment and Biodiversity Conservation Act *1999* included in the water-dependent asset register

Data: Australian Government Department of the Environment (Dataset 5)

Species habitats

The PAE for the Maranoa-Balonne-Condamine subregion includes the potential spatial habitat distribution of 99 species listed under the EPBC Act and a further 66 species listed under the Nature Conservation Act. Amongst the 99 EPBC Act-listed species, almost half (22 bird, four mammal, 11 plant, five reptile, one fish, one invertebrate and one amphibian) are included in the water-dependent asset register (Table 9). Among the 66 species listed under the Nature Conservation Act, 23 are included in the water-dependent asset register including three amphibians, four birds, three mammals, 11 plants and two reptiles (Table 10). The asset under

consideration is the habitat of these species rather than the species per se, hence these assets are listed under the 'Vegetation' subgroup. These species habitats are considered water dependent if there is evidence for any of the following habitat conditions:

- an association with drainage lines
- an association with alluvial and soakage areas
- an association with wetland and/or permanent open water
- a dependency or an association with floodplain or riparian vegetation communities
- an association with mound springs.

The decision not to include species in the register was based on evidence from species profiles and other published material that show that these habitats are almost entirely restricted to grassland, woodland, dry scrub, open forest, heathlands or rainforest vegetation communities or rocky outcrops.

Table 9 Species listed under the Commonwealth's Environment Protection and Biodiversity Conservation Act 1999 within the preliminary assessment extent (PAE) of the Maranoa-Balonne-Condamine subregion determined as potentially water dependent (based on a literature review of habitat requirements)

Although examples of individual species are listed, bioregional assessments consider the potential impact to the habitat of species not individual species per se.
Listing status as of March 2015

Functional group	Asset name[a]	Status	Decision
Amphibian	Fleay's Frog (Mixophyes fleayi)	Endangered	Habitat features consistent with water dependency, associated with alluvium (river and creek flats) as well as upland sites
Bird	Australasian Bittern (Botaurus poiciloptilus)	Endangered	Habitat features consistent with water dependency, species is wetland dependent
	Australian Painted Snipe (Rostratula australis)	Endangered	Habitat features consistent with water dependency, species is wetland dependent
	Cattle Egret (Ardea ibis)	Marine; Migratory	Habitat features consistent with water dependency, species requires permanent water for roosting
	Curlew Sandpiper (Calidris ferruginea)	Marine; Migratory	Habitat features consistent with water dependency, species is wetland dependent
	Eastern Bristlebird (Dasyornis brachypterus)	Endangered	Habitat features consistent with water dependency, associated with lowland habitats and wetlands
	Fork-tailed Swift (Apus pacificus)	Marine; Migratory	Habitat features consistent with water dependency, associated with alluvium (river and creek flats) as well as upland sites
	Great Egret (Ardea alba)	Marine; Migratory	Habitat features consistent with water dependency, species is wetland dependent
	Latham's Snipe (Gallinago hardwickii)	Marine; Migratory	Habitat features consistent with water dependency, species is wetland dependent

Functional group	Asset name[a]	Status	Decision
	Marsh Sandpiper (Tringa stagnatilis)	Marine; Migratory	Habitat features consistent with water dependency, species is wetland dependent
	Osprey (Pandion haliaetus)	Marine; Migratory	Habitat features consistent with water dependency, species is wetland dependent
	Red-capped Plover (Charadrius ruficapillus)	Marine	Habitat features consistent with water dependency, species is wetland dependent
	Red-necked Avocet (Recurvirostra novaehollandiae)	Marine	Habitat features consistent with water dependency, species is wetland dependent
	Red-necked Stint (Calidris ruficollis)	Marine; Migratory	Habitat features consistent with water dependency, species is wetland dependent
	Red Goshawk (Erythrotriorchis radiatus)	Vulnerable	Habitat features consistent with water dependency, associated with alluvium (river and creek flats) as well as upland sites
	Regent Honeyeater (Anthochaera phrygia)	Endangered	Habitat features consistent with water dependency, associated with groundwater-dependent riparian trees
	Satin Flycatcher (Myiagra cyanoleuca)	Marine; Migratory	Habitat features consistent with water dependency, associated with alluvium (river and creek flats) as well as upland sites
	Sharp-tailed Sandpiper (Calidris acuminata)	Marine; Migratory	Habitat features consistent with water dependency, species is wetland dependent
	Spectacled Monarch (Monarcha trivirgatus)	Marine; Migratory	Habitat features consistent with water dependency, associated with riparian and alluvial sites
	Star Finch (eastern) (Neochmia ruficauda ruficauda)	Endangered	Habitat features consistent with water dependency, associated with groundwater-dependent riparian trees
	Swift Parrot (Lathamus discolor)	Endangered and Marine	Habitat features consistent with water dependency, associated with groundwater-dependent riparian trees
	White-bellied Sea-Eagle (Haliaeetus leucogaster)	Marine; Migratory	Habitat features consistent with demonstrated water dependency and are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea)
	Wood Sandpiper (Tringa glareola)	Marine; Migratory	Habitat features consistent with water dependency, species is wetland dependent
Fish	Australian Lungfish (Neoceratodus forsteri)	Vulnerable	Habitat features consistent with water dependency, species is wetland dependent
Invertebrate	Boggomoss Snail (Adclarkia dawsonensis)	Vulnerable	Habitat features consistent with water dependency, associated with riparian and alluvial sites

Functional group	Asset name[a]	Status	Decision
Mammal	Grey-headed Flying-fox (Pteropus poliocephalus)	Vulnerable	Habitat features consistent with water dependency, associated with alluvium (river and creek flats) as well as upland sites
	Hastings River Mouse (Pseudomys oralis)	Endangered	Habitat features consistent with water dependency, associated with alluvium (river and creek flats) as well as upland sites
	Koala (Phascolarctos cinereus (combined populations of Queensland, NSW and the ACT))	Vulnerable	Habitat features consistent with water dependency, associated with groundwater-dependent riparian trees
	Spot-tailed Quoll (Dasyurus maculatus maculatus (SE mainland population))	Endangered	Habitat features consistent with water dependency, associated with groundwater-dependent riparian trees
Plant	Belson's Panic (Homopholis belsonii)	Vulnerable	Habitat features consistent with water dependency, prefers alluvial areas and/or drainage lines
	Finger Panic Grass (Digitaria porrecta)	Restricted	Habitat features consistent with water dependency, prefers dry to wet soils
	Hairy-joint Grass (Arthraxon hispidus)	Vulnerable	Habitat features consistent with water dependency, associated with alluvium (river and creek flats) as well as upland sites
	Lloyd's Olive (Notelaea lloydii)	Vulnerable	Habitat features consistent with water dependency, prefers dry to wet soils
	Microcarpaea agonis	Endangered	Habitat features consistent with water dependency, associated with lowland habitats and wetlands
	Minute Orchid (Taeniophyllum muelleri)	Not listed	Habitat features consistent with water dependency, associated with riparian and alluvial sites
	Salt Pipewort (Eriocaulon carsonii)	Endangered	Habitat features consistent with water dependency, associated with mound springs
	Siah's Backbone (Streblus pendulinus)	Endangered	Habitat features consistent with water dependency, associated with riparian and alluvial sites
	Slender Darling-pea (Swainsona murrayana)	Vulnerable	Habitat features consistent with water dependency, associated with riparian and alluvial sites
	Stream Clematis (Clematis fawcettii)	Vulnerable	Habitat features consistent with water dependency, associated with riparian and alluvial sites
	Wandering Pepper-cress (Lepidium peregrinum)	Endangered	Habitat features consistent with water dependency, associated with riparian and alluvial sites
Reptile	Collared Delma (Delma torquata)	Vulnerable	Habitat features consistent with water dependency, associated with alluvium (river and creek flats) as well as upland sites

Functional group	Asset name[a]	Status	Decision
	Dunmall's Snake (Furina dunmalli)	Vulnerable	Habitat features consistent with water dependency, associated with alluvium (river and creek flats) as well as upland sites
	Five-clawed Worm-skink (Anomalopus mackayi)	Vulnerable	Habitat features consistent with demonstrated water dependency, associated with floodplain coolibah / black box vegetation
	Ornamental Snake (Denisonia maculata)	Vulnerable	Habitat features consistent with demonstrated water dependency, associated with floodplain coolibah / black box vegetation
	Yakka Skink (Egernia rugosa)	Vulnerable	Habitat features consistent with water dependency, associated with alluvium (river and creek flats) as well as upland sites

Data: Bioregional Assessment Programme (Dataset 6)
[a]Punctuation and typography appear as used in the asset database.

Table 10 Species listed under Queensland's *Nature Conservation Act 1992* within the preliminary assessment extent (PAE) of the Maranoa-Balonne-Condamine subregion determined as potentially water dependent (based on a literature review of habitat requirements)

Although examples of individual species are listed, bioregional assessments consider the potential impact to the habitat of species not individual species per se.
Listing status as of March 2015

Functional group	Asset name[a]	Status	Decision
Amphibian	Adelotus brevis	Vulnerable	Habitat features consistent with water dependency, associated with riparian and alluvial sites
	Giant Barred Frog, Southern Barred Frog (Mixophyes iteratus)	Endangered	Habitat features consistent with water dependency, associated with riparian and alluvial sites
	Litoria pearsoniana	Vulnerable	Habitat features consistent with water dependency, associated with riparian and alluvial sites
Bird	Chalinolobus dwyeri	Vulnerable	Habitat features consistent with water dependency, associated with alluvium (river and creek flats) as well as upland sites
	Grantiella picta	Vulnerable	Habitat features consistent with water dependency, associated with alluvium (river and creek flats) as well as upland sites
	Lophochroa leadbeateri	Vulnerable	Habitat features consistent with water dependency, associated with alluvium (river and creek flats) as well as upland sites
	Poephila cincta cincta	Endangered	Habitat features consistent with water dependency, associated with alluvium (river and creek flats) as well as upland sites
Mammal	Ball Nut, Possum Nut, Big Nut, Beefwood (Floydia praealta)	Vulnerable	Habitat features consistent with water dependency, associated with riparian and alluvial sites
	Dasyurus maculatus maculatus	Vulnerable	Habitat features consistent with water dependency, associated with groundwater-dependent riparian trees

Functional group	Asset name[a]	Status	Decision
	Phascolarctos cinereus	Not listed	Habitat features consistent with water dependency, associated with alluvium (river and creek flats) as well as upland sites
Plant	Acacia pedleyi	Vulnerable	Habitat features consistent with water dependency, associated with alluvium (river and creek flats) as well as upland sites
	Corymbia petalophylla	Vulnerable	Habitat features consistent with water dependency, associated with alluvium (river and creek flats) as well as upland sites
	Eucalyptus dunnii	Near Threatened	Habitat features consistent with water dependency, associated with alluvium (river and creek flats) as well as upland sites
	Fontainea venosa	Vulnerable	Habitat features consistent with water dependency, associated with riparian and alluvial sites
	Leptospermum oreophilum	Vulnerable	Not enough habitat information to assess
	Lesser Swamp-orchid (Phaius australis)	Endangered	Habitat features consistent with water dependency, associated with riparian and alluvial sites
	Melaleuca irbyana	Endangered	Community demonstrates water dependency, intersects with maximum flood extent
	Melaleuca williamsii subsp fletcheri	Vulnerable	Habitat features consistent with water dependency, associated with riparian and alluvial sites
	Picris barbarorum	Vulnerable	Not enough habitat information to assess
	Ricinocarpos speciosus	Vulnerable	Habitat features consistent with water dependency, associated with riparian and alluvial sites
	Samadera bidwillii	Vulnerable	Habitat features consistent with water dependency, associated with alluvium (river and creek flats) as well as upland sites
Reptile	Hemiaspis damelii	Endangered	Habitat features consistent with water dependency, associated with riparian and alluvial sites
	Tympanocryptis cf tetraporophora	Endangered	Habitat features consistent with water dependency, associated with alluvium (river and creek flats) as well as upland sites

Data: Bioregional Assessment Programme (Dataset 1)
[a]Punctuation and typography appear as used in the asset database.

Protected and riparian areas

Of the remaining 95 assets in the 'Vegetation' subgroup classed as 'Habitat (potential species distribution)' and 'Riparian vegetation' classes, 73 are considered water dependent (Table 11), comprising:

- 50 reserves and parks (Collaborative Australian Protected Area Database (CAPAD) (Australian Government Department of the Environment, Dataset 7) and Water Assessment Information Tool database (WAIT) (Australian Government Department of the Environment, Dataset 8, Dataset 9))
- three bird habitats (Important Bird Areas (Birdlife Australia, 2014) (Birds Australia, Dataset 3))
- 20 riparian vegetation (Water Assessment Information Tool database (WAIT) (Australian Government Department of the Environment, Dataset 8) and Key Environmental Asset (KEA) (Murray-Darling Basin Authority, Dataset 10)).

Those assets that satisfy the water-dependent criteria outlined in Section 1.3.1.4 are included in the water-dependent asset register. Of these 95 assets in the database, 22 are not considered water dependent and are excluded from the water-dependent asset register.

Table 11 Water-dependent assets from protected areas and rational for inclusion in the water-dependent asset register

Source	Asset name[a]	Decision
Collaborative Australian Protected Area Database	Alton National Park	Contains assets identified as water dependent
	Auburn River National Park	Intersects with Queensland floodplain mapping and contains assets identified as water dependent
	Bendidee National Park	Contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Boggomoss Nature Refuge	Contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Bowman Park Koala Nature Refuge	Contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Boyneside Nature Refuge	Intersects with Queensland floodplain mapping and contains assets identified as water dependent
	Bunya Mountains National Park	Intersects with Queensland floodplain mapping, contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Calingunee Nature Refuge	Contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Carraba Conservation Park	Intersects with Queensland floodplain mapping, contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Chinchilla Rifle Range Nature Refuge	Intersects with Queensland floodplain mapping and contains assets identified as water dependent

Source	Asset name[a]	Decision
	Coolmunda Conservation Park	Contains assets identified as water dependent
	CR 'George' Telford Nature Refuge	Intersects with Queensland floodplain mapping and contains assets identified as water dependent
	Crows Nest National Park	Intersects with Queensland floodplain mapping, contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Dawson River Conservation Park	Intersects with Queensland floodplain mapping and contains assets identified as water dependent
	Dwyers Scrub Conservation Park	Contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Eversfield Station Nature Refuge	Intersects with Queensland floodplain mapping and contains assets identified as water dependent
	Expedition (Limited Depth) National Park	Intersects with Queensland floodplain mapping, contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Expedition Resources Reserve	Intersects with Queensland floodplain mapping and contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Flagstone Creek Conservation Park	Contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Gatton National Park	Contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Highworth Bend Conservation Park	Intersects with Queensland floodplain mapping and contains assets identified as water dependent
	Kalisha Nature Refuge	Contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Lake Broadwater Conservation Park	Intersects with existing Australian National Aquatic Ecosystems or Queensland wetland mapping and contains assets identified as water dependent
	Lake Broadwater Resources Reserve	Intersects with Queensland floodplain mapping and contains assets identified as water dependent
	Lake Murphy Conservation Park	Intersects with Queensland floodplain mapping, contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Long Grass Nature Refuge	Contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Main Range National Park	Contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Moorabinda Nature Refuge	Intersects with Queensland floodplain mapping, contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Mount Rose Nature Refuge	Contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent

Source	Asset name[a]	Decision
	Myall Park Nature Refuge	Intersects with existing Australian National Aquatic Ecosystems or Queensland wetland mapping, contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Nyalar Miru_gan-ah Nature Refuge	Intersects with existing Australian National Aquatic Ecosystems or Queensland wetland mapping, contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Old Hiddenvale Nature Refuge	Contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Precipice National Park	Intersects with Queensland floodplain mapping and contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Puntdaloo Nature Refuge	Contains assets identified as water dependent
	Red Cap Hill Nature Refuge	Contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Richard Underwood Nature Refuge	Intersects with Queensland floodplain mapping and contains assets identified as water dependent
	Southwood National Park	Intersects with Queensland floodplain mapping, contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Thornton View Nature Refuge	Contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Walker's Wilderness Nature Refuge	Contains assets identified as water dependent
	Willawa Nature Refuge	Intersects with Queensland floodplain mapping and contains assets identified as water dependent
Important Bird Areas	Bunya Mountains & Yarraman Important Bird Area	Intersects with Queensland floodplain mapping, contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Scenic Rim Important Bird Area	Intersects with existing wetland mapping and contains assets identified as water dependent
	Traprock Important Bird Area	Intersects with Queensland floodplain mapping, contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
Water Assessment Information Tool database	Bunya Mountains National Park[b]	Intersects with Queensland floodplain mapping, contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Crows Nest National Park	Intersects with Queensland floodplain mapping, contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Floodplain Veg Aggregate - Condamine - Black Box (EEC Endangered Ecological Community)	Assumed to be water dependent

Source	Asset name[a]	Decision
	Floodplain Veg Aggregate - Moonie - Black Box (EEC Endangered Ecological Community)	Assumed to be water dependent
	Gatton National Park	Contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Lockyer National Park Ravensbourne National Park Lockyer Resources Reserve Lockyer State Forest	Intersects with existing Australian National Aquatic Ecosystems or Queensland wetland mapping, contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	Main Range National Park 1	Contains areas of shallow groundwater less than 10 m and contains assets identified as water dependent
	St Ruths Reserve	Intersects with existing Australian National Aquatic Ecosystems or Queensland wetland mapping and contains assets identified as water dependent
	Western Downs State Forests	Intersects with existing Australian National Aquatic Ecosystems or Queensland wetland mapping and contains assets identified as water dependent
	Riparian habitat[c]	Assumed to be water dependent
Key Environmental Asset (KEA)	Lower Balonne System including the Culgoa, Birrie and Bokhara River systems	Assumed to be water dependent

Data: Australian Government Department of the Environment (Dataset 7, Dataset 8) and Birds Australia (Dataset 3)
[a]Punctuation and typography appear as used in the asset database.
[b]Includes two separate listing for this park
[c]Includes all 19 separate assets named riparian habitat

Groundwater-dependent ecosystems

As stated in Section 1.3.1.4, those GDEs sourced from the *National atlas of groundwater dependent ecosystems* identified from previous studies, or classified as having high or medium potential for groundwater interaction are included in the water-dependent asset register given the inherent uncertainty around GDE mapping in many areas (Bureau of Meteorology, 2012; Bureau of Meteorology, Dataset 4). Additionally, all of the GDEs identified in the Queensland Government GDE mapping (DSITIA, 2012, Dataset 11) are included in the asset register. Of the 66 subsurface GDEs (those that rely on the subsurface presence of groundwater), only 46 were classified as having medium or high potential for groundwater interaction and are included in the water-dependent asset register (Figure 6). Subsurface GDEs can include vegetation communities that interact with a groundwater system beneath the surface. A further 267 of the 282 surface GDEs (those that rely on the surface expression of groundwater) are included in the water-dependent asset register (Figure 7). These GDEs include vegetation communities that are associated with groundwater discharged to the surface as springs or baseflow such as vegetation in fringing waterways or wetlands.

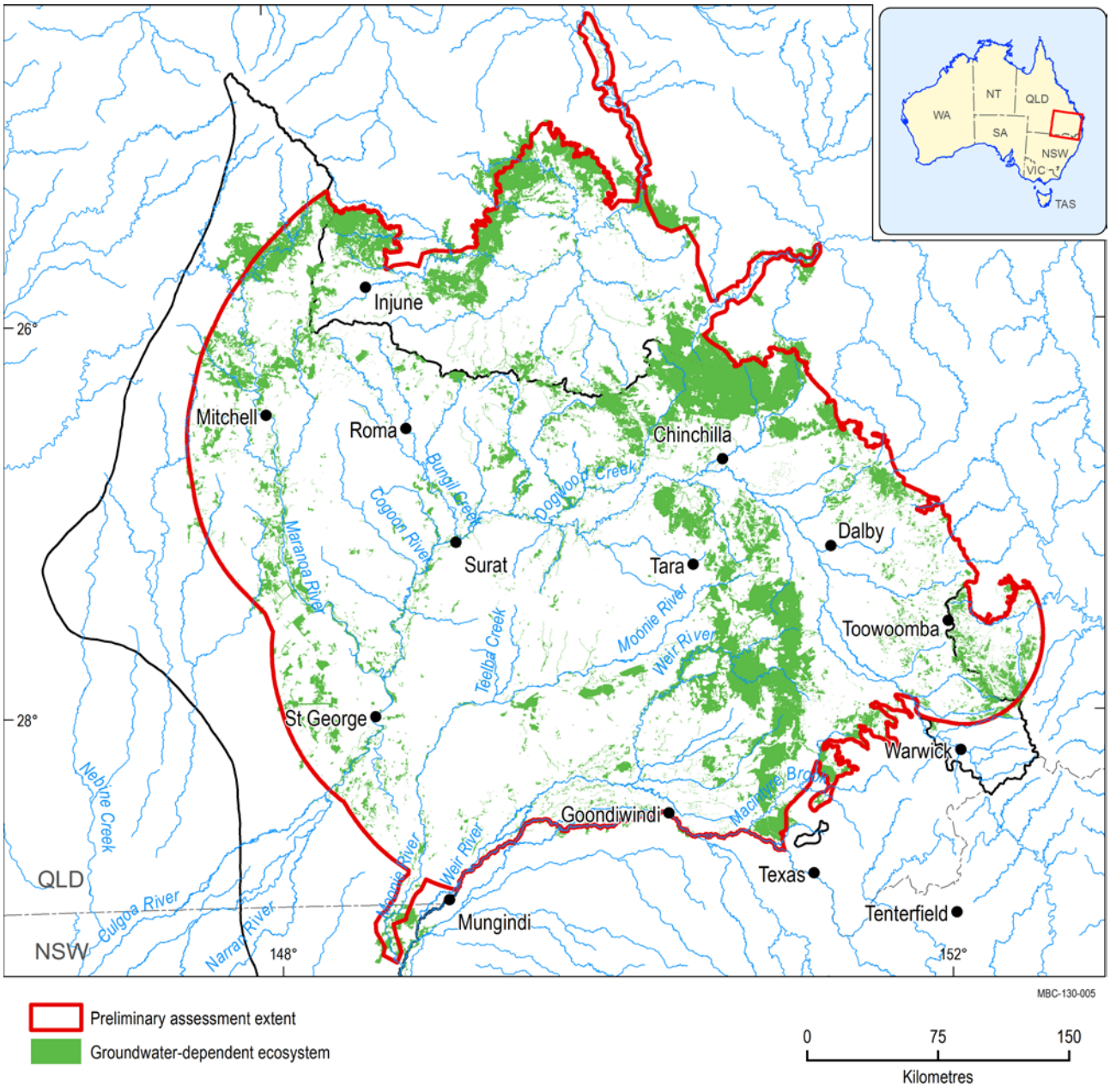

Figure 6 Groundwater-dependent ecosystems that rely on the subsurface expression of groundwater

Data: Bioregional Assessment Programme (Dataset 1), Bureau of Meteorology (Dataset 4)

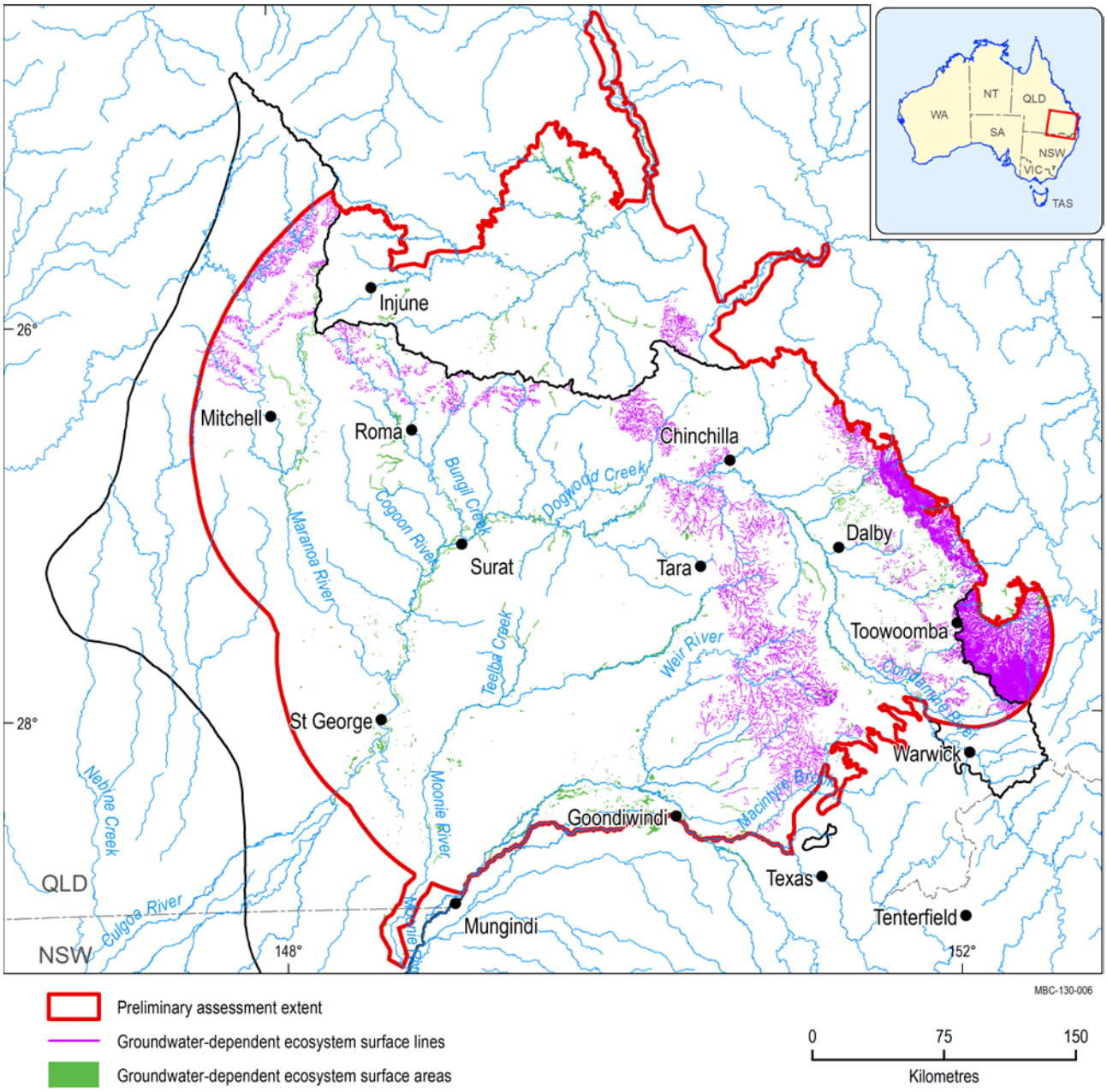

Figure 7 Groundwater-dependent ecosystems that rely on the surface expression of groundwater including surface water channels (surface line features) and vegetation communities (surface area features)

Data: Bioregional Assessment Programme (Dataset 1), Bureau of Meteorology (Dataset 4)

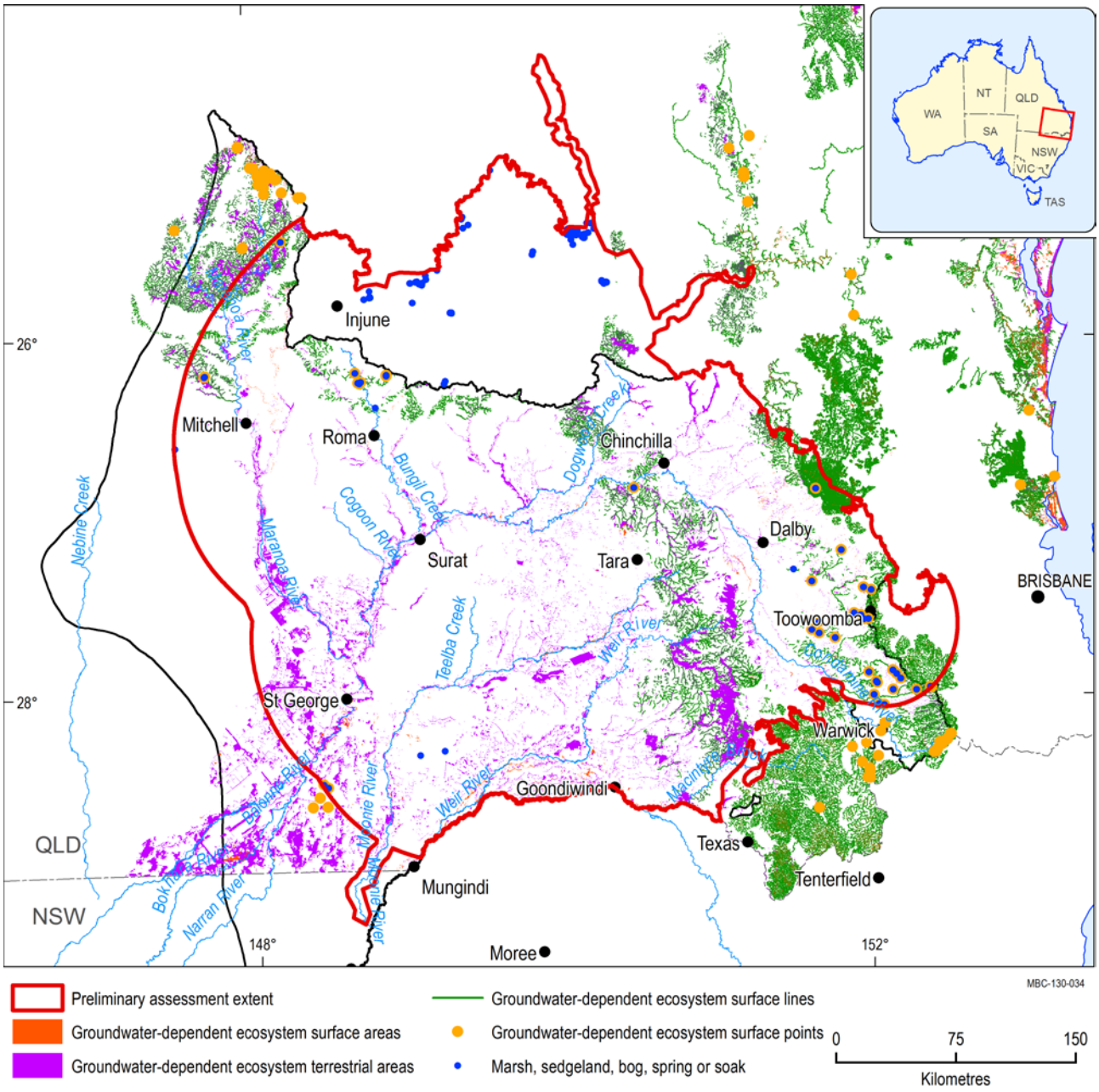

Figure 8 Groundwater-dependent ecosystems based on Queensland mapping including terrestrial and surface areas and surface points (Marsh, sedgeland, bog, spring or soak) and lines (stream segments)

Data: Bioregional Assessment Programme (Dataset 1), Department of Science, Information Technology, Innovation and the Arts (Dataset 11)

1.3.2.2 Gaps

Based on the approach and consultation undertaken to determine assets in the Maranoa-Balonne-Condamine subregion, the Assessment team is not currently aware of any information or knowledge gaps. Feedback from relevant stakeholders at the Assets workshop identified four additional data sources that have been included in the asset list (see Section 1.3.1.2.2 for details).

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1.3.3 Economic assets

Summary

The water-dependent asset register for the Maranoa-Balonne-Condamine subregion has 310 economic water-dependent assets comprising 10,825 elements. There are 183 economic assets within the economic asset subgroup 'Surface water management zone or area' comprising 829 surface water access entitlement elements and six 'Water supply and monitoring infrastructure' elements. There are 127 economic assets within the economic subgroup 'Groundwater management zone or area' comprising 9977 groundwater access entitlement elements and 13 'Water supply and monitoring infrastructure' elements.

1.3.3.1 Description

The total number of economic water-dependent assets in the preliminary assessment extent (PAE) of the Maranoa-Balonne-Condamine subregion is 310 (comprising 10,825 elements). This includes 829 surface water access entitlements and 9977 groundwater access entitlements. It is important to make a distinction between 'actual use' (measured as metred use) and 'entitlement', which is an amount assigned to the user but not necessarily extracted. Surface water access entitlements have a total share component of 16,501 ML/year and groundwater access entitlements have a total share component of 344,518 ML/year. Queensland also collects data by area of land that can be irrigated in ha/year, which is additional to the volume that can be extracted in ML/year. This is 9753 ha/year for surface water access entitlements and 1598 ha/year for groundwater access entitlements. There are also six surface water elements and 13 groundwater elements classed as 'Water supply and monitoring infrastructure' that have been identified by the Water Asset Information Tool (WAIT) database in South East Queensland.

Share components are a specified share or volume of water that can be extracted within a specified water management area. Total share components include basic landholder rights described in water sharing plans (WSPs) (NSW Department of Primary Industries, 2014). Water access entitlements for surface water and groundwater include basic landholder rights described in the WSPs for NSW, which are also classed as 'Basic water right (stock and domestic)'.

Water access rights that do not require a works approval are included in the water-dependent asset register by assigning the water access right to the water source area (polygon). Seven water access rights (6409 ML/year) without corresponding work approvals are located in the Border Rivers Regulated Rivers. These seven water access rights have been amalgamated to one element and one asset.

Within the asset database, every 'Water access right' and 'Basic water right (stock and domestic)' is an element, and elements are grouped by type and spatial location to create assets (see Section 1.3.1.2).

Table 13 shows the breakdown of water access entitlements (economic elements) for surface water and groundwater in the PAE of the Maranoa-Balonne-Condamine subregion.

Table 12 Summary of the economic elements within the preliminary assessment extent (PAE) of the Maranoa-Balonne-Condamine subregion

Subgroup	Class	Number of elements	Number of assets
Groundwater management zone or area (surface area)	A groundwater feature used for water supply	0	0
	Water supply and monitoring infrastructure	13	13
	Water access right	5,567	76
	Basic water right (stock and domestic)	4,410	38
	Groundwater total	**9,990**	**127**
Surface water management zone or area (surface area)	A surface water feature used for water supply	0	0
	Water supply and monitoring infrastructure	6	6
	Water access right	781	145
	Basic water right (stock and domestic)	48	32
	Surface water total	**835**	**183**
Total		**10,825**	**310**

Data[a]: Bioregional Assessment Programme (Dataset 2, Dataset 3, Dataset 4, Dataset 5), NSW Office of Water (Dataset 6), Australian Government Department of the Environment (Dataset 7)
[a]The asset database (Bioregional Assessment Programme, Dataset 1) is a collation of all these source datasets.

Table 13 Total share components for surface water and groundwater access entitlements

Subgroup	Total share component (ML/y)	Total share component (ha/y)
Groundwater management zone or area (surface area)	344,517	1,598
Surface water management zone or area (surface area)	16,501	9,753
Total	**361,018**	**11,351**

Data[a]: Queensland Department of Natural Resources and Mines (Dataset 2, Dataset 3, Dataset 4, Dataset 5), NSW Office of Water (Dataset 6)
[a]The asset database (Bioregional Assessment Programme, Dataset 1) is a collation of all these source datasets.
Please note these figures exclude the volume of 250 licences in the Central Lockyer Valley without volumetric limits at this time. The metred groundwater use for the 2009 to 2010 period was 6046 ML/year (Dataset 8)

The locations of the economic assets (i.e. the grouped elements) are shown in Figure 9 (surface water access entitlements), Figure 10 (groundwater water access entitlements) and Figure 11 (water supply and monitoring infrastructure assets).

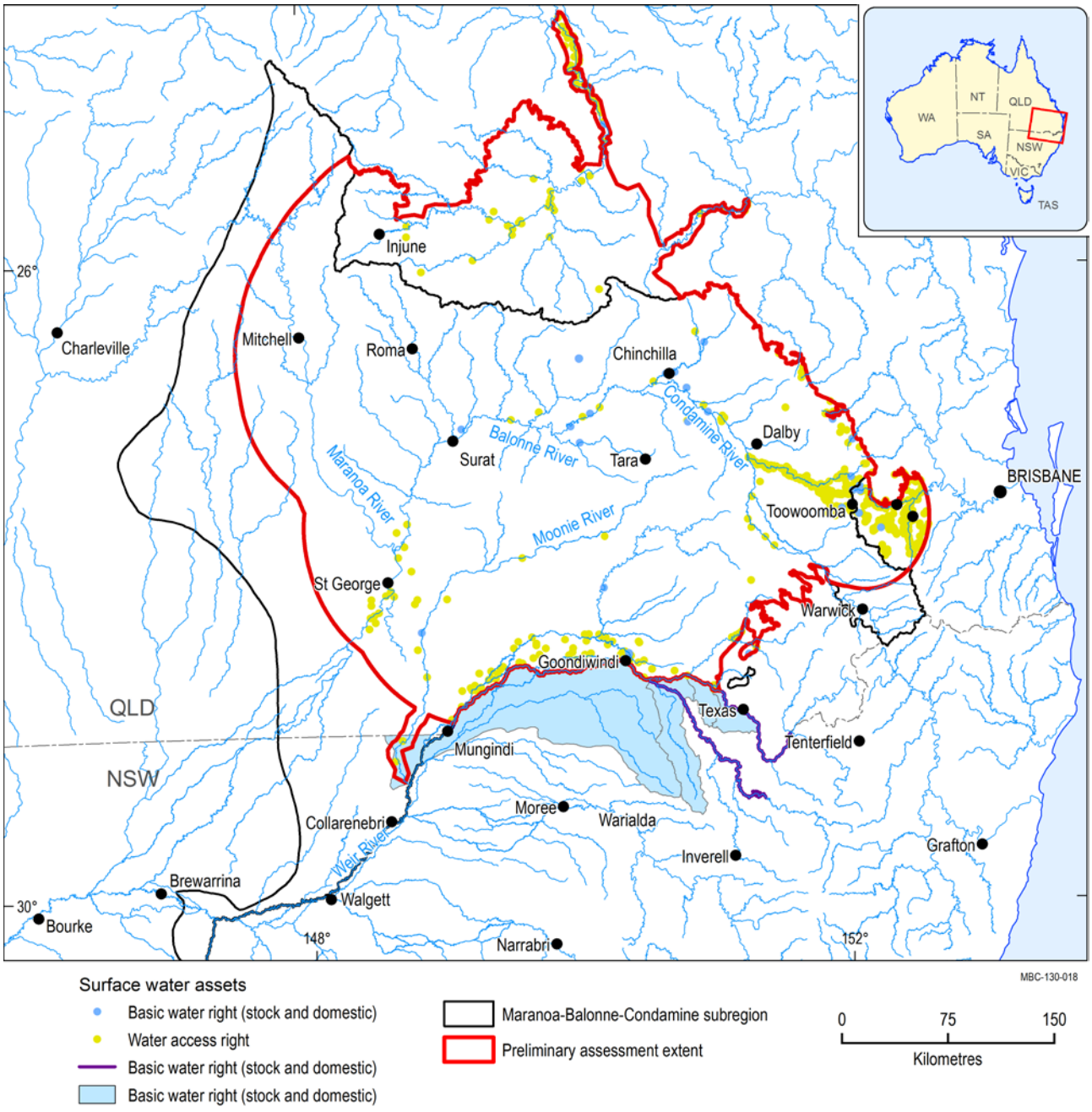

Figure 9 Location of surface water access right and basic water right assets in the preliminary assessment extent (PAE) of the Maranoa-Balonne-Condamine subregion

Data: Bioregional Assessment Programme (Dataset 1, Dataset 3, Dataset 5), NSW Office of Water (Dataset 6) and Australian Government Department of the Environment (Dataset 7)

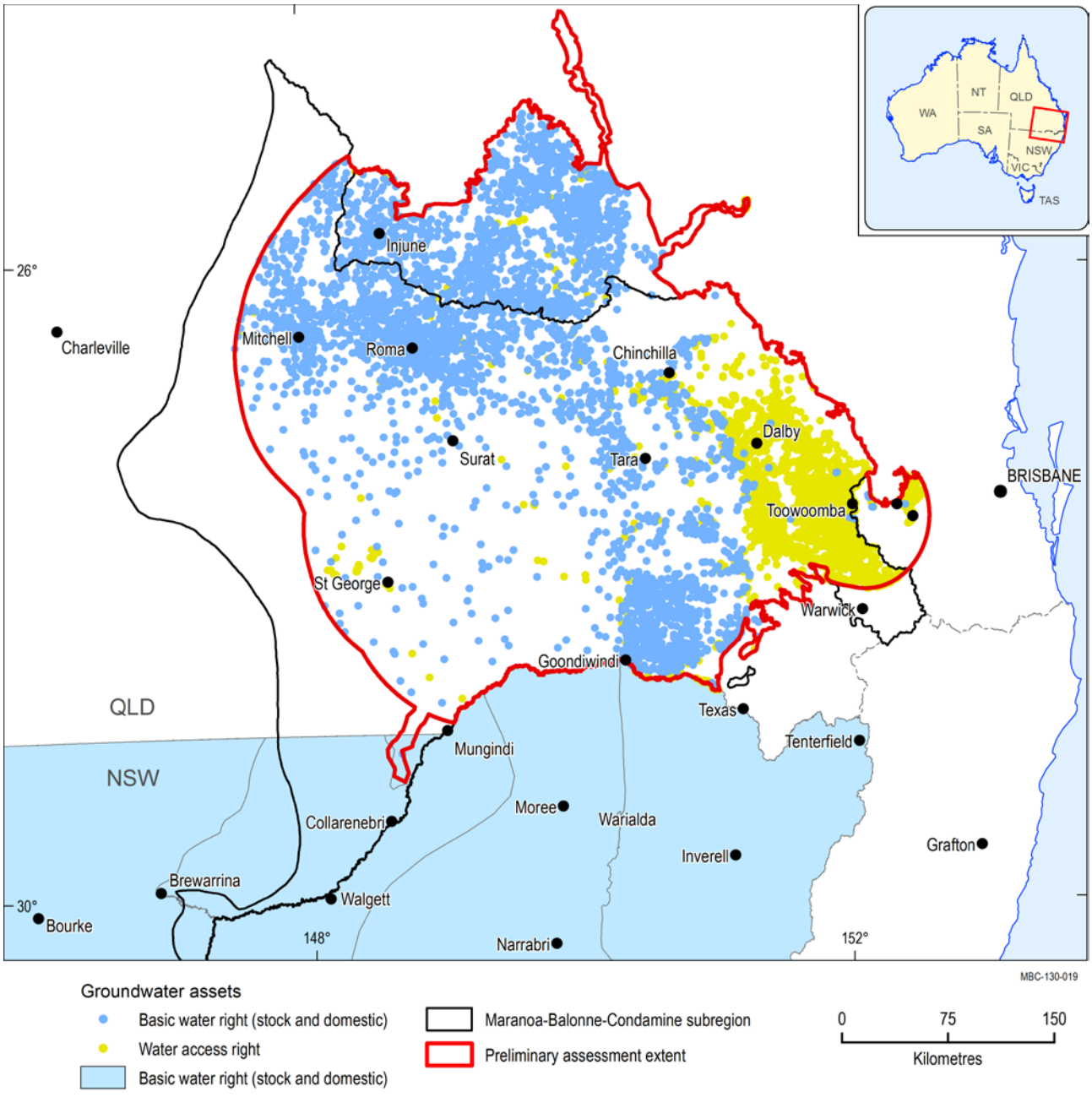

Figure 10 Location of groundwater water access right and basic water right assets in the preliminary assessment (PAE) extent of the Maranoa-Balonne-Condamine subregion

Data: Bioregional Assessment Programme (Dataset 1, Dataset 2, Dataset 4) and NSW Office of Water (Dataset 6)

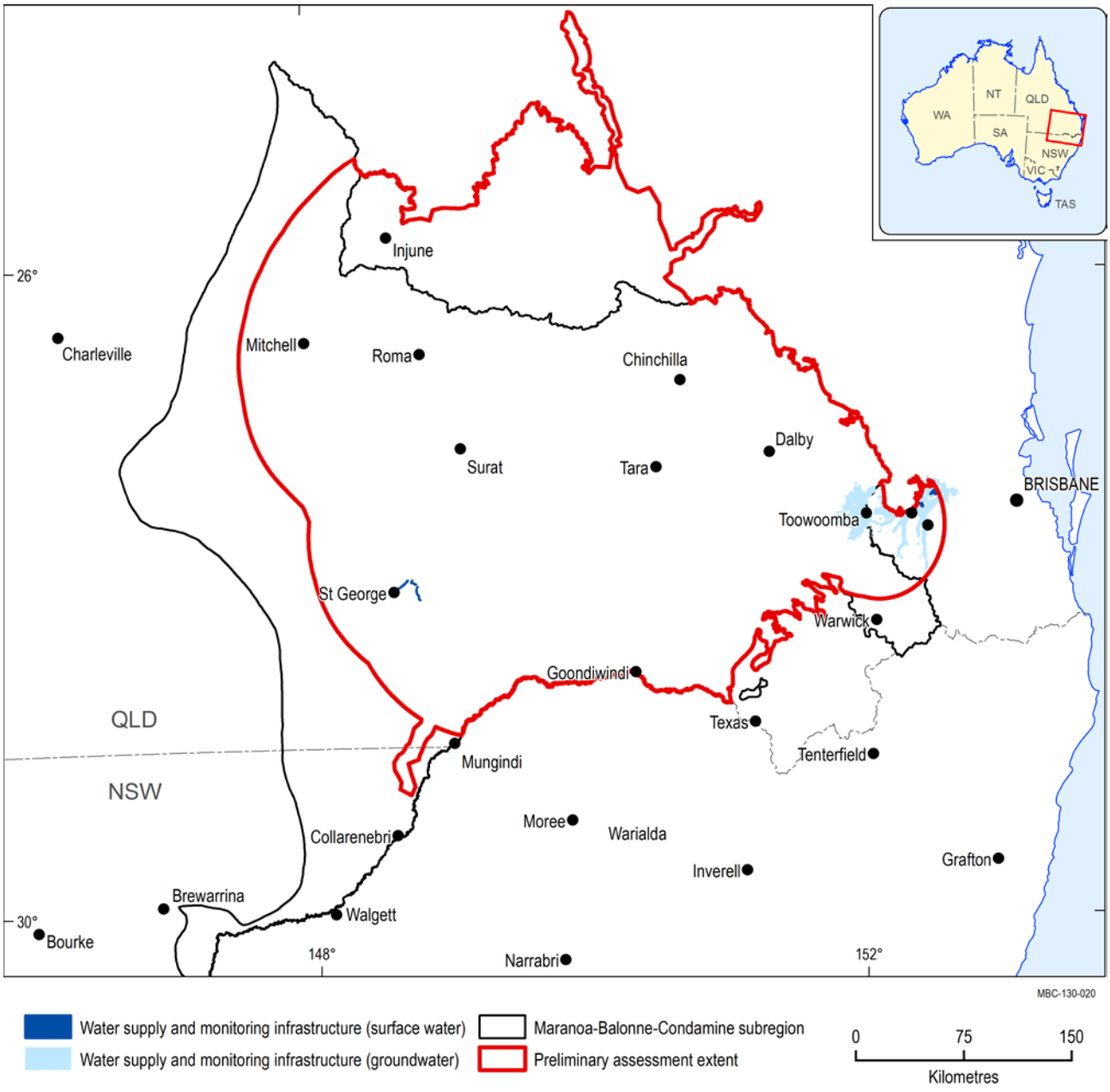

Figure 11 Location of water supply and monitoring infrastructure assets in the preliminary assessment extent (PAE) of the Maranoa-Balonne-Condamine subregion

Data: Bioregional Assessment Programme (Dataset 1), Australian Government Department of the Environment (Dataset 7)

1.3.3.2 Gaps

Queensland entitlement volumes may not represent total extraction due to the exclusions that exist under Queensland's *Water Act 2000*, where entitlements are not required for stock/domestic and other low risk activities for surface water. Similarly, extraction of groundwater does not require an entitlement unless specified under a water resource plan, Wild River Declaration, moratorium area or under the Water Regulation 2002 (NWC, 2014).

Data for surface water and groundwater access entitlements were extracted from the NSW Office of Water licensing system in November 2013 and the Queensland Department of Natural Resources and Mines water access entitlements were extracted in December 2013. The total

volume of entitlements is not expected to change significantly on a monthly basis, therefore the difference in timing is considered immaterial.

Floodplain harvesting has been identified in other NSW bioregions as economic assets. Floodplain harvesting water storages are in the process of being digitised by the NSW Office of Water, but were not available for inclusion in the water-dependent asset register at this time.

Many of the economic asset polygons in NSW include a negligible portion of the entire asset polygon within the PAE, which is mostly an artefact of the GIS overlaying process. Therefore, many of these NSW economic assets are included in the asset database, even if only a negligible portion of a polygon overlaps within the PAE.

The surface water access entitlement data received from NSW Office of Water do not include details of the river reach where the offtake was located, instead they include the water source and water management zone associated with the WSP. A water source can be any set of rivers, aquifers or lakes and the like, which are defined by a gazetted WSP to be a water source. Therefore when the elements are aggregated into the asset, water access entitlements are grouped together across the water source area (a large polygon). This will need to be taken into account when assigning receptor locations as the water source may include multiple river reaches and potentially multiple river branches.

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1.3.4 Sociocultural assets

Summary

The 127 sociocultural assets were sourced from the Australian Heritage Database (Department of the Environment, 2014; Australian Government Department of the Environment, Dataset 2, Dataset 3, Dataset 4). No further sociocultural assets were nominated following the Maranoa-Balonne-Condamine asset workshop in Toowoomba in December 2014. Sociocultural assets in the Maranoa-Balonne-Condamine subregion include the National Heritage-listed Gondwana Rainforests of Australia and the Taroom Aboriginal Reserve, which are considered to be water dependent.

The water-dependent asset register for the preliminary assessment extent (PAE) of the Maranoa-Balonne-Condamine subregion contains 79 sociocultural assets that are considered to be water dependent based on the presence of floodplain and wetland areas and shallow groundwater within their spatial extent. These include 39 of the 68 built heritage and 11 of the 14 war memorials in the asset list that are classed as heritage sites. Three of the ten Indigenous sites listed in the Australian Heritage Database are considered to be water dependent. Twenty-six recreation areas, which include national parks and areas of remnant vegetation, are considered to be water dependent based on the presence of floodplain and wetland areas and shallow groundwater.

Meetings have been held with Indigenous knowledge holders in the Maranoa-Balonne-Condamine subregion to gain an understanding of Indigenous cultural water-dependent assets.

1.3.4.1 Description

A total of 127 sociocultural assets were sourced from the Australian Heritage Database (Department of the Environment, 2014; Australian Government Department of the Environment, Dataset 2, Dataset 3, Dataset 4) comprising 124 assets from the Register of the National Estate, two assets from the National Heritage List and one asset from the World Heritage List. No additional sociocultural assets were nominated at the Maranoa-Balonne-Condamine asset workshop in Toowoomba in December 2014. Table 15 shows the breakdown of sociocultural elements and assets by subgroup and class. This includes two assets with similar names: the 'Gondwana Rainforests of Australia world heritage area' and the 'National Heritage Listed Gondwana Rainforests of Australia', which are in the south-east of the Maranoa-Balonne-Condamine PAE (Figure 12) and are both considered to be water dependent. The National Heritage-listed Taroom Aboriginal Reserve is included in the Indigenous site class of the cultural assets subgroup and is considered to be water dependent based on the presence of floodplain and wetland areas within its spatial extent.

Table 14 Number of sociocultural assets according to subgroup and class in the preliminary assessment extent (PAE) of the Maranoa-Balonne-Condamine subregion

Group	Subgroup	Class	Number of elements	Number of assets
Sociocultural	Cultural	Heritage site	84	84
	Cultural	Indigenous site	10	10
	Social	Recreation area	33	33
Total			**127**	**127**

Data: Bioregional Assessment Programme (Dataset 1)

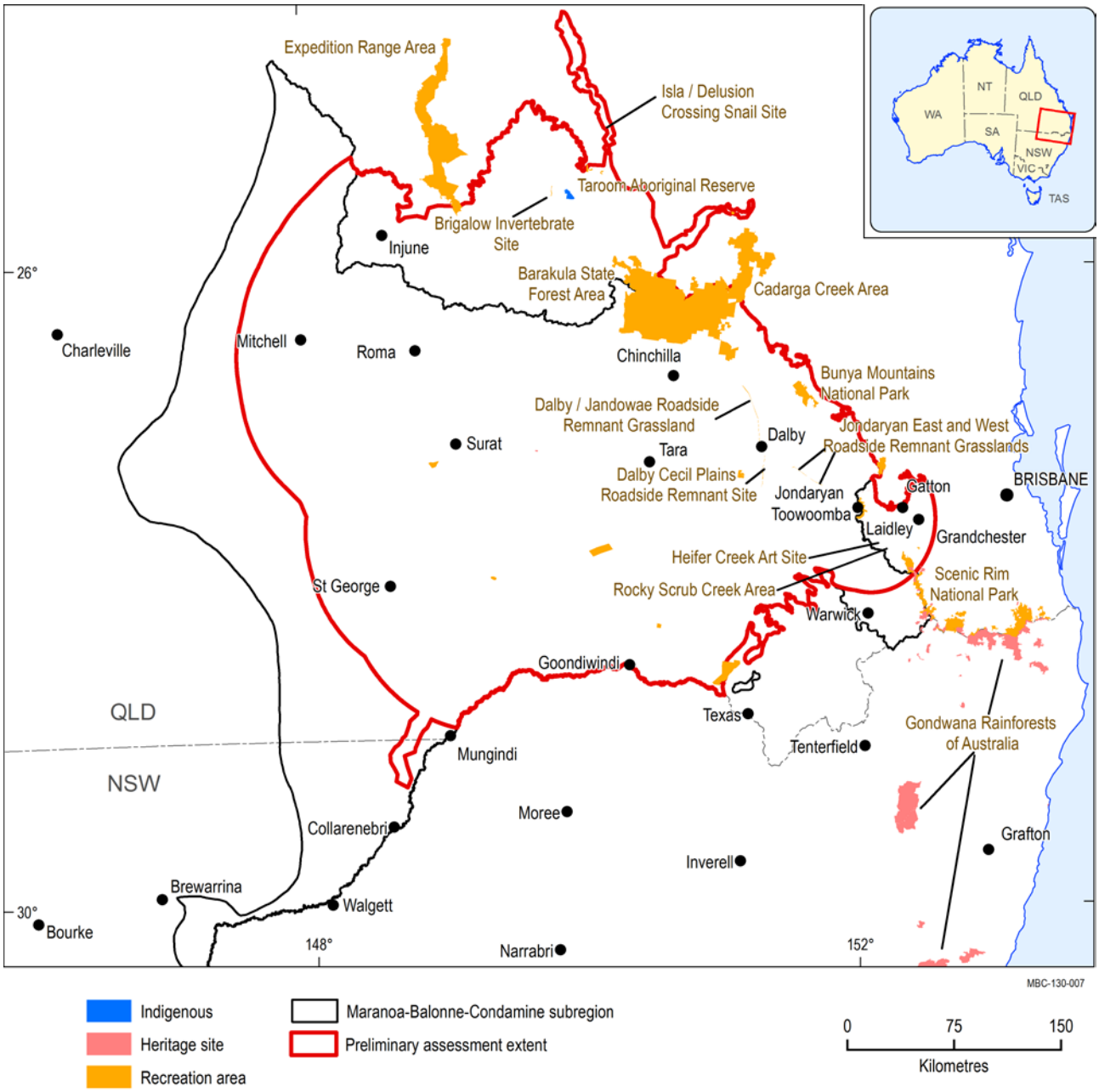

Figure 12 Location of sociocultural assets in the Maranoa-Balonne-Condamine subregion

Data: Bioregional Assessment Programme (Dataset 1), Australian Government Department of the Environment (Dataset 2, Dataset 3 and Dataset 4)

Most of the sociocultural assets classed as heritage sites are derived from geographically intersecting the Australian Heritage Database with the preliminary assessment extent (PAE) of the Maranoa-Balonne-Condamine subregion. They comprise 68 built heritage and 14 war memorials located in towns such as Dalby, Gatton, Grandchester, Goondiwindi, Jondaryan, Laidley, Mitchell, Roma and Toowoomba (Figure 12). Almost half of the heritage sites (48%) are considered to be water dependent.

The asset list includes ten Indigenous sites from the Australian Heritage Database (Department of the Environment, 2014; Australian Government Department of the Environment, Dataset 2, Dataset 3, Dataset 4), including the National Heritage-listed Taroom Aboriginal Reserve. Other Indigenous sites included in the asset list are Stone Arrangements located near Bell, Cawdor, Gatton and Kogan, the Heifer Creek Art Site near West Haldon, and the Lundavra Carved Trees and Weengallon Rockwells near Goondiwindi (Figure 12). Only three of the ten Indigenous sites are considered to be water dependent: the National Heritage-listed Taroom Aboriginal Reserve, the Heifer Creek Art Site near West Haldon and Rocky Scrub Creek Area on Chalk Mine Rd near Gatton.

The 33 assets classed as recreation areas are predominantly national parks or areas of remnant habitat and most (26) are considered to be water dependent based on the presence of floodplain and wetland areas and shallow groundwater (Figure 12). These include the Bunya Mountains and Scenic Rim national parks, Cadarga Creek Area near Mundubbera, Expedition Range Area near Bauhinia Downs and Barakula State Forest Area near Miles. Remnant habitat areas that are considered water dependent include remnant grassland near Dalby and Jondaryan (approximately 1300 ha), the Isla / Delusion Crossing Snail Site along the Dawson River (approximately 66 ha), the Brigalow Invertebrate Site near Taroom (approximately 245 ha) and the Dalby Cecil Plains Roadside Remnant Dichanthium sericeum Site (approximately 342 ha).

1.3.4.2 Gaps

No further sociocultural assets were nominated following the Maranoa-Balonne-Condamine asset workshop in Toowoomba in December 2014. For bioregional assessment purposes, no specific gaps in the knowledge base related to sociocultural assets in the Maranoa-Balonne-Condamine subregion have been identified.

Meetings have been held with Indigenous knowledge holders in the Maranoa-Balonne-Condamine subregion to gain further understanding of Indigenous cultural water-dependent assets. Where possible and appropriate, and with the agreement of Indigenous knowledge holders, these additional Indigenous water-related values will be published in a separate report. Identified assets will be incorporated into an updated water-dependent asset register and/or incorporated into later technical products.

References

Department of the Environment (2014) Australian Heritage Database online. Viewed 18 February 2015, http://www.environment.gov.au/topics/heritage/publications-and-resources/australian-heritage-database.

Datasets

Dataset 1 Bioregional Assessment Programme (2015) Asset database for the Maranoa-Balonne-Condamine subregion on 26 June 2015. Bioregional Assessment Derived Dataset. Viewed 06 July 2015, http://data.bioregionalassessments.gov.au/dataset/35e95025-f962-4425-83c7-767e2d6722e6.

Dataset 2 Australian Government Department of the Environment (2014) Australia, Register of the National Estate (RNE) – Spatial Database (RNESDB) Internal. Bioregional Assessment Source Dataset. Viewed 13 April 2015, http://data.bioregionalassessments.gov.au/dataset/878f6780-be97-469b-8517-54bd12a407d0.

Dataset 3 Australian Government Department of the Environment (2013) Australia World Heritage Areas. Bioregional Assessment Source Dataset. Viewed 19 April 2015, http://data.bioregionalassessments.gov.au/dataset/4927789b-7ba7-4a77-b6fc-be1b29b6590c.

Dataset 4 Australian Government Department of the Environment (2014) National Heritage List Spatial Database (NHL) (v2.1). Bioregional Assessment Source Dataset. Viewed 13 April 2015, http://data.bioregionalassessments.gov.au/dataset/26daa8d7-a90e-47f3-982b-0df362414e65.

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