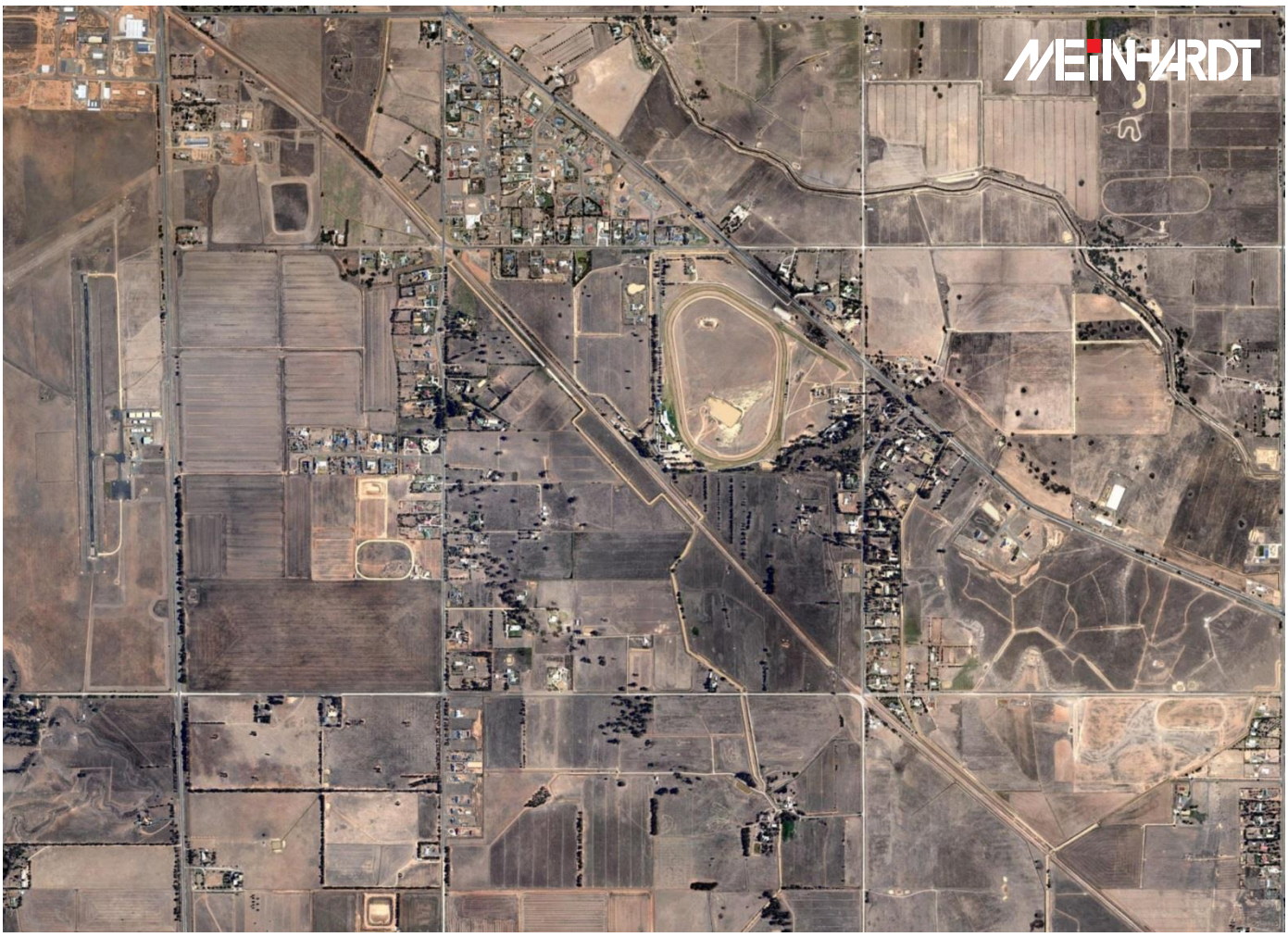

Echuca South East - Outline Drainage Plan

December 2014

Prepared For:

DTPLI & Campaspe Shire Council

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1 Executive Summary

The Shire of Campaspe is looking to facilitate the growth of the Echuca South East Rural Living Area for rural living purposes. A Precinct Structure Plan has been prepared and has considered the key strategic issues affecting the precinct. The Structure Plan has identified the need for a drainage plan which ensures that future development of the area can be appropriately drained. Preparation of an Outline Drainage plan will assist in the implementation and overall development of the Echuca South East rural living area.

The purpose of this report was to complete an assessment of the Echuca South East Rural Living Precinct (study site) following the preparation of a Precinct Structure Plan. The key objectives of this body of work were to:

- Provide an evidence base detailing the key drainage issues affecting the study area;
- Provide a logical, co-ordinated, and consistent approach to addressing drainage issues across the study area.
- Test the appropriateness of Precincts to enable Development Plans to be prepared.
- Identify information requirements to enable detailed development plans to be prepared and submitted on a precinct basis consistent with the overall strategy.

This study initially reviewed existing Stormwater Acts, Policy and Guidelines and summarised the appropriateness of such on the study area. Several local policies were identified that have been adopted by Shire of Campaspe to date.

A review of key areas of concern for drainage and flooding within the study area was identified through desktop assessment, site inspection and discussion with stakeholders. This assessment looked at issues such as land ownership, topography, drainage conveyance and flooding. The key areas requiring further assessment and flood mitigation were detailed in conjunction with proposals for formalisation of the drainage network required to facilitate development of the study area as rural living, low density residential area. A gap analysis of existing information was incorporated into findings and recommendations for future assessment were provided.

Key findings

The following key findings were determined as part of this body of work:

1. A large volume of local, state and national policy exists that is surrounding and applicable to stormwater management within the study area. This report seeks to consolidate this policy direction, providing clear objectives to the requirements of any further development within the study area.
2. The study site is an area of highly complicated topography with natural flat topography that is traversed by constructed drainage channels and local depressions which alter and sometimes limit the movement of overland flow following storm events. This complicated topography leads to a requirement for further detailed hydrological flood modelling to confirm stormwater movement, conveyance capacity and to correlate existing flood mapping.
3. Existing flood ways and 100 year flood zones can be formalised and channelized as part of any further development of the study area. This formalisation could mitigate existing flood issues within the study area.
4. A prioritisation plan for council capital drainage works within the study area, outside of parcels subject to further development, should be determined following any flood modelling of the subject site
5. A plan should be formalised for the study area that outlines formal drainage corridors, major stormwater infrastructure, allowable development densities, road reserves and other features.

Strategic benefits

Introduction of these measures will provide the following strategic benefits:

- Identification of drainage flows, areas appropriate for development, and areas requiring protection providing greater certainty for stakeholders (Council, authorities, landholders, community).
- Strategic justification for future changes to the Campaspe Planning Scheme.
- Co-ordinated land use and development – delivering better planning and development outcomes.

2 Definitions

ESRLP	Echuca South East Rural Living Precinct
G-MW	Goulburn-Murray Water
SOC	Shire of Campaspe
ARI	Average Recurrence Interval
WSUD	Water Sensitive Urban Design
NCCMA	North Central Catchment Management Authority
Clear zone	An area adjacent to traffic lanes which should be kept free from features that would be potentially hazardous to errant vehicles.
LDRZ	Low density residential zone

3 Purpose

Council is looking to facilitate the growth of the Echuca South East Rural Living Area for rural living purposes. A Precinct Structure Plan has been prepared and has considered the key strategic issues affecting the precinct. The Structure Plan has identified the need for a drainage plan which ensures that future development of the area can be appropriately drained. Preparation of an Outline Drainage plan will assist in the implementation and overall development of the Echuca South East rural living area.

3.1 Objectives

Objectives of the project seek to:

Provide an evidence base detailing the key drainage issues affecting the study area.

- Provide a logical, co-ordinated, and consistent approach to addressing drainage issues across the study area.
- Test the appropriateness of Precincts to enable Development Plans to be prepared.
- Identify information requirements to enable detailed development plans to be prepared and submitted on a precinct basis consistent with the overall strategy.

3.2 Deliverables

Key deliverables of the project are:

- Development of overall drainage plan in response to the recommendations from the Echuca South East Rural Living Precinct Structure Plan.
- Recommendations for its implementation (It is intended that Council will consider the findings of this report with the view to preparing an amendment to the Campaspe Planning Scheme in the near future).

4 Statement of Methodology

The methodology used to prepare this report is set out below in Table 1:

Table 1 - Methodology

Status	Tasks
Development of overall drainage plan in response to the recommendations from the Echuca South East Rural Living Precinct Structure Plan	• Discussions with Council Planning and Engineering Departments. • Site Visit • Discussions with GBCMA and G-MW. • Consideration of authority plans and standards. • Consider local rainfall conditions / characteristics. • Review relevant Structure Plan, including any relevant technical reports prepared to support the Structure Plan. • Review hydrology and topographical detail. • Strategic Drainage analysis. • Preparation of a Draft Drainage Plan. • Meet with client to discuss and refine draft plan. • Finalise Drainage Plan in accordance with Council instructions.
Recommendations for its implementation	• Consideration of the statutory and practical implications arising from the study and provide Council with clear direction for action.
Development of guidelines/ up skilling for Council infrastructure/ planning staff in basic principles of plan development.	• Preparation of template drainage study document with key subject headings and relevant information requirements. • Preparation of checklist for Council. • Workshop with Council officers (in conjunction with Draft Report).

5 Study area

5.1 Regional context

The ESERLP is located to the south-east of Echuca in Northern Victoria.

The location of the study area is shown in Figure 1. The study area is located approximately 1.2km east of the Campaspe River and 3km south of the Murray River at the closest point. The study area is located approximately 5km south east of the confluence of the two rivers..

Figure 1 – ESERLP locality plan

5.2 Local Context

The study area is bounded generally by the following roads:

- North : Murray Valley Highway
- South: Kelsh Road
- East: Simmie Road
- West: Mary Ann Road (some PSP are to west of Mary Ann Road)

The study area is used predominately for rural living and rural purposes. Other prominent land uses within the study area include:

- The Echuca-Toolamba Railway line (operational) running diagonally through the study area.
- Echuca Aerodrome to the west.
- Echuca Racecourse to the north.

The Floodway Overlay and Land Subject to Inundation Overlay have been applied in recognition of the flooding constraints which apply within the subject land. In the most part, these follow watercourse and natural drainage lines. Council has expressed a willingness to retain watercourses and drainage lines (as practical as possible) within any future rural residential development. Modifications to drainage lines appear to have been restricted to date to:

- Small lot development has occurred to the north.
- Roads / Rail

A structure plan and associated report was prepared for the Shire of Campaspe by Spiire in 2014. The plan developed is shown in Figure 2 below and shows precincts within the study area which (in general terms) are reflective of land ownership. The full structure plan is shown in Appendix F of this document.

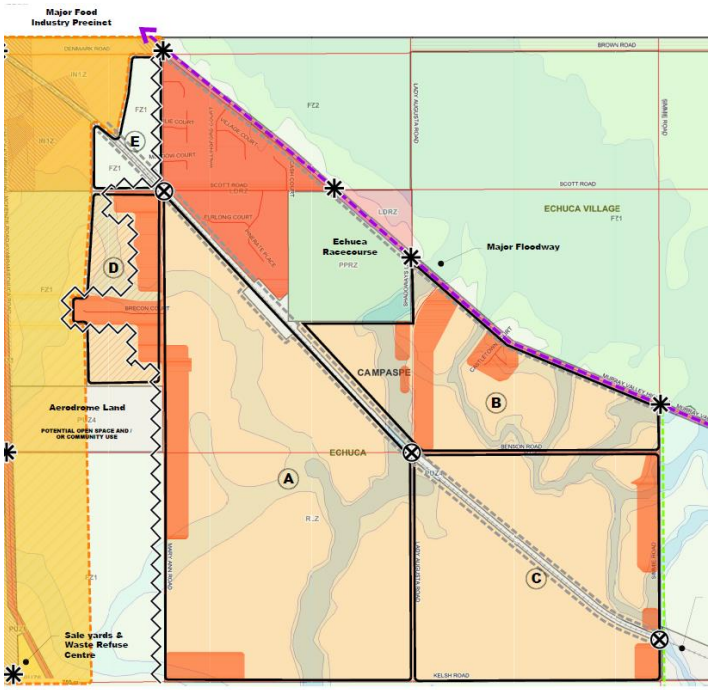


Figure 2 - ESERLP concept prepared by Spiire

5.3 Planning Policy Context

The Echuca South East Rural Living Precinct – Final Draft Structure Plan, 2014 prepared for the Study Area provides detailed consideration of planning policy affecting the subject land. It is not intended to repeat these findings. A concise summary of relevant planning policy factors is provided below.

State Planning Policy

The following State planning policies apply across the state are relevant to the consideration of settlement and drainage issues within the Study area:

- Settlement
- Environment and Landscape Values
- Environmental Risks
- Natural Resource Management
- Housing
- Economic Development
- Transport
- Infrastructure

Local Planning Policy

There are no Local policies specific to Echuca South East, although Clause 21.04-1 identifies broad strategic direction relating to Settlement which is relevant to this project. Other key themes identified in the LPPF relating to Housing, Infrastructure, Land Use, Flooding, and Environment are also of relevance to the consideration of settlement and drainage issues within the study area.

Zones

The following zones have been applied within the Study Area:

- Rural Living Zone
- Farming Zone
- Low Density Residential Zone
- Public Park and Recreation Zone
- Industrial 1 Zone

Overlays

The following Overlays have been applied within the Study Area:

- Land Subject to Inundation Overlay
- Environmental Significance Overlay
- Development Plan Overlay
- Design and Development Overlay

Planning Practice Notes and Guidelines

DTPLI Planning Practice Note 37 – Rural Residential Zones provides clear direction for the development of Rural Living land. Housing diversity, protection of natural resources, environmental and landscape capability are all key themes which emerge from the

Relevant Local and Regional Strategies

The following influence decision making relating to the rezoning and future use and development of land within the Study Area:

- Echuca South East Rural Living Precinct – Final Draft Structure Plan, 2014 provides a detailed description of the planning issues relevant to the project.
- Echuca Housing Strategy, 2011
- Regional Rural Land Use Strategy, October 2008 an August 20110
- Echuca South east Industrial and Commercial Growth Corridor Strategy – January 2011.

5.4 Key implications for arising from planning policy

The following issues arising from planning policy should be considered through the implementation of this project:

Rural Living Context

Policy and standards used to enable the consideration of settlement and drainage issues in a Rural Living context are different to those of an urban environment. This is relevant to the study area and reinforced through the DTPLI Planning Practice Note 37 – Rural Residential Zones which clearly identifies that the Rural Living Zone is not an urban or residential zone.

Applying this simple premise to the study area, and acknowledging the different factors at play which are identified in the *Echuca South East Rural Living Precinct – Final Draft Structure Plan, 2014,* we believe that drainage solutions are more likely to be realised working with the existing landscape rather than the mass re-engineering of it.

We believe that it is unlikely that drainage solutions requiring significant engineering, earthworks etc will be appropriate in a Rural Living environment due to the impact on environment, landscape, and rural amenity. Economic and financial drivers are also unlikely to support wholesale re-engineering of the subject land. Recommendations should be considered within this context.

Changing policy context

Techniques and standards for managing drainage have changed over time. It is important to recognise that what was appropriate and accepted 20 years ago will not necessarily suffice today. Environmental standards have increased, while new technologies and approaches are available to manage stormwater, drainage, and runoff. These need to be considered.

Recent changes to the Rural Living Zone provide for a more flexible approach to the use of the Zone. This includes reductions to the default minimum lot size and a “freeing-up” of additional uses which are permissible within the zone.

Any changes to zones considered through subsequent stages of the project will need to be undertaken through an Amendment to the Campaspe Planning Scheme. Consideration can be given to using the Schedule of the Rural Living Zone to specify different minimum lot sizes for within the study area.

The need for a co-ordinated approach

This drainage investigation is being undertaken within the context that some development on small lots has occurred within the study area already (particularly within the north of the study area). Different drainage solutions have been utilised. Once of the failings of existing precedents is the lack of co-ordination from one subdivision to the next. This is one of the key drivers for the project.

Council has sought a consistent and best practice approach to the management of drainage across the study area – specific to a Rural Living context. This report is not intended to provide a detailed plan for the future development of the study area. It is prepared on the expectation that more detailed planning will occur across the Study area. In this regard, we would suggest the following approach:

- Application of the Development Plan Overlay to the Study Area.
- In a general sense, this should seek to facilitate the development of smaller lots within the north of the study area, and larger lots to the south.
- The preparation of a Schedule to the Development Plan Overlay which includes:
    - Purpose
    - Objectives (Common to the study area as a whole)
    - Precinct Plan showing precinct boundaries by which a Development Plan must be prepared.
    - Any objectives specific to individual precincts.
    - Information Requirements to address for any future Development Plan.

The benefit of this approach is:

- An integrated approach to development can be applied across the precinct ensuring that both common and precinct specific issues can be addressed. With regards to drainage – Council’s overall strategy can be achieved on a piece by piece basis with clear knowledge as to “what comes next”.
- Third party appeal rights are waivered for permit applications which are deemed “generally in accordance with” the approved development plan.
- Applicants have the flexibility to prepare a Development Plan and a permit application concurrently.
- Minor modifications can be made to the Development Plan at subsequent stages without the need for a planning scheme amendment as lot designs are refined. This provides both Council and the applicant with the necessary flexibility to aid the development process.

We consider that use of the Development Plan Overlay is appropriate in this circumstance to address not only drainage considerations, but other settlement considerations (roads, environment, lot design, etc).

The need for clear guidance and an implementable solution.

We agree in broad terms with the recommended approach suggested by Spiire in the Echuca South East Rural Living Precinct – Final Draft Structure Plan, 2014 in terms of the structure of an amendment, application of precincts, informal sequencing of development, and reduction in minimum lot sizes. We provide further discussion of these issues in the recommendations section of this report.

6 Stormwater Acts, Policy and Guidelines

6.1 Acts

The Environment Protection Act 1970 is the main legislative vehicle for pollution control in Victoria. The Act establishes and defines the role of the Environment Protection Authority (EPA) and establishes controls to minimise pollution, wastes and environmental risks. It provides for the preparation of subordinate legislative tools including State Environment Protection Policies (SEPPs), works approvals, licences and notices.

The Water Act 1989 (Incorporating amendments as at 28 October 2010 is an Act of the Victorian Parliament relating to the control of water within the state of Victoria. The act has the following purposes:

a) To re-state, with amendments, the law relating to water in Victoria;
b) To provide for the integrated management of all elements of the terrestrial phase of the water cycle;
c) To promote the orderly, equitable and efficient use of water resources;
d) To make sure that water resources are conserved and properly managed for sustainable use for the benefit of present and future Victorians;
e) To maximise community involvement in the making and implementation of arrangements relating to the use, conservation or management of water resources;
f) To eliminate inconsistencies in the treatment of surface and groundwater resources and waterways;
g) to provide better definition of private water entitlements and the entitlements of Authorities;
h) to foster the provision of responsible and efficient water services suited to various needs and various consumers;
i) to provide recourse for persons affected by administrative decisions;
j) to provide formal means for the protection and enhancement of the environmental qualities of waterways and their in-stream uses;
k) to provide for the protection of catchment conditions;
l) to replace many forms of detailed administrative supervision of Authorities with general supervision by the Minister, through approved corporate plans and express directions
m) to continue in existence and to protect all public and private rights to water existing before the commencement of the relevant provisions of this Act.

The Health Act 1958 makes provision for the prevention and abatement of conditions and activities, which are or may be offensive or dangerous to public health.

The Planning and Environment Act 1987 requires the conservation and enhancement of those buildings, areas or other places which are of scientific, aesthetic, architectural or historical interest, or otherwise of special cultural value.

The Local Government Act 1989 is the current act that controls the third level of government in the State of Victoria. It resulted in the creation of 79 councils which are area-based, representative governments with a legislative and electoral mandate to manage local issues and plan for the community's needs.[1] The purpose of local government is to provide a system under which Councils perform the functions and exercise the powers conferred by or under the Act and any other Act for the peace, order and good government of their municipal districts.

The Flora and Fauna Guarantee Act 1988 specifies the protection and conservation of flora and fauna species and the management of potentially threatening processes. Threatening processes which impact on native flora and fauna which are relevant to the site include:

- *Invasion of native vegetation by environmental weeds;*
- *Increase in sediment output into Victorian waterways due to human activities;*
- *Alteration to the natural flow regimes of waterways; and*
- *Degradation of native vegetation along waterways.*

The Environment Protection (Scheduled Premises and Exemptions) Regulations 1996 describe premises and activities that are scheduled and subject to works approval and licensing provisions of the Environment Protection Act 1970. These regulations also provide for the exemption of certain scheduled activities and premises from the works approval and licensing provisions of the Environment Protection Act.

6.2 Local Policies

The Shire of Campaspe has prepared several stormwater related policies over the past two decades. Two key policies exist as follows:

- Campaspe Stormwater Management Plan Volume 1 & 2, 2001
- Shire of Campaspe, Campaspe Planning Scheme 22.07 Water Sensitive Urban Design (Stormwater Management)

The Stormwater Management Plan is the overarching stormwater management guidance document for the shire and stipulates minimum requirements for stormwater related issues. The Campaspe Stormwater Management

[1] Municipal Association of Victoria – About Local Government, accessed online December 2014

Plan is an important initiative to protect urban stormwater quality throughout the Shire of Campaspe, thereby protecting waterway values and enhancing the environmental, economic, recreational and cultural benefits they bring to the community. The Stormwater Management Plan provides a guide for Council in improving the environmental management of stormwater for major urban areas throughout the Shire.

Clause 22.07 of the Campaspe Planning Scheme stipulates requirements and minimum standards for stormwater treatment and WSUD elements constructed as part of developments within the shire.

Goulburn Murray Water is the Regional Water Authority for the subject site. GM-W is responsible under the Water Act 1989 for supplying drainage services to its gravity irrigation customers. They manage run-off from land into drainage and irrigation channels. G-MW has produced several of their own regulatory documents that relate to the management of stormwater quantity and conveyance on a larger scale. The following documents are attached in Appendix D of this report:

- G-MW Management Policy – Environment and Drainage, Acceptance of Urban and Industrial Water into Goulburn-Murray Water drains (1997/000168/1 June 2006)
- G-MW Surface Drainage Strategy, April 2000

The G-MW Surface Drainage Strategy listed out the objectives of the organisation in accordance with its surface drainage policy which states:

> *'In accordance with agreed standards and statutory obligations, Goulburn-Murray Water will manage its drainage network to agreed levels of service in an environmentally and economically sustainable manner, ensuring adverse downstream impacts are minimised'.*

The strategy outlines 14 key steps that GM-W were undertaking to meet its responsibilities stated in its surface drainage policy. The steps within this document may be somewhat outdated due to the document being prepared in 2001. The G-MW Strategic Connection Program is currently modernising the drainage and irrigation network within and around the study area. Due to confidentiality clauses surrounding this project it was difficult to gain further information from G-MW.

Conveyance of urban and industrial water (stormwater runoff, factory effluent and sewerage) is not part of G-MW's obligations under the Water Act. G-MW may therefore accept or reject discharge from such development. The G-MW Management policy, Acceptance of Urban and Industrial Water into GM-W Drains stipulates the requirements for urban, industrial and rural living developments that discharge into GM-W assets. The key policy is as follows:

> *'Direct discharge of urban and industrial waste water to G-MW water assets will only be accepted if it is of a suitable quantity and quality. G-MW supports waste water reuse, and accepts discharges of run off from land irrigated with wastewater to its drains, provided they are of suitable quality. The levels of assurance and management required by G-MW for such run off will match risk levels associated with discharges to G-MW drains from properties irrigated with waste water.*
>
> *The acceptance of discharge of urban and industrial waste water to G-MW drains will be subject to:*
>
> *i) The discharge quality conforming to the criteria specified in Schedule 1*
> *ii) The discharge quantity meeting the unit flow rates specified in Schedule 2*
> *iii) The drainage discharge connection meeting G-MW's engineering standards and operational requirements*
>
> *Schedule 1: General Water Quality Acceptance Criteria*

Suspended Solids	*30g/m^3*
Salinity	*1,200 µs/cm*
pH	*6.0-8.5*
Total Phosphorus	*2.0 g/m^3*
Total Nitrogen	*5.0 g/m^3*
5 day BOD	*40 g/m^3*
Blue Green Algae	*1,000 cells/ml*
E.Coli	*150 organisms/100ml*

Schedule 2: Drain Level of Service

Drain Level of Service	***Max. Allowable discharge Rate (l/s/ha)***
75mm of design rainfall depth in 24 hours removed in 5 days	*1.2*
50mm of design rainfall depth in 24 hours removed in 5 days	*0.7*

Above design rainfall events are equivalent to a 1 in 10 year and 1 in 2 year Average Recurrence Interval (ARI) rainfall event respectively in the Shepparton region.

The full policy is attached in Appendix D of this report.

It is recommended GM-W be consulted further on any future projects completed within the study area to determine the level of current policy and proposed modernisation works that may be completed. The modernisation work communicated to Meinhardt is discussed further in Section 7 of this report.

6.3 State Policies

State Environment Protection Policies (SEPPs) and Industrial Waste Management Policies (IWMPs) are developed under the Environment Protection Act 1970 to protect specific segments of the environment. SEPPs establish the basis for maintaining quality sufficient to protect existing and potential beneficial uses of the environment and to provide the basis for planning and licensing.

6.3.1 SEPP (Waters of Victoria) 2003

The SEPP (Waters of Victoria) 1988 and associated Variation to State Environment Protection Policy (Waters of Victoria) 2003 set acceptable water quality standards throughout the State and require government agencies and private individuals to work towards achieving and maintaining these standards. The policy also sets emission limits for waste discharges to water including a limit to the suspended solids load of stormwater discharges.

6.3.2 SEPP (Groundwaters of Victoria) 1997

The goal of this policy is to maintain and improve groundwater quality sufficient to protect existing and potential beneficial uses of groundwater throughout Victoria. Key underlying principles of the policy are:

- Groundwater is a valuable resource;
- Groundwater protection is fundamental to the protection of surface water;
- Protection of groundwater and aquifers shall be undertaken to the greatest extent practicable; and
- Protection and clean-up of groundwater is the responsibility of person/s whose activities may affect the beneficial use of that segment.

The beneficial uses that need protecting depend on the existing quality of groundwater, determined by its salinity. Where groundwater salinity is low the water has more beneficial uses, each of which require protection.

6.3.3 SEPP (Prevention and Management of Contamination of Land) 2002

The aim of this policy is to maintain and where appropriate and practicable improve the condition of the land environment sufficient to protect current and future beneficial uses of land from the detrimental effects of contamination by:

a) Preventing contamination of land; and
b) Where pollution has occurred, adopting management practices that will ensure:
   i. Unacceptable risks to human health and the environment are prevented; and
   ii. Pollution is cleaned-up or otherwise managed to protect beneficial uses.

6.3.4 The State (Victorian) Planning Policy Framework (SPPF)

The State (Victorian) Planning Policy Framework (SPPF) requires that planning authorities consider 'the impacts of poor water quality on downstream catchments and coastal marine environments, and where possible should encourage:

- The retention of natural drainage corridors with vegetated buffer zones at least 30 m wide along waterways to maintain natural drainage function, stream habitat and wildlife corridor and landscape values, to minimise erosion of stream banks and verges and to reduce polluted surface runoff from adjacent land uses;
- measures to minimise the quantity and retard the flow of stormwater runoff from developed areas; and
- Measures including the preservation of floodplain, or other land for wetlands and detention basins, to filter sediments and wastes from stormwater prior to its discharge into waterways.' (State Planning Policy Framework).

As part of the planning policy, soil is to be protected from degradation, including salinisation and erosion; adverse effects on groundwater recharge are to be minimised; land is to be used in a sustainable manner; and visual amenity and landscape quality are preserved and enhanced.

6.3.5 Other relevant policies

- Murray Darling Basin Commission Water Quality Policy, 1990

6.4 National Guidelines

6.4.1 ANZECC Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2004.

The Australian and New Zealand Environment and Conservation Council (ANZECC) guidelines provides a summary of the water quality guidelines proposed to protect and manage the environmental values supported by the water resources, outlines the management framework recommended for applying the water quality guidelines and provides advice on designing and implementing water quality monitoring and assessment programs (DEH 2006).

6.4.2 Best Practice Environmental Management Guidelines - Stormwater

The Environmental Protection Authority of Victoria (EPA) is responsible for the protection of the quality of Victoria's environment by application of the statutory powers described in the Environment Protection Act.

Urban run-off management objectives within the state of Victoria are controlled by local council planning schemes. Clause 56.07 of the Victorian Planning Scheme stipulates the minimum standards or applicable reference documents for the treatment, detention and conveyance of urban stormwater to Victorian receiving waters. A sub-clause of Clause 56.07 is the requirement that urban stormwater management systems must be *"designed to meet the current best practice performance objectives for stormwater quality as contained in the Urban Stormwater – Best Practice Environmental Management Guidelines (Victorian Stormwater Committee 1999) as amended."*[2]

This guideline, herein referred to as BPEMGS, was produced to respond to an EPA State Environment Protection Policy (SEPP) for Waters of Victoria[3]. The aim is to provide best practice objectives for the treatment of stormwater in order to ensure that runoff from urban and rural areas does not compromise beneficial use of receiving waters and also to improve the water quality of urban runoff conveyed to receiving waters.

The BPEMGS states that stormwater management should be based on the following principles:

- Preservation – preserve natural features
- Source control – limit changes to quantity and quality at source
- Structural control – use structural measures such as WSUD features

The current best practice performance objectives for stormwater stipulated with BPEMGS are shown below in Table 2.

[2] Urban Stormwater: Best Practice Environmental Management Guidelines, CSIRO 1999, Electronic Edition published 2006.
[3] State Environment Protection Policy (Waters Of Victoria), EPA Victoria, Edition 2003, accessed online

Table 2 - BPEMGS (Table 2.1) stormwater runoff performance objectives

Pollutant	Receiving water objective	Current best practice performance objective
Post construction phase		
Suspended solids (SS)	Comply with SEPP (e.g. not exceed the 90th percentile of 80mg/L	80% retention of the typical urban annual load
Total phosphorus (TP)	Comply with SEPP (e.g. base flow concentration not exceed the 90th percentile of 0.08mg/L	45% retention of the typical urban annual load
Total nitrogen (TN)	Comply with SEPP (e.g. base flow concentration not exceed the 90th percentile of 0.9mg/L	45% retention of the typical urban annual load
Litter	Comply with SEPP (e.g. no litter in waterways)	70% retention of the typical urban annual load
Flows	Maintain flows at pre-urbanisation levels	Maintain discharges for the 1.5 year ARI at pre-development levels
Construction phase		
Suspended Solids	Comply with SEPP	Effective treatment of 90% of daily run-off events
Litter	Comply with SEPP (e.g. no litter in waterways)	Prevent litter from entering stormwater system
Other pollutants	Comply with SEPP	Limit the application, generation and migration of toxic substances to the maximum extent practicable.

These objectives are applicable to developments greater than one hectare in size for residential development or five hectares for industrial development[4] or at the discretion of the planning authority.

6.4.3 Other Relevant guidelines

A summary of relevant guidelines for stormwater management within Victoria are as follows:

- Australian Rainfall and Runoff, A Guide to Flood Estimation (4th Edition, Engineers Australia, 1997)
- Australian Runoff Quality 2005
- Constructed waterways in urban environment, Melbourne Water
- Water Sensitive Urban Design Engineering Procedures 2005
- Land Development Manual (Melbourne Water, 1998);
- Infrastructure Design Manual, Victorian Councils

[4] Melbourne Water LDM Drainage Area Contributions 1.6.4

7 Discussion of existing drainage issues

7.1 Land ownership

Land ownership in the study area is fragmented with upwards of 350 land owners. Smaller lots are generally focussed towards the north of the study area and larger lots to the south. This fragmentation can make implementation of stormwater management more difficult. This level of fragmentation is not unique to the study area, and is common across the State of Victoria. It is possible to instigate area wide or localised planning controls on the different parcels of land but this can prove quite difficult on existing parcels. Controls that allow council access to manage and maintain drainage assets, such as Section 173 agreements or drainage reserves, should be added to planning permits associated with any further development or the land contained within the study area.

Through topographical and mapping analysis it can be seen that there are floodways that cross property boundaries containing dwellings. Refer to Section 7.4.1 below for detailed assessment.

Stormwater management within proposed rural living development parcels is easier to integrate into the subdivision design.

Photos of the study area shown in Appendix A give an indication of some of the drainage issues within the study area. Photo 4 shows a floodway containing water running through a private property.

7.2 Topography

7.2.1 Catchments

The study area topography is included in Appendix B. LiDAR survey information was provided under licence by North Central Catchment Management Authority (NCCMA) to be analysed as part of this study.

The study area is topographically flat with an elevation between 91.7m and 106.6m AHD and generally grades to the north and west. The catchment topography has been modified substantially since European settlement with a large number of irrigation channels, roads, dwellings and buildings and a railway line constructed. These modifications to the natural topography all affect the movement of surface water across the study area. Storm flow is generally conveyed initially overland and then to minor depressions and channels which convey flows to major floodways and depressions.

A major floodway traverses the site north from Kelsh Road splitting to the Echuca Racecourse and McKenzie Road. Smaller floodways exist in the Simmie Road vicinity which also drains north towards Murray Valley Highway.

7.3 Drainage conveyance

7.3.1 Existing drainage conveyance

Drainage conveyance across the study area is generally via open swale drains and sheet flow. Channels and floodways are conveyed across surface features such as roads and the railway by piped culvert. Anecdotal evidence and a flood study of the north west portion of the study area currently being completed by consultants GHD[5] for the Shire of Campaspe suggest that constructed stormwater infrastructure in some areas is not adequately sized to convey storm flows.

Assessment of the capacity of existing culvert and channel infrastructure to catchment flows adequately is not part of this study but should be completed in future hydrological analysis of the study area.

Evidence provided by council suggests that the majority of the study drains to the north with some draining west. Further hydrological assessment and catchment delineation is required to confirm this. All flows to the north are intercepted by the G-MW Southern Cross Drain which is located north of the Murray Valley Highway. Flows discharging to this G-MW asset are controlled by G-MW flow acceptance policy.

Community Surface Drains also exist within the study area and the wider G-MW regulatory region. The schemes are still a feature of the Water Act. These drains are drainage assets generally through private property that are managed through the community group with council acting as a mechanism for collecting rates for maintenance. G-MW generally control the Community Surface Drains on behalf of Community

A Community Surface Drain exists on Lady Augusta Drive within the study area.

7.3.2 Irrigation Channels

Irrigation channels that form part of the Goulburn-Murray Water (G-MW) irrigation network traverse the study site. The locations of these channels are shown in Appendix B.

[5] GHD Echuca South Drainage Study – Hydraulic Modelling and Options Report, Shire of Campaspe 2014

7.3.3 Irrigation channel modernisation project

Goulburn-Murray Water is currently undertaking a modernisation project of the irrigation infrastructure within the Murray Goulburn Basin. G-MW representatives have confirmed modernisation within the study area is proposed. Detailed information of proposed modernisation was not available at the time of writing but it is believed any modernisation may have the following effects on the study area:

- Decommissioning and full backfilling of spur lines
- Piping of some existing backbone channels and decommissioning of channels (extent of works to be confirmed by G-MW)
- Decommissioning of channels will result in changes to catchment topography and flow corridors due to backfilling of existing channels
- Formalisation and modernisation of existing drainage channels may provide more conveyance capacity.

The extent of G-MW channels and proposed high level approach to modernisation is shown in Appendix E of this report.

7.4 Flooding

7.4.1 Floodways and inundation

Defined floodways and 100 year ARI event flood zones exist within the study area and can be attributed to the Murray River and Campaspe River flood plains.

As shown in the flood map contained within Appendix B there is a large portion of the study area contained within existing floodways or inundated within the 1 in 100 year ARI event. The approximate delineation of these areas is as follows:

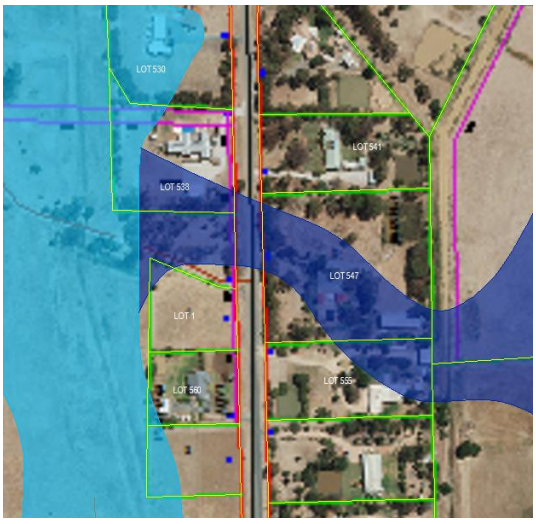
- Total site area = 950ha
- 100 year ARI event inundation = Approximately 190ha
- Floodway area (on top of 100 year ARI event inundation) = Approximately 130ha

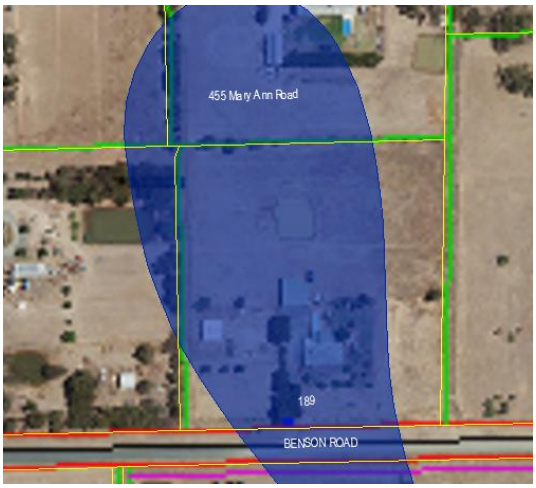
An NCCMA major flood level plan is attached as Appendix B.

Floodways are known to cross several of the developed properties within the study area (properties with dwellings). The properties affected are shown in Table 3. The photo log attached in Appendix A gives more details of sites discussed below in Table 3.

Further 2d hydrological modelling is required to confirm the expected flooding depths for the 1 in 100 year ARI event, determine what level of flooding may occur within these properties and any flood mitigation measures that would be suitable. Data analysis is limited to desktop review of flood levels and contour information.

Table 3 - Flood way and 100 year ARI flood interaction with developed properties

Address	Issue	Discussion
530 Shadoways Lane 538 Shadoways Lane 547 Shadoways Lane 560 Shadoways Lane 555 Shadoways Lane		A major floodway crosses Shadoways Lane through private property. Council should investigate existing title controls on subject properties and look for construct a formal drainage channel and associated road crossing to mitigate risk of flooding to dwellings. Formalisation of the major south-north channel as part of future development could further mitigate risk of flooding to properties in Shadoways lane

Address	Issue	Discussion
1 Foxdale Court 2 Foxdale Court 3 Foxdale Court 4 Foxdale Court 2 Castletown Court 6 Castletown Court 7 Castletown Court		Construction of the residental subdivision and Castletown Crt has resulted in diversion of some flood flows around the south of the residential lots. A pumped outfall retention basin associated with the development consists of permanent water body with detention head space to allow for storage of the 1 in 100 year ARI event prior to pumped discharge. Further catchment storage could be provided by drawing down the entirety of the storage in the period after rainfall to provide more capacity for minor and major floods.
12 Brecon Court 24 Brecon Court 30 Brecon Court 35 Brecon Court 38 Brecon Court 46 Brecon Court 48 Brecon Court 54 Brecon Court 58 Brecon Court Echuca Historical Society Museum (not shown)		A floodway exists across Mary Ann Road with an existing pipe that acts as a siphon with a depression in the road pavement allowing conveyance of the 1 in 100 year ARI event flows. It appears that substantial overland flooding still occurs in major rainfall events. Site inspection indicates the road crossing culvert requires maintenance as water was still pooled in the area. The road crossing culvert could be upsized to accommodate additional storm flows and prevent backlog of flows.
455 Mary Ann Road 189 Benson Road		Flooding in these properties is due to topography with a local low point. It is recommended mitigation could occur as part of any future development of this parcel with cutoff channel on Benson Road and localised filling to remove low point.

Address	Issue	Discussion
488 Simmie Road 624 Simmie Road 632 Simmie Road 636 Simmie Road 640 Simmie Road 650 Simmie Road 682 Simmie Road 686 Simmie Road 688 Simmie Road 720 Simmie Road 724 Simmie Road		Further assessment of this area is required. Anecdotal evidence has suggested flooding occurs from inflow from the east of Simmie Road but also potentially in major storm events through flooding of the irrigation channel. It is noted that some dwellings have floor levels below that of the GM-W irrigation channel.

Table Key

Defined floodway (also incorporates 100 year ARI event flood inundation)

100 year ARI event flood inundation

Data source: Victorian Water Resources, MapShare, accessed online

In addition to the above flood overlays, site specific feedback has been provided by Goulburn Broken Catchment Management Authority (Guy Tierney email 10.11.14 GBCMA). Figure 3 shows the additional flooding issues that have been identified by GBCMA

The following text is associated with this figure:

> *Mr Barnes (land owner) is concerned about a number of dwellings at near risk of above floor flooding and the significant duration of flooding (three months). He wants drainage relief for the area including his neighbours.*
>
> *There are two blockages: Benson Road "T" intersection with Simmie Road, and a private concrete irrigation pipeline supply (as shown in figure) which has been present for decades. Mr Barnes has constructed a drain to assist drainage conveyance through to a G-MW culvert, but ultimately, water ponds upstream of the two obstructions.*
>
> *The priority for Mr Barnes is to have a culvert placed under Benson Road (at the "T" intersection) to take drainage along the Simmie Road table-drain to the MVH and beyond to the Deakin Main Drain (under the control of G-MW). Mr Barnes see this as a practicable solution for all.*
>
> *Ultimately Mr Barnes would like to see a subway placed under the concrete pipeline and the 300mm pipe culvert in the MVH at least duplicated.*

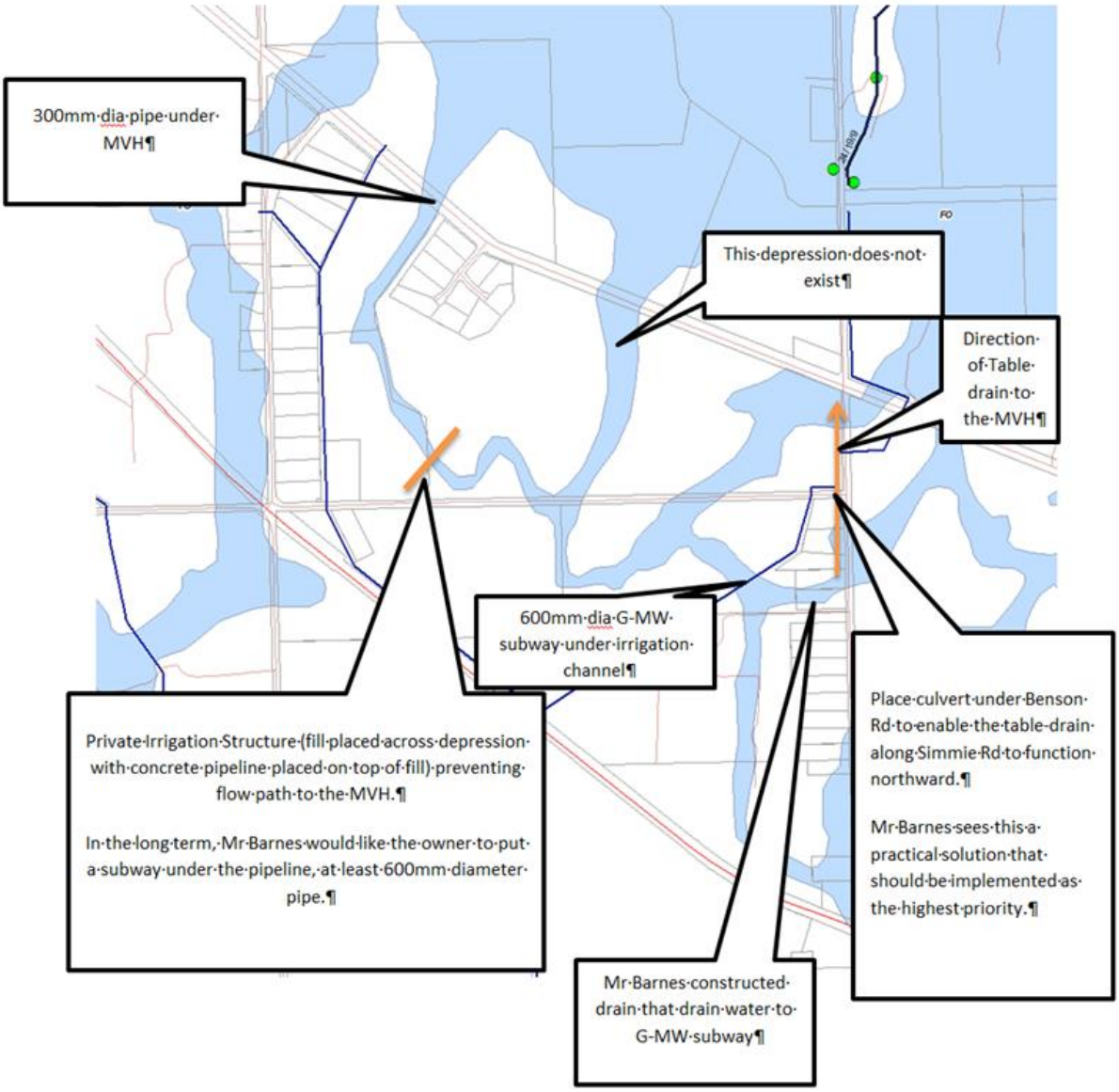


Figure 3 - GBCMA existing condition comments

7.5 Stormwater Quality

Existing stormwater quality is difficult to estimate for the study area without detailed assessment. Stormwater quality can be divided into two main runoff categories for the investigation area. These are as follows:

- **Constructed catchment runoff:** Runoff from areas of road, dwellings and other developed areas that have formalised drainage infrastructure such as pits and pipes, swales and channels
- **Rural catchment runoff:** Sheet flow runoff across agricultural areas to topographical low points or formal channels

It is assumed that runoff quality is of reasonably high quality due to the amount of buffer between stormwater source and outfall to major drainage channels. Stormwater flow over agricultural fields and within drainage swales can encourage sedimentation and drop out of suspended solids hence resulting in higher quality outfall prior to discharge to receiving waters.

There is limited or no formal stormwater treatment infrastructure within the study area currently other than drainage swales. Buffer strips (large areas of overland flow) and drainage swales do form part of an effective part of a stormwater treatment train but fall short of providing full treatment to stormwater runoff, particularly runoff from urban or rural living catchments. The following statement from WSUD Engineering Procedures[6] describes the function of such swales:

> "The interaction between flow and vegetation along swales facilitates pollutant settlement and retention. Swale vegetation acts to spread and slow velocities, which in turn aids sediment deposition. Swales alone can rarely provide sufficient treatment to meet objectives for all pollutants, but can provide an important pre-treatment function for other Water Sensitive Urban Design (WSUD) measures. They are particularly good at coarse sediment removal and can be incorporated in street designs to enhance the aesthetics of an area.
>
> Buffer strips (or buffers) are areas of vegetation through which runoff passes while travelling to a discharge point. They reduce sediment loads by passing a shallow depth of flow though vegetation and rely upon well-distributed shallow flows across them. Interaction with the vegetation tends to slow velocities and coarse sediments are retained. Buffers can be used as edges to swales, particularly where flows are distributed along the banks of the swale."

Stormwater runoff quality is heavily influenced by agricultural practices and condition of fields and paddocks. Effective management of runoff is controlled by Catchment Management Authorities.

[6] WSUD Engineering Procedures Stormwater, CSIRO, 2005

8 Outline Drainage plan

8.1 Limitations

Due to the complicated topography within the study area it is not possible to determine stormwater discharge flow rates without detailed topographic, hydrological and hydraulic analysis. This analysis was not part of the brief for this phase of the project but is recommended as the next stage of the project.

8.2 Design Criteria

The Shire of Campaspe is a signatory to the Infrastructure Design Manual (IDM Version 4.2, 2013). The IDM was designed to document and standardise Council requirements for the design of development infrastructure. The document has been adopted by 41 Victorian councils currently and stipulates design criteria for all elements of Engineering design and construction of rural and urban development. The IDM clauses applicable as part of this drainage plan are as follows:

- Clause 17, Rural Drainage
- Clause 18, Retardation Basins
- Clause 19, On-site Detention Systems
- Clause 20, Stormwater Treatment
- Clause 21, Stormwater Discharge Points
- Clause 22, Environmental Management During Construction

The design and construction of any future development of the study area should be in line with the IDM and any additional local authority requirements.

IDM takes precedence over other relevant design standards. Where specific requirements are not available within IDM designers should refer to Austroads Guide to Road Design Part 5: Drainage Design and any Vicroads supplement.

8.3 Land Ownership

Council may need to acquire drainage reserves or easements over existing developed rural living properties where known floodways exist as documented in Table 3 or this report. Evidence provided by the council planning team suggests that some properties with channels traversing them already have either easements, drainage reserves or S173 agreements allowing council access to properties. These existing title controls should be utilised to allow the formalisation of drainage channels to convey minor and major flows through the area more effectively by removing choke points in the area. Further input from council is required to confirm access agreements. It is recommended that the full width of any easement or reserve be taken to construct large capacity channels.

8.4 Topography

The existing topography and drainage ability of the study area is controlled by constructed surface features such as roads, irrigation channels and a railway line. Filling and reshaping of development areas to drain to major channels would mitigate flooding private property.

8.5 Flooding

Flooding in major events has been identified as an issue within the study area. Any further development of the study area should be accompanied by a hydrological flood study to confirm floodwater coverage and determine the level of earthworks required to construct formal corridors. Flood mitigation opportunities exist across the study area through formalisation of corridors and channels to ensure developable area is maximised.

8.5.1 Floor levels

All proposed building floor levels should be set at a **minimum 300mm above** the major flood level (1 in 100 year ARI event) determined by any hydrological flood study of the study area.

8.6 Stormwater Conveyance

A large percentage of the study area currently lacks formal stormwater infrastructure. Areas drain overland to irrigation channels and natural depressions which results in surface flooding in major events. Localised stormwater infrastructure is provided for developed parcels but the integration of these networks with the wider study area is required in order to facilitate further development.

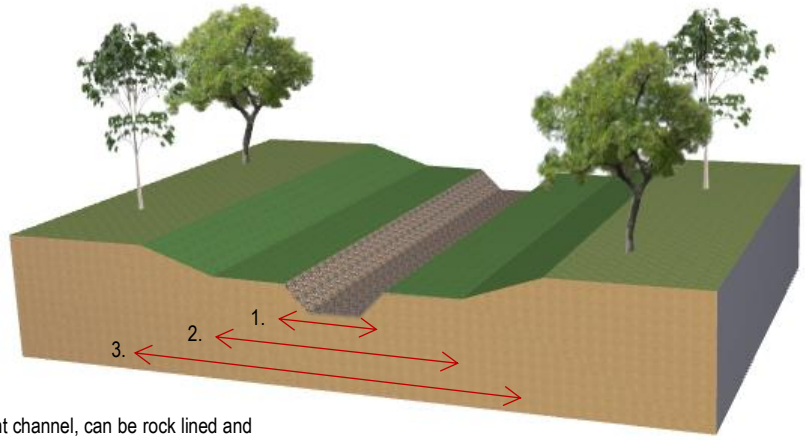
A preliminary drainage channel concept has been developed for the study area and is attached in Appendix C. This network formalises existing floodways and 100 year ARI event flood zones and would allow for conveyance of storm flows away from the area. The design intent for these channels is that all surface flooding be contained

within the extremities of the constructed channels. Further assessment is required to confirm the interaction between proposed channels and existing irrigation channels and other surface features. Culverts may be required to convey floodwater across channels.

8.6.1 Floodways and drainage channels

Formalisation of floodways through constructed drainage channels will mitigate the major storm flooding that currently occurs within the study area. The following design criteria should be adopted for any constructed floodways or drainage channels:

- Fully contain 100 year ARI storm flow for catchment within design profile;
- be on located within road reserves, drainage reserves or Public Open Space;
- Minimum width of easements is 5 metres;
- The desirable maximum side batter slope within the clear zone is 1 in 6, with the absolute maximum batter slope of 1 in 4. Where the floodway or drainage channel is outside the clear zone the maximum batter slope is 1 in 1.5;
- A minimum longitudinal slope of earth drains is 1 in 2000 (As per IDM Table 16);
- Minimum base width of 1m;
- Minimum flow velocity for minor design storm to ensure sediment conveyance for design particle;
- Maximum average flow velocity 1.5m/s;
- Product of depth (in m) and velocity of flow (in m/s) should be no more than 0.35m^2/s;
- Depth should be limited to a maximum of 1.2m where possible;
- Channel to be trapezoidal with typical low flow section as per Figure 4.



1. Minor storm event channel, can be rock lined and should meander through channel profile as natural stream, maximum width should be limited
2. Major storm event channel, grass lined
3. Extent of drainage channel, 300mm vertical freeboard should be provided for major storm event

Figure 4 - Typical drainage channel profile

Any floodways and drainage channels are to be designed in accordance with council, CMA and relevant authorities as per the IDM and Austroads Guide to Road Design Part 5: Drainage Design

Where overland floodwaters or flood-storage is or will be altered or changed as part of a Development, compensatory works must be assessed and implemented.

8.7 Stormwater Detention

As regional centres like Echuca continue to expand, development moves into areas served by G-MW drains. This pre-existing drainage infrastructure was designed to convey runoff from rural catchments and in most cases must continue to do so to rural properties upstream and downstream of urban development.

The increase in impervious area as a result of urban development into rural catchments increases both the volume and time of concentration of runoff to the drainage network. G-MW's regional drains are generally constructed to provide either a 1 in 2 year, or 1 in 10 year level of service.[7] That is, they are designed to remove within a defined period (usually 5 days) the runoff resulting from the design rainfall event falling uniformly over an irrigated catchment.

[7] Drainage Discharge Agreements – A way of managing risk, Mr. Sam Green, Goulburn Murray Water, accessed online through irrigation.org.au publications

Stormwater detention is required for any proposed development within the study area. In areas that outfall to Goulburn Murray Water assets (Southern Cross drain) council have requested G-MW rates to apply for LDRZ being 1.2 L/s/Ha for 1 in 100 year ARI events with a storm duration of 72 Hours.

In the case of zero discharge applications for the 1 in 100 ARI event a 24 hour duration storm should be used to size detention basins.

In areas where discharge is not to G-MW assets runoff will be restricted to predevelopment runoff rates for all events up to and including the 1 in 100 year ARI event in order to mitigate flooding within the study area.

A discharge coefficient of C= 0.4 applies to LDRZ zoning.

Any discharge to the G-MW drain network is subject to the approval of the authority and requires appropriate hydrological assessment to prove discharge is in line with the above requirements and those set out in G-MW Management Policy 1997/000168/1 Acceptance of Urban and Industrial Water into Goulburn Murray Water Drains (Attached in Appendix D). Any detention storage provided should be in line with G-MW Surface Drainage Strategy.

Further flood assessment recommended as part of the conclusions to this plan would allow for positioning of any regional detention facilities or flood mitigation measures.

8.8 Stormwater Quality

As discussed in Section 6.4.2 of this report, strict water quality objectives exist for subdivision of any land within the State of Victoria. Where proposed subdivision is greater than 1 hectare in size, water quality objectives outlined in BPEMGS must be adhered to. Water quality objectives can be met through the integration of a treatment train of Water Sensitive Urban Design (WSUD) measures.

The WSUD measures used in low-density residential environments varies from their urban counterparts. This is mainly due to design objectives, contributing catchment areas and the space available for such measures. Figure 5 and Figure 6 below show the difference between low and medium-high density development. Low density residential is generally characterised by the following design elements:

- Limited or no kerb and channel on roads;
- Road pavement falling to roadside swales for conveyance to major drainage system;
- Absence of formal nature strips;
- Larger lots resulting in fewer driveway entry points.
- Use of culverts for drainage conveyance as opposed to pit and pipe conveyance.

Figure 5 - Typical rural-residential road design

Figure 6 - Typical urban road design

A summary of WSUD measures traditionally applied in a low-density residential setting is shown below in

.

Table 4 - WSUD measures summary

WSUD Element	Use	Benefits	Limitations
Rainwater tanks 	Rainwater tanks are an effective WSUD measure and can be utilised on constructed buildings or underground to drain hard stand areas. Rainwater tanks can also be utilised as detention storage to lower the peak storm flow	- Reduced volume of runoff from development due to water usage - Reduce potable water demand - Detain or delay storm peak if tank not at capacity - Can be applied to individual lot scale - Low capital outlay	- Beneficial use of rainwater limits catchment type generally to roof or treated hard stand - Catchment areas limit potential stored volume - Water quality improvements achieved only through use of rainwater rather than biological process
Vegetated Swales 	Vegetated swales are used to convey stormwater in lieu of pipes. They provide a buffer between source and receiving waters and allow bioretention, sedimentation and infiltration treatment of stormwater flows	- Lower construction cost than other WSUD measures - Effective in topographically flat areas - Varied cross sectional profiles allow swales to be effective in many situations - Reduce stormwater volume through infiltration and evaporation	- Vegetation maintenance can be difficult - Most effective on slopes of 2 to 4%. For steep sites check dams required - Requires land corridors and easements that limit developable area
Rain gardens 	Bioretention basins are a constructed basin lined with an engineered filter media and vegetated with select plants. They can be used on small or medium sized catchments and are considered one of the more effective treatment measures due to the nutrient reductions achieved verses footprint required.	- Smaller footprint for same treatment efficiency as other WSUD measures - Able to be incorporated into urban environment - No permanent water body - Aesthetically pleasing due to vegetation - Large flexibility in design and shape.	- Require ongoing maintenance of vegetation, filtration media and inlet and outlet zones. - Require complete rebuild every 10 -15 years depending on incoming loading - Susceptible to damage from building construction on estates if not managed
Constructed Wetlands 	Constructed wetlands are multi zoned, shallow and extensively vegetated water bodies used for treatment of stormwater. Constructed wetlands can incorporate detention storage zones to mitigate increases in peak storm flows post development. They utilise fine filtration, long retention and pollutant uptake processes treat stormwater runoff.	- Can be small or large scale, good for regional treatment - Adds aesthetic value to a development by providing green space - Increases local biodiversity and provide habitat for fauna - Can be incorporated into public open space areas	- Permanent water body can cause safety issues - Ineffective management can lead to stagnant water and mosquito growth - Large capital outlay - Large land take due to configuration required to achieve effective flow through and treatment

8.8.1 Water quality requirements

Water quality requirements for any rural living developments should be in line with BPEMGS requirements for water quantity, quality and detention as shown in Table 2.

9 Recommendations

9.1 Objectives

A summary of Council's drainage management objectives are:

9.1.1 Water quality objectives

Table 5 contains an extract from the Campaspe Planning Scheme Clause 22.07 Water Sensitive Urban Design that refers to the minimum stormwater quality objectives for any development within the study area

Table 5 - Water quality objectives

Policy	Objective
Reference Document	Ensure that developments are designed to include best practice measures for stormwater quality such as those contained in the Urban Stormwater Best Practice Environmental Management Guidelines, CSIRO 1999as amended.
Nutrient Reduction Targets	Ensure post construction stormwater run-off should be treated to remove 80% suspended solids, 45% total phosphorous and 45% total nitrogen of typical urban annual load and maintain discharges for the 1.5 year ARI at pre-development levels.
Gross pollutant management	Ensure stormwater quality treatment measures be designed to prevent litter being carried to receiving waters. This includes, appropriate design of waste enclosures and use of gross pollutant traps for development with potential to generate significant amounts of litter.

9.1.2 Detention objectives

Table 6 below outlines the stormwater detention objectives of council for the study area. These objectives are influenced by GM-W assets within the study area.

Table 6 - Detention objectives

Outfall type	Objective
Outfall to GM-W drainage channels and assets	Discharge rate of 1.2 L/s/Ha for 1 in 100 year ARI events with a storm duration of 72 Hours.
Outfall to all other areas	No increased flow rate from pre-developed conditions for all events up to 1 in 100 year ARI event

9.1.3 Storm flow conveyance objectives

Table 7 - Storm flow conveyance objectives

Storm Event	Objective
Up to 1 in 3 month ARI storm event Regular Event	Conveyance through formal drainage infrastructure and treatment of all stormwater runoff to the council water quality reduction objectives
Up to 1 in 5 year ARI storm event Minor Event	Conveyance through formal drainage infrastructure such as constructed channels, pipes and culverts
Up to 1 in 100 year ARI storm event Major Event	Conveyance of storm flows overland and within major drainage channels. Building floor levels to be at least 300mm above major event flood level

9.2 Relevant standards

The following engineering standards should be imposed on developers by council:

- IDM
- Shire of Campaspe, Campaspe Planning Scheme 22.07 Water Sensitive Urban Design (Stormwater Management)
- Campaspe Stormwater Management Plan, Shire of Campaspe, December, 2001
- BPEMG Stormwater Guidelines
- Guidelines for rural living
- Stormwater Management Devices: Design Guidelines Manual (TP10) (Auckland Regional Council 2003)

10 Implementation

10.1 Key findings

The following key findings were determined as part of this body of work:

1. A large volume of local, state and national policy exists that is surrounding and applicable to stormwater management within the study area. This report seeks to consolidate this policy direction, providing clear objectives to the requirements of any further development within the study area.
2. The study site is an area of highly complicated topography with natural flat topography that is traversed by constructed drainage channels and local depressions which alter and sometimes limit the movement of overland flow following storm events. This complicated topography leads to a requirement for further detailed hydrological flood modelling to confirm stormwater movement, conveyance capacity and to correlate existing flood mapping.
3. Existing flood ways and 100 year flood zones can be formalised and channelized as part of any further development of the study area. This formalisation could mitigate existing flood issues within the study area.
4. A prioritisation plan for council capital drainage works within the study area, outside of parcels subject to further development, should be determined following any flood modelling of the subject site
5. A plan should be formalised for the study area that outlines formal drainage corridors, major stormwater infrastructure, allowable development densities, road reserves and other features.

10.2 Future Work

10.2.1 Stormwater Analysis and design

Due to the complicated topography within the study area it is not possible to determine stormwater discharge flow rates without detailed topographic, hydrological and hydraulic analysis. This analysis was not part of the brief for this phase of the project but is recommended as the next stage of the project. Prior to any further development within the study area, a detailed hydrological flood assessment of the study area should be completed to confirm major storm event flood locations and levels. A 2d hydrological analysis of the study area within TUFLOW model or similar would be most appropriate given the number of catchments that exist due to surface features such as roads, drainage and irrigation channels and a railway line.

The following are considered the next steps required for implementation of an affective drainage plan for the study area:

Step 1

- Completion of a ESERLP Flood study (hydrological flood assessment) to confirm and locate flood prone areas, estimate major drainage corridor and culvert crossing flows and quantify and propose mitigation options for major storm event flood areas.
- Coordinate findings from ESERLP with G-MW modernisation program to ensure any works are supportive of modernisation project outcomes;
- Council review of drainage easements, reserves or S173 agreements on properties where major drainage conveyance channels exist, for example within Shadoways Lane, in order to allow construction of formal channels to remove choke points

Step 2

- Identify flood mitigation works within the study area but outside of future developable areas for inclusion in council capital drainage works program;
- Utilise findings of this report and of the ESERLP flood study to complete an overarching drainage layout for the study area which stipulates major drainage channel layout and sizes required, mitigation works and capital works. This will enable council to control the location of drainage channels and corridor widths prior to any further development of the study area;
- Require inclusion of the following statement in any planning scheme for the study area *"a drainage management plan in line with the ESERLP Flood study must be prepared and implemented for the area and approved by the Council and the floodplain management authority";*

Step 3

- Functional and detailed design of scheme drainage channels, flood mitigation works and capital drainage works developed in Steps 1 and 2

10.2.2 Planning Scheme Amendment

We would assume that Council will seek to implement the findings of this report when its seeks to implement the Structure Plan for the broader area. Changes specific to the subject land would include:

MSS and Local Planning Policy

- Clarify the role of the Echuca South East Area and acknowledge the need for
- Specify future work to include preparation of a hydraulic analysis of the subject land.

Application of the Rural Living Zone

Consideration can be given to using the Schedule of the Rural Living Zone to specify different minimum lot sizes for within the study area. In a general sense, this should seek to facilitate the development of smaller lots within the north of the study area, and larger lots to the south.

Application of the Development Plan Overlay

This report is not intended to provide a detailed plan for the future development of the study area. It is prepared on the expectation that more detailed planning will occur across the Study area. Given current land ownership, this is most likely to be facilitated on a precinct by precinct basis.

In this regard, we would suggest the following approach:

- Application of the Development Plan Overlay to the Study Area.
- The preparation of a Schedule to the Development Plan Overlay which includes:
    - Purpose
    - Objectives (Common to the study area as a whole)
    - Precinct Plan showing precinct boundaries by which a Development Plan must be prepared.
    - Any objectives specific to individual precincts.
    - Information Requirements to address for any future Development Plan.

10.2.3 Preparation of Development Plans and planning permit applications

Following the preparation of a planning scheme amendment (or concurrent with the draft planning provisions being developed), Development Plans can be prepared for each precinct. The Development Plan Overlay should specify the minimum information requirements necessary to support a Development Plan: Once approved by Council, permit applications submitted generally in accordance with an approved Development Plan are exempt from third party notice and review. In practice, permit applications should

Development Plan Overlay

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- The preparation of a Schedule to the Development Plan Overlay which includes:
    - Purpose
    - Objectives (Common to the study area as a whole)
    - Precinct Plan showing precinct boundaries by which a Development Plan must be prepared.
    - Any objectives specific to individual precincts.
    - Information Requirements to address for any future Development Plan.

The benefit of this approach is:

- An integrated approach to development can be applied across the precinct ensuring that both common and precinct specific issues can be addressed. With regards to drainage – Council's overall strategy can be achieved on a piece by piece basis with clear knowledge as to "what comes next".
- Third party appeal rights are waivered for permit applications which are deemed "generally in accordance with" the approved development plan.
- Applicants have the flexibility to prepare a Development Plan and a permit application concurrently.
- Minor modifications can be made to the Development Plan at subsequent stages without the need for a planning scheme amendment as lot designs are refined. This provides both Council and the applicant with the necessary flexibility to aid the development process.

We consider that use of the Development Plan Overlay is appropriate in this circumstance to address not only drainage considerations, but other settlement considerations (roads, environment, lot design, etc).

Appendix A. Photo Log

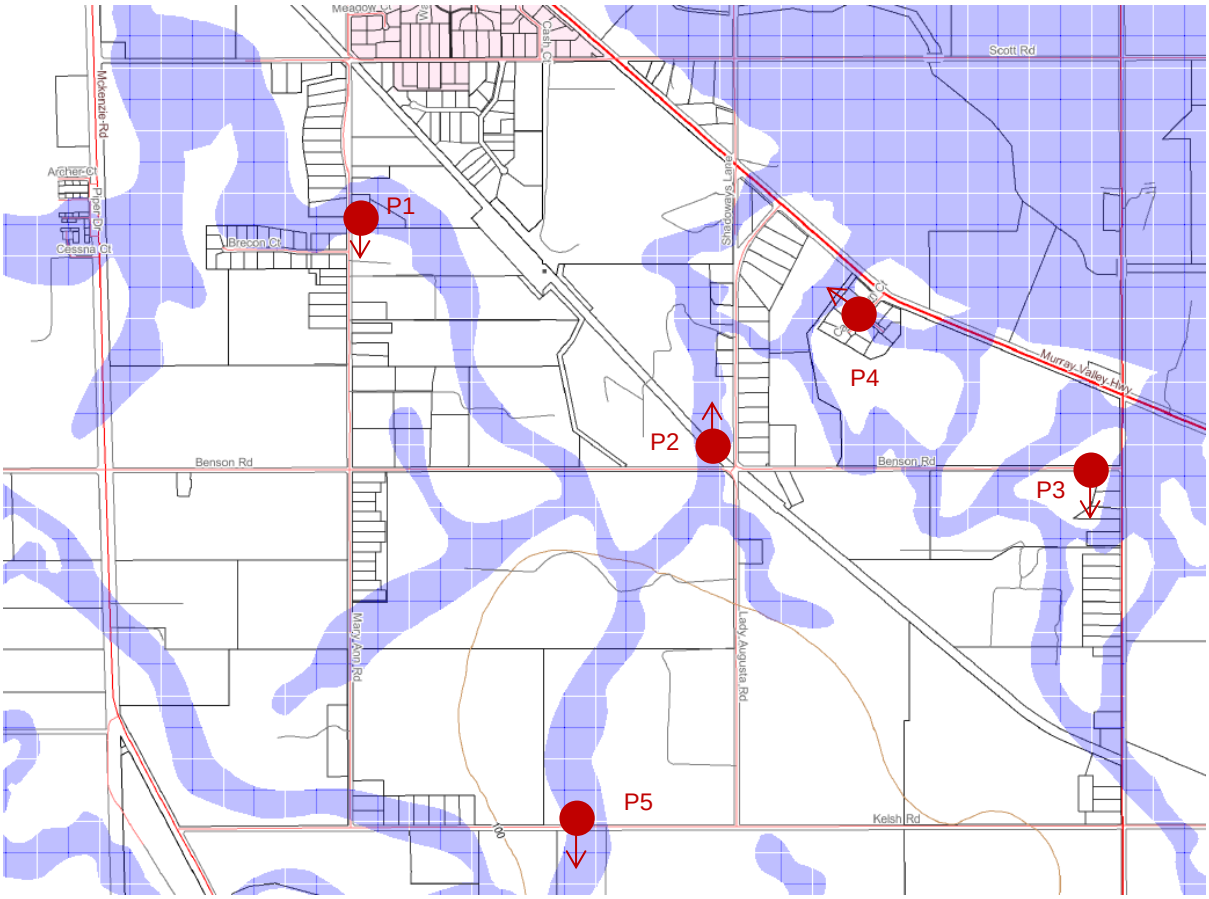


Photo locality map

Photo 1 – Mary Ann Road (North of Brecon Court) showing water held adjacent to culvert at floodway

Photo 2 – View north at Benson Road/Lady Augusta Road from railway bridge looking at existing drainage channel

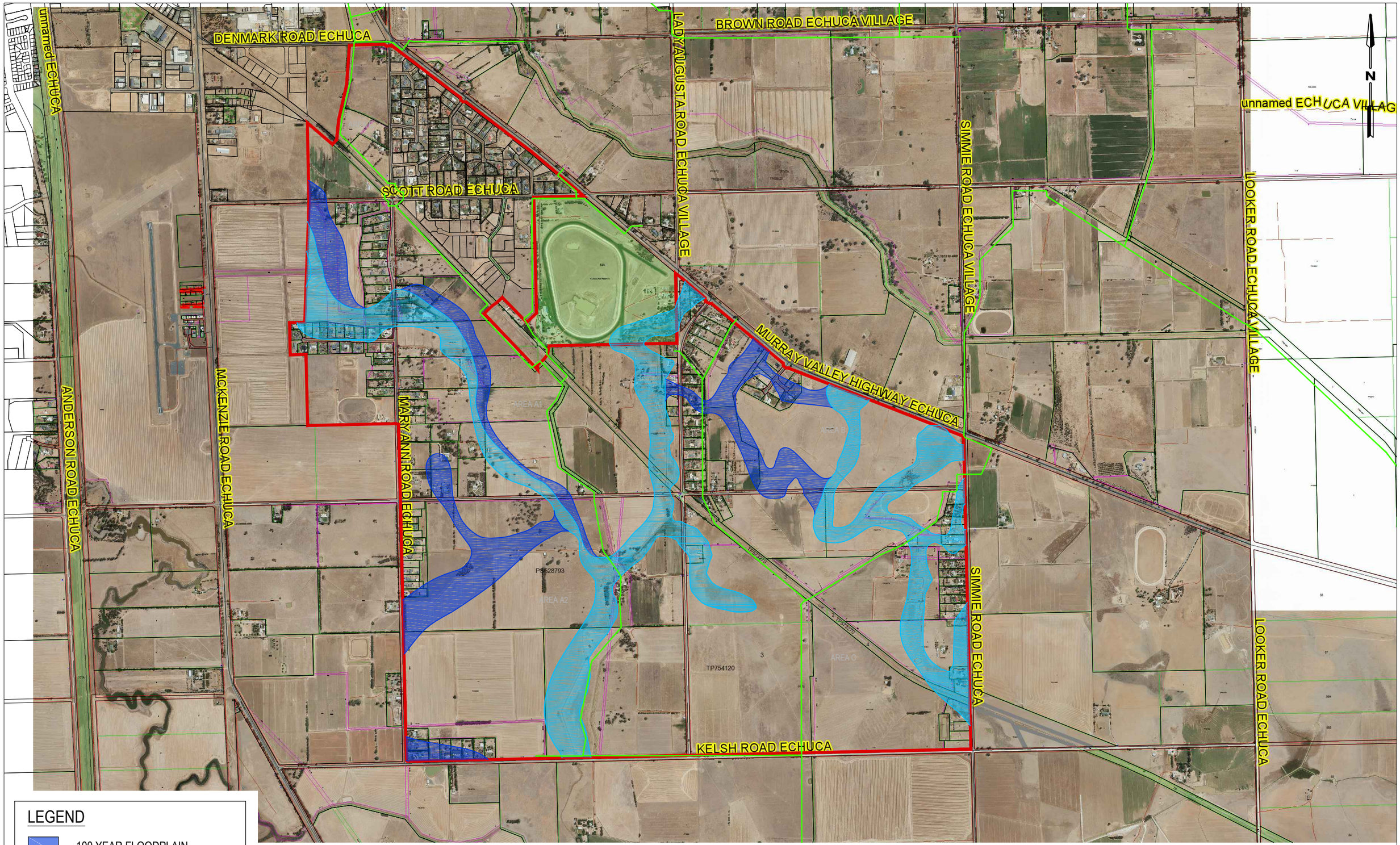
Photo 3 – Looking south along GM-W channel adjacent to property on corner of Benson and Simmie Roads. Water level above floor level of dwelling

Photo 4 – Castletown Ct looking north west at full retention basin. Limited capacity for large events

Photo 5 – Kelsh Road looking north, major irrigation channel traversing study area

Photo 6 – Easement over private land between Murray Valley Highway and Tasman Court, drainage channel through property

Appendix B. Existing Conditions Plan



LEGEND

- 100 YEAR FLOODPLAIN
- FLOODWAY
- GOULBURN-MURRAY WATER EXISTING DRAINAGE CHANNELS
- EXTENT OF STUDY AREA

0 200 400 600 800 1000m

SCALE 1:20000 AT ORIGINAL SIZE

MEINHARDT

DTPLI ECHUCA EAST DRAINAGE STUDY

FIGURE 1 - EXISTING CONDITIONS

PROJECT No	DRAWING No	REV
113271	F01	A

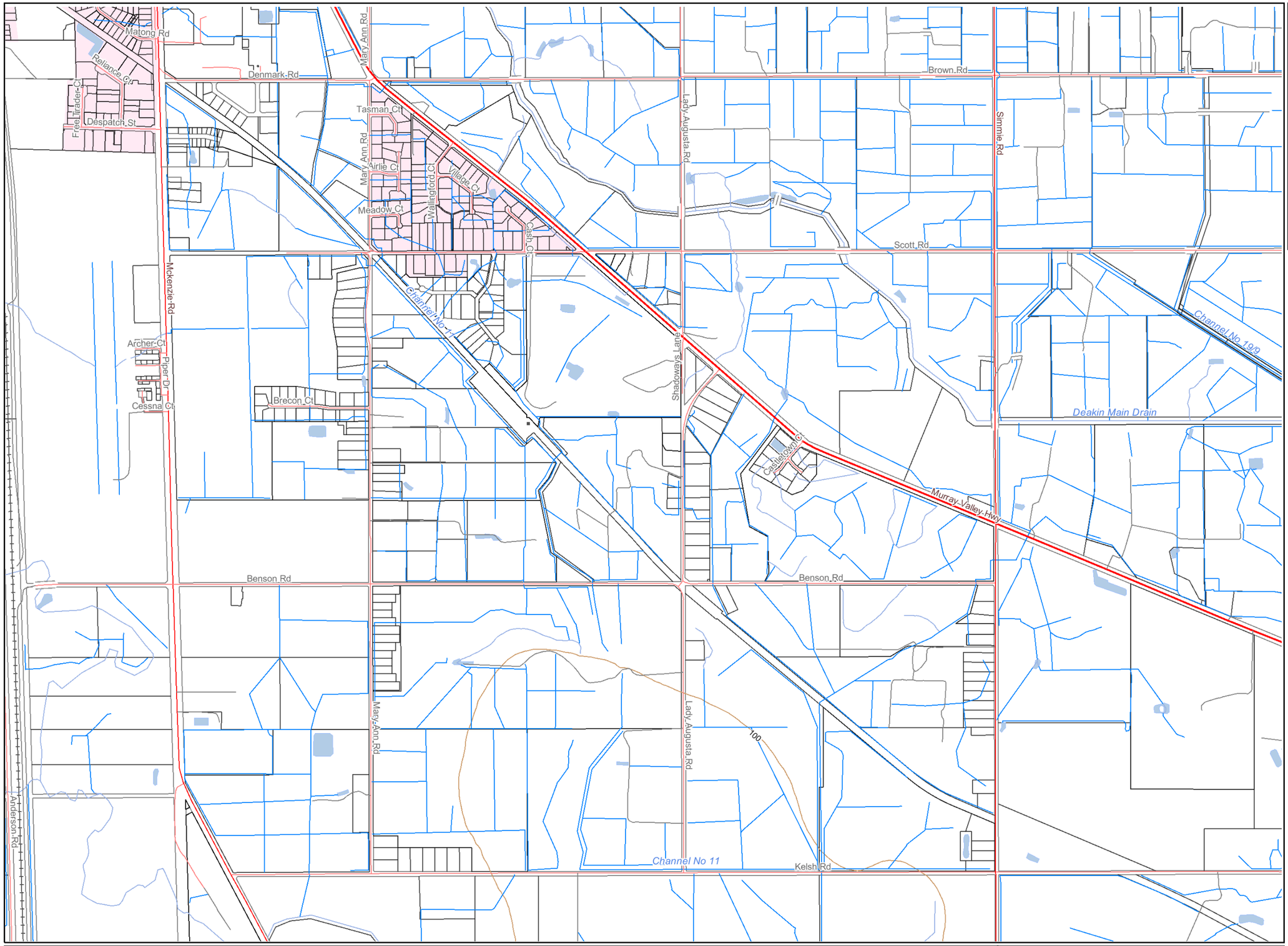
DWG FILE: X:\113271 - DTPLI-Echuca-East Drainage-Study\6BIM\6_3 MHT MIE\6_3_1 MHT ENV\Figures\113271-F01-A.dwg - MH PLOT TIME: 29 Oct 2014, 10:21am

Department of Sustainability and Environment

DRAINAGE CHANNEL PLAN

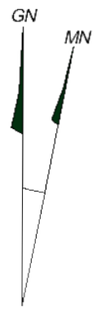
Department of Environment and Primary Industries

Victoria



* Refer to page 2 for legend details

Legend



Generated at http://nremap-sc.nre.vic.gov.au/MapShare.v2/ Produced on Thu Oct 16 10:50:49 EST 2014

Map Scale 1:20,000

NOT FOR NAVIGATION

GDA Vicgrid94

State Government Victoria

Map Server: nremap.nre.vic.gov.au Map Service: wsg_waterresource_v4

Department of Sustainability and Environment

DRAINAGE CHANNEL PLAN

Department of Environment and Primary Industries

State Government Victoria

Generated at http://nremap-sc.nre.vic.gov.au/MapShare.v2/ Produced on Thu Oct 16 10:50:49 EST 2014

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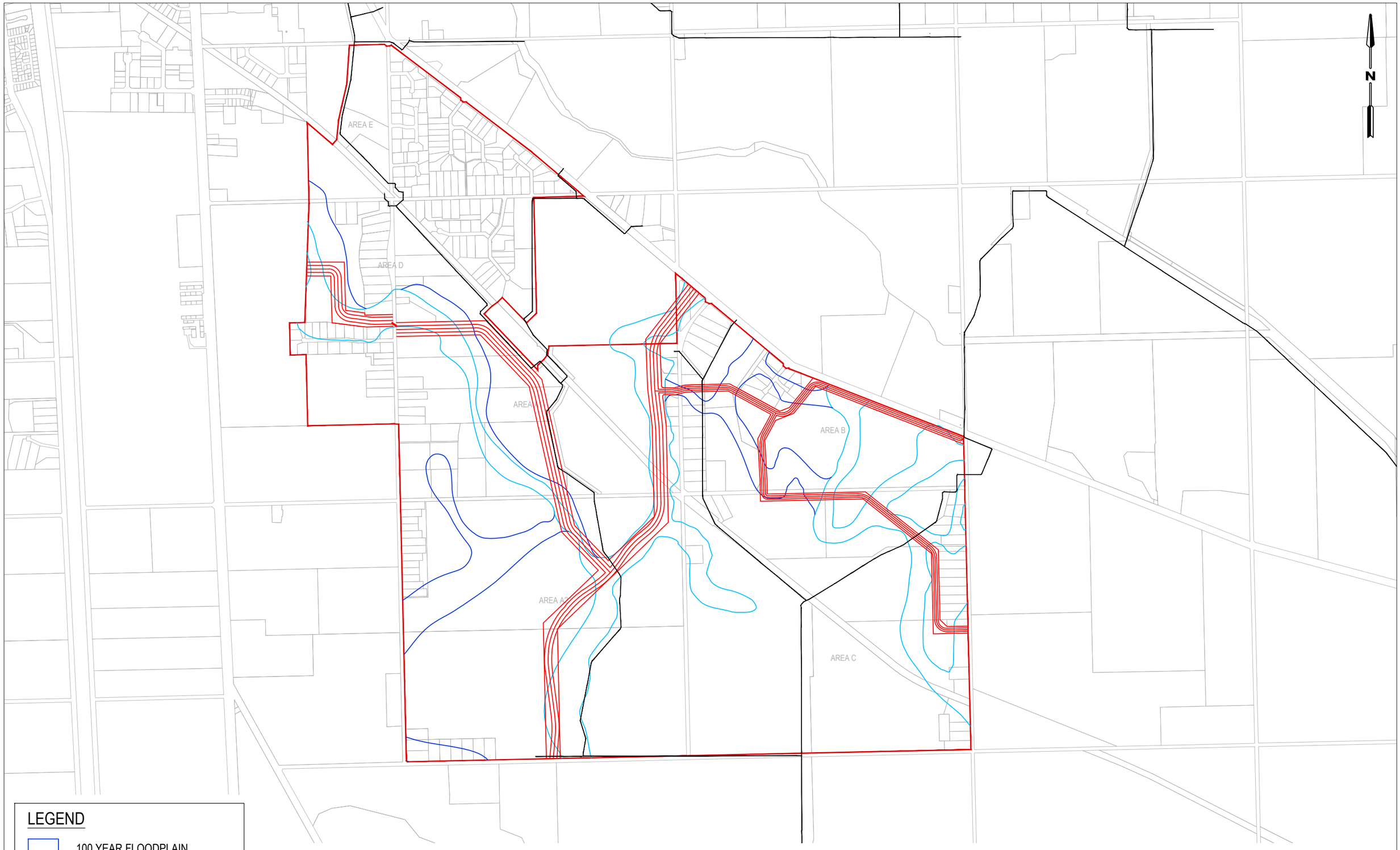
Vicgrid94

State Government Victoria

Appendix C. Proposed Drainage Strategy Plan



LEGEND

- 100 YEAR FLOODPLAIN
- FLOODWAY
- PROPOSED FLOOD MITIGATION
- EXISTING DRAINAGE CHANNELS

0 200 400 600 800 1000m

SCALE 1:20000 AT ORIGINAL SIZE

MEINHARDT

DTPLI ECHUCA EAST DRAINAGE STUDY

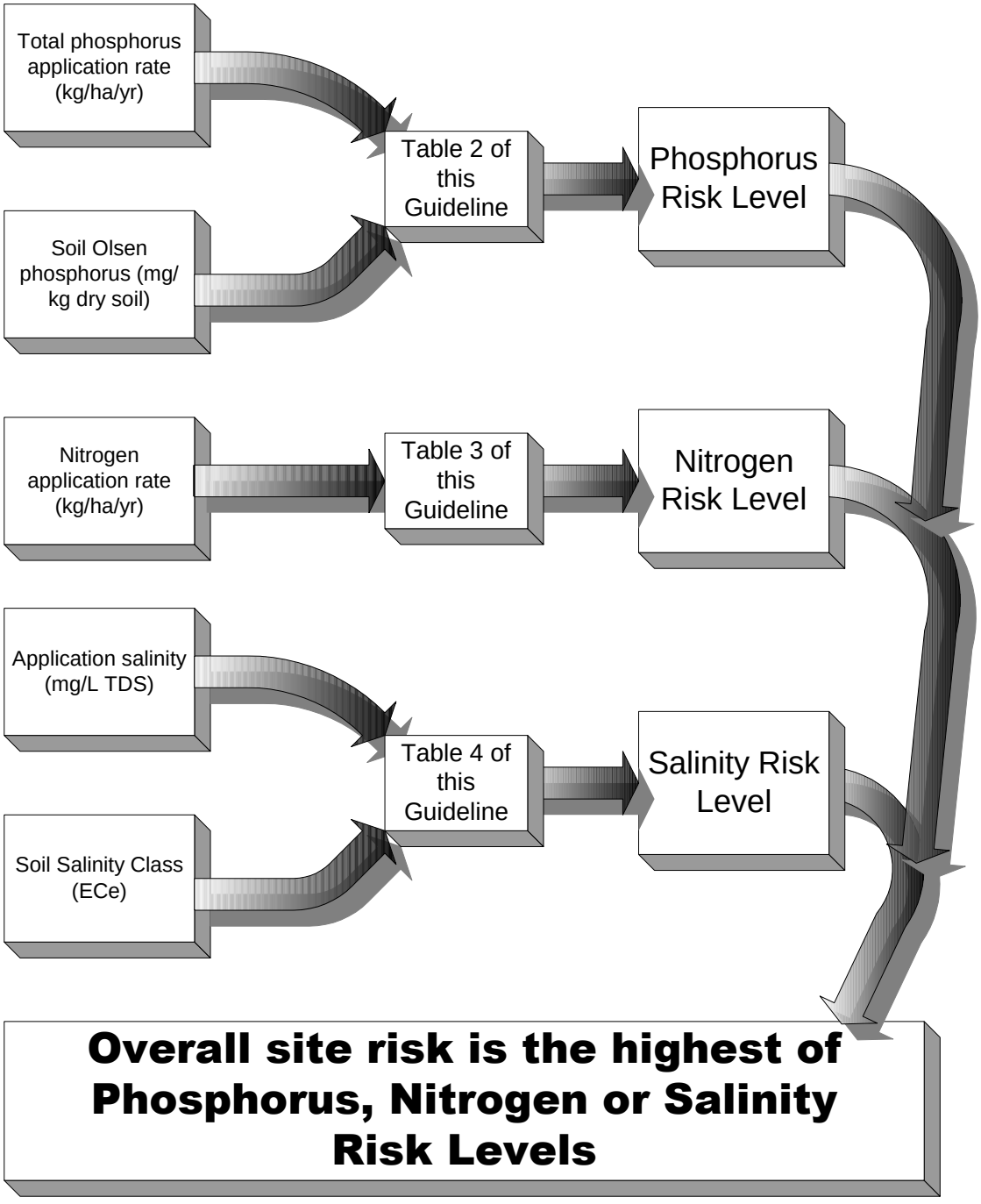
FIGURE 2 - PROPOSED FLOOD MITIGATION

PROJECT No	DRAWING No	REV
113271	F02	A

DWG FILE: X:\113271 - DTPLI-Echuca-East Drainage-Study\6BIM\6_3 MHT MIE\6_3_1 MHT ENV\Figures\113271-F02-A.dwg - MH PLOT TIME: 29 Oct 2014, 9:05am

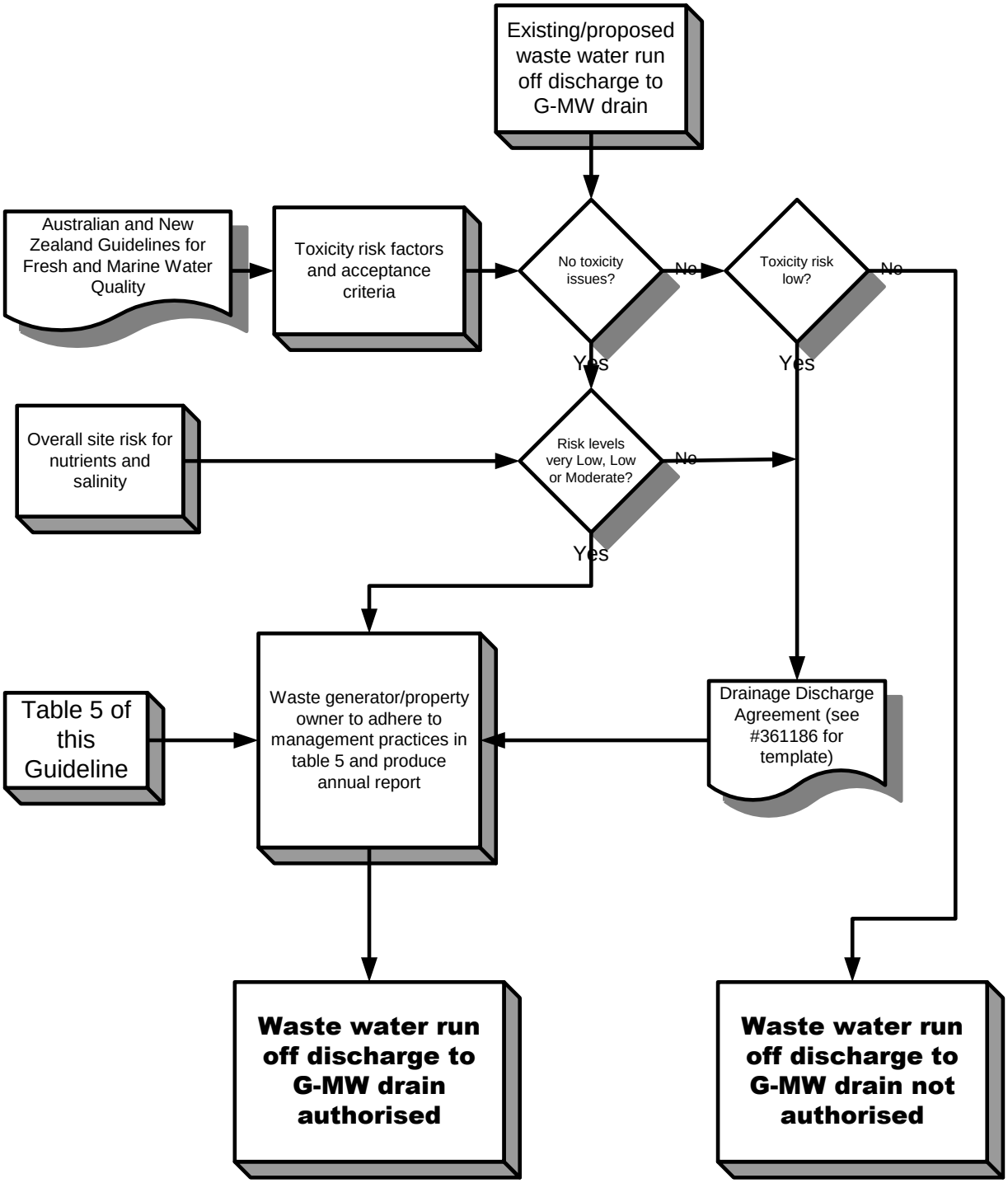
Appendix D. G-MW Policy

1. Run Off To Drain From Properties Irrigated With Wastewater – Site Risk Assessment Flowchart For Nutrients And Salinity



NOTE: "Olsen Phosphorus" is the standard analytical technique for determining soil phosphorus concentration

2. Run Off To Drain From Properties Irrigated With Wastewater – Acceptance Process Flowchart



3. Roles and Responsibilities

- The Area Manager responsible for the drain in question will be responsible for completing this assessment and for granting or withholding authorisation for discharge of run off from land irrigated with waste water.
- The responsible Area Manager will obtain a written report from the waste generator or property owner detailing the nutrient risk factors.
- The responsible Area Manager will complete and document the overall site risk for nutrients and salinity.
- The responsible Area Manager will obtain written advice from the Manager Water Systems Health on whether there are any toxicity issues.
- If there are toxicity issues, the responsible Area Manager will:-
  - require the waste generator/property owner to produce a written report on toxicity risk factors by a suitably qualified consultant, and
  - obtain a written report from the Manager Water Systems Health or a suitably qualified consultant on toxicity acceptance criteria.
- Where required, the responsible Area Manager will prepare the Drainage Discharge Agreement in consultation with the Manager Environment.
- Where required, the responsible Area Manager will execute the Drainage Discharge Agreement on behalf of G-MW

4. Risk based Approach decision Support Tools

Table 1: Risk categories

CATEGORY	DESCRIPTION OF PRACTICES
Very Low (VL)	Conservative agriculture
Low (L)	Common agriculture
Moderate (M)	Acceptable high input agriculture
High (H)	Questionable agriculture, but theoretically possible
Extreme (EX)	To be avoided

Table 2: Phosphorus risk

Total Phosphorus Application Rate (kg/ha/yr)[1]	Soil Phosphorus Status (Olsen Phosphorus – mg/kg dry soil)				
	<20	20-30	30-40	40-60	>60
<20	VL	VL	L	M	H
20-40	VL	L	M	H	H
40-60	L	M	H	H	EX
>60	M	H	H	EX	EX

Table 3: Nitrogen risk

Nitrogen Application Rate (kg/ha/yr)[1]	
<50	VL
50-100	L
100-300	M
>300	H
>300 kg/ha/yr applied and monitoring indicates 5 mg/L in run off	EX

[1] Rate includes all fertiliser, not just the nutrient contained in applied wastewater.

Table 4: Salinity risk

Application Salinity (mg/L TDS)[1]	Soil Salinity Status (Salinity Class)			
	A (ECe<3.8)	**B** (3.8 < ECe < 6.5) <80% A	**C** (6.5 < ECe < 8.6) <80% A+B	**D** (ECe > 8.6) <10% D
<175 (<500)	VL	L	M[2]	H
175 – 500 (500 – 1,000)	L	L	M[3]	H
500 – 1,000 (1,000 – 1,500)	L	M	H	H
1,000 – 1,500 (1,500 – 2,000)	M	M	H	EX
>1,500 (>2,000)	M	H	EX	EX

[1] Application salinity is the annual average of all sources of irrigation water applied to the site. The categories are based around the salinity classes of irrigation waters outlined in the "Guidelines for Wastewater Irrigation (EPA Publication 168, 1991). Where irrigation demand is less than 5 Ml/ha/yr for perennial pasture (i.e. in high rainfall areas) the application risk factors are shown in brackets.

[2] Risk is moderate if the advent of irrigation improves soil salinity to Class B over time. Otherwise, risk is high.

Table 5: Levels of assurance and management practices required.

Risk Level	Record Application of waste water and fertiliser	Soil test for risk factor	Notify G-MW	Demonstrate tailwater functions or appropriate water scheduling (see Table 6)	Measure volume of water discharging to drain	Measure quality of water discharging to drain	Obtain permission to discharge to drain
VL	✓ (except toxicants)	✓ (except toxicants)	Only if:- • Olsen Phosphorus >30 or P allocations >40 kg/ha/yr • Nitrogen applications >50 kg/ha/yr • Salinity applications is >800 EC • Inputs from wastewater source change such that toxicants may be present	✖	✖	✖	✖
L	✓	✓	Annual report	✖	✖	✖	✖
M	✓	✓ EM 38 survey if salinity risk M, H or EX	Annual report	✓	✓	3 discharge events per year[1] to demonstrate:- • P < 2mg/L[2] • N < 5 mg/L • Salinity <1,000 EC[3] • No significant toxicants[4]	✖

[1] Event monitoring must record time of rainfall and time of grab sample collection. To facilitate sampling, a collection point (comprising a bank/drain to direct run-off to a small sump) should be installed at the point of discharge. Depending on seasonal rainfall patterns, there may not be sufficient rainfall to generate run-off in a single year.

[2] Run-off quality objectives will be median values of sample results over a calendar year. The threshold values of 2 mg/L P and 5 mg/L N are best estimate upper levels, to be confirmed by monitoring. These levels may be varied out of consideration of the receiving water quality or external regulatory constraints.

[3] In some saline, high water table areas, background rainfall runoff may exceed 1,000 EC and a different salinity threshold may need to be established.

[4] Monitoring for toxicants will only be required where there is a specific indication that they are present in significant concentrations.

Risk Level	Record Application of waste water and fertiliser	Soil test for risk factor	Notify G-MW	Demonstrate tailwater functions or appropriate water scheduling (see Table 6)	Measure volume of water discharging to drain	Measure quality of water discharging to drain	Obtain permission to discharge to drain
H	✓	✓ EM 38 survey if salinity risk M, H or EX	Annual report	✓	✓	each event[1] prior to discharge to demonstrate:- • P < 2mg/L[2] • N < 5 mg/L • Salinity <1,000 EC[3] No significant toxicants[4]	✖
EX	✓	✓ EM 38 survey if salinity risk M, H or EX	Annual report	✓	✓	✓	✓

5. Worked Examples Of The Application Of This Guideline

Example 1: Under a licence granted by EPA, Urban Water Authority M wishes to supply dairy farmer N with C Class effluent, which will be shandied with channel water at a ratio of 1:4. Risk factors from tables 2 – 4 are as follows:-

- Total phosphorus in shandied water — 25 kg/ha/yr
- Phosphorus fertilizer applications — Nil
- Soil Olsen Phosphorus results — 28 mg/kg dry soil
- Resultant Phosphorus risk — LOW

- Nitrogen in shandied water — 135 kg/ha/yr
- Nitrogen fertilizer applications — Nil
- Resultant Nitrogen risk — MODERATE

- Total salt in shandied water — 425 mg/L TDS
- Soil salinity status — 4.2 ECe
- Resultant Salinity risk — LOW

C Class effluent does not pose any pathogen risks and there are no toxicity issues. The overall risk defaults to the highest risk level for the individual risk factors, which is moderate risk.

Outcome: Farmer N can continue his connection to the G-MW drain. A Drainage Discharge Agreement will not be required, conditional on the following:-

- Farmer N to record all waste water and fertiliser applications;
- Farmer N to arrange for annual soil tests for phosphorus, nitrogen and salinity and to undertake an EM 38 (salinity) survey;
- Urban Water Authority M to provide G-MW with an annual report on the above, and
- Risk levels continue not to exceed moderate.

Agreement will be reached on these conditions with farmer N and the urban water authority through exchange of letters.

Example 2: Under the same EPA licence, Urban Water Authority M also wishes to supply dairy farmer P with C Class effluent, which will be shandied with channel water at a ratio of 1:3. Risk factors from tables 2 – 4 are as follows:-

- Total phosphorus in shandied water — 33 kg/ha/yr
- Phosphorus fertilizer applications — 17 kg/ha/yr
- Soil Olsen Phosphorus results — 55 mg/kg dry soil
- Resultant Phosphorus risk — HIGH

- Nitrogen in shandied water — 180 kg/ha/yr
- Nitrogen fertilizer applications — Nil
- Resultant Nitrogen risk — MODERATE

- Total salt in shandied water — 567 mg/L TDS
- Soil salinity status — 6.1 ECe
- Resultant Salinity risk — LOW

Stocking rates are high, and milking cows are given supplementary feed on a 12 hour rotation. Effluent from this feed pad and the large rotary dairy shed are piped to the meter wheel where they are also added to the shandy, according to best practice. This and the superphosphate applications account for the high phosphorus risk.

C Class effluent does not pose any pathogen risks and there are no toxicity issues. The overall risk defaults to the highest risk level for the individual risk factors, which is high risk.

Outcome: Farmer N can continue his connection to the G-MW drain provided he executes a Drainage Discharge Agreement with the following conditions:-

- Farmer N to record all waste water and fertiliser applications;
- Farmer N to arrange for annual soil tests for phosphorus, nitrogen and salinity and to undertake an EM 38 (salinity) survey;
- Urban Water Authority M to provide G-MW with an annual report on the above, and
- Farmer N must demonstrate prior to any individual discharge that the total phosphorus concentration does not exceed 2 mg/L, the nitrogen concentration does not exceed 5mg/L and salinity does not exceed 1,200 EC.

Example 3: Under a licence granted by EPA, food factory R proposes to supply dairy farmer T with effluent from its factory, which will be shandied with channel water at a ratio of 1:5. Risk factors from Tables 2-4 are as follows:-

- Total phosphorus in shandied water — 18 kg/ha/yr
- Phosphorus fertilizer applications — 20 kg/ha/yr
- Soil Olsen Phosphorus results — 22 mg/kg dry soil
- Resultant Phosphorus risk — LOW

- Nitrogen in shandied water — 285 kg/ha/yr
- Nitrogen fertilizer applications — Nil
- Resultant Nitrogen risk — MODERATE

- Total salt in shandied water — 1,250 mg/L TDS
- Soil salinity status — 4.1 ECe
- Resultant Salinity risk — MODERATE

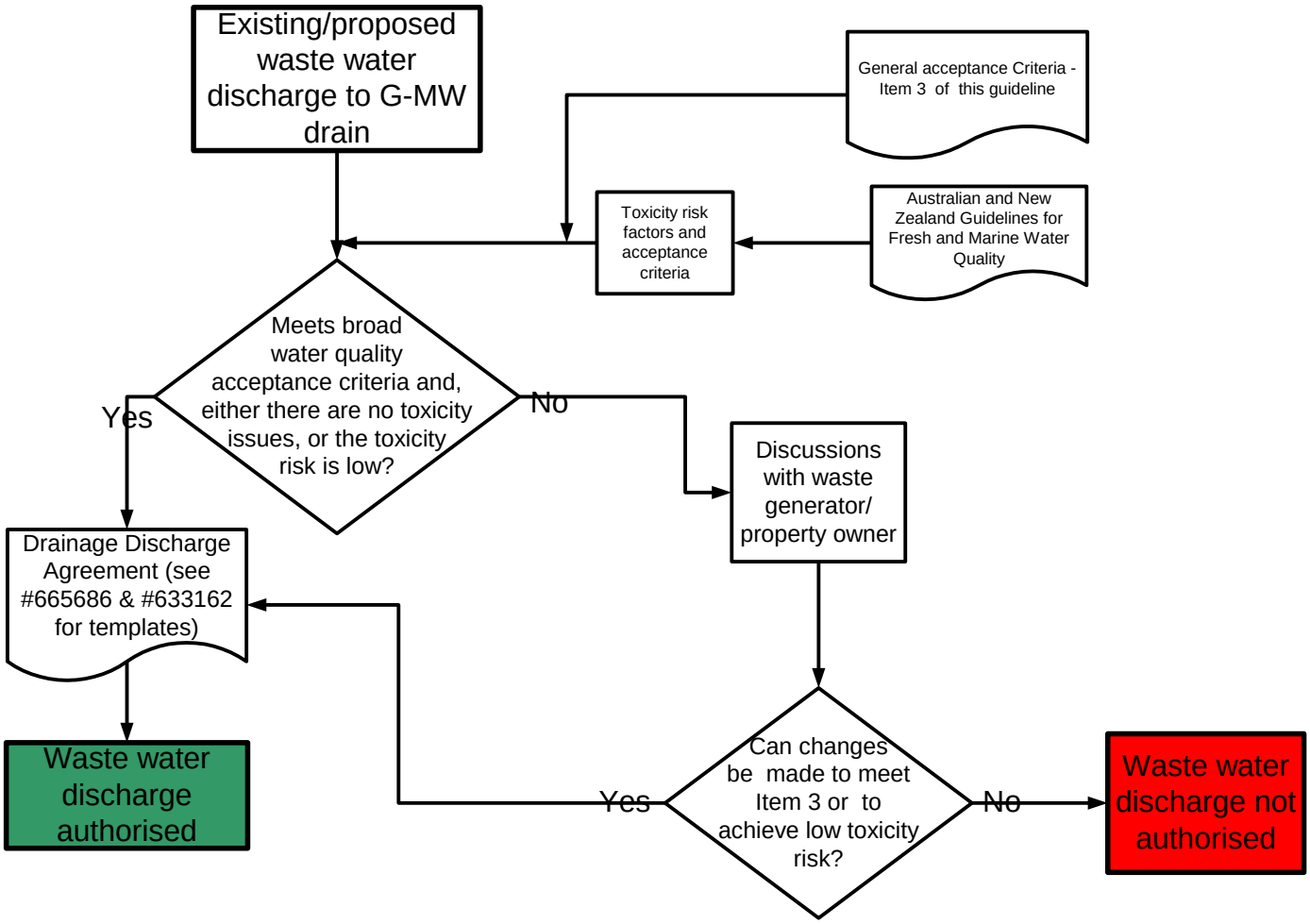
There are no E. coli in the effluent and it does not pose any pathogen risks. However, there are traces of pesticides in the effluent, probably from washing of vegetables prior to processing. There are pesticide risks for downstream drain diversion customers.

Outcome: Farmer T and food company R are requested to conduct a more rigorous pesticide risk assessment for all downstream beneficial uses. Provided this demonstrates that risks do not exceed thresholds stipulated in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, continued access to the G-MW drain will be granted under a Drainage Discharge Agreement. This agreement will have similar conditions to those in example 1, above, for phosphorus, nitrogen and salinity risk. In addition, the agreement will:-

- Stipulate an upper limit for pesticide concentrations in run-off from farmer T's property;
- Require food company R to regularly test pesticide levels in the effluent it supplies farmer T and provide the results to farmer T and G-MW;
- Require farmer T to test pesticide levels in his run off prior to discharge to the G-MW drain;
- Prohibit farmer T from discharging his run-off to the G-MW drain if pesticide concentrations exceed the stipulated limit;
- Require food company R to provide an annual report on the quality of the effluent it supplies farmer T and the quality of run off that he discharges to the G-MW drain

Copies of the more rigorous risk assessment will be circulated to regulatory agencies, such as EPA, for endorsement. If the risk assessment indicates that risks exceed thresholds stipulated in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, access to the G-MW drain will be withdrawn if waste water irrigation commences.

1. Waste Water Direct Discharge to Water Asset – Assessment and Acceptance Flowchart



2. Roles and Responsibilities

- The Area Manager responsible for the drain in question will be responsible for completing this assessment and for granting or withholding authorisation for direct discharge.
- The responsible Area Manager will obtain written advice from the Manager Water Systems Health on whether there are any toxicity issues.
- If there are toxicity issues, the responsible Area Manager will:-
  - require the waste generator/property owner to produce a written report on toxicity risk factors by a suitably qualified consultant, and
  - obtain a written report from the Manager Water Systems Health or a suitably qualified consultant on toxicity acceptance criteria.
- The responsible Area Manager will prepare the Drainage Discharge Agreement in consultation with the Manager Environment.
- The responsible Area Manager will execute the Drainage Discharge Agreement on behalf of G-MW.

NOTE: Control of direct discharge to natural waterways is the responsibility of EPA, **not** G-MW

3. 1: General Acceptance Criteria

Broad physio-chemical and microbiological criteria for determining acceptable quality for direct discharges to G-MW water assets include, but are not limited to, the following:-

Suspended Solids	30 g/m^3
Salinity	1,200 µs/cm
pH	6.0-8.5
Total Phosphorous	2.0 g/m^3
Total Nitrogen	5.0 g/m^3
5 day Biochemical Oxygen Demand	40 g/m^3
Blue green algae	1,000 cells/ml
Escherichia coli	150 organisms/100 ml

(Extract from *Management Policy on Acceptance of Urban and Industrial Water into G-MW Drains*, #1819681 v5).

4. Worked Examples Of The Application Of This Guideline

Example 1: Shire X wishes to connect its stormwater drain from a recent subdivision to a G-MW drain. The quality of the stormwater over a number of samples is as follows:-

- Suspended Solids 3 -45 g/m^3
- Salinity 100-330 µs/cm
- pH 6.5-7.2
- Total Phosphorous 0.1 -1.1 g/m^3
- Total Nitrogen 0.8 -2.3/m^3
- 5 day Biochemical Oxygen Demand 0.4-4.4 g/m^3
- Blue green algae 0-50 cells/ml
- *Escherichia coli* 0-27organisms/100 ml

Outcome: The stormwater quality meets the acceptance criteria in Schedule 1, except for suspended solids following heavy rain. There are no toxicity issues. A Drainage Discharge Agreement is executed binding G-MW to accept the stormwater, providing the Shire:-

- conforms to best practice and installs a stormwater retention basin to settle out peak suspended solids loads;
- continues to meet the Schedule 1 criteria, and
- samples and reports on water quality following 3 storm events annually.

Example 2: Shire Y wishes to connect its stormwater drain servicing a small township to a G-MW drain. The quality of the stormwater over a number of samples is as follows:-

- Suspended Solids 5 -25 g/m^3
- Salinity 250-800 µs/cm
- pH 6.5-7.3
- Total Phosphorous 1.1 -3.2 g/m^3
- Total Nitrogen 3.5 -8.7/m^3
- 5 day Biochemical Oxygen Demand 0.4-24.4 g/m^3
- Blue green algae 0-100 cells/ml
- *Escherichia coli* 250-9,800organisms/100 ml

There are no toxicity issues. A site inspection reveals that this township is unsewered and septic tanks are used to treat and dispose of household wastes. Housing allotments in the area are unsuitable for septic tanks and many of them overflow into the town stormwater drains. This is the most likely cause for the stormwater failing to meet many of the acceptance criteria in Schedule 1.

Outcome: Authority to connect to the G-MW drain is withheld. The Shire is advised that connection will be approved if it can demonstrate that stormwater quality has improved sufficiently to meet the Schedule 1 criteria. This will require more effective treatment of household wastes.

CRITERIA FOR RETARDATION BASIN DESIGN (Docs: #870414)
Goulburn-Murray Water Drains

The following criteria and conditions apply to the design of urban, industrial and semi-urban retardation basins in areas served by G-MW drains.

i) The design rainfall intensity to be used in determining the required capacity of the retardation basin shall have a 100 year return period (1% AEP) with durations of 30min, 1hr, 2hr 3hr, 6hr, 12hr & 24hr, considered with temporal pattern intervals as listed in Table 1. The basin or storage size required is the maximum storage volume necessary to contain excess runoff whilst limiting the outflow to that specified in (ii). Current IFD data is to be taken from Australian Rainfall and Runoff (ARR). (Example of Intensity Frequency Duration (IFD) data for Shepparton, Victoria attached).

ii) The rate of discharge to G-MW's drain from the retardation basin shall be limited to the maximum allowable discharge rate as detailed in Table 2 for land served by the basin.

iii) Control devices are to be installed on any pumped discharges which will automatically stop the pumps when the water level within the G-MW drain rises above the pre-development ground level adjacent to the rural inlet point. Gravity inflow may continue provided retardation basin outflow rates are less than that specified in (ii).

iv) The inlet pipe to the drain is to be sized for a maximum velocity of 0.6m/s. The pipe invert is to be at the drain bed level.

v) At the proposed retardation basin site, the watertable level and salinity should be measured and a soil profile should be obtained to at least 1m below the base level of the retardation basin. This information is to be included on the design drawing for the basin. The base of the retardation basin should be at least 1m above the watertable, or clay lined as approved by the Authority to minimise transfer of water to or from the watertable.

vi) The applicant must submit detailed plans, computations and specifications of all works, gain the Authority's formal approval, pay relevant fees and enter into construction and use of private works licences prior to connecting to the G-MW drainage system.

Special Conditions:

Certain land use activities may require additional features prior to obtaining permission to discharge to an Authority drain. The Authority will assess the need for special conditions at the time of application.

For example: Runoff likely to contain hydrocarbons should pass through a properly maintained triple interceptor pit before discharging to the retardation basin.

Table 1

Duration*	**Temporal Pattern Interval**
0.5hr, 1hr & 2hr	5min
3hr	15min
6hr & 12hr	30min
24hr	60min

Table 2

Drain Level of Service*	**Max. Allowable Discharge Rate (L/s/ha)**
1 in 10	1.2
1 in 2	0.7

*The level of service is defined in terms of the Average Recurrence Interval of the design rainfall depth in a 24 hour period, to be removed within 5 days.

EXAMPLE ONLY

Rainfall Intensity Frequency Duration data for; Shepparton Vic

Geographic Location: 36.3833 Deg. South 145.4 Deg. East

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AUSIFD Version 1.2 4-Sep 2002

Duration (mins)	Duration (hours)	1 Year ARI (mm/hour)	2 Year ARI (mm/hour)	5 Year ARI (mm/hour)	10 Year ARI (mm/hour)	20 Year ARI (mm/hour)	50 Year ARI (mm/hour)	100 Year ARI (mm/hour)
5	0.08	51	67	91	106	126	154	176
5.5	0.09	49.1	65	88	102	122	148	169
6	0.10	47.5	63	85	99	117	143	163
6.5	0.11	46.1	61	82	96	114	138	158
7	0.12	44.8	59	80	93	110	134	153
7.5	0.13	43.5	57	77	90	107	130	148
8	0.13	42.4	56	75	88	104	126	144
8.5	0.14	41.3	54	73	85	101	123	140
9	0.15	40.4	53	72	83	99	120	137
9.5	0.16	39.4	52	70	81	96	117	133
10	0.17	38.6	51	68	79	94	114	130
11	0.18	37	48.6	65	76	90	109	124
12	0.20	35.5	46.7	63	73	86	105	119
13	0.22	34.2	45	60	70	83	100	114
14	0.23	33.1	43.4	58	68	80	97	110
15	0.25	32	42	56	65	77	93	106
16	0.27	31	40.7	54	63	75	90	103
17	0.28	30.1	39.5	53	61	72	87	99
18	0.30	29.2	38.4	51	59	70	85	96
19	0.32	28.5	37.3	49.8	58	68	82	94
20	0.33	27.7	36.3	48.5	56	66	80	91
21	0.35	27	35.4	47.2	55	64	78	89
22	0.37	26.4	34.6	46.1	53	63	76	86
23	0.38	25.8	33.8	45	52	61	74	84
24	0.40	25.2	33	43.9	51	60	72	82
25	0.42	24.7	32.3	43	49.7	58	71	80
26	0.43	24.1	31.6	42	48.6	57	69	78
27	0.45	23.7	31	41.1	47.5	56	67	77
28	0.47	23.2	30.4	40.3	46.6	55	66	75
29	0.48	22.8	29.8	39.5	45.6	54	65	73
30	0.50	22.3	29.2	38.8	44.8	53	63	72
32	0.53	21.6	28.2	37.4	43.1	51	61	69
34	0.57	20.8	27.2	36.1	41.6	48.9	59	67
36	0.60	20.2	26.4	34.9	40.2	47.2	57	64
38	0.63	19.6	25.6	33.8	38.9	45.7	55	62
40	0.67	19	24.8	32.8	37.8	44.3	53	60
45	0.75	17.8	23.2	30.5	35.2	41.2	49.5	56
50	0.83	16.7	21.8	28.7	32.9	38.6	46.3	52
55	0.92	15.8	20.6	27	31.1	36.4	43.6	49.3
60	1.00	15	19.5	25.6	29.4	34.4	41.2	46.6
75	1.25	12.9	16.8	22	25.2	29.5	35.3	39.9
90	1.50	11.4	14.8	19.4	22.2	25.9	31	35
105	1.75	10.3	13.3	17.4	19.9	23.3	27.8	31.3
120	2.00	9.35	12.2	15.8	18.1	21.1	25.2	28.5
135	2.25	8.62	11.2	14.6	16.7	19.4	23.2	26.1
150	2.50	8.01	10.4	13.5	15.4	18	21.5	24.2

165	2.75	7.5	9.73	12.6	14.4	16.8	20	22.6
180	3.00	7.06	9.15	11.9	13.6	15.8	18.8	21.2
195	3.25	6.67	8.65	11.2	12.8	14.9	17.7	20
210	3.50	6.34	8.21	10.6	12.1	14.1	16.8	18.9
225	3.75	6.04	7.82	10.1	11.5	13.4	16	18
240	4.00	5.77	7.48	9.68	11	12.8	15.2	17.1
270	4.50	5.32	6.88	8.9	10.1	11.8	14	15.7
300	5.00	4.94	6.39	8.25	9.39	10.9	13	14.6
360	6.00	4.35	5.63	7.25	8.24	9.56	11.3	12.7
420	7.00	3.91	5.05	6.5	7.38	8.56	10.1	11.4
480	8.00	3.56	4.6	5.91	6.71	7.77	9.21	10.3
540	9.00	3.28	4.24	5.44	6.16	7.14	8.45	9.48
600	10.00	3.05	3.94	5.04	5.72	6.62	7.83	8.78
660	11.00	2.85	3.68	4.72	5.34	6.18	7.31	8.19
720	12.00	2.69	3.47	4.43	5.02	5.81	6.86	7.69
840	14.00	2.41	3.11	3.98	4.51	5.22	6.18	6.93
960	16.00	2.19	2.82	3.63	4.11	4.77	5.64	6.33
1080	18.00	2.01	2.6	3.34	3.79	4.39	5.21	5.84
1200	20.00	1.86	2.41	3.1	3.52	4.08	4.84	5.44
1320	22.00	1.74	2.25	2.9	3.29	3.82	4.54	5.09
1440	24.00	1.63	2.11	2.72	3.1	3.6	4.27	4.8
1800	30.00	1.38	1.79	2.32	2.64	3.07	3.65	4.11
2160	36.00	1.2	1.56	2.03	2.31	2.69	3.2	3.6
2520	42.00	1.07	1.39	1.8	2.06	2.4	2.86	3.22
2880	48.00	0.96	1.25	1.63	1.86	2.17	2.59	2.91
3240	54.00	0.87	1.14	1.48	1.69	1.98	2.36	2.66
3600	60.00	0.8	1.04	1.36	1.56	1.82	2.17	2.45
3960	66.00	0.74	0.96	1.26	1.44	1.68	2.01	2.27
4320	72.00	0.68	0.89	1.17	1.34	1.56	1.87	2.12

GOULBURN-MURRAY
WATER

SURFACE DRAINAGE STRATEGY

Executive Summary

Goulburn-Murray Water manages an extensive drainage network within the irrigation areas of its business. This network includes all Primary (or arterial) drains and some Community Surface drains.

This Surface Drainage Strategy will ensure that best practices are being applied by the Authority in managing surface drainage in accordance with its surface drainage policy, which states;

> 'In accordance with agreed standards and statutory obligations, Goulburn-Murray Water will manage its drainage network to agreed levels of service in an environmentally and economically sustainable manner, ensuring adverse downstream impacts are minimised.'

This Strategy document defines the steps that Goulburn-Murray Water is taking to meet its responsibilities stated in its surface drainage policy. A regular review of the Strategy is undertaken to report on progress to date and to reflect any changes to other strategies or incorporate endorsed recommendations.

The Strategy consists of 14 elements:

1. G-MW will design and manage its drainage systems to accord with the objectives of specific land and water management plans, Victoria's Biodiversity Strategy, and the Murray Darling Basin Commission's Salinity and Drainage Strategy.
2. A Memorandum of Understanding shall define the roles and responsibilities of Catchment Management Authorities, the Department of Natural Resources and Environment, local government and Goulburn-Murray Water.
3. G-MW will establish a pricing policy that will achieve long-term sustainability of all drainage services.
4. G-MW will establish an appropriate tariff for the drainage service.
5. G-MW will establish an effective monitoring network for flow and water quality parameters in drains to enable enhanced operation and system audits.
6. G-MW will successfully manage the transition of Community Surface Drain ownership from local government and community groups to G-MW, including the establishment of appropriate business rules for existing and future CSDs.

7. The hydraulic performance of all existing drains is to be assessed to ensure that their performance is in accordance with their declared level of service.

8. G-MW will document current drain design standards, including adopted practices, to ensure minimal impacts in terms of flow and water quality on receiving waters.

9. G-MW will assess and manage all risks associated with owning a drainage system including public liability, construction, flooding, water quality, pathogens etc. which will be in accordance with the Environmental Management System and the Environmental Audit of Drain Discharges.

10. G-MW will manage drainage diversion practices to:

- accord with the MDBC Cap and other water resource management agreements (Bulk Entitlements)
- minimise poor quality outfalls to downstream waterways in accordance with the objectives of approved Water Quality Strategies
- minimise any impacts on environmental flow requirements that have been established for natural depressions and significant wetlands as part of the drain design.

11. G-MW will manage subsurface drainage discharges into surface drains in accordance with established salt disposal entitlements.

12. G-MW will identify and manage all significant pollutant discharges entering the Authority's drains.

13. G-MW will effectively manage both the timing and flowrate of urban stormwater discharges into Authority drains.

14. G-MW will undertake research and investigation to ensure that the optimum design standards and management practices are being achieved in operating the drainage system, including a better understanding of associated risks.

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1 G-MW will design and manage its drainage systems to accord with the objectives of specific land and water management plans, Victoria's Biodiversity Strategy, and the Murray Darling Basin Commission's Salinity and Drainage Strategy. 1

2 A Memorandum of Understanding shall define the roles and responsibilities of Catchment Management Authorities, the Department of Natural Resources and Environment, local government and Goulburn-Murray Water. 2

3 G-MW will establish a pricing policy that will achieve long-term sustainability of all drainage services. 3

4 G-MW will establish an appropriate tariff for the drainage service. 3

5 G-MW will establish an effective monitoring network for flow and water quality parameters in drains to enable enhanced operation and system audits. 4

6 G-MW will successfully manage the transition of Community Surface Drain ownership from local government and community groups to G-MW, including the establishment of appropriate business rules for existing and future CSDs. 5

7 The hydraulic performance of all existing drains is to be assessed to ensure that their performance is in accordance with their declared level of service. 6

7.1 Surface Drainage Standard of Service 6

7.2 Performance Review of Drains 7

8 G-MW will document current drain design standards, including adopted practices, to ensure minimal impacts in terms of flow and water quality on receiving waters. 8

9 G-MW will assess and manage all risks associated with owning a drainage system including public liability, construction, flooding, water quality, pathogens etc. which will be in accordance with the Environmental Management System and the Environmental Audit of Drain Discharges. 9

10 Drainage diversion practices will be managed to: 9

10.1 accord with the Murray Darling Basin Commission Cap and other water resource management agreements (Bulk Entitlements): 9

10.2 minimise poor quality outfalls to downstream waterways in accordance with the objectives of approved Water Quality Strategies: 10

10.3 minimise any impacts on environmental flow requirements that have been established for natural depressions and significant wetlands as part of the drain design: 10

11 Sub-surface drainage discharges into surface drains will be managed to accord with established salt disposal entitlements. 12

12 G-MW will identify and manage all significant pollutant discharges entering the Authority's drains. 12

13 G-MW will effectively manage both the timing and flowrate of urban discharges into Authority drains. 14

14 G-MW will undertake research and investigations, including any necessary monitoring, to ensure that the optimum design standards and management practices are

being achieved in operating the drainage system, including a better understanding of associated risks. 15

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SURFACE DRAINAGE STRATEGY

G-MW manages an extensive drainage network within the irrigation areas of its business. This strategy will ensure that best practices are being applied by the Authority in managing surface drainage in accordance with its surface drainage policy. Elements of the strategy are;

1 G-MW will design and manage its drainage systems to accord with the objectives of specific land and water management plans, Victoria's Biodiversity Strategy, and the Murray Darling Basin Commission's Salinity and Drainage Strategy.

Close interaction exists between the Authority, the Catchment Management Authorities (CMA) and the Department of Natural Resources and Environment during the development, implementation and review of land and water management plans. All plans, including the surface drainage strategies, are developed in accordance with the objectives of Victoria's Biodiversity Strategy and the MDBC's Salinity and Drainage Strategy.

A review of the Shepparton Surface Drainage Strategy (SSDS), being a key component of the Shepparton Irrigation Region Land and Water Management Plan (SIRLWSMP), has been undertaken to ensure implementation has complied with the original objectives of the plan and to update the Strategy to address any new issues that have developed.

Stage 1 – Policies and Principles of the Loddon Murray Surface Water Management Strategy (LMSWMS) has been prepared as a working document and the final version will be presented to government at the conclusion of Stage 2. Stage 2 has been broken into 11 sub-catchment areas. Two of these catchments are being addressed and the Catchment Plans submitted to government for endorsement ahead of the full Strategy. The first Catchment Plan, Koondrook-Benjeroop, has been completed and endorsed by the North Central CMA and is awaiting endorsement by government. The remaining sub-catchments are due to be finalised by June 2002 and the Strategy will then be submitted for endorsement by government and all key stakeholders.

In February 2001 an Independent Review of the Environmental Aspects of Northern Victoria's Surface Drainage Programs in Irrigation Areas was submitted to the Minister. Goulburn-Murray Water provided a detailed written response on some of the key recommendations. G-MW will be actively involved in implementing any government endorsed recommendations.

How the Authority manages the existing drainage network and whether it complies with the Biodiversity Strategy etc. will be addressed by the Environmental Audit, the Environmental Management System and specific Drain Management Plans.

GAPS: Management of the Authority's existing drainage network to comply with the objectives of Victoria's Biodiversity Strategy

PRIORITY: High (work substantially progressed)

PROCESS: Review of Shepparton SDS by July 2001.

Adoption of Stage 1 and completion of Stage 2 of the LMSWM.

Review of Environmental Audit and completion of specific Drain Management Plans.

Policy document on tree planting along drains being developed by NRT.

RESOURCES/COST: Funding will be needed to complete all Drain Management Plans.

Funding required for review of SSDS provided by the Goulburn Broken Catchment Management Authority (GBCMA).

ACHIEVEMENTS: A draft Drain Management Plan has been developed for the Muckatah Drain.

2 A Memorandum of Understanding shall define the roles and responsibilities of Catchment Management Authorities, the Department of Natural Resources and Environment, local government and Goulburn-Murray Water.

A Memorandum of Understanding (cf. DOCS #230187v7) has been finalised following consultation between GBCMA, DNRE, Parks Victoria, G-MW and local council. Originally the document was to concentrate on new drains being constructed in waterways declared by CMAs, however it has been expanded to cover both new and existing drains and where drains are located in the natural depression.

GAPS: Nil.

PRIORITY: High.

PROCESS: Finalised MoU to be signed by other Shires and CMAs within G-MW's Irrigation Areas.

RESOURCES/COST: Minimal.

ACHEIVEMENTS: First MoU has been signed with GBCMA, DNRE, Parks Victoria, G-MW and City of Greater Shepparton.

3 G-MW will establish a pricing policy that will achieve long-term sustainability of all drainage services.

The G-MW Board as its December 1999 meeting adopted a new pricing policy. The policy will ensure the financial viability of all G-MW services, including the surface drainage services. The significant change from the previous pricing policy was the inclusion of overdraft repayment in prices. Previously, only the interest on overdraft was included in prices. The impact of this change may be to increase prices in some surface drainage services, especially where increased revenue from drain diversion permits or new customers (as primary drains are constructed) is not anticipated.

GAPS: Nil.

PRIORITY: Medium

PROCESS: Annual process

RESOURCES/COST: Minimal

ACHEIVEMENTS:

4 G-MW will establish an appropriate tariff for the drainage service.

The review of drainage tariffs will commence following the completion of the Retail Entitlement Reform process. (RER)

Some approved policy not directly related to drainage tariff but to rating include:

- The three year rating rule established (August 1996) for Community Surface Drainage catchments once primary drain outfall is provided.
- The provision of Land Information Statement by G-MW during the Sale of Land. Previously these statements have only identified outstanding rates and charges but will now include additional property details.

GAPS: Suitability of current drainage divisions. Suitability of mix of applied volume to area watered. Existing tariff structure does not suit rating of G-MW community drains.

PRIORITY: Medium. The RER implementation is likely to take a further year before this review can commence.

PROCESS: Tariff Review Committee already established within G-MW.

RESOURCES/COST: To be established following reconvening of Tariff Review Committee.

ACHIEVEMENTS: The three year rating rule for CSD catchments with available outfall was implemented as of July 2001.

5 G-MW will establish an effective monitoring network for flow and water quality parameters in drains to enable enhanced operation and system audits.

A Project Team was formed several years ago by GBCMA (G-MW representatives) to determine whether the extent of monitoring being undertaken within the SIRLWSMP was adequate to ensure compliance with the plan's objectives. It was recommended that;

- Compliance monitoring for drains outfalling to the River Murray should aim to ensure that the total area monitored directly or via the regional stream outfalls, is at least 80% of the area proposed to be drained under the Plan, and includes at least 80% of the drained area's water use.
- Similarly, compliance monitoring for major regional streams (Goulburn River, Broken Creek) should aim to ensure that the total area monitored for each stream is at least 60% of the area to be drained to each stream under the Plan, and includes at least 60% of the drained area water use.

As a result of this review several additional monitoring sites were constructed principally in the Broken Creek catchment. The cost of these compliance monitoring sites has been funded by the Salinity Program and only recently has G-MW contributed to the operational costs.

The monitoring requirements of the 11 sub-catchments of the LMSWMS will be reviewed as part of the development of Stage 2 of the Strategy.

More recently a draft paper has been prepared identifying additional mandatory, management & strategic monitoring requirements for improved management of the drainage system by G-MW. This paper has been presented to the DCC where concern was expressed about the cost and the number of monitoring sites proposed. Further work is needed in this area.

GAPS: Confirmation of the amount of monitoring necessary to ensure optimum management of the drainage network.

Reconvene G-MW Water Quality Monitoring Committee.

PRIORITY: High

PROCESS: Review of Draft paper on monitoring requirements. Paper has been submitted to the DCC for comment.

RESOURCES/COST: Preliminary cost estimates have been established for additional monitoring stations to allow for improved management of drainage. (diversion) Costs are significant and external funding contributions are being sought. This is currently being presented to Water Services Committees as part of the Drainage Diversion Strategy**.**

ACHIEVEMENTS: Drain Diversion Management Strategy approved by Board at its October 2000 meeting.

6 G-MW will successfully manage the transition of Community Surface Drain ownership from local government and community groups to G-MW, including the establishment of appropriate business rules for existing and future CSDs.

The G-MW Community Surface Drain Administration Manual has been completed and endorsed by the Statewide Community Surface Drainage Co-ordinating Committee and approved by the Board.

All community groups petitioning for G-MW ownership shall do so in accordance with procedures outlined in this document. Controlled copies of this document have been issued to all relevant parties including local government, CMAs, DNRE and within G-MW.

The Guidelines for Design of Community Surface Drainage Schemes has also been updated and issued to the relevant parties.

Currently five completed community surface drains have been submitted to the Authority for a 'due diligence' assessment for determining whether they are appropriate for G-MW ownership. In addition there are five petitions for new CSDs under G-MW management.

GAPS: Nil

PRIORITY: High

PROCESS: Completed

RESOURCES/COST: Additional resources already employed within Distribution Assets Tatura. Similarly resources are being employed at Kerang to finalise Stage 2 of the LMSWMS and to review CSD applications for G-MW ownership.

ACHIVEMENTS: G-MW formally accepted the first five local government CSDs in July 2001.

7 The hydraulic performance of all existing drains is to be assessed to ensure that their performance is in accordance with their declared level of service.

This is not only to review the integrity of the system in terms of existing assets but also to assess the appropriateness of current maintenance practices in achieving this objective.

7.1 Surface Drainage Standard of Service

Goulburn-Murray Water will facilitate the provision of surface drainage to currently undrained irrigated land within its irrigation districts where there is an identified community need provided that any new Goulburn- Murray Water works are financially and economically viable.

The Authority must, by resolution, declare the level of service to be provided and the area to which that service level shall apply. This level of service shall be determined in consultation with the local community after considering any associated financial and economic implications for Goulburn-Murray Water. It should be based on the methods specified in the G-MW Surface Drain Design Manual for determining run-off and water levels at the time of declaring the level of service.

All landowners to which a declared level of service applies, or will apply, shall be advised of their respective levels of service and any associated rate implications.

All new and upgraded drainage systems shall be constructed and maintained such that they will protect the adjacent land from at least the additional run-off generated as a result of the drained catchment being irrigated by water supplied from Goulburn-Murray Water's supply system.

A level of service must be declared where new surface drains are being installed, or where a previous declaration has not been made for existing Goulburn-Murray Water drains.

The declared level of service provided by existing Goulburn-Murray Water surface drainage systems may be adjusted subject to new works being constructed, there being an identified community need and the new Goulburn-Murray Water works being financially and economically viable.

Once a level of service has been declared for a particular drainage system, that surface drainage system will be maintained such that the declared level of service is achieved.

Until such time as service is declared, existing Goulburn-Murray Water drains which do not have a declared level of service will be maintained to provide a level of service consistent with the works on each drainage system.

Accurate records of planning, design, construction, operation and maintenance activities and data associated with Goulburn-Murray Water drains shall be maintained. The information shall include at least the date and detail of any level of service declaration along with the area serviced directly and the area serviced indirectly by community drains outfalling via Goulburn-Murray Water's drainage systems.

7.2 Performance Review of Drains

Although some individual drains have been assessed for performance (level of service) in comparison with the design intent, generally little is known about how drains are performing hydraulically. By June 2000 a program will be established identifying priorities, time frames and estimated costs for undertaking a hydraulic review of all drains. These reviews will identify available drain waterway, drain grades and structure capacity and be compared with the original design. It would be appropriate to include these reviews as part of an asset management strategy for the drainage sub-catchment.

In conjunction with establishing a program for hydraulically reviewing all drains, maintenance practices within drains will also be reviewed. Currently batter stabilisation trials are being undertaken and several sections of drain will not be sprayed to enable establishment of a 'natural' vegetation cover, which can then be used to compare against the design friction coefficient. It is anticipated that the review of current maintenance practices of drains will be completed by August 2001.

GAPS:	Need to review/update Surface Drainage, Standards of Service Policy.
	Loss of original design plans used for performance review.
	Standards of Service Policy does not cover Community Surface Drains, although CSDs are covered by an agreed level of service.
PRIORITY:	Medium/Low for hydraulic review of drain performance.
	High for reviewing current drain maintenance practices.
	High for review of Surface Drainage, Standard of Service Policy in the Loddon-Murray Area.
PROCESS:	Program for review of hydraulic performance to be approved and implemented as required.

A review of current maintenance practices to be completed by August 2001.

RESOURCES/COST: To be determined following preparation of program for hydraulic drain review. The review of the hydraulic performance of drains would be a costly process simply for the survey/investigation with additional capital costs following for any necessary works.

ACHIEVEMENTS: Final draft for review of hydraulic performance completed June 2000.

8 G-MW will document current drain design standards, including adopted practices, to ensure minimal impacts in terms of flow and water quality on receiving waters.

Community Surface Drain – Guidelines for Design are continually reviewed to include latest developments.

The preparation of a design manual for G-MW Primary Drains is in progress and will be completed by August 2001.

GAPS: Design documentation is available for primary drains but is not formalised into a document similar to the CSD –Guidelines for Design.

PRIORITY: High

PROCESS: Approve general layout of Primary Drain Design Manual and proceed with its development.

RESOURCES/COST: To be established for Primary Drain Design Manual with funding likely to be shared between G-MW and government .

Community Surface Drain – Guidelines for Design is a statewide document and funded by government.

ACHIEVEMENTS: CSD Design Guidelines updated in September 1999 and November 2000.

Primary Drain Design Manual layout approved.

9 G-MW will assess and manage all risks associated with owning a drainage system including public liability, construction, flooding, water quality, pathogens etc. which will be in accordance with the Environmental Management System and the Environmental Audit of Drain Discharges.

The Environmental Management System has been approved by the Board and training undertaken across the Authority. High risk items have been identified in the Environmental Audit and processes are being developed to address these.

GAPS: Nil

PRIORITY: Largely completed

PROCESS: Implementation and review of systems in place. EMS training completed.

RESOURCES/COST: Costs will be included as part of operating G-MW Business

ACHIEVEMENTS: Drain Audit Implementation Schedule developed

10 Drainage diversion practices will be managed to:

10.1 accord with the Murray Darling Basin Commission Cap and other water resource management agreements (Bulk Entitlements):

The objective of the Drainage Diversion Strategy is to improve the water quality of receiving waters by reducing irrigation drainage outfalls through increased drainage diversion. The preparation of a Drain Diversion Plan for each drainage catchment is a key component. Drainage diversion is aimed at harvesting irrigation induced run-off induced, not to harvest the non-irrigation induced run-off. Flows from upstream dryland catchments are not to be included in high flow estimates for diversion. Diversion allocation targets are based on the added run-off from the irrigated catchment as compared to dryland catchment.

The target set for high flow diversion, 20% of total available high flow rainfall run-off, will only draw from the additional rainfall run-off generated by prior irrigation in the catchments. A brief analysis of typical run-off coefficients and hydrologic modelling indicates that the set target for high flow diversion (20% of estimated run-off) gives a storage fill ratio of just over one (1) (ie. On average high flow diverters will be able to fill their storage's annually).

The low flow drain diversion targets, by definition, relate to run-off induced by irrigation water. Therefore, drainage diversion is considered to be directly related to irrigation induced run-off and should not be considered as part of the Murray Darling Basin Cap.

GAPS: Winter run-off is included in assessment for HFD. Can it be considered as irrigation induced?

PRIORITY: High.

PROCESS: Confirmation of above justification by senior management.

Adopt recommendations of farm dam review.

RESOURCES/COST: Not Applicable.

ACHIEVEMENTS:

10.2 minimise poor quality outfalls to downstream waterways in accordance with the objectives of approved Water Quality Strategies:

The Goulburn Broken Water Quality Strategy listed as one of its key targets that phosphorus loads leaving the Goulburn Broken catchment would be reduced by 65%. A major component of this was irrigation drainage, which was targeted to reduce its phosphorus load by 50%.

To achieve this reduction, drainage diversion will be increased thereby reducing outfall volumes (and associated phosphorus loads) entering receiving waterways. G-MW will also promote and be actively involved in whole of catchment nutrient and flow best management practices, such as irrigation efficiency and reuse systems.

GAPS: Approval to construct diversion weirs in drains;

Inconsistencies with High Flow Diversions Guidelines across Areas.

PRIORITY: High

PROCESS: Substantially completed.

RESOURCES/COST: Process established. Cost of implementation likely to be significant with funding shared between G-MW and government funded programs.

ACHIEVEMENTS: Drainage Diversion Strategy (cf. DOCS #371695) was approved by the Board at its October 2000 meeting.

10.3 minimise any impacts on environmental flow requirements that have been established for natural depressions and significant wetlands as part of the drain design:

The management of environmental flows for wetlands has been included in the draft Drainage Diversion Strategy. Key components include:

- For catchments which incorporate nutrient stripping features such as en-route or offline wetlands, sumps, cutoff loops, etc or environmental enhancement/restoration of existing wetlands; the process requires that the total annual volume required by these features be subtracted from the total high flow estimate before applying the decision criteria for assessment of high flow drainage diversion applications.
- The design of a new drainage system is to accord with the requirements for wetlands included in the drainage design guidelines and the draft 'Environmental Assessment Procedure for Integrated Surface Water Management'. The annual volume and pattern required to simulate the wetting and drying regime of the wetland (to be established by the Department of Natural Resources and Environment) must be made explicit by the designer so it can be subtracted from the high flow estimate. This volume should be specified on the basis of long-term catchment development rather than interim conditions.
- Where environmental flows have been agreed for an existing or proposed wetland-type feature, arrangements have been made with DNRE to monitor the frequency, flow and water quality of discharges to these wetlands. Modification to diversion allocations and associated works maybe required depending on the general health of the wetland.
- Wetland Management Plans are being established by DNRE in conjunction with G-MW for key wetlands.

GAPS: Concerns from high flow diverters adjacent to key wetlands regarding their allocations

PRIORITY: High

PROCESS: Largely established.

Wetland Management Plans being developed for Reedy, Gaynors and Mansfield Swamps.

RESOURCES/COST: Many of the guidelines drafted. Monitoring requirements to be established. (refer to Element 5)

ACHIEVEMENTS: Drainage Diversion Strategy has been approved by the Board.

The 'Environmental Assessment Procedure for Integrated Surface Water Management' prepared by DNRE has been included in the CSD Design Guidelines.

Private Wetland Management plan developed for Brays Swamp.

11 Sub-surface drainage discharges into surface drains will be managed to accord with established salt disposal entitlements.

Following investigations undertaken by SKM and endorsement by GBCMA, limits have been established for discharge to drains based on existing drain salinities. Guidelines adopted for controlled groundwater discharge into G-MW primary drains or CSD's for the Shepparton Irrigation region:

- For existing drain salinities less than 530 EC, an upper limit of 800 EC; and
- For existing salinities more than 530 EC, an allowable increase of 50% with an upper limit of 1,700 EC.

These baselines and resultant salinities are irrigation season flow weighted averages for low flow periods and average seasonal conditions (SKM 1998). The existing salinities refer to best estimates of salinities for the period 1994 to 1997 used in developing guidelines.

Currently a Catchment Salinity Network Model is being developed to plan groundwater pump discharges into drainage systems. It will indicate whether or not additional pumps can be allowed to discharge into a drain based on the limits set for drain salinities. For efficiency, the drain network modelling has been aligned with the program for developing Drain Diversion Plans as both exercises have similar data input requirements.

GAPS: Whether there is a need for similar discharge guidelines within the western irrigation Areas of the Authority.

PRIORITY: High (work commenced)

PROCESS: Apply Catchment Salinity Network Model to remaining catchments

RESOURCES/COST: To be established

ACHEIVEMENTS: As at February 2001, catchment characterisation, data collation and model construction has been completed for; Murray Valley Drains 6, 13 & 18, Deakin Drainage System, Warrigal Creek Drainage System, Bamawm Drain, Rodney/Ardmona Drainage System and Shepparton Drains 3, 4, 11 & 12.

12 G-MW will identify and manage all significant pollutant discharges entering the Authority's drains.

This will be achieved by;

- the implementation of G-MW Drain Management Plans, and
- the implementation of relevant sections of G-MW's Environmental Policy and Environmental objectives
- the establishment of Drainage Discharge Agreements for all significant urban and industrial pollutant discharges in accordance with the Policy on Acceptance of Urban and Industrial Wastewater Into Goulburn-Murray Water Drains.
- Drafting of Drainage By-laws for specific pollutants entering the Authority's drains. (eg sullage)

Currently an investigation is proceeding in Shepparton East assessing both the hydraulic performance and pollution sources entering the drains from individual properties. Formalising drainage inlets and controlling sullage and runoff from cool stores etc. will be first trialed in the Shepparton Area. It is likely G-MW will need to fund any farm works and capital cost of Authority banks and drainage inlets.

GAPS: Nil.

PRIORITY: High

PROCESS: Drainage Discharge Agreements for key urban and industrial pollutant discharges have been established. eg Goulburn Valley Water wastewater farm.

Process for establishing Drainage By-laws for specific pollutants has been initiated .

RESOURCES/COST: Investigation of Shepparton East drains is being funded by the Shepparton Area. Costs associated with establishing By-laws have been estimated and the process approved by Manager Water Services. Costs involved in implementing the sullage By-law are likely to be significant.

ACHIEVEMENTS: Draft Drain Management Plan for the Muckatah completed.

Drainage Inlet Audit substantially completed

Implementation of Dairy Shed Effluent Acceptance policy.

13 G-MW will effectively manage both the timing and flowrate of urban discharges into Authority drains.

A review of urban drainage discharges into G-MW drains is being undertaken in conjunction with City Of Greater Shepparton and G-MW.

The criteria for the review methodology is detailed below:-

- Review existing criteria;
  - Pre development rural runoff rates;
  - Allowable urban discharge rates;
  - Retardation basin capacity;
  - Recurrence interval event;
  - Rainfall duration;
  - Drainage inlet design (erosion, litter interception);
  - Operation of inlet (pumped, gravity);
  - Site investigation requirements;
  - Ongoing site monitoring;
- Extend criteria to all systems likely to be affected by urban development;
  - Utilise Shepparton East Drain Study;
  - Anecdotal evidence of drain performance;
- Identify options for minimising basin capacity (eg. Pre-rural peak flow discharge);
  - assess drain flow behaviour;
  - determine available flow capacity;
  - establish discharge capacity sharing criteria;
- Consultation with Municipalities, Water Services Committees

GAPS: Documented consistent approach required across all Irrigation Areas.

PRIORITY: Medium

PROCESS: Review process in place with outcome likely by August 2001. Outcomes should be integrated with local government Stormwater Management Plans.

RESOURCES/COST: Resources required minimal at this stage and will be funded by Areas.

ACHIEVEMENTS:

14 G-MW will undertake research and investigations, including any necessary monitoring, to ensure that the optimum design standards and management practices are being achieved in operating the drainage system, including a better understanding of associated risks.

Investigative projects are important to ensure the Authority remains abreast of key issues eg . nutrients entering drainage system.

A Technical Project Team was established in November 1996 to investigate management of nutrients in drains. The Project Team included representatives from DNRE, GBCMA, CRC for Freshwater Ecology, G-MW, SKM and other waterway consultants. Trials include:

- Batter stabilisation trials have been in place since October 1998. An interim report has been prepared on some of the findings with the final report due July 2001.
- Inline wetland trial in drains has been established at Invergordon. This trial has been fully monitored over a three year period and funded by LWRRDC, Salinity Program (SIR) and G-MW.
- Created wetland and vegetated floodways for sedimentation/filtration established on the lower end of the new Muckatah Drain adjacent to Kinnairds Swamp.

G-MW has strong links with many research bodies and government agencies and is actively involved in several research projects relating to whole of catchment management techniques and their impacts on drainage flows and water quality. Current projects include:

- Bio-monitoring of drains,
- Sediment stabilisation trails using PAM,
- Statistical analysis of nutrient concentration and flows,
- Ecological Risk Assessment,
- Nutrient run-off from farms,
- Input in the development of various Best Management Practices and Codes of Practice.

GAPS: Sources of nutrients entering Authority drains. A project has now been initiated by Natural Resources Tatura to address this issue.

PRIORITY: High

PROCESS: Continuation and monitoring of existing trials including consultation.

Initiation of additional investigations

RESOURCES/COST: Established and reporting mechanisms in place for existing trials.

The investigation into identification of nutrient sources entering drains is to be funded externally.

ACHIEVEMENTS: Second LWRRDC milestone report on In-line wetlands prepared in November 2000.

References

SIRLWSMP

SIRSDS

Victoria's Biodiversity Strategy

MDBC Salinity and Drainage Strategy

GBCMA Water Quality Strategy

NCCMA Water Quality Strategy

NECMA Water Quality Strategy

Loddon-Murray Surface Water Management Strategy

MoU for waterways and drains

Management Policy

Function:
Environmental Management

Subject: Environment and Drainage

Title: Acceptance of Urban and Industrial Water into Goulburn-Murray Water Drains

File No: 1997/000168/1 **Date:** 16 June 2006

Purpose of Policy

To facilitate waste water reuse and establish a framework for acceptance of urban and industrial water into Goulburn-Murray Water (G-MW) drains.

Related Policies

- Surface Drainage, Standards of Service Policy, adopted August 1993 and reaffirmed at Meeting 1, held on 1 July 1994. Refer Policy Manual #463401
- Surface Drainage Strategy, 20 April 2000, refers to Strategy #234997.
- Environment Policy, established by the Board at Meeting 127, held on 20 April 2005. Refer Policy Manual #463401.

This management policy replaces the Board policy "Acceptance of Urban and Industrial Water into Goulburn-Murray Water Drains", which was rescinded at Board Meeting 138, held on 24 May 2006. The Board policy was removed from the Policy Manual, #463401, in version 48.

Context

G-MW is responsible under the *Water Act* 1989 ("Act") for supplying drainage services to its gravity irrigation customers. Conveyance of urban and industrial water (stormwater runoff, factory effluent and sewerage) is not part of this service. G-MW may therefore accept or reject discharge from such development based on the risk it poses to G-MW, its customers, assets or the environment.

Under Section 12 of the Act an Authority, in authorising or permitting any activity or any change to land use that may affect the existing drainage regime:-

a) must attach conditions which, in the opinion of the appropriate officer are required to ensure the conservation of waterways, wetlands and aquifers; and
b) may withhold the authorisation until any works are carried out that are required by the Authority for avoiding or lessening any possible adverse effect.

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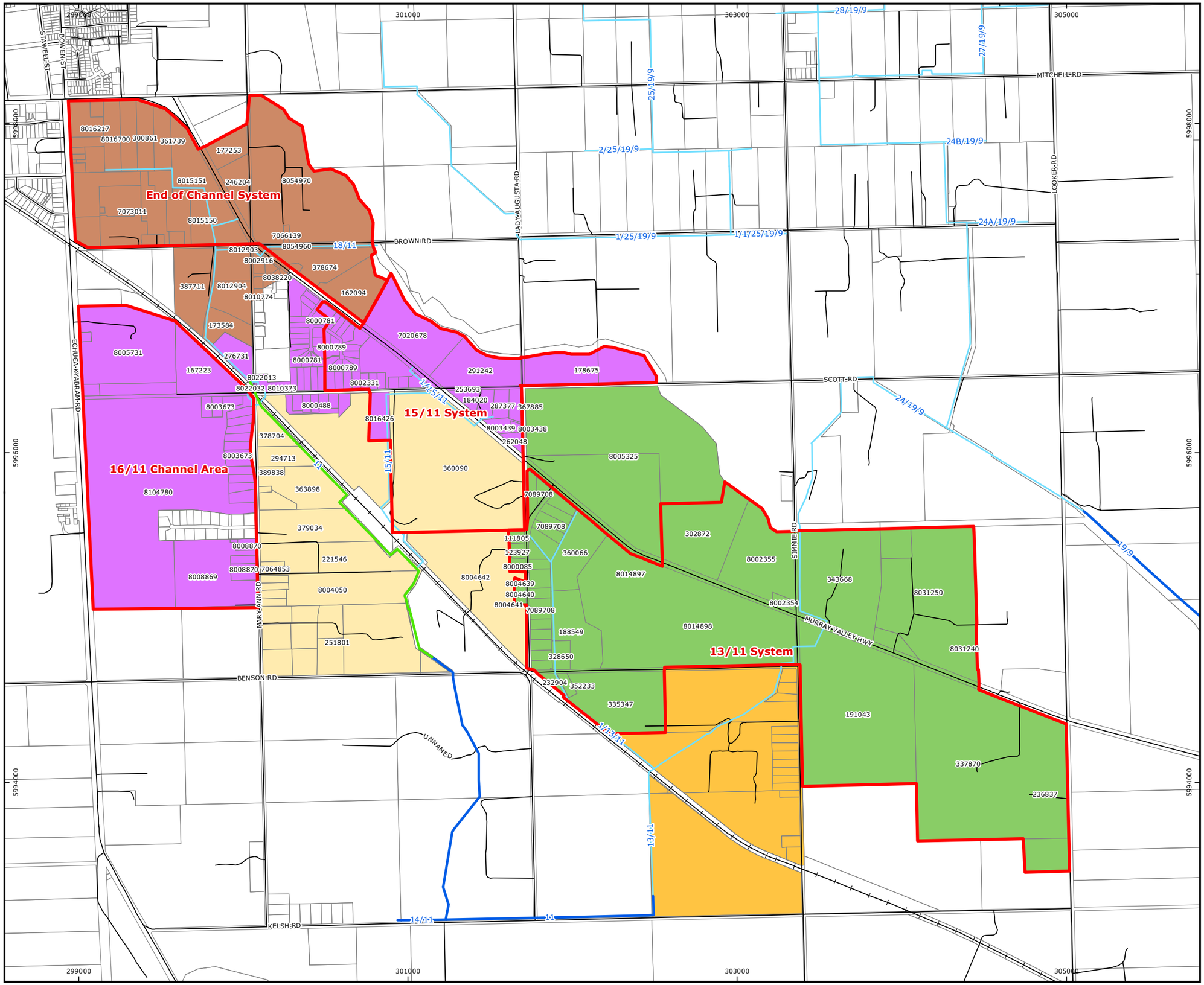
Appendix E. G-MW Maps and plans



LEGEND

- Proposed Backbone Extension
- Backbone Channel
- Non-Backbone Channel
- Railway
- Road
- Murray River
- Cadastre
- Project Area Extents

Preferred Connection Option

- D&S Service
- Direct Connection to Backbone Pipe
- Individual Connection to Backbone Extension
- New Piped Service
- New Piped Service

N

250 0 250 500
Metres

APPROX SCALE 1:22,500 @ A3

GDA 1994 MGA Zone 55

DATA SOURCES

CLient
RPS
Geoscience Australia

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Please verify the accuracy of all information prior to use.

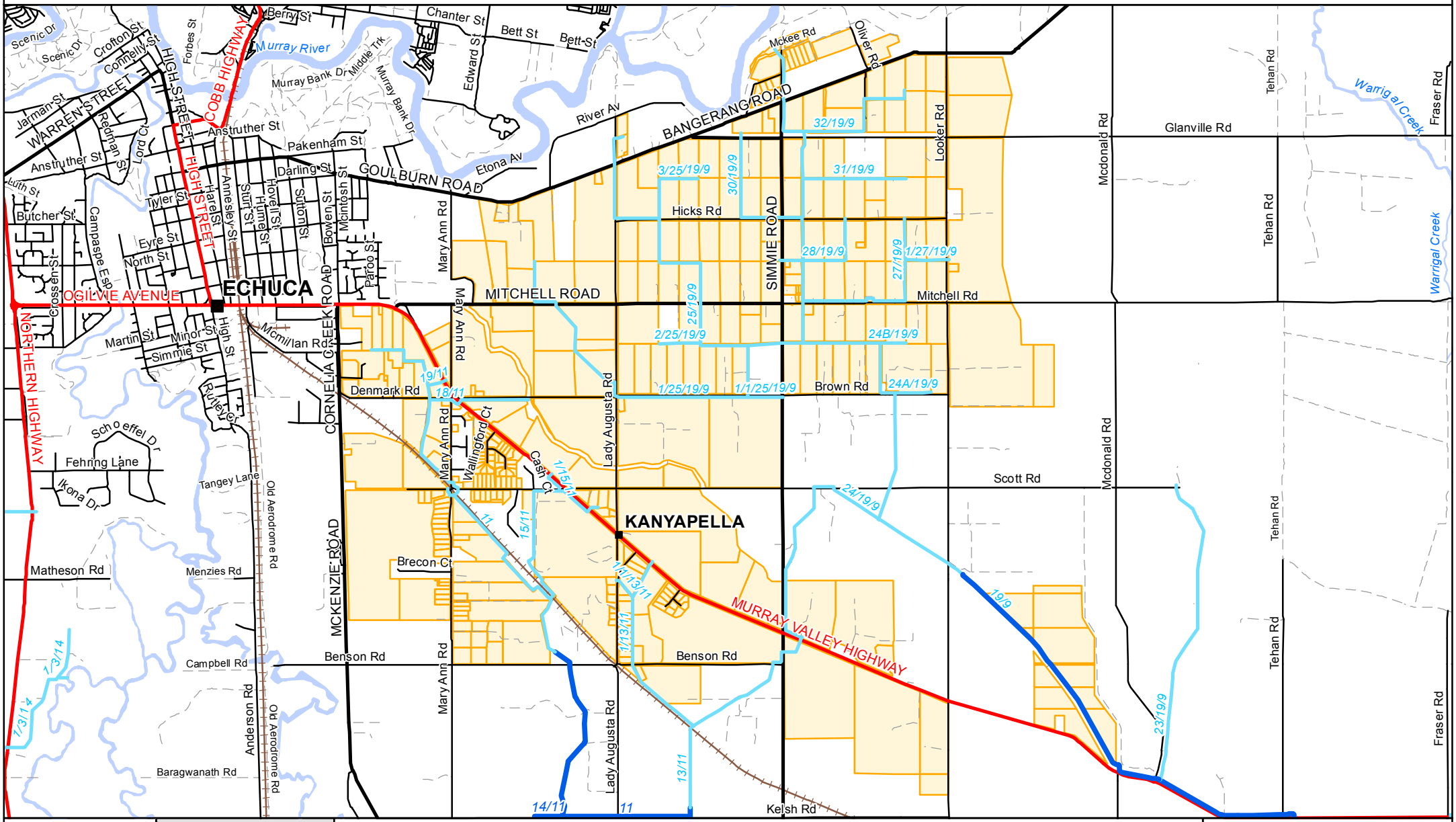
RPS

FIGURE 1

RO_SCP_10
PREFERRED OPTION

CG_SCP_45B & RO_SCP_10

GOULBURN-MURRAY WATER STRATEGIC CONNECTION PROGRAM



GOULBURN-MURRAY WATER

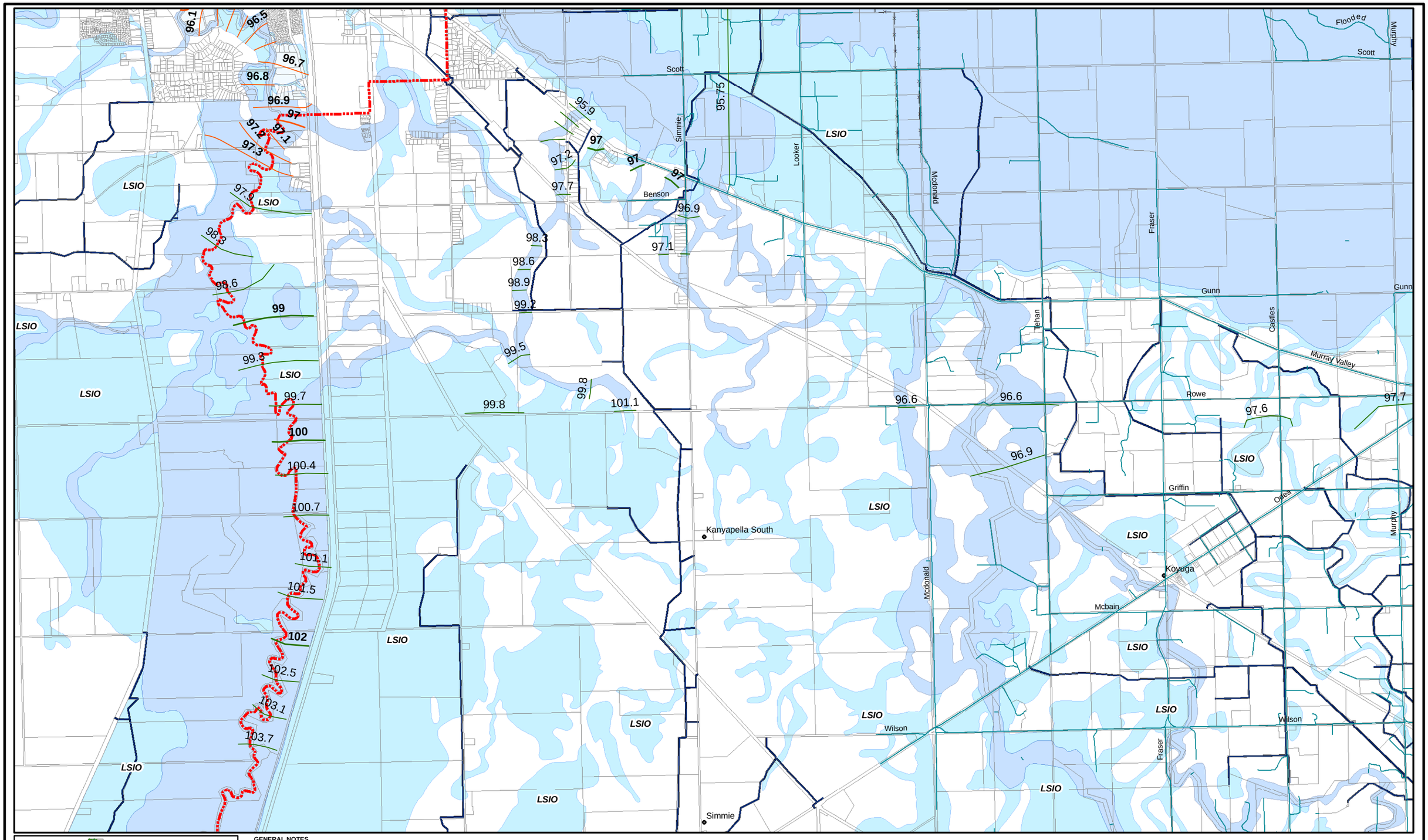
IR24550

31 JAN 2014

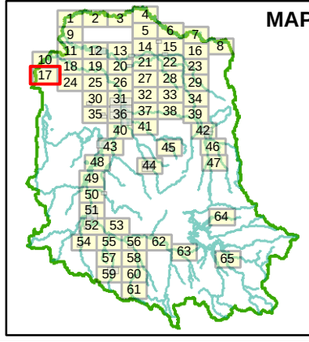
GOULBURN-MURRAY WATER
Ph 1800 013 357
www.g-mwater.com.au

SCALE AT A4 1:50,000

0 0.4 0.8 1.6 km



MAP KEY



GENERAL NOTES

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The Goulburn Broken Catchment Management Authority does not warrant that this document is definitive nor free of error and does not accept liability for any loss caused or arising from reliance upon information provided herein.

Cadastral information is supplied by Department of Sustainability and Environment.

This map has been prepared using the best available data and mapping techniques. The accuracy of this map however, is not absolute and reflects only the accuracy of the data and techniques used. This information is subject to change where new information is found or determined from future studies.

NOTES ON DECLARATION AND BEST ESTIMATED FLOOD LEVELS

The flood level lines shown on this plan define the surface level of the "1% probability flood". Where flood level declarations have occurred, this is the flood prescribed by Section 204 of the *Water Act 1989*, for floodplain management purposes and has a 1 in 100 chance of being equalled or exceeded in any one year. Other flood level contours represent the best estimate of the 1% probability flood.

The derivation of these 1% flood level lines has been based on available historical flood level and flow information, hydrologic and hydraulic modelling.

Areas outside the 1% probability flood limit may be inundated by rarer flood events.

For the purpose of determining flood levels for locations between flood level lines, it can be assumed that the flood surface levels change at a uniform rate between flood level lines.

The flood level lines shown on this plan can be used to assist in the determination of designated levels in accordance with Clause 6.2 of the *Building Regulations 1994*.

Although there may be buildings within the area covered by the flood level lines, it should not be assumed that the floor of any individual building is below flood level. Buildings should be surveyed to determine whether their floors are above or below the 1% flood level.

FLOOD OVERLAY INFORMATION

This map showing Urban Floodway Zone (UFZ), Floodway Overlay (FO or RFO) and Land Subject to Inundation Overlay (LSIO) are indicative only and not to be used as a substitute over the planning scheme maps.

0 0.25 0.5 1 1.5 2 Kilometres

Scale 1:50,000 at A3

Legend

- Declared/Designated Flood Contours (metres AHD)
- Best Estimated Flood Contours (metres AHD)
- Land Subject to Inundation Overlay
- Floodway or Rural Floodway Overlay
- Urban Floodway Zone
- Known Levees
- Irrigation Channels
- Waterways
- Roads
- GBCMA Waterway Boundary

AUSTRALIA
DEPARTMENT OF FINANCE AND ADMINISTRATION

GOULBURN BROKEN CATCHMENT MANAGEMENT AUTHORITY

GOULBURN BROKEN CATCHMENT MANAGEMENT AUTHORITY

1% FLOOD LEVEL CONTOUR ATLAS

Date: 30 June 2008

SHEET NUMBER **17** of **104**

DRAWING NUMBER **540335**

REVISION