Appendices

Appendix A

Assessment products

More information about the Northern Australia Water Resource Assessment can be found at https://www.csiro.au/en/Research/Major-initiatives/Northern-Australia/Current-work/NAWRA. The website provides readers with a communications suite including factsheets, multimedia content, FAQs, reports and links to other related sites, particularly about other research in northern Australia.

In order to meet the requirements specified in the contracted 'Timetable for the Services', the Assessment provided the following key deliverables:

- Technical reports present scientific work at a level of detail sufficient for technical and scientific experts to reproduce the work. Each of the activities of the Assessment has at least one corresponding technical report.
- Each of the three catchment reports (i.e. this report and another for the Fitzroy catchment and Darwin catchments) synthesises key material from the technical reports, providing well-informed but non-scientific readers with the information required to make decisions about the opportunities, costs and benefits associated with water resource development.
- A case study report, with case studies which show how information produced by the Assessment can be assembled to help readers 'answer their own questions'. They are also used to help readers understand the type and scale of opportunity for irrigated agriculture or aquaculture in selected parts of the Assessment area, and explore some of the nuances associated with greenfield developments in the study area. Case studies are provided for each study area.
- Three overview reports – one for each of the three study areas – are provided for a general public audience.
- Three factsheets provide key findings for each study area for a general public audience.

This appendix lists all such deliverables.

Please cite as they appear.

Methods reports

CSIRO (2018) Proposed methods report for the Darwin catchments. A report from the CSIRO Northern Australia Water Resource Assessment to the Government of Australia. CSIRO, Australia.

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Petheram C, Bruce C, Chilcott C and Watson I (eds) (2018) Water resource assessment for the Fitzroy catchment. A report to the Australian Government from the CSIRO Northern Australia Water Resource Assessment, part of the National Water Infrastructure Development Fund: Water Resource Assessments. CSIRO, Australia.

Petheram C, Watson I, Bruce C and Chilcott C (eds) (2018) Water resource assessment for the Mitchell catchment. A report to the Australian Government from the CSIRO Northern Australia Water Resource Assessment, part of the National Water Infrastructure Development Fund: Water Resource Assessments. CSIRO, Australia.

Case study report

CSIRO (2018) Case study examples for the Northern Australia Water Resource Assessment. A report to the Australian Government from the CSIRO Northern Australia Water Resource Assessment, part of the National Water Infrastructure Development Fund: Water Resource Assessments. CSIRO, Australia.

Overview reports

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Appendix B

Shortened forms

SHORT FORM	MEANING
AEM	airborne electromagnetics
AHD	Australian Height Datum
APSIM	Agricultural Production Systems Simulator
AWRC	Australian Water Resources Council
CGE	Computable General Equilibrium
CSO	community service obligations
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEM	digital elevation model
FTE	full-time equivalents
GAB	Great Artesian Basin
GCMs	global climate models
GCM-ES	global climate model output empirically scaled to provide catchment-scale variables
IPCC AR4	the Fourth Assessment Report of the Intergovernmental Panel on Climate Change
IDAS	Integrated development assessment system
IQQM	Integrated Quantity-Quality Model – a river systems model
IRR	internal rate of return
Landsat TM	Landsat Thematic Mapper
MODIS	Moderate Resolution Imaging Spectroradiometer
NABSA	North Australia Beef System Analysis
NPV	net present value
NQIAS	North Queensland Irrigated Agriculture Strategy
NRM	natural resource management
ONA	the Australian Government Office of Northern Australia
OWL	the Open Water Likelihood algorithm
PAWC	plant available water capacity
PE	potential evaporation
RCP	representative concentration pathway
Sacramento	a rainfall-runoff model

SHORT FORM	MEANING
SALI	the Soil and Land Information System for Queensland
SLAs	statistical local areas
SRTM	shuttle radar topography mission
TRaCK	Tropical Rivers and Coastal Knowledge Research Hub
WRON	CSIRO’s Water Resource Observation Network

Units

MEASUREMENT UNITS	DESCRIPTION
BP	before present
GL	gigalitres, 1,000,000,000 litres
keV	kilo-electronvolts
kL	kilolitres, 1000 litres
km	kilometres, 1000 metres
kPa	kilopascal
Kt	kiloton
L	litres
m	metres
Ma	million years
MB	megabyte
mAHD	metres above Australian Height Datum
mEGM96	Earth Gravitational Model 1996 geoid heights in metres
MeV	mega-electronvolts
mg	milligrams

Data sources and availability

The Northern Australia Water Resource Assessment obtained a range of data for use under licence from a number of organisations, including the following:

- State of Queensland (Business Queensland)
  - Digital Cadastral Database - The Digital Cadastral Database (DCDB) contains the property boundaries and related property description of all land parcels in Queensland. It provides the base for searching, planning and analysing land related information and is primarily used by most local governments for these purposes.
    - Licence: Data downloaded via QSpatial as open data is provided under a Creative Commons CC-By licence.
    - https://www.business.qld.gov.au/running-business/support-assistance/mapping-data-imagery/data/digital-cadastral
- State of Queensland
  - Queensland's Regional Ecosystem Description Database
    - Licence: This work is licensed under a Creative Commons Attribution 3.0 Licence
    - Conditions of use statement: The database was developed using data compiled by the State of Queensland as represented by the Queensland Herbarium, Department of Environment and Science. While every effort has been made to ensure that the material contained in the database is accurate, the State of Queensland accepts no liability and gives no assurance in respect of its accuracy and shall not be liable for any loss or damage arising from the use of the database.
  - https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/descriptions
- Australian Government (Geoscience Australia)
  - GEODATA Topo 250K Series 3 – spatial data for mapping
    - Licence: Creative Commons Attribution 3.0 Australia, http://creativecommons.org/licenses/by/3.0/au/, (c) Commonwealth of Australia (Geoscience Australia) 2014
    - https://data.gov.au/dataset/a0650f18-518a-4b99-a553-44f82f28bb5f
  - SRTM-derived 3 Second Digital Elevation Models Version 1.0
    - Licence: The 3 second DEMs were released under Creative Commons attribution licensing in ESRI Grid format
    - https://ecat.ga.gov.au/geonetwork/srv/eng/catalog.search?node=srv#/metadata/aac46307-fce9-449d-e044-00144fdd4fa6
  - GEODATA 9 second DEM and D8: Digital Elevation Model Version 3
    - Licence: Creative Commons Attribution 4.0 International Licence
    - https://ecat.ga.gov.au/geonetwork/srv/eng/catalog.search?node=srv#/metadata/a05f7892-d78f-7506-e044-00144fdd4fa6

- Esri
  - *World Imagery Map Service* – map service of satellite imagery for the world and high-resolution imagery for the United States and other areas around the world. Imagery is sourced from GeoEye IKONOS, Getmapping, AeroGRID, IGN Spain, IGP Portugal, i-cubed, USGS, AEX, Aerogrid, Swisstopo and by the GIS User Community.
    - https://www.arcgis.com/home/item.html?id=10df2279f9684e4a9f6a7f08febac2a9
- Atlas of Living Australia - a collaborative, national project that aggregates biodiversity data from multiple sources and is freely available and usable online.
  - https://www.ala.org.au/
- Australian Wetlands Database - online access to information on Australia's Ramsar wetlands and sites listed in the Directory of Important Wetlands of Australia, Australia’s internationally and nationally important wetlands respectively.
  - http://www.environment.gov.au/water/wetlands/australian-wetlands-database

Glossary and terms

Anthropogenic: a human impact on the environment.

Aquifer: a permeable geological material that can transmit significant quantities of water to a bore, spring, or surface water body. Generally, 'significant' is defined based on human need, rather than on an absolute standard.

Aquitard (confining layers): a saturated geological unit that is less permeable than an aquifer, and incapable of transmitting useful quantities of water. Aquitards often form a confining layer over an artesian aquifer.

Artesian: a general term used when describing certain types of groundwater resources. Artesian water is underground water confined and pressurised within a porous and permeable geological formation. An artesian aquifer has enough natural pressure to allow water in a bore to rise to the ground surface. Subartesian water is water that occurs naturally in an aquifer, which if tapped by a bore, would not flow naturally to the surface. Artesian conditions refer to the characteristics of water under pressure.

Basement: the crust below the rocks of interest. In hydrogeology it means non-prospective rocks below accessible groundwater. Commonly refers to igneous and metamorphic rocks which are unconformably overlain by sedimentary beds or cover material, and sometimes used to indicate 'bedrock' (i.e. underlying or encasing palaeovalley sediments).

Benthic: the ecological region at the lowest level of a body of water such as an ocean or a lake, including the sediment surface and some sub-surface layers.

Current development: the level of surface water, groundwater and economic development in place as of 1 July 2013. The Assessment assumes that all current water entitlements are being fully used.

Development: see entries for 'current development' and 'future irrigation development'.

Discount rate: the percentage by which future cost and benefits are discounted each year (compounded) to convert them to their equivalent present value (PV)

Drainage division: the area of land where surface water drains to a common point. There are 12 major drainage divisions in Australia. At a smaller scale, surface water drainage areas are also referred to as river basins, catchments, or watersheds.

Drawdown: the lowering of groundwater level resulting from the extraction of water, oil or gas from an aquifer.

Ecosystem services: the contributions that ecosystems make to human wellbeing.

Eutrophication: the ecosystem response to the addition of artificial or natural substances, such as nitrates and phosphates, through fertilizers or sewage, to an aquatic system. One example is an 'algal bloom' or great increase of phytoplankton in a water body as a response to increased levels of nutrients.

Environmental flows: describe the quantity, timing and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well being that depend on these ecosystems.

Flow regime: the entire pattern of flow in a river – from how long it lasts, to how frequently it flows and how large it is.

Fecundity: the potential reproductive capacity of an individual or population.

Fertigation: application of crop nutrients through the irrigation system (i.e. liquid fertiliser)

Future irrigation development: is described by each case study storyline (see chapters 8 to 10); river inflow and agricultural productivity are modified accordingly.

Geological basin: layers of rock that have been deformed by mega-scale geological forces to become bowlshaped. Often these are round or oblong with a depression in the middle of the basin.

Geological formation: geological formations consist of rock layers that have common physical characteristics (lithology) deposited during a specific period of geological time.

Groundwater (hydrogeology): water that occurs within the zone of saturation beneath the Earth's surface. The study of hydrogeology focuses on movement of fluids through geological materials (e.g. layers of rock).

Groundwater basin: a groundwater basin is a non-geological delineation for describing a region of groundwater flow. Within a groundwater basin, water enters through recharge areas and flows toward discharge areas.

Groundwater divide: a divide that is defined by groundwater flow directions that flow in opposite directions perpendicular to the location of the divide.

Groundwater flow (hydrodynamics): within a groundwater basin, the path from a recharge area to a discharge area is referred to as a groundwater flow system, where travel time may be as short as days or longer than centuries, depending on depth. The mechanics of groundwater flow – the hydrodynamics – are governed by the structure and nature of the sequence of aquifers.

Groundwater flow model: a computer simulation of groundwater conditions in an aquifer or entire groundwater basin. The simulations are representations based on the physical structure and nature of the sequence of aquifers and rates of inflow – from recharge areas – and outflow – through springs and bores. **Groundwater level:** in this report refers to the elevation of equivalent freshwater hydraulic head at 25 °C

Groundwater recharge and discharge: recharge occurs where rainfall or surface water drains downward and is added to groundwater (the zone of saturation). Discharge occurs where groundwater emerges from the Earth, such as through springs or seepage into rivers.

Hydrodynamics: the study of liquids in motion.

Internal rate of return (IRR): the discount rate at which the net present value (NPV) is zero.

Legume: pulse crop.

Lithology: the character of a rock; its composition, structure, texture, and hardness.

Net present value: a standard method for using the time value of money to appraise long-term projects by measuring the differences between costs and revenues in present value terms.

Palaeochannel: refers to the main channel of ancient rivers, sometimes called the 'thalweg', the lowest point of incision along the river bed where coarser sediments are commonly deposited. Former river channels that are recognised in the surface (from aerial or satellite images) or subsurface (typically in aerial electromagnetic surveys or drilling).

Permeability: a measurement describing the ability of any fluid (water, oil) to pass through a porous material. Values vary widely, with higher values corresponding to aquifers (i.e., highly permeable) and lower values corresponding to aquitards (i.e. less permeable).

Refugia: habitat for species to retreat to and persist in.

Regolith: weathered upper layer.

Residual value: calculated as the proportional asset life remaining multiplied by the original asset price.

Riparian: of, on, or relating to the banks of a watercourse. A riparian zone is the area of land immediately adjacent to a stream or river. Plants found within this zone are collectively known as riparian vegetation. This vegetation frequently contains large trees that stabilise the river bank and shade part of the river.

River reach: an extent or stretch of river between two bends.

Streamflow: is the flow of water in rivers and other channels (creeks, streams etc.). Water flowing in channels comes from surface runoff, from groundwater flow, and from water discharged from pipes. There are a variety of ways to measure streamflow – a gauge provides continuous flow over time at one location for water resource and environmental management or other purposes; it can be estimated by mathematical equations. The record of flow over time is called a hydrograph. Flooding occurs when the volume of water exceeds the capacity of the channel.

Triple-bottom-line: an accounting framework that incorporates three dimensions of performance: social, environmental and financial.

Watertable: the surface where the groundwater level is balanced against atmospheric pressure. Often, this is the shallowest water below the ground.

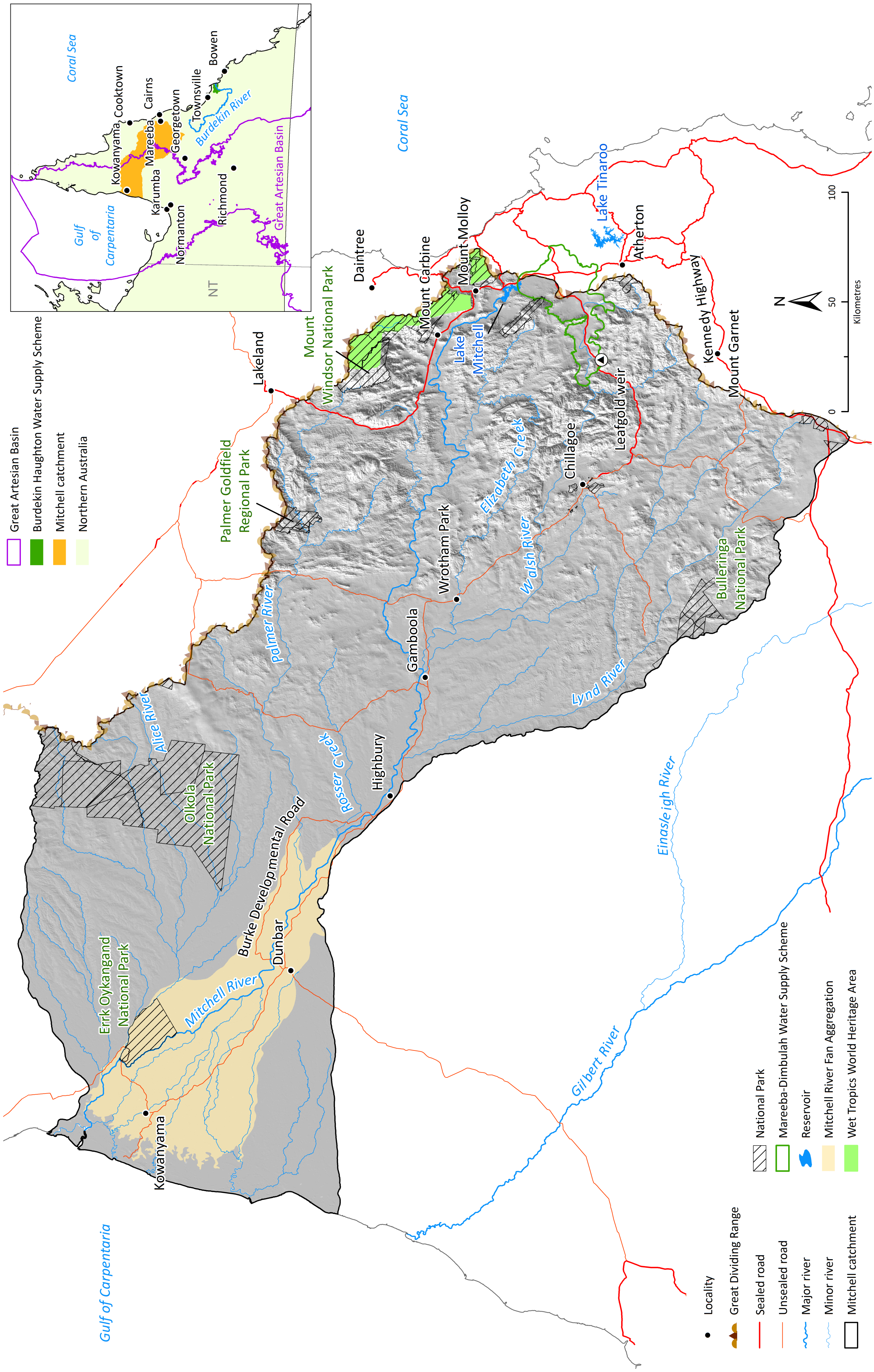
Appendix C

List of figures

List of tables

Appendix D

Detailed location map of the Mitchell catchment and surrounds


Great Artesian Basin
Burdekin Haughton Water Supply Scheme
Mitchell catchment
Northern Australia
Coral Sea
Gulf of Carpentaria
Cooktown
Cairns
Kowanyama
Mareeba
Georgetown
Townsville
Bowen
Burdekin River
Karumba
Normanton
Richmond
Great Artesian Basin
NT
Coral Sea
Lake Tinaroo
Atherton
Daintree
Mount Molloy
Mount Carbine
Lake Mitchell
Mount Windsor National Park
Lakeland
Palmer Goldfield Regional Park
Kennedy Highway
Mount Garnet
Leafgold weir
Chillagoe
Elizabeth Creek
Walsh River
Wrotham Park
Bulleringa National Park
Gamboola
Palmer River
Lynd River
Alice River
Olkola National Park
Highbury
Rosser Creek
Burke Developmental Road
Dunbar
Mitchell River
Errk Oykangand National Park
Kowanyama
Einasleigh River
Gilbert River
Gulf of Carpentaria
N
0
50
100
Kilometres
Locality
Great Dividing Range
Sealed road
Unsealed road
Major river
Minor river
Mitchell catchment
National Park
Mareeba-Dimbulah Water Supply Scheme
Reservoir
Mitchell River Fan Aggregation
Wet Tropics World Heritage Area

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