Water Management Plan for the town of York

June 2010

Rural Towns - Liquid Assets

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Summary

The Rural Towns—Liquid Assets (RT–LA) project was established in 2005 with the aim of integrating salinity, waterlogging and flooding control to the development of new water supplies in wheatbelt towns. This water resource is then available for purposes such as irrigation of Shire ovals, parks, and public gardens as well as for commercial use.

Following the identification of effective integrated water management strategies, these have been partially implemented in the 15 shires participating in the RT-LA project.

This report summarised the outcomes from all scientific investigations undertaken for York. In addition it presents the water management options, a preliminary analysis of those options, priority recommendations and some estimated costs.

As the cost of scheme water increases and supplies become less available an option to add a new harvesting system has been recommended, this makes use of existing ex-Department of Water storage dams in the town. The current and proposed surface water diversion and harvesting infrastructure will over time lower the groundwater levels in town.

Four holes were drilled in the York Jockey Club area to explore for a tributary palaeovalley aquifer thought to be supplying bore YJC01, which is used to irrigate the racecourse, with up to 6 L/s of low-salinity groundwater. Coarse-grained, permeable sediments were only located in the easternmost hole (08YK37D), indicating that the water in YJC01 is probably derived from weathered or fractured bedrock, rather than a palaeovalley aquifer. Although the yield of 08YK37D declined during air-lifting, suggesting that it is located at the western margin of the main palaeovalley aquifer, an extraction rate of 2.0 L/s or more should be obtainable from a properly constructed production bore at this location.

The results of groundwater modelling indicate that it would take up to 8 years for highly saline water from the Avon River to be drawn into production bores slotted in the main palaeovalley aquifer, if the bores are located 300 m or so away from river channel. The rate of saline water intrusion could be minimised by pumping at a low rate from several widely-spaced production bores located along the length of the palaeovalley aquifer. RTP monitoring data show that groundwater with a low enough salinity to be used for irrigation occurs in some sections of the palaeovalley aquifer within the York townsite, however the yields in these areas are likely to be too low to warrant the establishment of production bores.

Further groundwater exploration for an irrigation supply should concentrate on the area SE and E of 08YK37D, where high yields should be obtainable from the main palaeovalley aquifer. In that area the palaeovalley aquifer is far enough from the Avon River to prevent significant saline water incursion from the river, and low salinity within the aquifer is maintained by high rates of runoff from Mt Bakewell. Monitoring bores should be drilled between the production bores and river channel to detect the passage of any saline plume from the river and enable the pumping rates to be adjusted accordingly.

An exploration hole should also be drilled nearby to bore YJC01 to determine the nature of the aquifer from which the bore is drawing a large volume of low-salinity water. The exploration hole could be cased and then used as a monitoring bore and the results of the drilling could be used to guide further exploration in the area.

Other sources of high-yielding, low-salinity groundwater at York are likely to be restricted to fractured bedrock, as may occur along faults or shears, or the contacts of dolerite dykes which are common in the region. However, in comparison to sedimentary aquifers, bedrock aquifers are difficult to locate and may exhibit rapidly declining yields as the storage is depleted.

Appendices C and J provide detailed assessments and drainage specifications for alleviating flooding and waterlogging in susceptible areas including the hotel intersection. Appendix C includes modelled runoff volumes within the York town sub catchments. This data has been used to evaluate the proposed options for surface water management.

With the exception of groundwater supply potential found in the York Race Club, the Water Management Plan (WMP) produced by the RT-LA project has focussed on surface water management options that will enable the integration of salinity, watertable, waterlogging and flooding control as well as provide cost-effective solutions to new water supplies. However, a watching brief should still be maintained on shallow and deeper groundwater levels in critical areas. If rainfall patterns intensify it would be necessary to reassess and possibly upgrade surface water and shallow drainage infrastructure. The recommended schedule for surface water management has been costed in stages to facilitate timely implementation by the Shire.

The current and proposed surface water diversion and harvesting infrastructure is primarily aimed at alleviating flooding within the town due to stormwater. A by-product of the stormwater drainage design will be an increased efficiency of surface water harvesting by the town's existing main dam.

Contents

Page

Figures

Tables

1. Introduction

1.1 Background

The Department of Agriculture and Food, Western Australia (DAFWA) with a number of project partners including CSIRO, CRC LEME, UWA and the WA Chemistry Centre is delivering the $6 million Rural Towns—Liquid Assets (RT-LA) project.

For York, the project was funded by the Western Australian Government, the Shire of York and the National Action Plan for Salinity and Water Quality. The other major stakeholder is the Wheatbelt (formally known as Avon), Catchment Council.

The Project aims to devise solutions to potential and existing townsite salinity problems as well as developing new locally based water resources for participating 15 rural towns. New research and existing knowledge of groundwater systems will be used to identify water management options and construct townsite Water Management Plans that focus on improved and integrated water management strategies.

York, one of the 15 towns participating in the RT-LA Project, is located approximately 97 kilometres East of Perth (Figure 1) and has a population of approximately 3,342 residents. The York Shire has been involved in the Rural Towns Program since June 2001.

1.2 Water management objectives

The objectives are to develop a water management plan that will:

- identify opportunities for ground and surface water resource development, primarily for irrigation
- reduce salinity and waterlogging via surface water control
- identify socio-economic concerns associated with greater water resource availability.

1.3 Socio-economic study results

A short desktop socio-economic study was conducted with a small group of residents (Appendix A) to identify perceived water management issues within the town. This study highlighted issues surrounding water management are associated with availability and quality of water resources (for residents on farm without access to scheme water) and salinity.

The majority of individuals participating in the study perceived that salinity is not a problem in York, however is affecting the surrounding agricultural land.

Suggested uses for additional water sources included town beautification, and for new water related industries such as eco-tourism, floriculture and salt tolerant plant industries. The majority did not want mineral harvesting industries in the Shire.

From a Shire perspective the preferred use for any excess (abstracted) water would be for arable land development for such industries as horticulture and floriculture. Overall, the Shire aimed to reduce Water Corporation costs by effective water harvesting strategies and to use the saved money on community facilities.

1.4 Shire priorities

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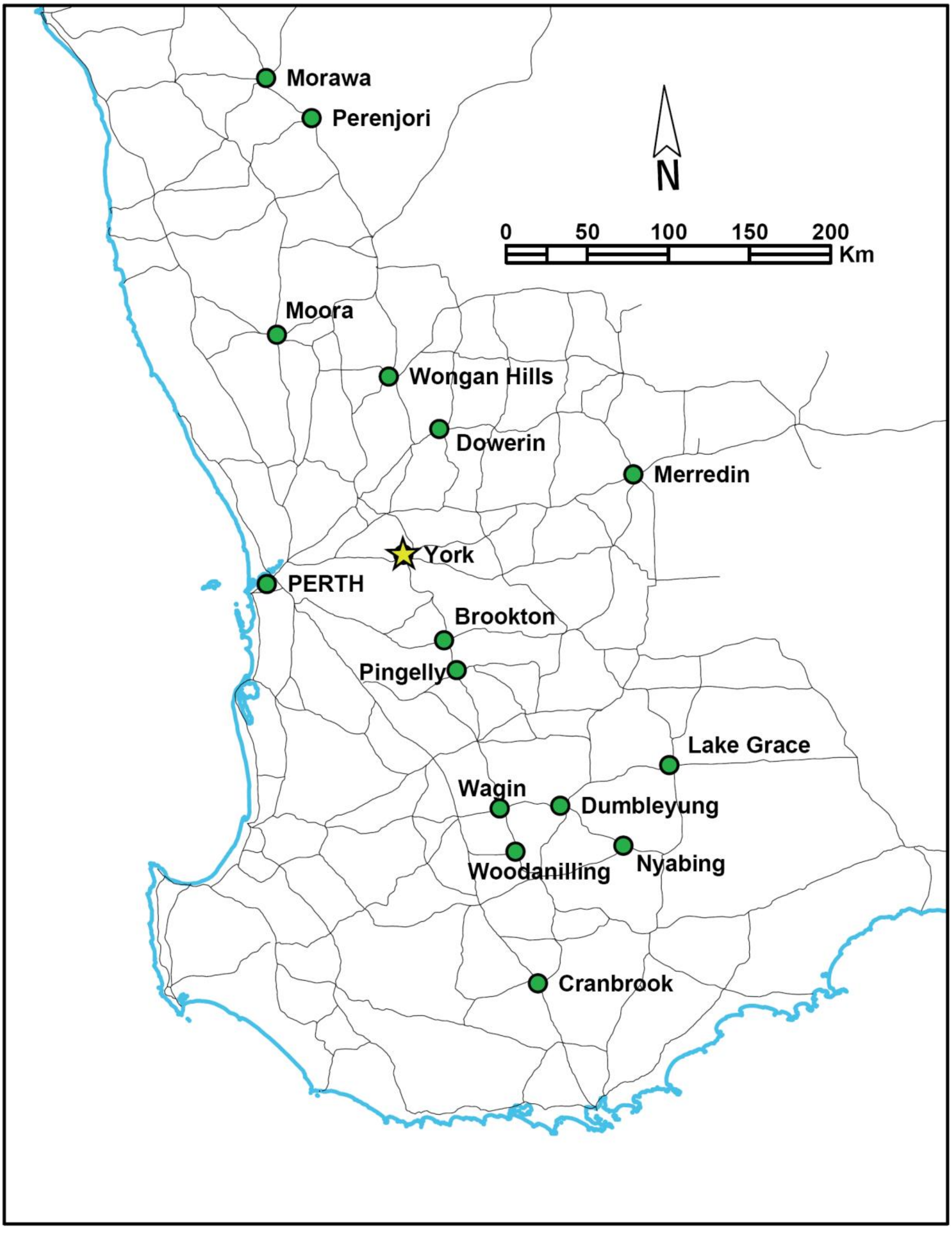

Figure 1 **Locations of York and other towns participating in the RT-LA Project.**

1.5 Purpose of the Water Management Plan

The Water Management Plan for York is based on ten technical reports covering the following topics. The reports are attached to this report:

- A brief socio-economic report and Shire consultation notes (Appendix A and B).
- Surface water management (Appendix C)
- Geophysics (Appendix D)
- Groundwater study (Appendix E)
- Assessment of infrastructure damage (Appendix F)
- Groundwater quality (Appendix G)
- Methodology for assessment of water management options (Appendix H)
- GHD Report (Appendix I)

Based on these technical reports the purpose of the Water Management Plan is to:

- recommend priority water management options for controlling salinity and developing new water supplies.
- present preliminary engineering designs for water management options;
- present estimated costs for the recommended water management options.

1.6 Summary of the issues

While many towns in the agricultural region of Western Australia have limited or expensive water supplies, they also have problems caused by too much water—usually salinity, waterlogging and inundation. These excess water problems result in damage to the environment and infrastructure. This project explores whether the excess water causing the damage can be converted to useable water supplies.

Even in small towns, hydrological systems are usually complex. Water comes into town in several ways: as rain falling directly on the townsite, as surface water run-on, groundwater inflows from surrounding catchments and through the scheme. It is likely that all of these sources contribute to some degree to the salinity, waterlogging and inundation problems. General descriptions of what is meant by the terms inundation, salinity and waterlogging and their main causes are described in Box 1.

Box 1: General definitions and descriptions of processes

Inundation

An area covered in water is said to be inundated. The water may be flowing or still (ponded). The source of the water may be:

- rain falling directly on the area
- surface water inflow from surrounding upslope areas
- water overflowing the banks of a natural or manmade watercourse (flooding), or
- a combination of more than one of these sources.

It is possible for groundwater discharge to contribute to surface inundation, but generally in Western Australian wheatbelt towns this is a small component. A rise in watertable level below an area can worsen its risk of inundation because there is less capacity in the soil for storing infiltrating surface water.

Salinity

Most Western Australian salinity problems are caused by groundwater, but the processes involved can change from site to site. Commonly, the salinisation is a result of either rises in watertable or increases in pressure of deep groundwater systems, or a combination of both. The extra water causing the salinisation can enter the groundwater systems close to or far away from the problem area.

Rising Damp/Waterlogging

In towns, this can affect buildings, paved areas and underground services. This can be caused by:

- water perching above a shallow, low permeability layer such as bedrock, cemented soils, or a clay layer; or
- elevated watertables or high groundwater pressure.

The water may be fresh or saline.

Two conventional approaches to reducing the damage are:

- diverting water before it reaches an area of inundation, salinisation or waterlogging
- removing or diverting water from the affected site.

Unlike natural catchments, townsites have low runoff thresholds. That is, they can produce runoff from low intensity or infrequent rainfall events because water flows from the streets, roofs and other hard surfaces In contrast to many farmland catchments, townsite runoff is often relatively high quality; uncontaminated by salt, sediment or debris.

As a general rule, salinity, waterlogging and flooding impacts are reduced if the water is diverted before it reaches the affected area. Generally, water quality is also improved if it is diverted earlier than later.

In order to produce this Water Management Plan, a number of investigations were completed to identify the sources of problem water and strategies for its diversion.

A set of principles has been adopted in drafting this water management plan (Box 2).

Box 2: Principles guiding RT-LA Water Management Plans

Water is valuable: minimise unnecessary use and pollution.

- Excess groundwater recharge commonly causes problems: minimise recharge unless an ecosystem or water supply is dependent on it.
- Reduce surface water flows where they cause damage but maintain good quality surface water flows to dependent ecosystems.
- Minimise dependence on scheme water where fit-for-purpose alternatives are available, e.g. for townsite irrigation.

Assessing impacts of management changes

The aim is to identify, quantify and document the likely environmental, social and economic impacts (both within and outside of the town) of any proposed water management changes so that they can be taken into consideration by decision-makers so that water management changes neither create nor worsen any problems.

RT-LA plans are designed to enhance land condition, not to trigger or exacerbate existing land degradation.

Encourage adoption of Waterwise and Saltwise guidelines

Encourage adoption of Water Corporation Waterwise and DAFWA Waterwise = Saltwise guidelines for households, businesses, schools and councils.

Practical approaches to applying principles

- Reduce dependence on scheme water. Supplement with harvested surface and groundwater.
- Reduce local recharge and associated salinity, waterlogging and flooding, by irrigating less frequently.
- Ensure no infiltration from leaky manmade drainage, pipework and storage systems.
- Reduce wastewater volumes, thus reducing the need for excess treatment and storage capacity.
- Minimise evaporation losses from water supply storages by covering dams or using tanks.

Benefits

- Increased volume of water available for watering townsite amenities.
- Less dependence on high quality and expensive scheme water for irrigation.
- Less townsite salinity, flooding and waterlogging.
- A ‘greener, softer, cooler’ townscape in which to live in, work in and visit.
- More water available for environmental flows or commercial uses.

Costs

- Time and money spent in establishing more efficient water management systems and practices.
- Less wastewater from the treatment plant available for recycling.
- Cost of professionally designed and constructed infrastructure.

2. Townsite water management concerns

Water-related problems identified by the York Shire Council and community were: damage to buildings and roads in town particularly in the Hotel and SES area, inundation of areas around town, securing water resources for the future and for expansion of industries and the high cost of scheme water (Appendix A and B).

- There are possibilities currently around the town landscape where inundation and in-situ recharge occur. This is seen at xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

It is important to remove water available for in-situ recharge if the water table and salinity are to be controlled.

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Visible water damage to roads and buildings in the townsite caused by inundation, waterlogging or salinity has been documented but not their rates of increase. It is not known whether the damage is stable, or increasing.

Salinity risk maps (Figures 2 and 3), based on interpolating groundwater level and salinity measurements between piezometer sites has been prepared for York along with estimates of damage cost to infrastructure (Appendix F).

Since saline land is one of the possible causes of high conductivity levels, this map may provide indications of distribution and severity of salinity.

Although all these types of salinity maps provide some information on salt-affected sites, they do not tell us clearly when expansions in the problems have occurred (worsening every winter, or after large summer storms, or after inundation events, etc.) or if further increases are probable.

3. Townsite water status

This section presents some estimates of the status and volumes of water associated with the various components of York's water balance. It is intended to place the different surface water sources into context and to indicate those which are suited to developing as water supplies.

3.1 Water inputs

The town inputs to be estimated are:

- direct rainfall on the town
- surface water flowing into the town
- groundwater flowing into the town
- scheme water and wastewater piped into the town or to the water treatment plant.

3.2 Surface water status

3.2.1 Direct rainfall on the townsite

York is located in the medium rainfall district with an average annual rainfall of xxxx millimetres (source: Bureau of Meteorology).

Climate file data from the SILO Agro-Meteorological Datasets for Geo-Spatial Modellers covering 56 years from 1950 to 2005 was used to model the average annual rainfall of 490 millimetres and an average of 1 439 millimetres of evaporation.

Note that rainfall and evaporation are highly seasonal, with the wet months of May to August having the most rainfall and least evaporation and extremely high evaporation and low rainfall in the summer months (Appendix H).

An analysis of rainfall figures since 2000 show that there has been up to a three percent decline in rainfall in the last ten years from the long term average. A decrease in annual rainfall should lead to a decrease in groundwater recharge (Appendix G).

3.2.2 Inflowing surface water

The surface water flows affecting the Town of York are characterised by the term “riverine”, this mechanism will be explained in greater detail below.

Surface water processes encompass two components: runoff and subsurface flow. Runoff is derived from soil infiltration excess or soil saturation excess. When rainfall occurs, a proportion infiltrates the soil surface and the remainder is attributed to runoff. Runoff can distribute across the landscape from meters to many 100’s of meters.

Subsurface flow is the portion of rainfall that has infiltrated the soil profile. If the soil profile has sufficient conductivity (porosity) and connectivity (permeability) then water can move through the soil, and slope water will drain down slope until a change in soil type or characteristic occurs.

Once runoff enters valley landscapes it is described as stream flow and these flows combine with flows from adjacent watersheds, eventually the flows from all the watersheds enter a river, lake, estuary, reservoir, wetland sea or ocean.

At localised the low points in the valley water can collect and will cause some form of land degradation either water logging or salinity.

Runoff and stream flow can degrade the landscape if redistribution is not sufficiently controlled and any excess removed safely. Overland flow can become saline through two processes: accumulation of salt by passing over degraded saline soils or once inundated the water infiltrates the soil and under capillary and evaporative pressure ex-filtrates, causing the remobilisation of salt towards the ground surface. Over time the soil and water resources become increasingly more saline.

The town of York has both surface and subsurface runoff processes to manage.

3.3 Surface water summary and recommendations

The Project has identified a number of surface water engineering solutions to achieve three major goals:

1. Upgrade stormwater drainage to reduce the risk of flooding due to intensive summer storms and occasional heavy winter rains
2. Identify new surface water harvesting opportunities and implement systems for runoff capture, storage and reticulation
3. Reduced salinity by diverting surface water from salt affected and waterlogging prone areas.

XXXX main surface water control strategies are recommended:

Additional surface water harvesting opportunities have been identified which will allow the Shire to manage the risk of future water shortages for irrigation purposes. The options and costs for surface water management are presented in Appendix C.

3.4 Groundwater status

The RT-LA Program undertook a drilling program to assess the viability of obtaining a groundwater supply from bores within the township that could also lower watertables and help control salinity (Appendix E).

The York townsite is in the centre of a X ha catchment. The catchment is cleared for agriculture and approximately 10% remnant native vegetation can be found to the North of and around the townsite.

Agriculture is the main industry in the district. Wheat and sheep farming dominate, with lupins, legumes, barley and canola grown in cropping rotations.

3.4.1 Collective RT-LA groundwater studies

An initial groundwater investigation comprising the drilling of one production bore and 77 monitoring bores at 32 sites within York was undertaken by DAFWA's Rural Towns Program (RTP), in 2002 (Crossley 2004). The drilling revealed that weathered bedrock aquifers are poorly developed at York, but that the town is underlain by a deep palaeovalley infilled with coarse- to fine-grained sediments deposited by the ancestral Avon River. Water levels in the monitoring bores showed that the groundwater in all but a few areas is too deep for the development of secondary salinity and that localised damage to the foundations of buildings in the lower-lying part of the town is probably caused by the seasonal development of a shallow, perched aquifer along the Avon River floodplain. Development of the perched aquifer was mainly attributed to uncontrolled surface water flow, over-watering and poor drainage along the floodplain.

Owing to the absence of significant secondary salinity in York, the focus of RT–LA's groundwater-related involvement in the town became one of developing a low-salinity water supply that could be used in place of potable-quality scheme water to irrigate parks, ovals and gardens within the townsite.

Another groundwater investigation, with the specific aim of identifying low-salinity groundwater resources within York, was performed by consultants GHD in early 2008 (GHD 2008). The study, which was commissioned by the Avon Catchment Council, comprised an analysis of the RT–LA water level and quality monitoring data, a hydrogeochemical sampling programme, a ground geophysical survey and a pumping test. On the basis of water quality, likely bore yields and estimates of groundwater storage and recharge, two areas were identified as having significant potential for the development of low-salinity groundwater resources. One of these areas, situated at the York Jockey Club (YJC), about 3 km north of the town centre (Figure 1), was regarded as being particularly prospective because it includes a bore with a reported yield of 6 L/s and a salinity of about 2,000 mg/L TDS (Total Dissolved Solids) which is currently being used to irrigate the racecourse. The low salinity and high yield of this bore was thought to be the result of it having been drilled into a tributary of the palaeovalley intersected by the RT–LA bores in the York townsite.

To test the suitability of the YJC area for further groundwater development, Rockwater was commissioned by RT–LA to undertake an exploratory drilling programme, which, if successful, would lead to the establishment of a production bore that could be used to supply low-salinity groundwater for irrigation in York. The results of the drilling programme are presented in this report. Also included are the results of groundwater modelling which was conducted to assess whether pumping from the main palaeovalley aquifer in York will draw in highly saline water from the channel of the Avon River.

Gravity surveys show lower gravity over areas where bedrock is deeper and overlain by greater thickness of sediments. Gravity surveys are useful to provide infill information between bores and are a cost effective way of determining sub-surface geometry and guiding further drilling. A survey was conducted in York in XXXX, to provide information on depth to bedrock and geological structures (Appendix D).

This showed depth to bedrock ranging from very near surface to about xxx metres below ground level. Previous borehole investigations have only drilled as deep as xx metres. The survey showed that the greatest depth to bedrock is close to bore xxx

Monitoring of groundwater levels in the townsite since 2002 shows that in the main, water levels have stabilised.

Rainfall records from York reveal there has been a decrease in rainfall of almost 3 per cent over the long term trend since 2000, but the water levels have mostly stabilised at there 2000 levels of around two metres.

A paleochannel were identified by Crossley (2002) found a lens of sand with brackish water. This area was targeted for the test pumping program.

The DAFWA and RT-LA groundwater study (Appendix E) did identify a groundwater resource.

3.5 Groundwater pumping options

Groundwater pumping is an option for York to provide an additional water supply and for salinity outcomes.

Figure 2: Groundwater levels of selected bores on York townsite

4 Salinity and water quality

From 2002 to 2010 groundwater levels in York have mostly stabilised.

The spatial distribution of the salinity risk for York townsite is shown in Figure 2. The high salinity risk zones are located along the local drainage path, and salinity risk reduces to the north-east and south-west from the high values.

Peak runoff rates (peakflows) have been modelled for three different areas of the town catchment in Appendix I. Calculated yields for the town catchment areas for nominated rainfall/runoff events are presented in Appendix C and J along with identification of the most important source areas for each of those events.

The water distribution process and rainfall dictates where recharge occurs. If the water is inundating areas or flooding areas, in-situ recharge will occur. There are locations around the townsite where inundation and in-situ recharge occurs. It is therefore important to remove water from these sites before recharge can occur.

Sources of recharge and waterlogging within the townsite are likely to be:

- direct infiltration of rain where it falls
- infiltration below areas subject to inundation (termed ‘indirect’ infiltration)
- percolation below over-irrigated vegetation
- leakage from water supply and wastewater pipes, drains, dams, pools, sumps
- limited laterally moving groundwater controlled by break-of-slope topography.

Most direct infiltration probably occurs below seasonally vegetated areas with minor amounts below compacted soils and well-vegetated areas, and only negligible amounts below roofs and paved areas. Direct infiltration of rainfall will be confined to when rainfall events occur. However, short duration but intensive (episodic), summer rains can have as much impact on watertables as prolonged winter rains.

Recharge from over-irrigation of parks, sportsgrounds and gardens, will be restricted to areas below or close to those areas. Most recharge from over-irrigation could be expected to occur during non-rainy periods (unless watering habits are particularly profligate).

Any leakage from pipes is likely to occur throughout the year, seepage from dams, pools or sumps could occur whenever they contain water, but drain leakage would depend on runoff from recent rainfall.

Groundwater salinity in Morawa in both shallow and deeper groundwater systems show electrical conductivities (ECs), ranging between 1,000 and 4,000 mS/m (equivalent to a total dissolved solids concentration ranging between 5,500 mg/L and 22,000 mg/L). The average groundwater salinity in the townsite is about 2,200 mS/m or approximately 12,200 mg/L (Groundwater Quality, Appendix G).

The Groundwater Quality study reports that groundwater salinity and pH trends are steady.

Trace element organics and microbiological status of groundwater was found to be acceptable for groundwater recovery for non-potable use with no evidence of organic compound contamination and no microbiological contamination detected.

Groundwater pumping is an option at this time (Appendix E).

5. Infrastructure damage through salinity

Evaluation of the salinity risk towards the infrastructure damage was based on the long-term average groundwater level for the shallow observation bores. The level of risk was estimated in accordance with soil saturation level at 1 m depth below the ground level (Figure 3).

The estimated damage cost for the different land use zones as described in the town planning scheme is given as an annual damage cost ($83.2K) and projected NPV of costs over next 20 years within a do-nothing scenario ($881.7K) (Figure 3).

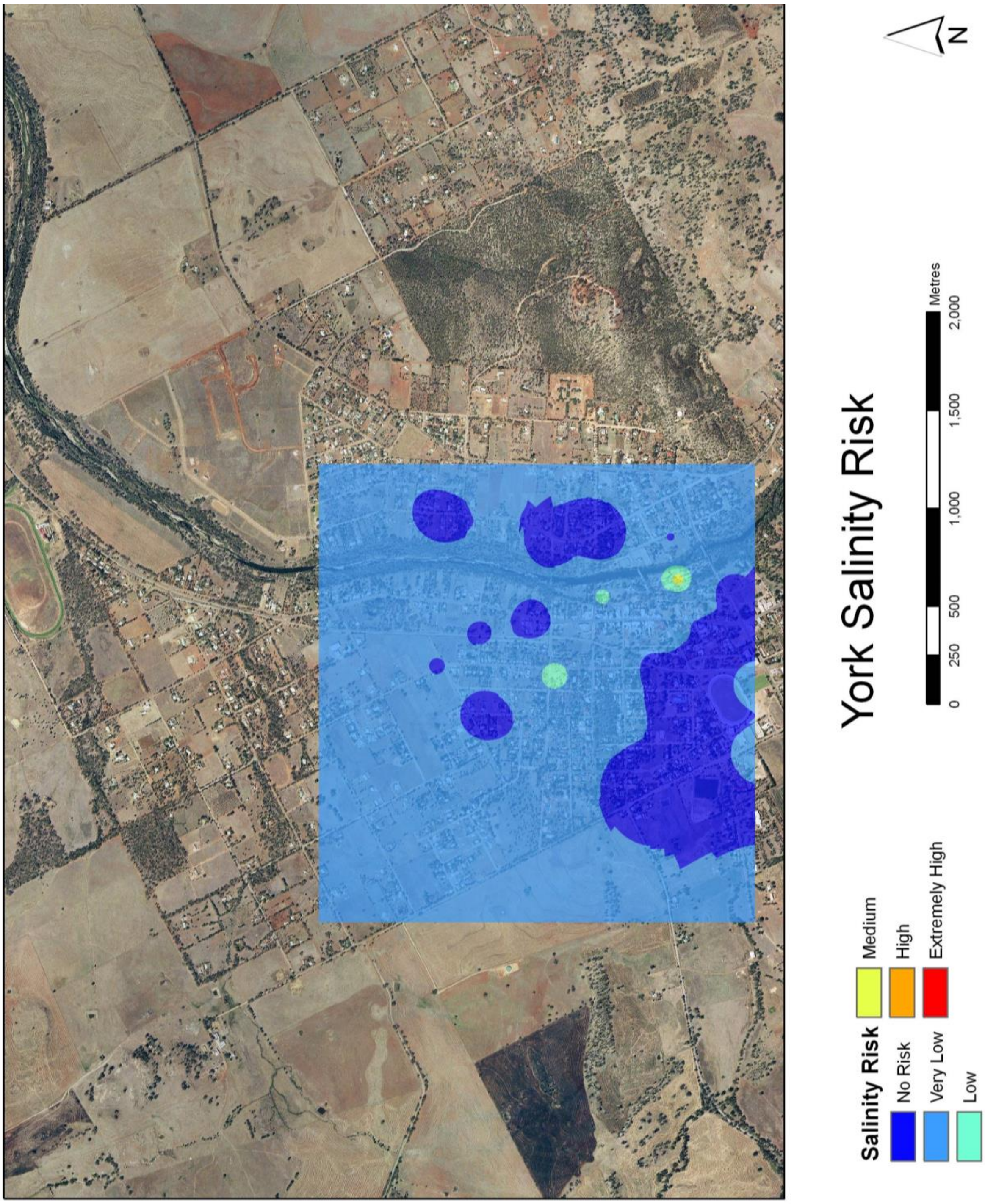

Figure 3: **Salinity risk in York based on groundwater saturation at 1.0m depth from surface**

6. Water management options

Water management options were formulated following investigation of current practices, and discussions between the planning team and Shire representatives.

Water management options are outlined below. These address water resources, salinity and socio-economic development objectives.

Figure 4 **Surface water and groundwater management options for York**

6.2 Other water management options

- Waterwise = Saltwise. Plant drought tolerant or salt tolerant species following guidelines in the DAFWA Bulletin #4628 which can be found at: http://www.agric.wa.gov.au/content/HORT/FLOR/BULLETIN4628.PDF
- This website also contains other useful material from the Dowerin Waterwise = Saltwise workshop held in 2004.
- Optimise irrigation scheduling and water use efficiency so as not to over water sportsground, parks and gardens.

7. Analysis of water management options

York Shire has a total estimated irrigation demand of XX ML/year within the town (Appendix C).

xx ML/yr from the xxxx Dam is consumed by the Shire for irrigation of sports oval.

Additional scheme water is used for parks and gardens, topping up the swimming pool and for general purpose use. The remaining xx ML/yr of scheme water is used outdoors by local residents and businesses including farmers who cart water during summer.

York has the potential to increase the demand of irrigation quality water by an estimated xxx ML/year to a total of xxx ML/year[1].

Although there is no existing irrigation water shortfall, there is a potential additional 30 ML that could be supplied by the proposed water supply improvements summarised in Table 4 below.

7.1 Existing irrigation water supplies - Shire dams

An analysis of existing water supplies from three Shire owned dams is outlined in Table 3.

The York town site currently available water resources for irrigation are:

Table 3: **Summary of town water resources**

	Total capacity (ML)	Est'd effective yield (ML/yr)	Comments

An additional XXML/yr would be made up by proposed water supply improvements outlined in Table 4 below:

Table 4: Existing infrastructure and proposed new works   Key: TS = Town Site

Asset #	Status	Dams	Sumps	Tanks	Irrigation Pipelines	Volume or Length	Capital Cost	Operating Cost per Annum
1	Existing							
2	Existing							
3	Existing							
4	Existing							
Asset #	**Status**	**Dams**	**Sumps**	**Tanks**	**Irrigation Pipelines**	**Volume, Length or Area**	**Capital Cost Commercial Rates**	**Operating Cost per Annum**
5	Proposed							
6	Proposed							
7	Proposed							

Note: The capital cost of " Sumps " includes provision of power supply if not already in existence.

TABLE C2:

Ref #	Assumptions	Cost
1		
2		
3		
4		

8. Conclusions

DAFWA and its partners have undertaken several comprehensive studies to investigate the bio-physical and some of the social elements that shape York's environment. In consultation with the Shire and other sectors of the community, options for improved water management in York have been devised. The Project objectives were to provide water resource development; salinity management and identify socio-economic opportunities associated with the provision of new water resources.

This Water Management Plan synthesises outcomes from all the scientific studies and recommends suitable water management options. Investigations undertaken by the RT–LA project team conclude that:

- Town catchment runoff is responsible for townsite inundation, waterlogging and recharging of the local groundwater system. Inflows from the wider catchment or regional groundwater system are negligible.

- Improved surface water drainage, increased water harvesting, and tree planting in and immediately around the town will reduce recharge to groundwater.

- The Shire's existing water re-use scheme has reduced the reliance on scheme water for irrigating the sportsgrounds. The scheme has meant considerable savings in scheme water. However, it is important to extend the scheme's capacity to enable complete irrigation water self sufficiency.

9. Recommendations

The Rural Towns - Liquid Assets project has prioritised actions that will develop sustainable water resources. The priority recommendations are:

10. References

11. Appendices

A –York community profile

B – Shire meeting notes

C – York surface water report

D – York geophysical report

E – York groundwater report

F – Assessment of infrastructure damage caused by salinity

G – York water quality report

H – Methodology for assessment of options

I – York stormwater drainage report