

Chapter 4 – Matters of national environmental significance

Contents

4	MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE	4-2
4.1	Inventory of surveys	4-2
4.2	Output of the Protected Matters Search Tool	4-8
4.2.1	Ramsar wetlands	4-8
4.2.1.1	Ramsar wetlands within and adjacent to the GMID	4-9
4.2.1.2	Ramsar wetlands outside of the GMID	4-9
4.2.2	Listed threatened species and ecological communities	4-11
4.2.3	Listed migratory species	4-11
4.3	Impact pathways	4-12
4.4	Summary	4-20

Figures

Figure 4-1:	Location of the ten Ramsar wetlands identified by the PMST	4-10
Figure 4-1:	Location of the ten Ramsar wetlands identified by the PMST	4-10

Tables

Table 4-1:	Table of relevant outputs from the PMST for each summary report	4-3
Table 4-2:	Technical reports identifying MNES and appendix location	4-4
Table 4-3:	Sources of information used to identify MNES and their reliability	4-5
Table 4-4:	Summary of EPBC Act listed threatened species and communities that are present or potentially present in the GMID (+40 km buffer)	4-11
Table 4-5:	Summary of EPBC Act listed migratory species that are present or potentially present in the GMID (+40 km buffer)	4-12
Table 4-6:	Project related changes, impact pathways and potential ecological consequences from the modified operation of the fully modernised GMID	4-15

4 Matters of national environmental significance

This chapter deals with the specific matters that are required to be assessed under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act).

The Department of Environment, Water, Heritage and the Arts (**DEWHA**) determined on 6 November 2009 that the proposed action is a ‘controlled action’ requiring approval under the EPBC Act.

The controlling provisions of the EPBC Act in relation to this decision are related to matters of national environmental significance (**MNES**) and include:

- wetlands of international importance (sections 16 and 17B)
- listed threatened species and communities (sections 18 and 18A)
- listed migratory species (sections 20 and 20A).

4.1 Inventory of surveys

The information on MNES presented in this chapter has been drawn from the summary reports generated by the Protected Matters Search Tool (**PMST**) that are shown in Table 4-1 and additional information sources.

Seven searches using the PMST were conducted to cover the entire area of the Goulburn Murray Irrigation District (**GMID**) plus a 40 km buffer zone. This buffer distance was selected to incorporate the regional occurrence of populations because many species in the area have the capacity to move long distances and use a network of wetland habitats (Brett Lane and Associates 2009). The area covered by these searches is shown by the coordinates for each summary report in Table 4-1.

The summary reports from the PMST are described in Section 4.2 and can be found at Appendix 8a-g.

Given the large size of the GMID, the identification of MNES in this report relies upon existing survey and database information. No specific field surveys were conducted to identify the presence of MNES in the GMID.

It is not anticipated that any future office-based or field-based studies regarding MNES will be conducted for the purposes of this Public Environment Report.

Table 4-1: Table of relevant outputs from the PMST for each summary report

Appendix Number	Co-ordinates of search area	Ramsar sites	Threatened species	Threatened communities	Migratory species
8a	Coordinates: - 34.4669,141.9265, - 34.9287,141.9265, - 34.9287,142.8179, - 34.4669,142.8179	8	23	2	19
8b	Coordinates: - 34.5392,142.7818, - 35.1576,142.7818, - 35.1576,143.4283, - 34.5392,143.4283	12	27	3	36
8c	Coordinates: -35.0291,143.3841, -36.5027,143.3841, -36.5027,143.9422, -35.0291,143.9422	10	44	4	37
8d	Coordinates: - 35.4065,143.9222, - 36.5309,143.9222, - 36.5309,144.3599, - 35.4065,144.3599	5	33	3	37
8e	Coordinates: - 35.7237,144.3518, - 36.5710,144.3518, - 36.5710,144.7453, - 35.7237,144.7453	4	36	3	21
8f	Coordinates: - 35.5270,144.8578, - 36.4064,144.8578, - 36.4064,145.3075, - 35.5270,145.3075	5	33	3	12

Appendix Number	Co-ordinates of search area	Ramsar sites	Threatened species	Threatened communities	Migratory species
8g	Coordinates: - 35.6836,145.3236, - 36.6031,145.3236, - 36.6031,145.7532, - 35.6836,145.7532	4	33	3	12

Source: PMST

It is important to note that together these summary reports often contain multiple records for a species because it may occur in several of the search areas. Therefore, the total number of MNES should not be calculated from the above table. See Table 4-4 for the summary numbers of MNES in each category.

Table 4-2: Technical reports identifying MNES and appendix location

Appendix	Technical Reports
9	Hale, J 2009, <i>NVIRP: Operational Impact Assessment on Wetlands of International Importance (Ramsar Wetlands)</i> . Report to Hydro Environmental, Jennifer Hale, Kinglake.
10	Ecological Associates 2009, <i>NVIRP: Assessment of Impacts on Flora Issues of National Environmental Significance</i> , Ecological Associates, Malvern
11	King, AJ & Tonkin, Z 2009. <i>NVIRP: Operational impact assessment on aquatic fauna</i> . Arthur Rylah Institute for Environmental Research, Heidelberg
12	Brett Lane and Associates 2009, <i>NVIRP: Operational Impact Assessment Terrestrial Vertebrate Fauna</i> , Brett Lane and Associates, Hawthorn

A list of all information sources used in the technical reports to identify MNES, and their reliability, is presented in Table 4-3.

Table 4-3: Sources of information used to identify MNES and their reliability

Source	Data Obtained	Reliability of Information
Atlas of Victorian Wildlife (AVW)	Terrestrial fauna records with grid reference of location (most recent data 2006).	This database is administered by the Department of Sustainability and Environment (DSE) and holds all records of fauna species within Victoria prior to 2007. Data for this database has been gathered from ecological surveys undertaken by DSE, museum specimens, professional zoologists outside DSE, competent field naturalists and zoological literature. Records from this database provide an indication of which species are present in an area and are not an estimate of population size.
EPBC Act Protected Matters Search Tool	List of wetlands, species (terrestrial and aquatic flora and fauna) and communities likely to occur in GMID and a 40 kilometre buffer. No specific records obtained therefore no date is provided.	This online database is administered by DEWHA. Information originates from AVW and Flora Information System (FIS) and Bioclim modelling of potential species occurrence.
Atlas of New South Wales Wildlife	Terrestrial fauna records with grid reference of location (most recent data 2009).	This database is administered by the NSW Department of Environment, Climate Change and Water (DECCW). Data for this database has been gathered from ecological surveys undertaken by DECCW, professional zoologists outside DECCW and competent field naturalists, supplemented by museum specimen records and information from zoological literature. Records from this database provide an indication of which species are present in an area and are not an estimate of population size.
Birds Australia	Bird records with grid reference of location (most recent data 2009).	This is a national database of bird sighting by reliable observers, vetted carefully by professional ornithologists. Records date from the late 1990s onwards.

Source	Data Obtained	Reliability of Information
Environmental Water Allocation (EWA) Monitoring (provided by Keith Ward, Goulburn Broken Catchment Authority (GBCMA))	Monitoring records for Kinnairds Swamp, Black Swamp and Reedy Swamp (most recent data in 2009).	Data has been collected by appropriately trained professionals working for the GBCMA.
Ecological response of four wetlands to the application of environmental water: final report on monitoring from May to December 2008 (prepared by Australian Ecosystems, January 2009 and provided by Rolf Weber, DSE)	Monitoring records for Kinnairds Swamp, Black Swamp, Reedy Swamp and Moodies Swamp (most recent data 2008).	This report has been provided by appropriately trained professionals working for Australian Ecosystems.
NVIRP Pre-construction surveys	Records of vertebrate fauna obtained during pre-construction surveys of areas of irrigation channel where works were proposed.	As part of the NVIRP pre-construction surveys, ecological site surveys are undertaken within individual construction footprints prior to the relevant program of works. Sites are selected for ecological site surveys using a risk based process of desktop and preliminary site assessment. Field data was collected by competent field ecologists in 2009.
Victorian aquatic fauna database	Data on aquatic fauna only.	This database is administered by DSE and holds all records of fauna species within Victoria prior to 2007. Data for this database has been gathered from ecological surveys undertaken by DSE. The database was relatively up to date until approximately 2003, however, data input from surveys undertaken after this time are limited.

Source	Data Obtained	Reliability of Information
Recent unpublished and published technical reports and project specific databases	Data on aquatic fauna only	There have been extensive surveys of aquatic fauna within the GMID over the last decade that have not yet been documented on DSE and/or Department of Primary Industries (DPI) databases. Most relevant are the Sustainable Rivers Audit (Davies et al. 2008); assessment of fish in the GMID (O'Connor et al. 2008); and Living Murray Icon site fish monitoring programs (Rehwinkel and Sharpe 2009; Rourke and Tonkin 2009), as well as other site specific surveys and summary reports (e.g. Lintermans 2007; Koster et al. 2006, 2009; Stoessel 2007, 2008; Macdonald 2008).
Flora Information System (FIS)	List of MNES flora species likely to occur in GMID and a 40 km buffer south of the Victorian border	The FIS is a geographically registered, relational database of distribution and descriptive data on Victorian plants. The FIS is managed by the Information Services Section (ISS) of DSE. It contains nearly 1.8 million records of over 7,000 species, sub-species, varieties, forms, hybrids and undescribed taxa of plants (vascular and non-vascular) from over 240,000 survey or collection sites. Data have been gathered from ecological surveys carried out by DSE, herbarium specimens, professional botanists outside of DSE, competent field naturalists and the botanical literature. All distribution data within the FIS has passed through three validation tests before incorporation. Data that fails any of the tests is withheld from the FIS until it has been checked and amended.

Source	Data Obtained	Reliability of Information
Available information (sourced from the Australian Wetlands Database), predominantly in Ramsar Information Sheets (RIS) and Management Plans.	Information on wetlands of international importance	<p>This database is maintained by DEWHA and provides online access to information on Australia's Ramsar wetlands and sites listed in the Directory of Important Wetlands of Australia.</p> <p>Ramsar Information Sheest (RIS) for all sites designated as wetlands of international importance are provided to the Ramsar Secretariat at the time of nomination of a site and are updated at intervals of six years or when there are any significant changes in the sites' ecological character.</p> <p>Approved Management Plans are consistent with the Ramsar Convention, Schedule 6 of the EPBC Act Regulations 2000 and relevant National Guidelines for Ramsar Wetlands – Implementing the Ramsar Convention in Australia.</p>

4.2 Output of the Protected Matters Search Tool

The PMST and other information sources in Table 4-3 were used to search the total area of the action and the 40 km buffer for the presence of MNES. In total, ten Ramsar wetlands, 61 threatened species, 5 threatened ecological communities, 54 migratory species and 7 marine overfly species were identified as being present or potentially present in the GMID.

Four bird species are both threatened and migratory.

A summary of the species and ecological communities identified from the PMST and other information sources is included at Appendix 13.

4.2.1 Ramsar wetlands

Wetlands of international importance are wetlands that are listed under Article 2 of the Ramsar Convention for Inclusion on the List of Wetlands of International Importance. In Australia, the Commonwealth Government designates wetlands of international importance and these are protected under the EPBC Act.

Ramsar sites that could potentially be impacted by the proposed action were identified using the PMST. A total of ten Ramsar sites were identified from the seven reports generated by the PMST and their location is shown in Figure 4-1.

See Appendix 14 for a description of all 10 Ramsar sites.

4.2.1.1 Ramsar wetlands within and adjacent to the GMID

Four Ramsar wetlands are within or on the floodplain adjacent to the GMID. The sites comprise:

- Barmah Forest
- Gunbower Forest
- NSW Central Murray State Forests
- Kerang Wetlands.

4.2.1.2 Ramsar wetlands outside of the GMID

The Ramsar wetlands identified by the PMST outside of the GMID are listed below:

- Hattah-Kulkyne Lakes
- Riverland
- Banrock Station Wetland Complex
- Coorong and Lakes Alexandrina and Albert
- Fivebough and Tuckerbil Swamps
- Lake Albacutya

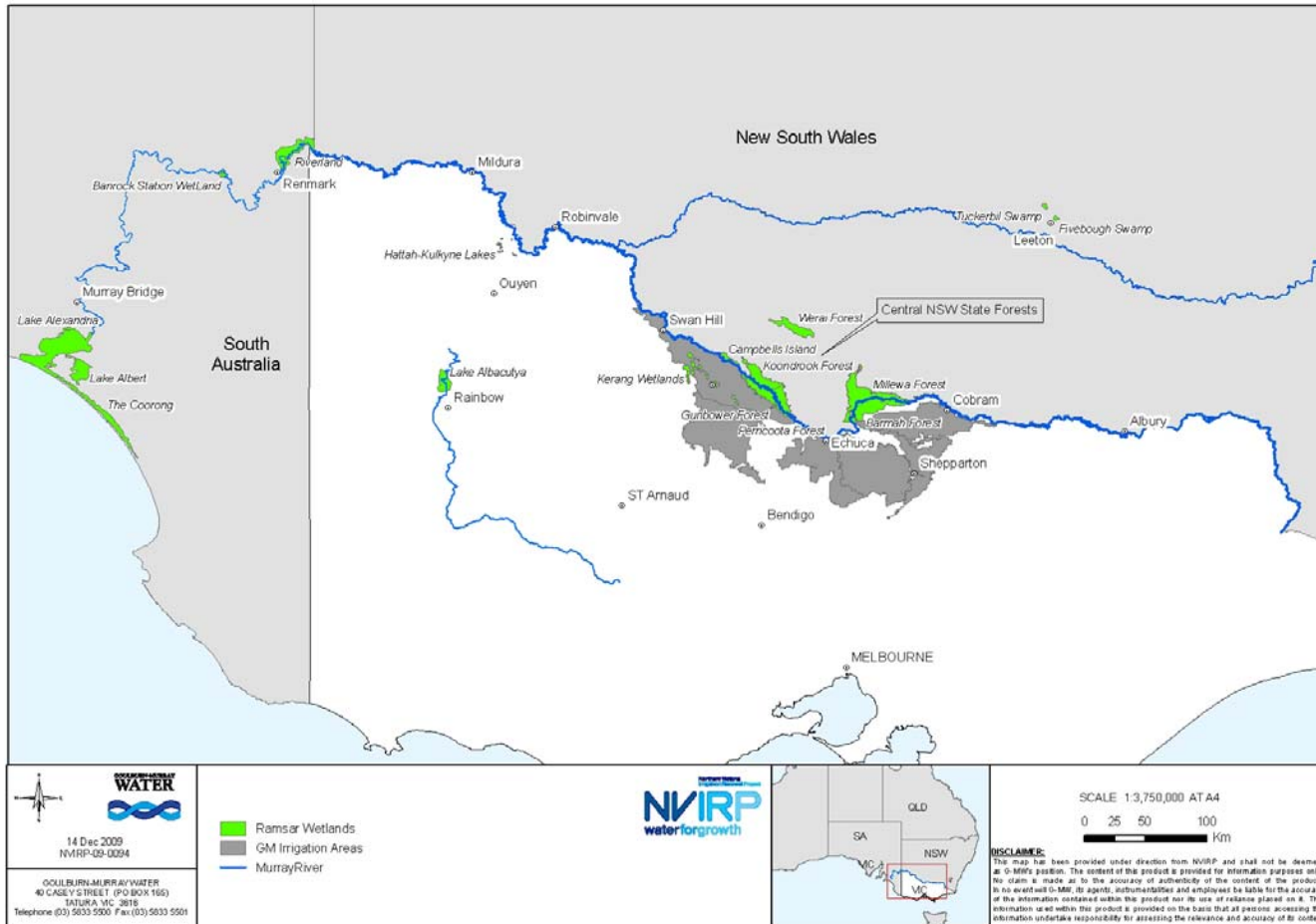


Figure 4-1: Location of the ten Ramsar wetlands identified by the PMST

4.2.2 Listed threatened species and ecological communities

A total of 61 threatened species and five threatened ecological communities (one community that was nominated for listing in April 2009 but is not yet listed has been included here) were identified as being present or potentially present in the GMID and surrounding 40 km buffer. A summary of these species, by group, is shown in Table 4-4. The full listing details for each species are shown in Appendix 13.

A description of each species and ecological community is given in Appendix 14.

Table 4-4: Summary of EPBC Act listed threatened species and communities that are present or potentially present in the GMID (+40 km buffer)

Species Group	Vulnerable	Endangered	Critically Endangered	Total Listed (Threatened)
Flora	24	12	2	38
Communities	0	2	2	5 [^]
Invertebrates	0	0	1	1
Frogs	1	0	0	1
Reptiles	2	0	0	2
Fish	2	2	0	4
Birds	6 [#]	4 [*]	0	10
Mammals	2	3	0	5
Total	37	23	5	66

[#] Australian Painted Snipe (*Rostratula australis*) and Malleefowl (*Leipoa ocellata*) are both Vulnerable and Migratory

^{*} Regent Honeyeater (*Xanthomyza phrygia*) and Black-eared Miner (*Manorina melanotis*) are both Endangered and Migratory

[^] One community, Inland Grey Box Woodland Ecological Community, has been nominated for listing but is not yet officially listed. It has been included in the total.

4.2.3 Listed migratory species

The EPBC Act list of migratory species contains species listed as either migratory (species that migrate to Australia and its external territories) or marine overfly (species that pass through or over Australian waters during their annual migrations).

The EPBC Act national list of migratory species contains species listed under International Conventions, those relevant to this project are as follows:

- Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment (JAMBA) - 1981

- Agreement between the Government of Australia and the Government of the People's Republic of China for the protection of Migratory Birds and their Environment (CAMBA) - 1988
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) - 1991
- Agreement with the Government of the Republic of Korea on the Protection of Migratory Birds, and Exchange of Notes (ROKAMBA) – 2007.

A total of 54 listed migratory species (all birds) and seven marine overfly species were identified as being present or potentially present in the GMID and surrounding 40 km buffer. A summary of these species is shown in Table 4-5 and information on each species and the International Conventions they are listed under is found in Appendix 13.

Table 4-5: Summary of EPBC Act listed migratory species that are present or potentially present in the GMID (+40 km buffer)

Species Group	Migratory	Listed Marine Overfly Species	Total Listed (Migratory and Marine Overfly)
Birds	54#*	7	61

Australian Painted Snipe (*Rostratula australis*) and Malleefowl (*Leipoa ocellata*) are both Vulnerable and Migratory

* Regent Honeyeater (*Xanthomyza phrygia*) and Black-eared Miner (*Manorina melanotis*) are both Endangered and Migratory

The full species listing for each category is shown in Appendix 13.

4.3 Impact pathways

NVIRP aims to modernise the majority of the GMID, thereby improving system efficiency and the level of service to irrigators. NVIRP will recover up to 425 GL of long term annual average system losses resulting in an overall system efficiency of around 85% through the following components of modernised operation:

- automated channels
- meter accuracy
- lined channels and piping
- reconfiguration.

The ecological consequences of the project are related to hydrological changes. The NVIRP modernisation is expected to have four potential hydrological impacts (SKM 2008, SKM 2009a, SKM 2009b):

- reduction in gross water diversions to irrigation areas due to reduced need to supply losses
- reduction in channel seepage and bank leakage resulting in reduced recharge to the groundwater system, and consequently reduced watertable levels
- changes in lateral groundwater flows and salt load into waterways
- reduction in channel outfall contributions to drains, wetlands and river flows due to improved technology and system operations.

These hydrological effects are described in more detail in Chapter 5.

All of these are planned effects, contributing to the achievement of the project's objectives, including:

- save up to 425 GL (long term annual average) of channel conveyance water losses
- coordinate irrigation modernisation and Commonwealth water buyback by assigning priority to buyback from low productivity, environmentally damaging zones which do not have a long term sustainable irrigation future while undertaking modernisation in the more environmentally and economically sustainable areas
- enhance catchment environmental outcomes by reducing the footprint of irrigation within environmentally sensitive areas of the district such as river floodplains and high salinity zones.

In many instances the modified operation will alter the hydrology towards more beneficial pre-irrigation characteristics. Leakage and seepage from the current irrigation system contribute to salinisation of wetlands, waterways and soils associated with shallow groundwater tables. This is a substantial threat to environmental values and sustainable irrigation throughout large areas of the GMID. In addition, inefficient irrigation practices lead to water-logging which is detrimental to soil quality and environmental values generally. Modernisation involves management changes at both a system and farm level that will abate these existing threats.

Modernisation will provide opportunities to improve water delivery to environmental sites in terms of capacity, seasonality and wetting and drying cycles. The improved control over water delivery will enable active management of the water resource, to mitigate any potential impacts that may result from the modified operation, and will better manage environmental assets throughout northern Victoria.

While many of the hydrological effects are expected to be beneficial, a set of impact pathways was developed to identify potential adverse impacts on MNES. The impact pathways were developed, in consultation with the authors of the ecological assessments, to show how the project related hydrological changes could have ecological consequences, including potential effects on MNES. No impact pathways other than hydrological effects were identified.

In assessing the effects, the following assumptions were made:

- Water savings of 425 GL in accordance with the project's objectives. The water savings estimates were developed using Phase 1 estimates for a water savings project, as set out in the Water Savings Protocol (Appendix 6). Phase 1 estimates provide initial long term estimates of water savings for the planned program of works, including backbone and connections.
- Allocation of 175 GL water savings as entitlements to irrigators.
- Allocation of 75 GL water savings as an entitlement to Melbourne. This is achieved by the back-trade (reduction) of inter-valley transfers to supply Melbourne from water savings on the River Murray. In practical terms this means that less water is supplied from the Goulburn River to the River Murray over the supplying period (summer and autumn), resulting in a reduction in flow in the Goulburn River. Minimum passing flows will be maintained using releases from Lake Eildon (not including environmental entitlements).
- No allocation of 175 GL water savings as an entitlement to the environment. Its use will be determined by environmental priorities at the time that cannot be predicted now. This results in a highly conservative assessment (i.e. showed worse case impacts) because it does not include the beneficial effects of the 175 GL for the environment. If the use of this water were taken into account, then there would be significant net benefits for MNES.

Each of the ecological impact assessment reports in Table 4-2 then used these impact pathways to determine the likely effects of hydrological changes on Ramsar sites, listed threatened and migratory species (including flora and ecological communities, terrestrial fauna and aquatic fauna). These are outlined in Table 4-6.

The ecological effects of the project are described in more detail in Chapter 6.

Table 4-6: Project related changes, impact pathways and potential ecological consequences from the modified operation of the fully modernised GMID

Project related change	
Reduction in gross water diversions to irrigation areas due to reduced need to supply losses	
Impact pathway	Potential ecological consequence or change
Return to more highly seasonal water regime in wetlands and waterways	<p>Ramsar sites:</p> <ul style="list-style-type: none"> Reduced waterbird habitat (summer) <p>Flora and ecological communities:</p> <ul style="list-style-type: none"> Improved habitat for indigenous aquatic and riparian vegetation. Productivity and recruitment increase <p>Terrestrial fauna:</p> <ul style="list-style-type: none"> Return to more natural wetting and drying cycle, promoting greater nutrient and carbon cycling, with periods of higher wetland productivity <p>Aquatic fauna:</p> <ul style="list-style-type: none"> Improved habitat quality, as moving to more natural conditions (such as increased productivity) which is advantageous to species and processes that are adapted to pre-regulated conditions Reduced habitat quality in flow-stressed systems that rely on outfalls for flow
Reduced spring/summer water depth (volume) in wetlands and waterways	<p>Ramsar sites:</p> <ul style="list-style-type: none"> Reduced waterbird habitat (summer) <p>Flora and ecological communities:</p> <ul style="list-style-type: none"> Reduced habitat for aquatic vegetation. Productivity and recruitment decrease Reduced water availability for riparian vegetation. Productivity and recruitment decrease <p>Terrestrial fauna:</p> <ul style="list-style-type: none"> Return to more natural wetting and drying cycle, promoting greater nutrient and carbon cycling, with periods of higher wetland productivity <p>Aquatic fauna:</p> <ul style="list-style-type: none"> Decreased habitat availability in outfall and drain dependent waterways and wetlands Altered diversity and abundance of hydraulic related habitat patches in waterways (slackwaters to fast flowing) due to alteration of waterway hydraulics Reduced habitat quality in flow-stressed systems that rely on outfalls for flow Improvement in water quality due to reduction in poor quality water sourced from irrigation channels (e.g. high nutrient loads)
Changes in salinity in wetlands and waterways	<p>Ramsar sites:</p> <ul style="list-style-type: none"> Increased salinity leads to decreased health of aquatic fauna (including native fish); decreased vegetation health and altered vegetation community composition <p>Flora and ecological communities:</p> <ul style="list-style-type: none"> Salinity exceeds the tolerance of indigenous aquatic and riparian vegetation. Productivity and recruitment decrease <p>Terrestrial fauna:</p> <ul style="list-style-type: none"> Reduction in habitat quality if salinity levels rise <p>Aquatic fauna:</p> <ul style="list-style-type: none"> Potential breach of salinity tolerance thresholds of EPBC listed species and/or critical components of their core habitat

<p>Increased temperature variability in wetlands and waterways</p>	<p>Ramsar sites:</p> <ul style="list-style-type: none"> • Interference with temperature-related triggers for breeding (mostly aquatic fauna) <p>Flora and ecological communities - nil</p> <p>Terrestrial fauna:</p> <ul style="list-style-type: none"> • Interference with temperature-related triggers or breeding (mostly aquatic fauna) <p>Aquatic fauna:</p> <ul style="list-style-type: none"> • Increased productivity • Reduced habitat quality in systems that rely on outfalls for flow • Potential breach of temperature tolerance thresholds as well as other related habitat requirements such as dissolved oxygen thresholds for EPBC listed species and/or critical components of their core habitat
<p>Changes to timing, frequency, magnitude, and duration of floodplain inundation</p>	<p>Ramsar sites:</p> <ul style="list-style-type: none"> • Potential for altered nutrient and carbon transport and subsequent reduction in instream and floodplain productivity. Flow-on impacts to waterbird and fish breeding success due to decreased food resources • Decreased vegetation health and altered community composition <p>Flora and ecological communities:</p> <ul style="list-style-type: none"> • Depending on changes in spring/summer floodplain inundation, inundation either fails to meet water requirements of aquatic and riparian vegetation in floodplain areas, or contributes to it. Productivity and recruitment decreases or increases <p>Terrestrial fauna:</p> <ul style="list-style-type: none"> • Potential for altered nutrient and carbon transport and subsequent reduction in instream productivity • Reduced habitat availability and quality for floodplain dependent fauna, due to drier conditions on floodplains <p>Aquatic fauna:</p> <ul style="list-style-type: none"> • Altered nutrient and carbon transport and subsequent reduction in productivity • Reduced input of terrestrial and flood generated prey items for aquatic fauna • Improved habitat quality, as moving to more to natural conditions which is advantageous to species and processes that are adapted to pre-regulated conditions

Project related change	
Reduction in channel seepage and bank leakage resulting in reduced recharge to the groundwater system, and consequently reduced watertable levels	
Impact pathway	Potential ecological consequence or change
Reduced depth and area in naturally saline wetlands	<p>Ramsar sites:</p> <ul style="list-style-type: none"> Increased shallow water habitats in saline wetlands, favouring some species (e.g. shorebirds) over others and reduced area of deeper saline habitats <p>Flora and ecological communities:</p> <ul style="list-style-type: none"> Loss of habitat for salt tolerant aquatic vegetation. Productivity and recruitment decrease <p>Terrestrial fauna:</p> <ul style="list-style-type: none"> Increased shallow water habitats in saline wetlands, favouring some species over others and reduced area of deeper saline habitats <p>Aquatic fauna:</p> <ul style="list-style-type: none"> Decreased habitat availability in saline wetlands Potential breach of temperature tolerance thresholds as well as other related habitat requirements such as dissolved oxygen thresholds for EPBC listed species and/or critical components of their core habitat
Reduced saline discharge into wetlands and waterways	<p>Ramsar sites:</p> <ul style="list-style-type: none"> Improved water quality and habitat in freshwater aquatic systems <p>Flora and ecological communities:</p> <ul style="list-style-type: none"> Existing salt stress to indigenous aquatic and riparian vegetation is reduced. Productivity and recruitment increase <p>Terrestrial fauna:</p> <ul style="list-style-type: none"> Improved water quality and habitat in freshwater aquatic systems <p>Aquatic fauna:</p> <ul style="list-style-type: none"> Improvement in water quality in waterways due to reduction in salinity levels Potential breach of salinity tolerance thresholds for EPBC listed species and/or critical components of their core habitat in saline wetlands
Reduced incidence of waterlogging near recharge sources	<p>Ramsar wetlands - nil</p> <p>Flora and ecological communities</p> <ul style="list-style-type: none"> Reduced availability of aquatic habitat in distribution and drainage channels affecting extent of aquatic and riparian habitat <p>Terrestrial fauna:</p> <ul style="list-style-type: none"> Reduced habitat availability and quality in wetlands dependent on waterlogging due to drier conditions <p>Aquatic fauna – nil</p>

Project related change	
Changes in lateral groundwater flows and salt load into waterways	
Impact pathway	Potential ecological consequence or change
Reduced groundwater discharge into waterways	<p>Ramsar sites:</p> <ul style="list-style-type: none"> Localised decreases in salinity near discharge zones, improving local habitat quality Reduced habitat availability and quality for floodplain dependent fauna, due to drier conditions on floodplains Return to more natural flow regime. This would be advantageous to species and processes that are adapted to pre-regulated conditions <p>Flora and ecological communities - nil</p> <p>Terrestrial fauna:</p> <ul style="list-style-type: none"> Localised decreases in salinity near discharge zones, improving local habitat quality Potential for altered nutrient and carbon transport and subsequent reduction in instream productivity Reduced habitat availability and quality for floodplain dependent fauna, due to drier conditions on floodplains <p>Aquatic fauna:</p> <ul style="list-style-type: none"> Improvement in water quality in waterways due to reduction in salinity levels
Reduced movement of salt towards wetlands and waterways	<p>Ramsar wetlands - nil</p> <p>Flora and ecological communities:</p> <ul style="list-style-type: none"> Salinity no longer exceeds the tolerance of indigenous aquatic and riparian vegetation. Productivity and recruitment increase <p>Terrestrial fauna:</p> <ul style="list-style-type: none"> Localised decreases in salinity near discharge zones, improving habitat quality <p>Aquatic fauna:</p> <ul style="list-style-type: none"> Improvement in water quality in waterways due to reduction in salinity levels
Reduced flooding of waterways with significant groundwater supplied base-flows	<p>Ramsar sites- nil</p> <p>Flora and ecological communities:</p> <ul style="list-style-type: none"> Reduction in water available to aquatic and riparian vegetation. Productivity and recruitment decrease <p>Terrestrial fauna:</p> <ul style="list-style-type: none"> Potential for altered nutrient and carbon transport and subsequent reduction in instream productivity Reduced habitat availability and quality for floodplain dependent fauna, due to drier conditions on floodplains Return to more natural flow regime. This would be advantageous to species and processes that are adapted to pre-regulated conditions <p>Aquatic fauna:</p> <ul style="list-style-type: none"> Altered nutrient and carbon transport and subsequent reduction in productivity Reduced input of terrestrial and flood generated prey items for aquatic fauna

Project related change	
Reduction in channel outfall contributions to drains, wetlands and river flows due to improved technology and system operations	
Impact pathway	Potential ecological consequence or change
Reduced spring/summer water depth (volume) in wetlands and waterways	<p>Ramsar sites:</p> <ul style="list-style-type: none"> Reduced waterbird habitat (summer) <p>Flora and ecological communities:</p> <ul style="list-style-type: none"> Reduced habitat for aquatic vegetation. Productivity and recruitment decrease Reduced water availability for riparian vegetation. Productivity and recruitment decrease <p>Terrestrial fauna:</p> <ul style="list-style-type: none"> Return to more natural wetting and drying cycle, promoting greater nutrient and carbon cycling, with periods of higher wetland productivity Reduced number of summer drought refuge habitats for waterbirds <p>Aquatic fauna:</p> <ul style="list-style-type: none"> Decreased habitat availability in outfall and drain dependent waterways and wetlands Altered diversity and abundance of hydraulic related habitat patches in waterways (slackwaters to fast flowing) due to alteration of waterway hydraulics Reduced habitat quality in flow-stressed systems that rely on outfalls for flow Improvement in water quality due to reduction in poor quality water sourced from irrigation channels (e.g. high nutrient loads)
Return to more highly seasonal water regime in wetlands and waterways	<p>Ramsar sites:</p> <ul style="list-style-type: none"> Reduced waterbird habitat (summer) <p>Flora and ecological communities:</p> <ul style="list-style-type: none"> Improved habitat for indigenous aquatic and riparian vegetation. Productivity and recruitment increase <p>Terrestrial fauna:</p> <ul style="list-style-type: none"> Return to more natural wetting and drying cycle, promoting greater nutrient and carbon cycling, with periods of higher wetland productivity Reduced number of summer drought refuge habitats for waterbirds <p>Aquatic fauna:</p> <ul style="list-style-type: none"> Improved habitat quality, as moving to more to natural conditions (such as increased productivity) which is advantageous to species and processes that are adapted to pre-regulated conditions Reduced habitat quality in flow-stressed systems that rely on outfalls for flow
Increased salinity in wetlands and waterways	<p>Ramsar sites:</p> <ul style="list-style-type: none"> Increased salinity leads to decreased health of aquatic fauna (including native fish); decreased vegetation health and altered vegetation community composition <p>Flora and ecological communities:</p> <ul style="list-style-type: none"> Salinity exceeds the tolerance of indigenous aquatic and riparian vegetation. Productivity and recruitment decrease <p>Terrestrial fauna:</p> <ul style="list-style-type: none"> Reduction in habitat quality if salinity levels rise <p>Aquatic fauna:</p> <ul style="list-style-type: none"> Potential breach of salinity tolerance thresholds of EPBC listed species and/or critical components of their core habitat

<p>Increased temperature variability in wetlands and waterways</p>	<p>Ramsar sites:</p> <ul style="list-style-type: none"> • Interference with temperature-related triggers for breeding (mostly aquatic fauna) <p>Flora and ecological communities - nil</p> <p>Terrestrial fauna:</p> <ul style="list-style-type: none"> • Interference with temperature-related triggers or breeding (mostly aquatic fauna) <p>Aquatic fauna:</p> <ul style="list-style-type: none"> • Increased productivity • Reduced habitat quality in systems that rely on outfalls for flow • Potential breach of temperature tolerance thresholds as well as other related habitat requirements such as dissolved oxygen thresholds of EPBC listed species and/or critical components of their core habitat
<p>Changes to timing, frequency, magnitude, and duration of floodplain inundation</p>	<p>Ramsar sites:</p> <ul style="list-style-type: none"> • Potential for altered nutrient and carbon transport and subsequent reduction in instream and floodplain productivity. Flow-on impacts to waterbird and fish breeding success due to decreased food resources • Decreased vegetation health and altered community composition <p>Flora and ecological communities:</p> <ul style="list-style-type: none"> • Depending on changes in spring/summer floodplain inundation, inundation either fails to meet water requirements of aquatic riparian vegetation in floodplain areas, or contributes to it. Productivity and recruitment decreases or increases <p>Terrestrial fauna:</p> <ul style="list-style-type: none"> • Potential for altered nutrient and carbon transport and subsequent reduction in instream productivity • Reduced habitat availability and quality for floodplain dependent fauna, due to drier conditions on flood plains <p>Aquatic fauna:</p> <ul style="list-style-type: none"> • Altered nutrient and carbon transport and subsequent reduction in productivity • Reduced input of terrestrial and flood generated prey items for aquatic fauna • Improved habitat quality, as moving to more to natural conditions which is advantageous to species and processes that are adapted to pre-regulated conditions

Some wetlands, which may support MNES in the GMID are maintained by environmental water delivered through irrigation channels and meters. Some of this infrastructure may not be on the backbone, therefore environmental watering needs will be taken into consideration in the modernisation of the GMID in order to maintain environmental infrastructure. This is discussed further in Chapter 7.

4.4 Summary

MNES which may be impacted by the action have been identified from the Protected Matters Search Tool (PMST) and other information sources. In total, ten Ramsar wetlands, 61 threatened species, five threatened ecological communities, 54 migratory species and seven marine overfly species were identified as being present or potentially present in the GMID. Several bird species are both threatened and migratory.

NVIRP modernisation is expected to have four potential hydrological impacts. The ecological effects of these are expected to have beneficial effects, although there remains the potential for some adverse effects on MNES.

The hydrological effects are discussed further in Chapter 5. Chapter 6 discusses the relevant impacts on MNES of the action.