A vision for the future 2011 – 2020

Total Water Cycle Management is an integral part of the Natural Resource Management of the town. With the probability of declining rainfall and increased temperatures due to climate change it is prudent to understand the water cycles in our town, maximise capture and minimise evaporation from current water storages by various means

A Water Management Plan

Contents

Background

Townsite is a town located 20km to the West of Perth in an environment suffering from poor surface drainage (Kinhill Pty Ltd, 1999). Regional groundwater issues do not appear to play a major role in the immediate issues facing the town site although there has been some fretting of brick work possibly caused by saline ground water intrusion.

The Townsite town site is located within that part of the landscape commonly referred to as York Gum-Gimlet soils. These soils are heavier than the adjacent sandplain (ie. contain more clay), have very limited slopes and are generally at the base of the adjacent sandplain soils. The result is poorly defined drainage lines leading to water logging of some areas with groundwater discharging from the surrounding sandplain. It may be said that Townsite is located within the discharge area of a giant sandplain seep.

Climate

Townsite is characterised by a dry Mediterranean climate (dry, hot summer and cold, wet winter) with the majority of rainfall occurring during the winter months. Five to six months of the year are typically dry with little or no rainfall. Annual rainfall is approximately 320mm (see fig 1 & 2).

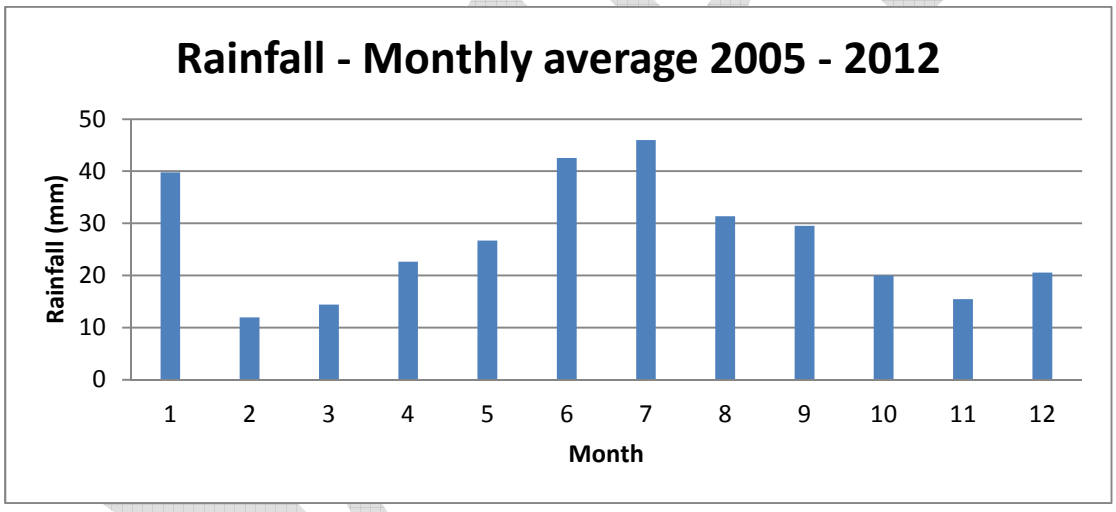


Figure 1. Seasonal rainfall pattern for town site in 2005 – 2012

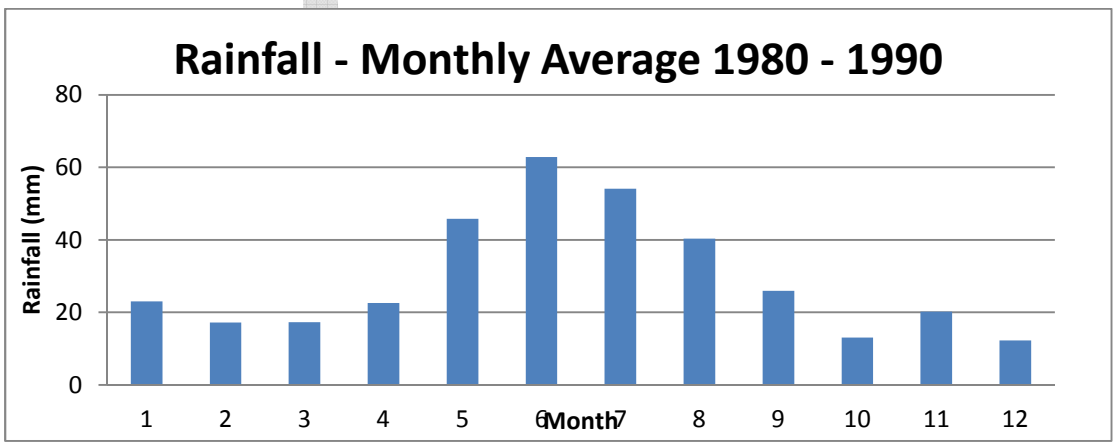
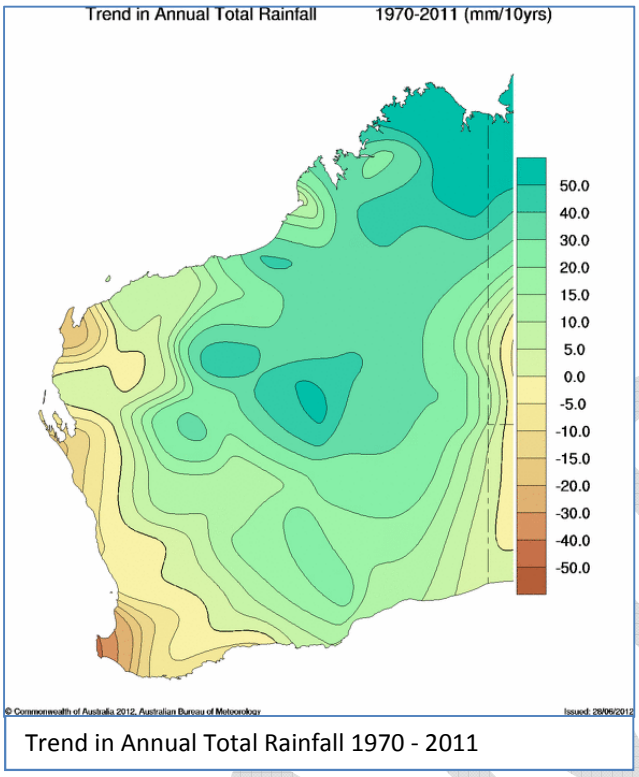


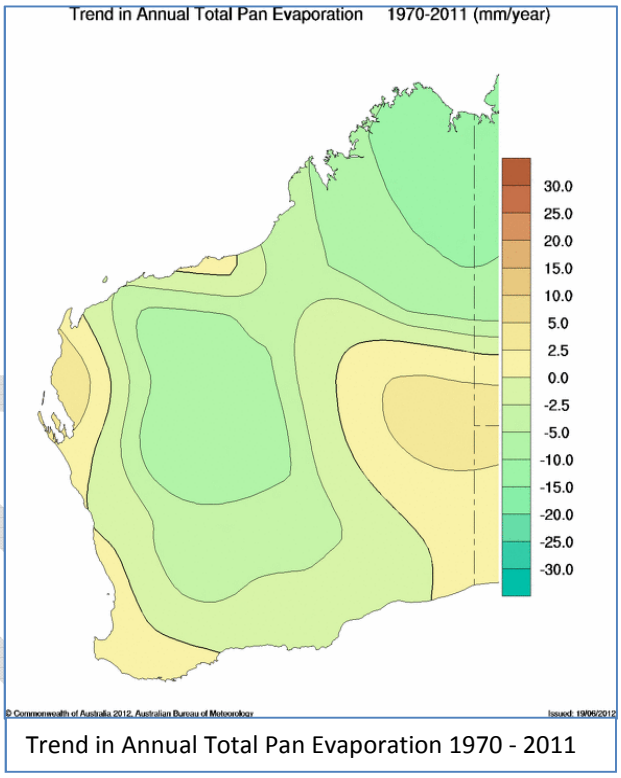
Fig 2. Seasonal rainfall pattern for town site in 1980 – 1990

Climate Variability

Townsite has shown a warming trend of 0.4ºC with a 5mm decrease in annual average rainfall and a 2.5mm increase in pan evaporation since 1970 (10 year average BOM). There is evidence that average winter rainfall has decreased and average summer rainfall has increased over the past 40 years.



Trend in Annual Total Rainfall 1970 - 2011



Trend in Annual Total Pan Evaporation 1970 - 2011

Fig 3. Trends in rainfall and evaporation for Western Australia (BOM)

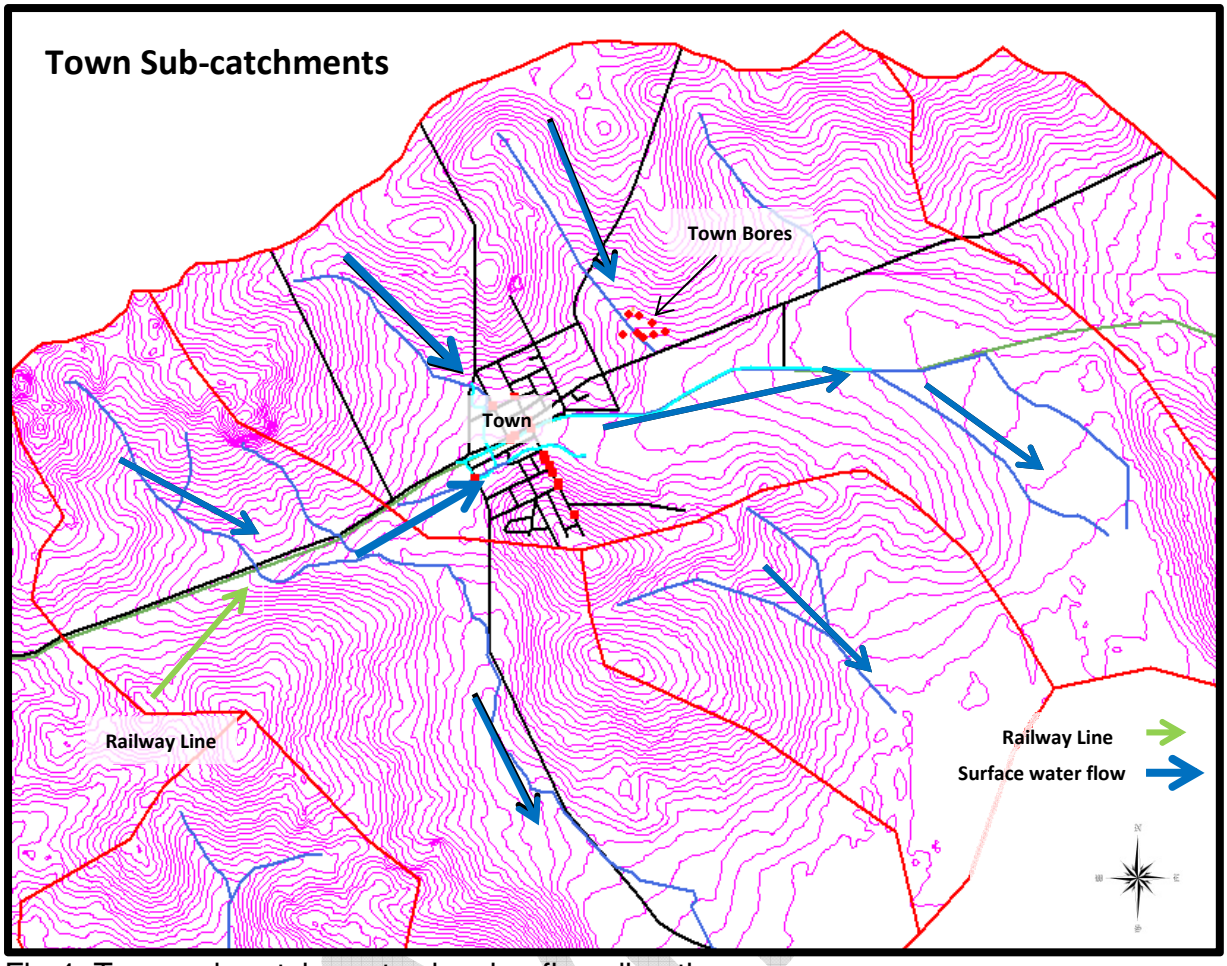


Fig 4. Town sub-catchments showing flow directions

Catchment Description

The catchment within which the town of Townsite is located is relatively small. The total catchment area is approximately 8030 hectares, borders the Townsite River system leading to the Townsite lake system to the southeast and extends up to 6km to the north and west. The catchment is located within the zone of ancient drainage which is characterised by broad flat valleys of low gradient with salt chains at their lowest point, gently sloping valley sides, some rock outcrop and large areas of yellow sandplain.

The dominant land use within the catchment it broadacre farming with two significant areas of remnant vegetation, one on either side of the town. The Townsite town site is centrally located within the catchment. The town site area, approximately 542 hectares, is distributed around the railway line running east-west through the centre of town. The change in landform from up-land areas of granite rock and yellow sandplain to mid-slope areas of heavier soils occurs in close proximity to the town.

Drainage Pattern

The sub catchments on the western and eastern ends of the catchment drain directly to the Townsite River system leading to Townsite lakes. The sub catchment to the northwest (mid Fig 4) discharges through the town centre. It is the northwest catchment, with the runoff from the commercial developments on the western side of

town that discharges through the town dams and overflows past the town oval. Figure 4 illustrates the general location of the Townsite catchment and its sub catchments. Identification of land management issues in Townsite land management issues within the catchment were identified through a report compiled by Kinhill Ltd Pty in 1999 through a review of relevant publications, examination of aerial photography, discussions with officers from the Shire of Townsite, local land owners and staff from the Department of Agriculture and Food WA.

The major issues were highlighted for the Townsite town site as summarised here: Surface groundwater management within and adjacent to the town site; and Groundwater discharge associated with sand plain seeps and geological features. Water tables are influenced by the presence of dolerite dykes.

SURFACE WATER

High Runoff Areas

High runoff areas are generally associated with compacted and paved areas such as the Cooperative Bulk Handling (CBH) site and commercial area on the western side of town.

CBH site constitutes a large area of roof area and bitumen paving. Runoff from a roofed area such as the CBH bins is typically 90% of the annual rainfall while bitumen catchment usually results in 75-90% of rainfall as runoff. By way of comparison, runoff from nearby farmland would be in the order of 0-10% of rainfall. The granite rock to the west of town is likely to result in 40-65% of rainfall as runoff

Inadequate surface water management associated with the high runoff areas has resulted in standing water and water logging in the adjacent areas of the town site.

Poor Drainage

Many areas within the town site are characterised by poor surface drainage. The reason for poor drainage can be summarised as very flat topography, inadequate consideration of levels and drainage associated with commercial development, undefined drainage lines and restriction on water flow caused by infrastructure such as culverts. Poor drainage is further exacerbated when culverts become partially blocked causing backwater situations.
Some areas of note are the commercial area near the CBH site, the western end of the town dams near the railway line and the drainage line entering the town from the North West and flowing to the upstream side of the town dams. Poor drainage has been an issue near the town oval in the past however drainage control work by the shire of Townsite has largely addressed this issue.

Flood Risk

Townsite can be classified as a high-risk town for flooding, inundation and waterlogging. This assessment was based on the assumption that rainfall events of 10- or 15-year ARI's would cause some inundation problems because of poorly defined drainage lines.

Average recurrence interval (years)	Rainfall duration (h)	Rainfall intensity (mm/hr)	Rainfall (mm)	Catchment run-off volume (m^3)	Townsite run-off volume (m^3)
2	1	15.0	15.0	19,800	3,200
	6	4.1	24.6	29,100	4,800
5	1	19.8	19.8	23,000	3,800
	6	5.9	35.4	37,900	6,200
10	1	24.0	24.0	26,800	4,400
	6	7.0	42.0	52,000	8,500
20	1	29.0	29.0	31,900	5,200
	6	8.6	51.6	60,400	9,900
50	1	37.0	37.0	38,300	6,300
	6	11.0	66.0	72,700	11,900
100	1	44.0	44.0	44,600	7,300
	6	14.0	84.0	91,800	15,000

Table 1. Run-off volumes generated by rainfalls of various ARIs, durations and intensities for the catchment of Townsite (area of 1,275 ha) assuming a run-off coefficient of 0.1 and the high run-off surfaces (total area of 23 ha) in the town site assuming a run-off coefficient of 0.9

Water Storage and Balance

The water storage capacity has been estimated to be an average of 3.4% of total runoff within the storage catchments in an average rainfall season. Evaporative loss form storage dams is around 44% or 36.5 ML/year.

Site	Catchment (Hct)	Run Off	Storage (ML)	Leakage	Evaporation 2.2m/yr (ML)	% Loss	% stored from catchment
Oval Dam	717.20	0.7	47.54	Leaks undetermined volume	20.919	44	4.14
Railway Dam	244.09	0.7	19.81	undetermined	8.715	44	3.86
School Dam	754.71	0.2	15.53	undetermined	6.831	44	3.43

Table 2. Water balance of town stormwater storage (average rainfall 320mm/yr)

Storm Water Reuse

Townsite currently uses harvested stormwater to irrigate the town and school ovals. Current usage patterns allow approximately 38 weeks of watering from the oval dam and 96 from the school dam.
The railway dam is currently used for emergency storage and can be pumped to the oval dam for top up when required.

Waste Water Treatment

Approximately one half of the buildings are connected to the reticulated deep sewerage. Waste water (sewerage) is not currently recycled for parks and garden reticulation use.

GROUNDWATER

Regional Aquifer

Groundwater information derived from existing production and monitoring bores within the town site suggest that regional groundwater is not a major factor affecting land management within the town. There is a wide variation of groundwater levels across the town site, this suggests that ground water issues are more likely associated with localised or perched water tables.

Dolerite Dykes

Analysis of aerial photographs has identified a number of linear features in and around the Townsite town site. Some of these features intersect within the town. The general pattern of linear features and groundwater levels supports the theory that linear features represent dolerite dykes (Chin 1986).

Groundwater Levels

Bore 1 on the northern side of town typically has groundwater at or near the surface. In addition, the pit at the old seed cleaners site to the north also experiences groundwater inflow.

A bore located on the southern side of the railway line (Bore 5) has groundwater at approximately 275m AHD. The shire bores to the east of town have groundwater at 271 – 262m AHD and the seed cleaners pit to the west of town does not experience groundwater difficulties.

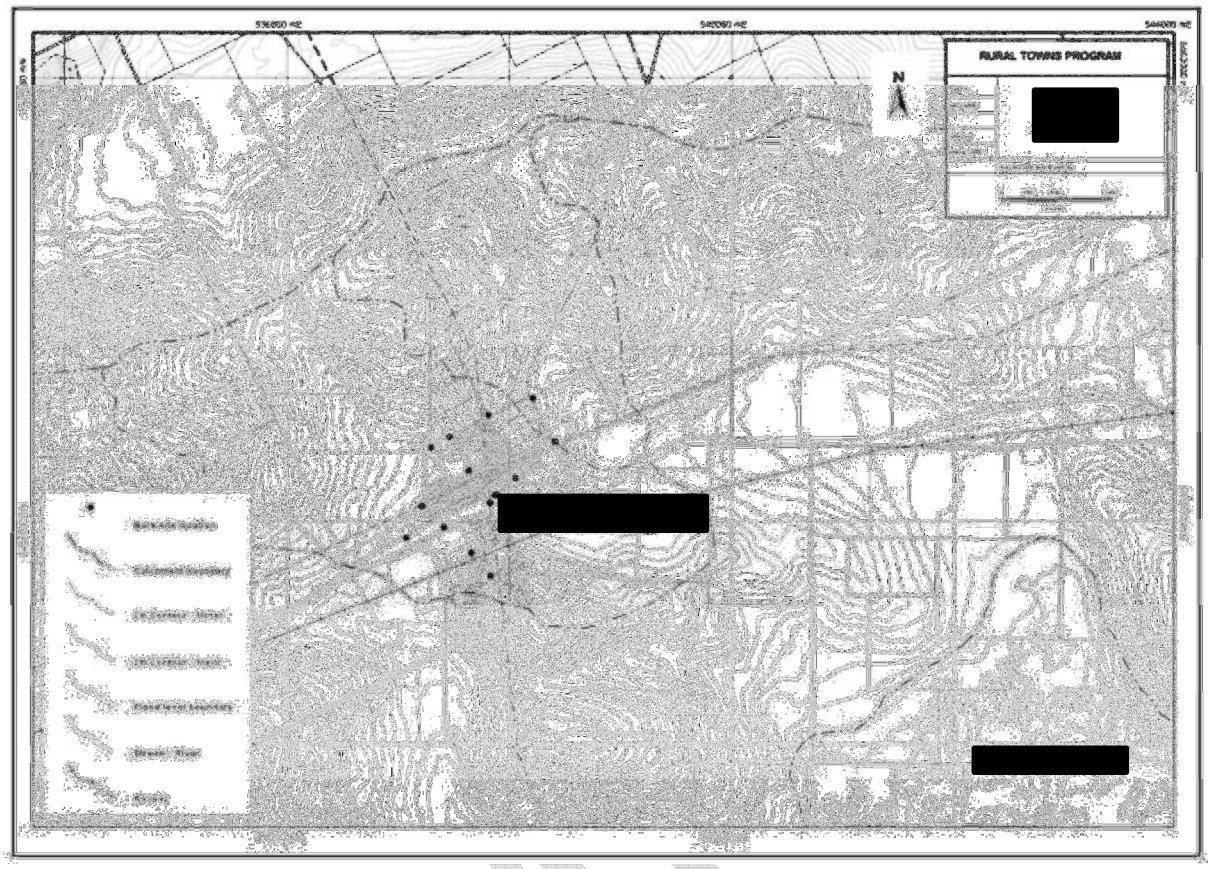


Fig. 6. Town map showing monitoring bore locations

Sandplain Seeps, Hillside Seeps and Water Logging

The majority of the soils to the north of the town site (which is also the up-slope side) are characterised by deep yellow sands. There is also a large granite rock and associated area of York-Gum-Jam soils to the north west of town. The soils within the town are typically represented by the heavier soils of Salmon Gum, Gimlet and York Gum vegetation types. These heavier soils also exhibit only limited relief. It is not surprising then to suggest that significant areas of town site and surrounding areas might be considered within the discharge area of sandplain or hill-side seeps.

The discharge area for groundwater in the yellow sands is typically the break in slope where the heavier soils are intersected. Evidence of this relationship is present to the east of town near bores 3,4 and 5.

Water Management Plan Objectives

The objectives of this water management plan are to:

- Summarise and highlight the water management issues, priorities and impacts in Townsite;
- Provide options for the management of surface water and groundwater to prevent waterlogging and salinity; and
- Identify opportunities for groundwater and surface water resource development, primarily for town site water use.

Long Term Outcomes
The following long term outcomes have been identified as priorities for Townsite to implement a Water Management Plan:

- To demonstrate land management techniques to alleviate downstream salinity, waterlogging, flooding, erosion and siltation problems. To demonstrate that water tables can be lowered on-site through warm season cropping and how water can be utilised from sandplain seeps.
- To facilitate the change in land, water and biodiversity management through the demonstration of sustainable and productive water management systems.
- To educate and raise community awareness on salinity issues within the Townsite and Avon regions.
- To protect local infrastructure
- To provide a water supply for industry and residents of the Dangin community, reducing their reliance on scheme water.
- To protect high quality remnant vegetation from the onset of salinity and increase biodiversity (700ha)
- To demonstrate several alternatives as to how potable water can be utilised/maximised for economic benefits to the community

These long term outcomes align with the objectives and principles of the Stormwater Management Manual for Western Australia:

- *Water Quality* - To maintain or improve the surface and groundwater quality within the development areas relative to predevelopment conditions.

- *Water Quantity* - To maintain the total water cycle balance within development areas relative to the pre-development conditions.

- *Water Conservation* - To maximise the reuse of stormwater.

- *Ecosystem Health* - To retain natural drainage systems and protect ecosystem health.

- *Economic Viability* - To implement stormwater management systems that are economically viable in the long term.

- *Public Health* - To minimise the public risk, including risk of injury or loss of life, to the community.

- *Protection of Property* - To protect the built environment from flooding and waterlogging.

- *Social Values* -To ensure that social, aesthetic and cultural values are recognised and maintained when managing stormwater.

- *Development* - To ensure the delivery of best practice stormwater management through planning and development of high quality developed areas in accordance with sustainability and precautionary principles.

Long Term Outcomes – Water Management Project List

The short, medium and long term water balance requirements of the Shire of Townsite town site need to be assessed to enable the robust planning to minimise the reliance on the reticulated water supply from the Goldfields and Agricultural Water Supply (GAWS). This will assist with the sustainable use of water and identify potential supply sources.

1. Surface Water Projects

Develop and implement processes to maximise the inflow to storage infrastructure, develop an integrated approach to the management of town water storage and minimise waste through evaporation and leakage.
Minimise flooding and ponding to limit recharge to local shallow ground water aquifers

1.1. Monitoring of Town storage infrastructure
- 1.1.1. Implement monthly monitoring of water levels in town catchment dams to determine actual evaporation and leakage

1.2. Railway Dam
- 1.2.1. Continue to monitor water levels and usage to determine future work requirements
- 1.2.2. Use the Railway Dam as an emergency water source due to its location (centre of town)
- 1.2.3. Construct a secured floating pump platform to enable rapid filling of fire fighting vehicles
- 1.2.4. Consider roofing dam in future to minimise evaporation and water fowl contamination

1.3. Nature Reserve catchment
- 1.3.1. Maximise storm water runoff from the Nature Reserve by improving/renovating the drainage channels and culverts to the School Dam

1.4. CBH catchment
- 1.4.1. Work with CBH to maximise the yield and quality of runoff water from their detention sump
- 1.4.2. Transfer water from the CBH sump to the School Dam (via pump and pipe) when required
- 1.4.3. Install mobile pumping unit to effectively transfer water between the CBH sump and the School Dam

1.5. Sports Oval Dam
- 1.5.1. Re-alignment of the open drain at the sports ground to increase water transfer efficiency
- 1.5.2. Increase the size of the Oval Dam to improve capacity and improve water efficiency.
- 1.5.3. Roof the Oval Dam to minimise evaporation and water fowl contamination

1.6. School Dam
- 1.6.1. Rejuvenation of the drainage lines with in the catchment to increase water transfer efficiency
- 1.6.2. Increase the size of the School Dam to improve capacity and improve water efficiency.
- 1.6.3. Roof the School Dam to minimise evaporation and water fowl contamination
- 1.6.4. Install pumping infrastructure to effectively transfer water between the School Dam and the CBH sump

1.7. Cemetery carpark - Managed Aquifer Recharge
- 1.7.1. Monitor surface water flows to determine quality and quantity of runoff
- 1.7.2. Monitor output from downstream bore
- 1.7.3. Curb South and West perimeter of carpark to direct runoff to the SW corner
- 1.7.4. Install sump tank and injection bore and associated infrastructure

1.8. Town Road
- 1.8.1. Assess catchment potential of town roads and drainage to maximise harvesting of stormwater
- 1.8.2. Implement structures to capture stormwater runoff and transfer to storages

1.9. School
- 1.9.1. Assess water catchment capability of School buildings and grounds
- 1.9.2. Assess water usage trends of School to determine storage requirements
- 1.9.3. Implement required storage infrastructure

1.10. Shire Buildings

Conduct an assessment of the stormwater catchment capacity of all Shire owned buildings including the logistics of reuse.
Install Rain Water tanks to harvest water to be plumbed for approved uses on all Shire owned buildings and/or direct runoff to other storages

- 1.10.1. Shire Office
- 1.10.2. CRC
- 1.10.3. Bowling Club
- 1.10.4. Community Building
- 1.10.5. Town Hall
- 1.10.6. Recycling Centre

To maximise the use of pumps a trailer mounted general purpose water pump with associated pipes, hoses and fittings will be constructed. The fittings will be compatible with emergency service vehicles and water transfer piping.

2. Ground Water Projects

Assess future viability of ground water requirements of the town

2.1. Bore Field/Town Common

2.1.1. Develop a management plan for the sustainable use of ground water, and for the maintenance of infrastructure

2.1.2. Develop and rejuvenate bores in the borefield/town common reserve

2.1.3. Develop infrastructure to store fresh ground water

2.2. Soak/Recycling Centre

2.2.1. Investigate local hydrology of the soak North of the Recycling Centre to determine sustainable use of this resource

2.2.2. Develop a management plan to maintain the quality of soak water

2.2.3. Develop infrastructure to harvest and use water

3. Educational Projects

An education programme is an essential adjunct to be incorporated into all projects. This will advise the public on better practices for the management of water.

3.1.1. Public – Reduce, Reuse

3.1.2. Industry – Reduce, Reuse, pollution control

3.1.3. Agricultural - Reduce, Reuse, pollution control, catchment water balance management

4. Residential Projects

Promote the use of water harvesting infrastructure to reduce the reliance of reticulated water for grey water and garden uses, and encourage the retention of stormwater on site to minimise the use of shire infrastructure to manage stormwater runoff.

Monitoring and Evaluation

Projects will be monitored in the long term to determine effectiveness and evaluated to enable improvement in subsequent plan versions.
Storages will be monitored (project 1.1) in the long term to determine effectiveness and evaluated to enable improvement in subsequent plan versions and ensure maintenance schedules are appropriate.

Project Feasibility and Sustainability – Economic and Environmental

Preliminary assessments of the projects have determined that over the life of the infrastructure there is a cost benefit to the community in saving water and money in the long term. This benefit will increase as the price of reticulated water increases. There are no identified environmental detriments from the projects.

2011 Estimate costs

Project Number	Outcome	Project Specifications	Budget
1.1	Monitoring	Monthly monitoring of water storages in town (including analysis)	$500
1.2	Railway Dam		
1.2.3	Pump Infrastructure	Install mobile pump infrastructure	$30,000
1.2.4	Roofing Dam		$350,000
1.3	Nature Reserve	Renovate drainage lines	$40,000
1.4	CBH site		
1.4.1	Monitoring	Management Plan and MOU	$5,000
1.4.2	Pump Infrastructure	Install mobile pump infrastructure CBH Sump	$30,000
1.4.3	Pump Infrastructure	Install mobile pump infrastructure School Dam	$30,000
1.5	Sports Oval Dam		
1.5.1	Drain realignment and renovation	Plan and reconstruct drain	$5000
1.5.2	Increase the size of the Oval Dam		$40,000
1.5.3	Roof Oval Dam		$454,800
1.6	School Dam		
1.6.1	Renovate drainage lines	Renovate drainage lines	$40,000
1.6.2	Increase the size of the School Dam		$50,000
1.6.3	Roof School Dam		$350,000
1.6.4	Pump Infrastructure		$30,000
1.7	Cemetery carpark - Managed Aquifer Recharge		
1.7.1	Monitoring	Surface water flows to determine quality and quantity of runoff and monitor output from downstream bore	$40,000
1.7.2	Curb	Install curbing	$10,000
1.7.3	Infrastructure	Install bore and infrastructure	$40,000
1.8	Town Roads		$50,000
1.8.1	Monitoring and assessment	Assess catchment capability of town roads	$20,000
1.8.2	Implement structures	Implement structures based on assessment, requirements and capability (subject to funding)	>$250,000
1.9	School assets		$100,000
1.9.1	Monitoring and assessment		$5,000

1.9.2	Evaluation	Evaluate future trends of use	$5,000
1.9.3	Implement required storage infrastructure		>$100 000
1.10	Shire Buildings		
1.10.1- 6	Assessment and evaluation		$20,000
2.1	Bore fields/town common		$20,000
	Management plan and assessment	Assessment, evaluation and management plan	$10,000
2.1.2	Renovate existing bores	Price each bore X 3	$5,000
2.1.3	Develop infrastructure	Tanks, pipe, pumps	>$50,000
2.2	Investigation and assessment	Hydrologic investigation of soak catchment and draw	$30,000
2.2.2	Management Plan		$5,000
2.2.3	Infrastructure		>$30,000
3.1.1- 3	Educational projects	Education to be added to all other project to enable greater understanding of water as a resource	$,1000/project
4	Residential Projects		
		Total estimated cost (2010)	$2,554,400

Document Review

Version	Review Date	Completion
Townsite V1.0	Jan 2015	

References

Groundwater study of the Townsite townsite. Travis Cattlin, Catchment Hydrology Group Agriculture Western Australia. Resource Management Technical Report 221

Potential Runoff Accumulation in Wheatbelt Towns of Western Australia. Mahtab Ali, Travis Cattlin, Neil Coles, Shahram Sharafi Dec 2001 Resource Management Technical Report 226

Quairading Water Plan. Shire of Quairading, Environment Officer

Kinhill PTY LTD 1999

Bureau of Meteorology, http://www.bom.gov.au/climate/data/index.shtml

Stormwater Management Manual for Western Australia February 2004

Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2) Stormwater Harvesting and Reuse July 2009