



# Dubbo City Urban Salinity Management Strategy

# Vision

*To minimise the current and future impacts of land degradation, inappropriate land use practices and climate change on production and the environmental and indigenous heritage values of land within the urban area of Dubbo.*

## Table of Contents:

### PART ONE: THE SALINITY CONTEXT

|                                         |   |
|-----------------------------------------|---|
| 1.0 Introduction .....                  | 3 |
| 1.1 Relationship with Other Plans ..... | 5 |
| 1.2 Understanding Urban Salinity .....  | 7 |
| 1.3 Salinity Snapshot .....             | 8 |

### PART TWO STRATEGY

|                                          |    |
|------------------------------------------|----|
| 2.0 Strategic Vision .....               | 15 |
| 2.1 Strategic Framework .....            | 15 |
| Strategy One: Salt Impact .....          | 16 |
| Strategy Two: Groundwater Recharge ..... | 17 |
| Strategy Three: Land Use .....           | 18 |
| Strategy Four: Infrastructure .....      | 19 |
| Strategy Five: Monitoring .....          | 20 |

### PART THREE: MONITORING AND EVALUATION

|                                                                 |    |
|-----------------------------------------------------------------|----|
| 3.0 Monitoring Salinity Targets and the Impact of Actions ..... | 21 |
| 3.1 Evaluating Performance .....                                | 21 |
| 3.2 Recording Data and Periodic Review .....                    | 22 |



# Part one: The Salinity Context

## 1.0 Introduction

Dubbo is situated in the Central West of New South Wales and is one of the largest inland cities supporting a resident population of 40,882 and a catchment area of more than 120,000 people. The main activities in the Dubbo area include construction, health care, government administration, education and training, retail, agriculture and tourism.

The Dubbo Local Government Area is located within the Macquarie – Bogan catchment and is part of the Murray Darling Basin. The Macquarie River is one of the major rivers running through the catchment. Salinity is an issue for the Local Government Area, occurring in various localised areas throughout the urban and rural landscapes. To monitor the impacts of salinity Council has established an extensive bore monitoring network consisting of 129 within the urban area. Council has also developed urban salinity hazard modelling to assess the risk of salinity to future developments.

The Salinity Management Strategy aims to minimise the current and future impacts of land degradation, inappropriate land use practices and climate change on production and the environmental and indigenous heritage values of land within the Dubbo Local Government Area.

The community's vision to prioritise environmental sustainability and management for the City was highlighted during the development of the Dubbo Community Strategic Plan 2036. The community identified the need for the principles of Ecologically Sustainable Development to be implemented, the importance of the community being supported to become environmentally sustainable and the need for the environmental impact from Council's activities and operations to be reduced in achieving these targets.

Through delivering the components of Dubbo Council's Corporate and Delivery Plan strategies, Dubbo City Council, in partnership with State Government and the community of Dubbo aims:

- To manage the collection and use of reliable baseline data to quantify the saline status and ensure future monitoring, management and planning is adequate, effective, scientifically justified and cost effective.
- To ensure that urban salinity identification, management and education is in accordance with best practice and is central to sound, responsible environmental and land use planning.



# Part one: The Salinity Context

The Salinity Management Strategy has been developed with an aim to minimise the current and future impacts of land degradation, inappropriate land use practices and climate change on production and the environmental and indigenous heritage values of land within the Dubbo Local Government Area.

Council has significant knowledge in the location, extent and spatial implications of urban salinity in the Dubbo Local Government Area due to the bore monitoring network, ongoing research investigations and community involvement. The Strategy will provide for the ongoing monitoring and management of salinity which will contribute to increasing the understanding of salinity within the urban area of Dubbo and allow the impacts of salinity to be minimised, particularly within the landscapes most at risk of impact by salinity.

The Strategy structures the factors of urban salinity into individual strategies and provides strategic outcomes as a basis for salinity management.

The Strategy will act as the main planning tool for salinity management, guiding salinity management actions. Salinity management actions will be applied to the priority Hydro-geological Landscapes (HGLs), identified in the Dubbo Urban Landscapes Interpretation Project which was carried out in 2010. The priority HGL are those landscapes that contribute significantly to rising salinity, locations that are important in the functioning and our understanding of salinity processes in the urban area and those areas that are significant in order to protect local assets and values. These HGLs are detailed in the Implementation Plan.

The Implementation Plan sets out the actions and tasks for achieving the strategic objectives under the individual strategies, as listed above. The management actions are allocated to specific hydro-geological landscapes with the aim to address the areas that are most at risk of salinity.

The Salinity Management Strategy incorporates the following individual strategies:

1. **Salt impact** – The type and quantity of salt present within the landscape is managed.
2. **Groundwater Recharge** – The amount of water mobilising and concentrating salts in the landscape is managed.
3. **Land use** – Use of the landscape and associated practises consider and manage salinity processes.
4. **Infrastructure** – Construction materials and methods are suited to the salinity hazard of the landscape.
5. **Monitoring** – Ongoing investigation and management of salinity processes and impacts.

# Part one: The Salinity Context

## 1.1 Relationship with Other Plans

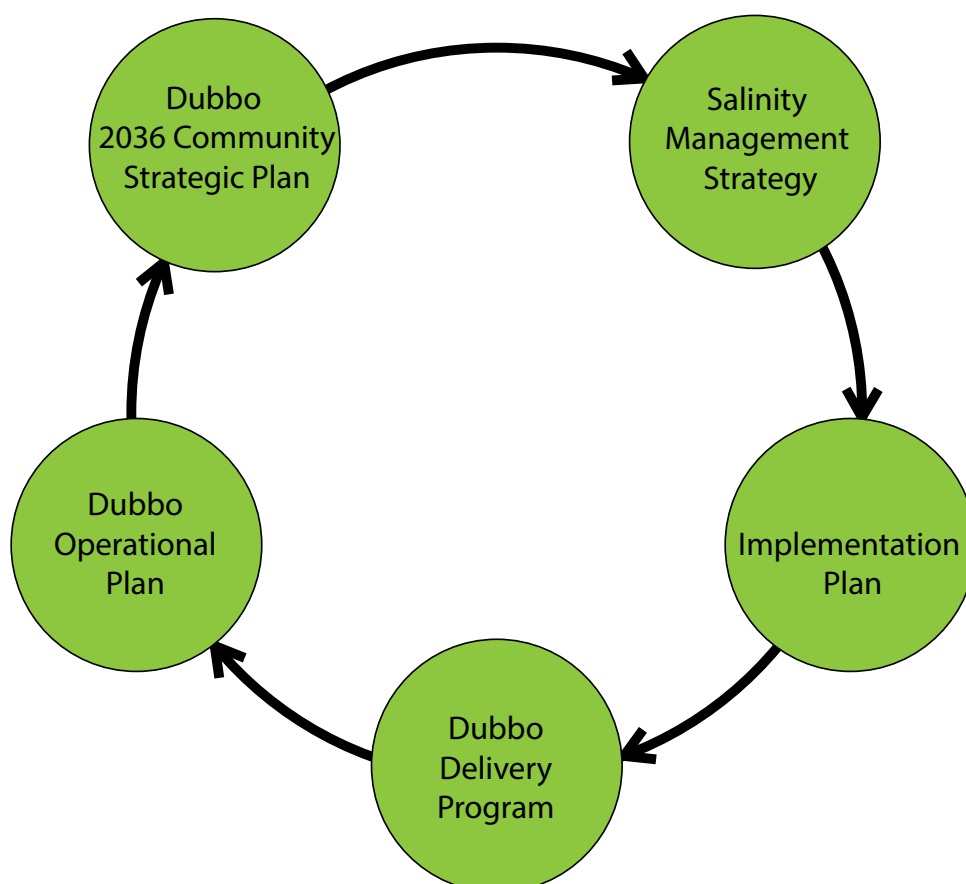
### Community Strategic Plan

The Dubbo 2036 Community Strategic Plan (CSP) was originally adopted in June 2012, as the new planning and reporting framework for Council. The Salinity Management Strategy is designed to support the achievement of numerous CSP outcomes ensuring environmental sustainability is a priority in the management of built and natural assets within the City.

The Community Strategic Plan provides a number of themes relating to strategic goals for future urban development and management. Each theme has specific aspirations or outcomes that also provide guiding principles

for the Salinity Management Strategy. Figure 1 shows the link between the Salinity Management Strategy, Salinity Management Implementation Plan and Dubbo 2036.

The community requirements identified in the CSP will continue to guide the direction and scope of this Strategy. Dubbo 2036 is required to be reviewed every four (4) years or within 12 months of the election of a new Council. The Salinity Management Strategy will be reviewed in line with a review of Dubbo 2036 and will include any new principles the community identifies as being important in the future conservation, growth and development of the Dubbo's urban area.



# Part one: The Salinity Context

The Salinity Strategy will support the achievement of numerous Strategic Outcomes within Council's planning framework, as outlined in Table 1.

Table 1. Salinity Strategy Delivery of Strategic Outcomes

| <u>Plan</u>                                | <u>Theme</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <u>Strategic Outcome</u>                                                                                                                                   |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Dubbo Community Strategic Plan</b>      | Our Place                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2.1 Environmental Sustainability and Management is a priority for the City                                                                                 |
|                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2.2 Land use management to improve and to sustain the City's built and natural environment.                                                                |
|                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2.3 Dubbo's rural areas continue to have the capacity to be a significant contributor to the local, regional and national economy.                         |
|                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2.4 Sufficient residential, industrial, recreational, commercial and institutional land zones are available to meet business, retails and lifestyle needs. |
|                                            | Our Infrastructure                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 3.2 The Dubbo community has a high standard of living through the provision of a superior water supply                                                     |
|                                            | Our Leadership                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 5.3 Sound management of the resources of Council is undertaken                                                                                             |
|                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 5.4 Statutory requirements are met and services are provided to the organisation in a cost effective and timely manner.                                    |
| <b>Dubbo ALIVE</b>                         | Land                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 2.1 Identify, protect, enhance and actively manage priority soil landscapes, environmentally sensitive areas and salinity impacts.                         |
| <b>Dubbo Local Environmental Plan 2011</b> | Aims to ensure development and land management practises do not further exacerbate the impact of urban salinity or result in new salinity outbreaks.                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                            |
| <b>Dubbo Development Control Plan</b>      | Aims to ensure development does not exacerbate the incidence of urban salinity; does not increase the risk of urban salinity; that incompatible development is not located in areas at risk of salinity; that suitable construction materials are used that will withstand salinity; that the impact of urban salinity on private and public infrastructure is minimised and that the development of land is undertaken in a manner which will facilitate the rehabilitation of any identified salinity outbreak. |                                                                                                                                                            |

# Part one: The Salinity Context

## 1.2 Understanding Urban Salinity

Salinity is term used to define the accumulation of salt in land and water to a level that impacts on the natural and built environment. While the term Salinity is used to describe the processes and impacts associated with the interaction of salt and water in a landscape, it is also used to describe the measure of salt in soil or water.

Salt is a naturally occurring mineral which is produced through the weathering of rocks, particularly marine sedimentary rocks. Salt may be carried inland from marine environments with wind and dispersed on the soil surface. Salt deposits on soil may be buried, but later exposed by erosion or mobilised by groundwater.

The Australian landscape contains large amounts of salt from the ocean, introduced through rainfall and the chemical weathering of rock. Clearing of native vegetation for urban development facilitates an increase of rainfall seepage into the groundwater systems of these landscapes, which causes the water tables to rise and brings saline ground water close to the land surface.

Water entering the soil through processes of irrigation as well as diversion and detention of stormwater can impact on soil and water processes and can contribute to urban salinity. The impacts of household irrigation of gardens as well as pipe leakage, sewer losses, rubble pits, stormwater inputs, and irrigation of sporting fields and parks are identified as significant in contributing to urban salinity.

Figure 2. shows how changed environmental conditions may alter the groundwater level through increased infiltration (input) and reduced transportation (output) increasing the exposure of salt to the soil surface.

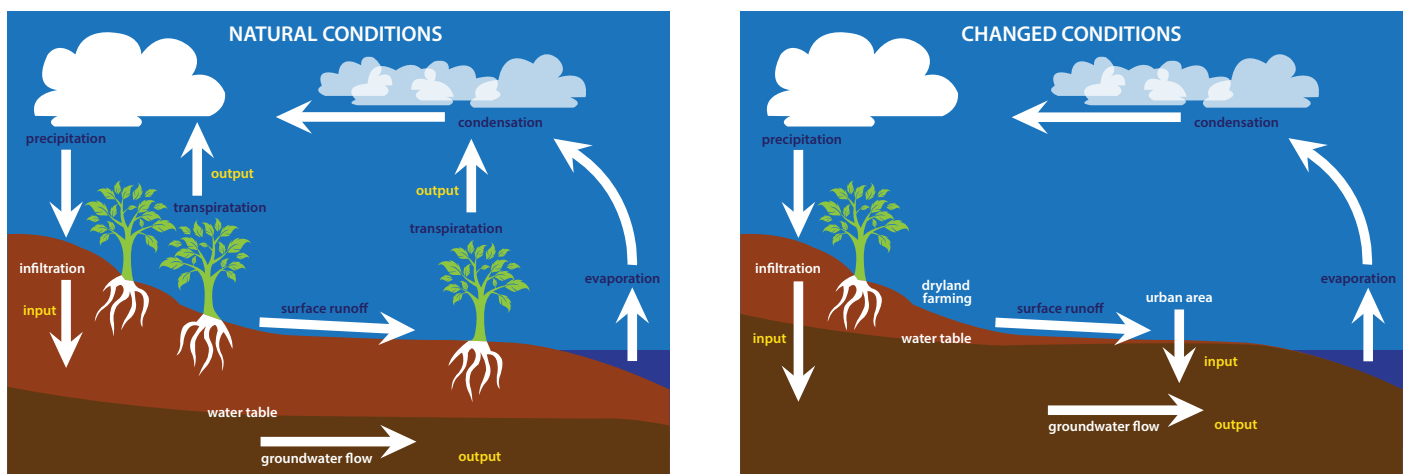


Figure 2. The Salinity Process

# Part one: The Salinity Context

## 1.3 Salinity Snapshot

### 1.3.1 The local setting

Urban Salinity is evident across Dubbo in various localised areas causing significant damage to homes, vegetation, water quality, infrastructure and amenities. It is often very site specific and occurs as a result of a very complex relationship between soil, surface water, ground water, climate, geology, water balance, vegetation, land use history, management and development. A number of sites have been identified, showing visual indicators of urban salinity including salt precipitate on soil surface, loss of vegetation, bare or damp soil, damage to brickwork, road damage and high or rapidly fluctuating water tables.

The physical and chemical properties of soil play a major role in the development of urban salinity in the Dubbo area. The local geological formations of the Dubbo area include a mixture of flat lying sediments, intrusive units, tertiary basalts and quaternary alluvium. The geological influences and inter-relationships strongly determine the salinity situation of the area.

Further, the accessibility of water in Dubbo due to its proximity to the Macquarie and Talbragar Rivers, has allowed significant application of water to residential areas over a significant period of time. This is identified as having a significant contribution to the urban salinity issue within Dubbo.

The Dubbo Urban Landscape Interpretation Project, undertaken in April 2010 identifies the following as the key causes of salinity in the wider Dubbo area:

- Changes in water balance;
- Sources of salt and redistribution in the landscape;
- Varieties of groundwater processes;
- Dry scald which expose salinity soils.

The Project contributes the increased occurrence of salinity in Dubbo to:

- A decrease in deep rooted vegetation;
- Over irrigation of crops, improved pastures and private gardens and lawns;

- Alteration of natural drainage patterns by the construction of houses, roads, railways and channels;
- Creation of wet zones of waterlogged soil by impeded drainage;
- Leaking standing water bodies, pools, lakes and service pipes;
- Expose of susceptible soils;
- Irrigation of sports grounds, golf courses, parks and gardens.





# Part one: The Salinity Context

## 1.3.2 History of Salinity Management in Dubbo

Council has engaged in various landscape investigations across the Dubbo Local Government Area since 1995 and specifically in response to the recognition of significant salinity in the Troy Gully area in 1994. A report to Council, detailing the findings of an initial site inspection of the Troy Gully area (1994) is recorded as the first identification of urban salinity in Dubbo.

Council took a proactive approach to the collection of background data, providing an increase in the understanding of cause and effect, the geological situation and the impacts of urban salinity in the area with the formation of the 'Troy Gully Urban Salinity Working Group' and recent completion of the Dubbo Urban Salinity Landscape Interpretation Project.

Through the extensive investigative work carried out over time and through a range of seasonal patterns and through changes in land use, Council has gained a significant level of understanding in regards to the location, extent and spatial implications of urban salinity management. Notably, the Dubbo Urban Landscape Interpretation Project and Groundwater Monitoring Network have provided significant data contributing to the current understanding of urban salinity within Dubbo.

### Dubbo Urban Landscape Interpretation Project (April 2010)

The Dubbo Urban Landscape Interpretation Project was initiated by Council in 2010 with a purpose to interrogate, interpret, model and review existing data to produce outputs and products, to further enhance the understanding of urban salinity in the Dubbo context. The key areas of work included in the project are as follows:

- Detailed soil/texture map for the Dubbo area, utilising the data from the construction logs of the peizometers established across Dubbo;
- Development of a depth to bedrock map for the Dubbo urban area, utilising data from the construction logs of the peizometers established across Dubbo;
- Development of Hydro-geological Landscapes (HGLs) for the Dubbo urban area;
- Detailed analysis of the Victoria Park Project;

- Modelling of groundwater using time series data to develop and understanding of groundwater and salinity through time and across the City;
- Development of a Salinity Risk and prediction map for the Dubbo Urban area.

The Hydro-Geological Landscapes developed as part of the project are incorporated in the Strategy as a means of allocating and prioritising actions for salinity management. As part of the Dubbo Urban Landscape Project, the HGLs were developed based on the geology and groundwater characteristics of the various landforms present in the urban area. A map identifying the boundaries of each of the Hydro-geological landscapes is shown as Figure 3.

The salinity hazard for each landscape was assessed based on salt impact, salt load export impact and impact on water quality. Table 2 details each Hydro-geological Landscape and the assessed salinity hazard (April 2010).

The Salinity Implementation Plan delivers actions specific to the Hydro-geological Landscapes with a focus on addressing the salinity hazard in the landscapes identified with an overall hazard of Very High, High or Medium. Further, the actions address bore sites determined as extreme, high and medium based on water quality and groundwater height over the period 2009 to 2012, as assessed by the Impax Group in February 2013 as part of the annual monitoring of the Urban Salinity Network.

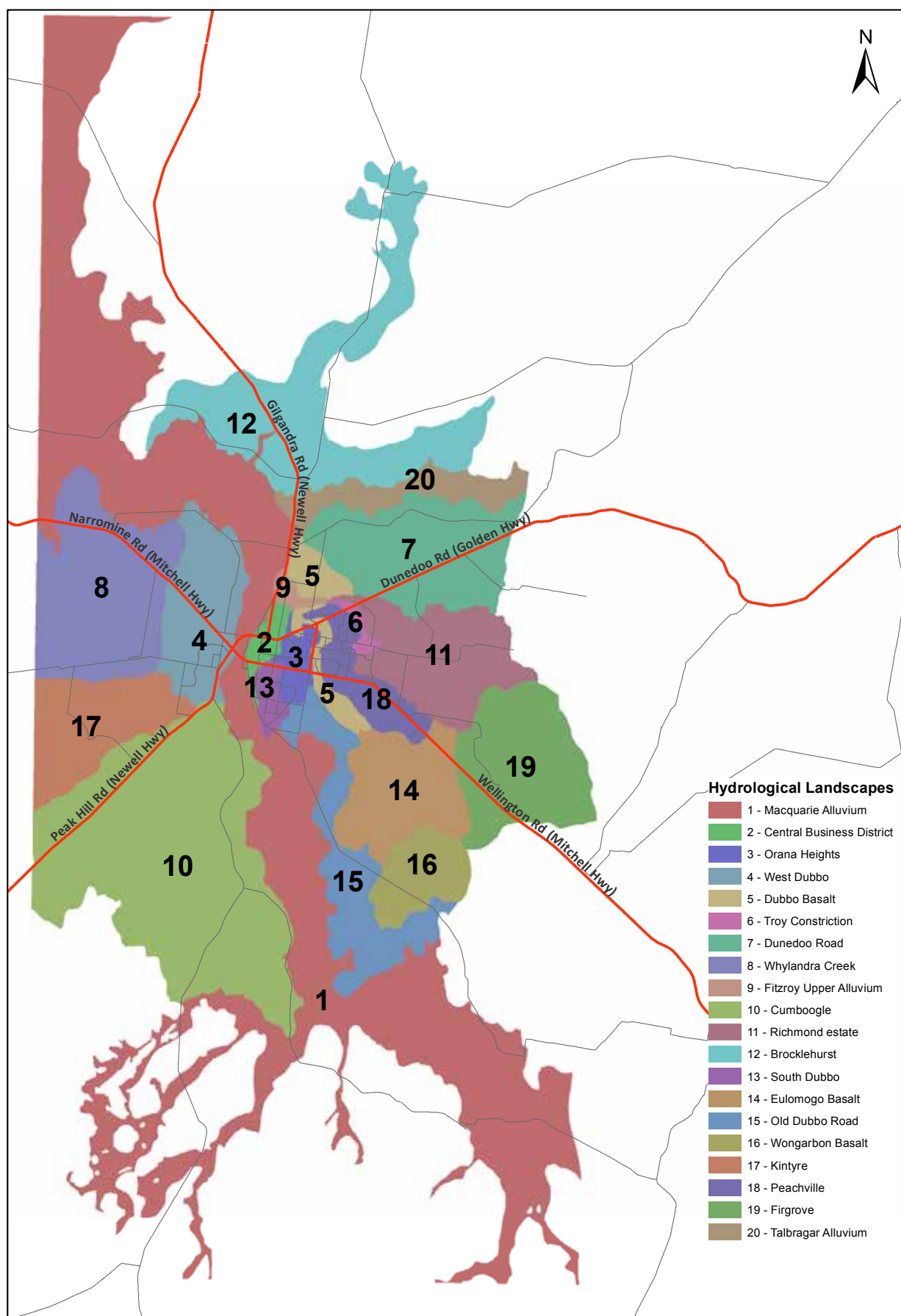
## Part one: The Salinity Context

Table 2. Dubbo Urban Areas Hydro-geological Landscapes (April 2010)

| Hydro-geological Landscapes |                           | Land Impact | Salt Load Export Impact | Impact on Water Quality | Overall Hazard |
|-----------------------------|---------------------------|-------------|-------------------------|-------------------------|----------------|
| 1                           | Macquarie Alluvium        | Low         | Moderate                | Low                     | Medium         |
| 2                           | Central Business District | High        | High                    | High                    | Very High      |
| 3                           | Orana Heights             | High        | Moderate                | Moderate                | High           |
| 4                           | West Dubbo                | Moderate    | Moderate                | Moderate                | Medium         |
| 5                           | Dubbo Basalt              | Moderate    | Moderate                | Low                     | Medium         |
| 6                           | Troy Creek Constriction   | High        | High                    | High                    | Very High      |
| 7                           | Dunedoo Road              | High        | Moderate                | High                    | High           |
| 8                           | Whylandra Creek           | Low         | Low                     | Low                     | Low            |
| 9                           | Fitzroy Upland Alluvium   | High        | High                    | Moderate                | High           |
| 10                          | Cumboogle                 | Moderate    | Low                     | Low                     | Low            |
| 11                          | Richmond Estate           | Moderate    | High                    | High                    | High           |
| 12                          | Brocklehurst              | Moderate    | Moderate                | Moderate                | Medium         |
| 13                          | South Dubbo               | High        | Moderate                | Moderate                | High           |
| 14                          | Eulomogo Estate           | High        | High                    | High                    | Very High      |
| 15                          | Old Dubbo Road            | Low         | Moderate                | Low                     | Low            |
| 16                          | Wongarbon Basalt          | Low         | Low                     | Low                     | Very Low       |
| 17                          | Kintyre                   | Moderate    | Moderate                | Moderate                | Medium         |
| 18                          | Peachville                | Low         | Moderate                | Low                     | Low            |
| 19                          | Firgrove                  | Low         | Moderate                | Low                     | Medium         |
| 20                          | Talbgagar Alluvium        | Low         | Moderate                | Moderate                | Low            |

# Part one: The Salinity Context

Figure 3. Dubbo Hydro-geological Landscapes



# Part one: The Salinity Context

## Groundwater Monitoring Network (October 2004)

The Groundwater Monitoring Network was initiated in October 2004 and established 129 bores, of which 110 have been converted to long term monitoring bores with the dual purpose of sampling monthly for standing water level (SWL) and salinity (EC). The location of Groundwater Monitoring Bores with the Dubbo Local Government Area is attached as Appendix B.

The Groundwater Salinity Monitoring Network is a valuable resource in documenting soil factors, depth to rock, shallower water table assessment and soil salinity profiles through detailed profile descriptions throughout the Dubbo urban area.

The Project assists Council in meeting the objectives of its strategic plans by targeting, monitoring and providing the baseline trend analysis data for scientifically supporting the strategic management of urban induced salinisation and identifying areas of naturally occurring salinity. Data collection is ongoing and allows Council to monitor the changes in groundwater resulting from changes in land use practices over time. It also allows Council to identify specific salinity management requirements for urban expansion areas and on future development areas.

The Groundwater Monitoring Network assists Council with:

- Strategic Planning
- Development assessment
- Assisting private developers through the provision of baseline data for strategic assessment and planning
- Assisting the community in the better management and protection of the built and natural environment of the City
- Infrastructure planning and maintenance

The Groundwater Monitoring Network assists in the preparation of the following information:

- Identification of naturally saline areas (groundwater and/or soils)
- Identification of shallow water tables
- Identification of urban development induced salinity
- Monitoring of the impacts of changed land use practices on groundwater

- Creation of baseline data for trend analysis over time
- Creation of baseline data for areas zoned for future development
- Creation of data for determining:
  - groundwater flow rates and directions
  - groundwater lateral and vertical head distributions
  - hydraulic gradients within single and between layered aquifers
- Creation of baseline scientific data to generate strategic planning tools including:
  - maps identifying areas of existing salinity
  - maps of areas with a potential salinity threat
  - maps of salinity sensitive lands
- Definitions for information for inclusion with development applications
- Community education of the impacts of land management techniques on salinity
- Community education of the impacts of land management techniques on groundwater
- Sufficient data to support environmental monitoring of groundwater



## Part one: The Salinity Context

In February 2013, Council commissioned an evaluation report of the Program including a data audit and salinity risk and class of each groundwater bore for the period 2009-2012. The evaluation included an audit of the groundwater bore data for the period 2009-2012. The average annual level of salinity risk and class were assessed to determine annual trends by comparing average annual data for the period. Appendix A details the groundwater bore sites identified with extreme, high or medium concern salinity hazard trends within the associated Hydro-geological Landscapes.

- 132 groundwater bores were monitored monthly for standing water level (SWL) and electrical conductivity (EC) for the period 2009-2012;
- For the period 2009-2012, the salinity hazard trends were as follows:
  - Extreme Concern – 2 groundwater bores (1.5% of total);
  - High Concern – 6 groundwater bores (4.5% of total);
  - Medium Concern – 21 groundwater bores (15.9% of total); and
  - Least Concern or dry/excluded – 103 groundwater bores (78.1% of total).
- Groundwater data was generally consistent with assessed HGL salinity hazards and modelled SWLs, and
- Groundwater bores that had a higher salinity hazard trend than their assessed HGL salinity hazard were GW 1 (Firgrove HGL), GW T302, GW 43, GW T303 and GW T307 (Peachville HGL).

The Evaluation Report made policy recommendations and actions and provided management directions for salinity. The Implementation Plan supports the recommendations of the Evaluation Report which actions strategies at groundwater bores with extreme, high and medium concern salinity hazard trends. Groundwater bore sites with an extreme, high or medium concern salinity hazard trend over the period 2009-2012 are located in the HGLs detailed in Table 3.

The HGLs identified in Table 3 are commonly identified as having a significant overall salinity hazard. The Peachville HGL is an exception, as it has a low overall salinity hazard concern though contains one bore identified as high and three bores identified as medium concern. This is an example of how one HGL can influence another.

Peachville has salt stores in the soil profile and ground water is generally deep, this will impact adjoining downstream units.

Accordingly, while the groundwater is saline it may not be at a depth that has the potential to cause salinity impacts within the HGLs itself, but rather in other HGLs.

Table 3. Extreme, High, Medium Concern Bore Sites (2009-2012)

| Hydro-geological Landscape |                         | Bore ID | Bore Monitoring Assessment |
|----------------------------|-------------------------|---------|----------------------------|
| 3                          | Orana Heights           | GW24    | Medium                     |
|                            |                         | GW59    | Medium                     |
|                            |                         | GW62    | Medium                     |
| 4                          | West Dubbo              | GW34    | Medium                     |
|                            |                         | GW85    | Medium                     |
|                            |                         | GW98    | Medium                     |
|                            |                         | GW109   | Medium                     |
| 5                          | Dubbo Basalt            | GW73    | Medium                     |
|                            |                         | GW107   | Medium                     |
| 6                          | Troy Creek Constriction | GW T129 | Medium                     |
|                            |                         | GW T130 | Medium                     |
|                            |                         | GW T132 | Medium                     |
| 9                          | Fitzroy Upland Alluvium | GW72    | High                       |
|                            |                         | GW T103 | Medium                     |
|                            |                         | GW T104 | Medium                     |
| 11                         | Richmond Estate         | GW8     | High                       |
|                            |                         | GW7     | Medium                     |
|                            |                         | GW106   | Medium                     |
| 13                         | South Dubbo             | GW75    | High                       |
|                            |                         | GW78    | High                       |
| 14                         | Eulomogo Basalt         | GW114   | Extreme                    |
|                            |                         | GW128   | Extreme                    |
| 18                         | Peachville              | GW T302 | High                       |
|                            |                         | GW43    | Medium                     |
|                            |                         | GW T303 | Medium                     |
|                            |                         | GW T307 | Medium                     |
| 19                         | Firgrove                | GW1     | High                       |
|                            |                         | GW5     | Medium                     |

# Part one: The Salinity Context

## 1.3.3 Cost of Salinity

A report commissioned by Dubbo City Council in 2003, 'Audit of current impacts and costs of dryland and urban salinity in the Dubbo LGA', detailed an estimated cost of \$7.47M per annum for both urban and dryland salinity within the Dubbo Local Government Area as follows:

- Rural and urban households (\$4.94M per annum)
- Commerce and Industry (\$1.94M per annum)
- Dryland agricultural producers (\$671,150 per annum)
- Local Government (\$379,130 per annum)
- State Government agencies and infrastructure based utilities (\$546,110 per annum)

While the costs to roads and infrastructure are not fully realised, it is estimated that the repair and maintenance costs for urban roads was \$2,400 per kilometre per year.



## 1.3.4 Salinity as a regional issue

Salinity has been recognised as a critical environmental issue in the Central West of NSW for over 80 years. As a fundamental land management issue, salinity has been the focus of government agencies, organisations and the community, increasing the opportunities available to further explore the salinity situation.

In March 2000, the New South Wales Government hosted a Salinity Summit in Dubbo to discuss the regional issue of salinity with key stakeholders including land managers, scientists, conservationists and representatives from indigenous groups and government bodies. In a response to the Summit recommendations the NSW Government prepared 'Taking on the challenge: NSW Salinity Strategy'. The Strategy is a long term commitment to slow down the increase in salinity within the State.

In addition, the 'Basin Salinity Management Strategy 2001-2015' was prepared by the Murray Darling Basin Authority to guide communities and Government in working together towards salinity management within catchments. The Strategy establishes clear end-of-valley salinity targets for each tributary valley within the Murray-Darling Basin system.

The Central West Local Land Service (CWLLS) is a statutory authority reporting directly to the Minister for Primary Industries, responsible for the management of natural resources, decision making and investment within the catchment.

The CWLLS strategic direction is provided by two key documents, the 'Strategic Plan' providing broad direction towards June 2015 and the 'Central West Catchment Action Plan' directing natural resource management outcomes towards 2021. This Strategy has been developed to integrate and support these overarching planning documents.

Salinity management is a major natural resource management objective of the Central West Local Land Services. Council currently maintains an active ongoing relationship with the Central West Local Land Services and is a member of the Salinity and Water Quality Alliance which is coordinated by the CWLLS.

# Part one: The Salinity Context

## 2.0 Strategic Vision

*To minimise the current and future impacts of land degradation, inappropriate land use practices and climate change on production and the environmental and indigenous heritage values of land within the urban area of Dubbo.*

Council has significant knowledge in the location, extent and spatial implications of urban salinity in the Dubbo Local Government Area due to the bore monitoring network, ongoing research investigations and community involvement. The Strategy will provide for the ongoing monitoring and management of salinity which will contribute to increasing the understanding of salinity within the urban area of Dubbo and allow the impacts of salinity to be minimised, particularly within the landscapes most at risk of impact by salinity.



## 2.1 Strategic Framework

This Strategy structures the factors of urban salinity into individual strategies and provides strategic outcomes as a template for salinity management. The individual strategies address:

1. Salt impact – The type and quantity of salt present within the landscape.
2. Groundwater Recharge – The amount of water mobilising and concentrating salts in particular areas of the landscape.
3. Land use – Use of the landscape and associated practises.
4. Infrastructure – Construction material and method used and maintenance of infrastructure.
5. Monitoring – Further investigation and management.

The Strategy will act as the main planning tool for salinity management, guiding salinity management actions. Salinity management actions will be applied to the priority Hydro-geological Landscapes (HGLs), identified as the landscapes that contribute significantly to rising salinity, locations that are important in the functioning and our understanding of salinity processes in the LGA and those areas that are significant in order to protect local assets and values. The groundwater bore sites prioritised in this context include those with extreme, high and medium concern salinity hazard trends (2009-2012) and those within the Central Business District HGL.

The Implementation Plan sets out the actions and tasks for achieving the strategic objectives under the individual strategies, as listed above. The management actions are allocated to specific hydro-geological landscapes with the aim to address the areas that are most at risk of salinity. The landscapes that are most at risk of salinity are defined as the HGLs identified with an overall hazard of Very High, High or Medium (April 2010) as detailed in Table 2, and includes the Macquarie Alluvium, Central Business District, Orana Heights, West Dubbo, Dubbo Basalt, Troy Creek Constriction, Dunedoo Road, Fitzroy Upland Alluvium, Richmond Estate, Brocklehurst, South Dubbo, Eulomogo Estate, Kintyre, and Firgrove HGLs.



## Part two: Strategy

### STRATEGY ONE: SALT IMPACT

*To ensure the salt impact on the landscape is minimised and managed.*

#### Rationale

The term Salinity is used to describe the processes and impacts associated with the interaction of salt and water in a landscape. It is also used to describe the measure of salt in soil or water.

Excess salt within a landscape can cause damage to infrastructure, impact on plant communities leading to further soil degradation, reduce water quality and damage building materials and urban infrastructure.

Where salinity is present within the landscape, or where site investigations have established a high level of electrical conductivity in the soil or groundwater, action is required to reduce the impacts of salt.

#### Strategic Outcomes

|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1.1</b> | <p><b>The discharge of salt into the groundwater system, river and streams is minimised.</b></p> <p>Employment of salt interception schemes and discharge management contribute to effectively minimise the introduction of salt into the landscape and water system. The discharges of saline water will be minimised through the implementation of these principles.</p>                                                                                                                                                                                                                                            |
| <b>1.2</b> | <p><b>Salt stores are buffered to limit their interaction with shallow groundwater.</b></p> <p>Salt may exist within the landscape as a deposit or store from a previous land use. Salt stores interact with shallow groundwater in the colluvial elements of the Firgrove, Richmond Estate and Fitzroy Upland Alluvium Hydro-Geological Landscapes. Within these landscapes the salt stores comprise a significant percentage of the area. Strategic planting of a vegetation buffer around the salt stores can limit the salinity impact through managing the interaction of the salt with shallow groundwater.</p> |



<sup>1</sup> Loose earth material of all sizes that accumulate at the bottom of slopes

## Part two: Strategy

### STRATEGY TWO: GROUNDWATER RECHARGE

*The volume of water with the potential to enter into and contaminate the natural system is minimised.*

#### Rationale

All water entering the water table is referred to as recharge. Groundwater receives recharge from rainfall, rivers, lakes, valleys and is affected by flooding, irrigation and leakage from stormwater, sewer and water supply systems.

Urban development has a significant impact on the groundwater system and recharge through interference with the natural movement of water above and below the soil; removal of vegetation can result in less transpiration and increased infiltration, installation of impervious surfaces can decrease evaporation and the compaction of soil for development alters decreases the void spaces between soil particles affecting the speed and direction of water movement.

The recharge of the water table and its rise is followed by increased rates of evaporation and therefore an increase in salt concentration. Further, a higher water table can mobilise salt stores that were previously deposited in the landscape and transport them to a discharge area in the lower elements of a landscape.

Dubbo is characterised by a shallow groundwater environment in which the management of water input in to the groundwater system is vital for salinity management. The water table will rise and fall in response to an increase or decrease in recharge, therefore reductions in recharge can have major impact on the water table and on salinity processes within Dubbo.



#### Strategic Outcomes

|     |                                                                                                                                                                                                                                                                                   |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2.1 | Lateral flow of shallow groundwater is intercepted and reduced.                                                                                                                                                                                                                   |
| 2.2 | Excess soil moisture within the landscape is utilised.<br>Maximising plant growth and water use is effective in order to use existing excess soil moisture and shallow groundwater. Further, vegetation can act as a buffer to groundwater accessions in wet seasonal conditions. |
| 2.3 | Ponding of water on discharge sites is minimised.                                                                                                                                                                                                                                 |
| 2.4 | Discharge to the groundwater system is minimised.<br>Vegetation can act as a buffer and plays a vital role in managing excess water input in to the groundwater system.                                                                                                           |
| 2.5 | Discharge of water into the landscape is minimised                                                                                                                                                                                                                                |



## Part two: Strategy

### STRATEGY THREE: LAND USE

*Water usage and land use activities are appropriate for the soil landscape in managing urban salinity and do not contribute to an increase in the assessed salinity hazard of the landscape.*

#### Rationale

The land use processes occurring within a landscape influence the interaction of salts and water and can result in the expression of salinity. Landscapes exhibit different symptoms as a result of salinity and may respond to the changes at different rates. Further, the location of the impact may not be within close proximity of the cause, dependant on the landscape characteristics.

Urban land use has a significant influence over the natural movement of water above and below the soil and plays a significant role in the development of salinity; removal of vegetation can result in less transpiration and increased infiltration, installation of impervious surfaces can decrease evaporation and the compaction of soil for development alters decreases the void spaces between soil particles affecting the speed and direction of water movement.

Effective planning of land at risk of salinity and land affected by salinity is vital to the sustainability of the landscape. Land use planning must consider the interaction between land use and geology.

#### Strategic Outcomes

|     |                                                                                                         |
|-----|---------------------------------------------------------------------------------------------------------|
| 3.1 | The use of salinity affected land is undertaken in accordance with best practice management principles. |
| 3.2 | Salinity risk is considered in the land use planning process.                                           |
| 3.3 | The extent to which land use activities and practises contribute to salinity hazard is understood.      |



## Part two: Strategy

### STRATEGY FOUR: INFRASTRUCTURE

*Public and private infrastructure development and maintenance is consistent with the salinity hazard of the landscape.*

#### Rationale

The development of infrastructure including roads, railway, buildings and services can act as barriers to water movement within the landscape. The compaction of soil for development further impacts on the landscape through decreasing the void spaces between soil particles affecting the speed and direction of water movement.

Infrastructure within a saline environment is impacted by salinity through decomposition of building materials, weathering of roads and decay of stormwater and sewer servicing pipes.

Management strategies are required to minimise the impact of infrastructure construction on salinity and the impacts of the saline landscape on infrastructure.



#### Strategic Outcomes

|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>4.1</b> | <b>Construction techniques are responsive and appropriate for the salinity risk of the landscape.</b><br><br>The National Construction Code enables the achievement of nationally consistent, minimum necessary standards providing a uniform set of technical provisions for the design and construction of buildings and other structures throughout Australia. It allows for variations in climate and geological or geographic conditions. |
| <b>4.2</b> | <b>Urban development on at risk landscapes specifically addresses the impacts on salinity.</b>                                                                                                                                                                                                                                                                                                                                                 |
| <b>4.3</b> | <b>Existing infrastructure is maintained to minimise salinity impacts on the landscape and ongoing maintenance requirements.</b>                                                                                                                                                                                                                                                                                                               |

## Part two: Strategy

### STRATEGY FIVE: MONITORING

*The capacity to predict and monitor salinity affected land resources and biodiversity is maintained.*

#### Rationale

To effectively manage salinity, it is vital to understanding the overall situation in the region and the process and interactions within the landscapes influencing the movement of salt causing the saline environments.

Ongoing monitoring is required to further understand the salinity within the Dubbo Hydro-geological Landscapes and the interaction between land use practises within landscapes and the resulting salt and water impacts in other landscapes.

Further monitoring and investigation is an ongoing priority for salinity management in the Dubbo Local Government Area. The processes for monitoring actions and evaluating performance are contained within Part Three: Monitoring Performance of the Salinity Management Strategy.

#### Strategic Outcomes

|            |                                                                                                                                                                                                                                                                                                                                               |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>5.1</b> | <b>The impacts of development on groundwater and salinity are recognised, measured and monitored.</b><br>The landscapes of Dubbo contain significant salinity and geological situations that predispose salinity development. Assessment of the location, intensity and scale of salinity is important in managing salinity in the landscape. |
| <b>5.2</b> | <b>The overall situation of salinity in Dubbo is understood.</b>                                                                                                                                                                                                                                                                              |
| <b>5.3</b> | <b>Groundwater modelling is provided in a spatial capacity.</b>                                                                                                                                                                                                                                                                               |



# Part three: Monitoring and Evaluation

## 3.0 Monitoring Salinity Targets and the Impact of Actions

Monitoring salinity targets involves the observation and recording of data that compares performance against baseline indicators. Council maintains the Urban Salinity Monitoring Network as a means of targeting, monitoring and providing baseline and trend analysis data for the strategic management of urban induced salinisation in the Dubbo Urban Area.

Council maintains salinity monitoring through monthly sampling for each of the groundwater network bores Standing Water Level (SWL) and Electrical Conductivity (EC). The first round of monitoring was conducted on 26 March 2005 and is used as baseline data for the network.

Monitoring the impact of actions across time and through varying climatic conditions requires the consideration of external factors, including changes in the extent and condition of native vegetation and changes in land management practises. Accordingly, additional data is required to support the groundwater salinity monitoring to adequately monitor the impact of salinity targets and actions. In previous studies climatic conditions obtained from the Bureau of Meteorology and household water consumption rates captured through Councils water billing system have been utilised as additional data sources.

The Central West Local Land Services, the Office of Environment and Heritage and the Office of Water monitor rural salt affected land and waterways as the responsible statutory authorities for natural resource management in New South Wales.

## 3.1 Evaluating Performance

Performance targets and strategic outcomes will be set in Councils Delivery and Operational Plans to guide the allocation of actions included in the Implementation Plan for each HGL. The actions will be periodically evaluated through an analysis of bore monitoring data in association with social and economic data to determine the success or otherwise of the actions meeting the performance targets and strategic outcomes.

A number of external factors can influence the performance of set actions including land use management decisions, the financial capacity of land managers and unexpected actions in the catchment, including weather, impacting on salinity. Further, the mix of actions selected to meet targets may have a smaller impact than predicted or be delayed in influencing the salinity hazard in the area.



## Part three: Monitoring and Evaluation

### 3.2 Recording Data and Periodic Review

To progressively improve performance, it is necessary to evaluate data periodically and review recommended actions. Council maintains the groundwater salinity monitoring network as a means of monitoring and providing baseline and trend analysis data for the strategic management of urban induced salinisation in Dubbo. Periodic reviews of the network data are undertaken and reported in accordance with the commitments in Council's strategic framework.

Table 2. Periodic review of progress towards Strategic Outcomes

| Frequency                 | Report                                                    | Description                                                                                                                                      |
|---------------------------|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| At least every six months | Progress Reports on Delivery Program 2013-2017            | Report on progress with respect to the principles activities detailed in the Delivery Program                                                    |
| Annually (March)          | Action of Delivery Program 2013-2017                      | Report on monitoring of the groundwater network                                                                                                  |
| Annually (June)           | Action of the Delivery Program 2013-2017                  | Review of the groundwater monitoring network in respect of salinity impacts on public open space                                                 |
| Annually (September)      | Annual Report                                             | Report provided to the community on Council's progress in the delivery of Dubbo 2036                                                             |
| Annually (October)        | Annual Report                                             | Annual report to the General Manager on progress with Dubbo 2036                                                                                 |
| Annually (November)       | State of the Environment Report and Annual Dubbo Snapshot | Report on environmental issues. Every four years a comprehensive report is prepared in accordance with the Local Government Act 1993 guidelines. |
| Four Yearly (November)    | End of Term Report                                        | Report on Council's achievements in implementing the CSP over the previous four years.                                                           |