Oaklands Park stormwater reuse scheme: Maintenance plan

PRELIMINARY DRAFT

DesignFlow
5 September 2013

Document control

Reference:	DesignFlow, 2013, Oaklands Park stormwater reuse scheme: Maintenance plan
Version:	PRELIMINARY DRAFT
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Date:	5 September 2013
Reference:	5092
Distribution:	Marion City Council

Contents

1 Introduction ... 6
1.1 Summary of require maintenance inspections and tasks ... 6
2 System operation overview ... 8
1.1 Components covered by this manual ... 12
3 Definitions ... 13
4 Start-up protocols ... 14
4.1 Harvest pump: Pump station 1 ... 14
4.2 Injection pumps: Pump station 2 ... 14
4.3 ASR well pumps ... 15
4.4 Distribution pumps: Pump station 3 ... 15
5 Sturt River off take structure ... 17
5.1 Purpose ... 17
5.2 Skills and equipment required ... 18
5.3 Maintenance tasks ... 19
5.3.1 Access to the grate ... 19
5.3.2 Debris removal from grate surface ... 19
5.3.3 Sediment removal from below the grate ... 19
5.3.4 Clean and recalibrate conductivity probe ... 19
5.4 Monthly requirements ... 20
5.5 Three Monthly requirements ... 20
5.6 Annual requirements ... 20
6 Harvest pump: Pump station 1 ... 21
6.1 Purpose ... 21
6.2 Monthly Requirements ... 21
6.3 Three Month Requirements ... 21
6.4 Annual Requirements ... 22
7 Gross pollutant trap (GPT) ... 23
7.1 Purpose ... 23
7.2 Skills and equipment required ... 23
7.3 Maintenance tasks ... 23
7.3.1 Inspections ... 23
7.3.2 Dewatering the GPT ... 25
7.3.3 Material removal ... 25

7.4 Monthly requirements 25
7.5 Three Monthly requirements 25
8 Inlet Pond 26
8.1 Purpose 26
8.2 Skills and equipment required 26
8.3 Maintenance tasks 27
8.3.1 Inspect hydraulic structures 27
8.3.2 Monitor for litter 28
8.3.3 Monitor sediment accumulation 28
8.3.4 Inspect vegetation 28
8.3.5 Dewatering and clean out 28
8.4 Monthly requirements 30
8.5 Annual requirements 30
9 Wetland 31
9.1 Purpose 31
9.2 Skills and equipment required 33
9.3 Maintenance tasks 33
9.3.1 Vegetation and weeding 33
9.3.2 Water levels 34
9.3.3 Dewatering, water level manipulation & refilling 34
9.3.4 Structures (weirs and pits) 37
9.3.5 Fauna management (fish & birds) 38
9.3.6 Algae 39
9.3.7 Bank erosion 39
9.4 Monthly Requirements 39
9.5 Three Month Requirements 39
9.6 Annual Requirements 40
10 Injection pump: Pump station 2 41
10.1 Purpose 41
10.2 Monthly Requirements 41
10.3 Three Month Requirements 42
10.4 Annual Requirements 42
11 ASR wells 43
11.1 Purpose 43
11.2 Monthly Requirements 43

11.3 Annual Requirements 44
12 Distribution pumps: Pump station 3 45
12.1 Purpose 45
12.2 Monthly Requirements 45
12.3 Annual Requirements 46
13 Distribution network 47
13.1 Purpose 47
13.2 Annual requirements 47
14 Monitoring & control systems 48
14.1 Purpose 48
14.2 Water Quality Parameters 48
14.2.1 Water Quality Set Points 48
Appendix A - Checklists 49
Appendix B - Water quality sensor maintenance 56
Appendix C - Actuator Testing Procedure 59
Appendix D - Assessing sediment contamination and disposal needs 60

1 INTRODUCTION

This document describes required maintenance activities associated with the Oaklands Park wetland stormwater reuse system. It includes a description of start-up sequences to operation the system, required inspections and maintenance as well as checklists and data collection forms for each component of the system.

Items covered include the diversion from Sturt River, the wetland system, ASR wells and all associated pumping and control systems.

The wetland system is designed to passively treat up to 500 ML each year at a rate of up to 50 L/s. It is intended to operate for harvesting during winter and for extraction from aquifers and distribution during summer (for irrigation).

A related document, the functional design report of the stormwater harvesting system in Oaklands Park should be read as a reference of the design intent of the system.

Treated flows from the wetland are to be injected into the Tertiary aquifer under the site through four wells located on the main project site and Oaklands Estate Reserve. The target aquifer is between 100-120m below ground surface and the wells are expected to be capable of accepting up to 10 L/s each during injection and produce up to 14 L/s during extraction.

Water quality and flow data are required to be collected and reported to EPA and the licence requirements for data collection and reporting are covered elsewhere.

During the irrigation season water will be pumped from the wells into an on-site 'buffer' tank. This tank will then be connected to a pump station that will deliver flows southwards from Oaklands Park at higher pressure (i.e. uphill) and northward at a lower pressure (i.e. downhill). A network of distribution pipes (approximately 11.5 km) will distribute flow at suitable flow rates and pressures to up to 35 sites around the City of Marion.

The peak irrigation rate for the system is designed to be 70 L/s for the current demands (i.e. irrigation of council reserves).

Maintenance tasks for the system include routine condition inspections, performance checking of components, vegetation management as well as regular pollutant removal activities (gross pollutants and sediments).

1.1 Summary of require maintenance inspections and tasks

The table below summarises the required inspections, their frequency and the likely tasks to be performed. The remainder of the document describes the tasks in more detail and the appendices contain checklists that can be used to perform the inspections and to record the results of maintenance as a historical record.

Table 1 Summary of required maintenance inspections and tasks

Item	Timing	Required tasks
Sturt River off-take	monthly	inspect for debris above and below grate
	3-monthly	calibrate and check integrity of salinity probe
	annual	remove colelcted material
Harvesting pumps (PS1)	monthly	inspect integrity of components
	3-monthly	calibrate and check integrity of salinity probe
	annual	service the Grunfos pump
Gross pollutant trap	monthly	monitor debris accumulation
	3-monthly	dewater and remove debris (if required)
Inlet pond	monthly	check water levels
		inspect integrity of hydraulic structures
		monitor vegetation, weed ingress & for litter accumulation
	annual	monitor sediment accumulation in the inlet pond
		dewater and remove sediment (if required ~ 2-5 years)
	summer	monitor algal growth
Wetland	monthly	check water levels
	3-monthly	weed and vegetation health inspections
		monitor for litter accumulation
		hydraulic structures inspections (inlet pond culverts, weirs & outlet pit)
	annual	checking of maintenance valves
		presence of fish (e.g. carp)
		impacts of fauna (birds, dogs)
		bank & bed erosion
	summer	monitor algal growth
Injection pump (PS2)	monthly	inspect sensors and structural integrity of system
	3-monthly	clean & calibrate sensors (pressure & water quality)
	Annual	replace turbidity lamp
		test all actuated valves
ASR well heads	monthly	inspections of all components and structural integrity of system
	annual	check air valves for leaks during injection cycle
		manual pressure gauge readings
		manual water sample (or more frequently as per licence)
Distribution pumps (PS3)	monthly	analyse outputs to ensure within expected range (probes)
		run the various modes of operation to test operation
		inspect and clean pump controllers
		inspect tank components and shed for vandalism
Distribution network	annual	check all valves and air release for operation integrity
Control system	on-going	monitor operation and system errors
	3-monthly	record & store operational data

2 SYSTEM OPERATION OVERVIEW

The wetland at Oaklands Park is designed to receive stormwater flows from the adjacent Sturt River channel.

Flow collects in a grated sump beneath an existing concrete channel and a pipe transfers flows to a pump station and rising main that delivers flows into the inlet pond of the wetland at a maximum pumping rate of 50 L/s. The grated sump is required to be clear of debris blockage and the sump emptied of sediment.

A gross pollutant trap (GPT) upstream of the inlet pond removes sediment and debris carried in stormwater and will require cleaning up to 5 times each year. Flow then continues (by gravity) to the inlet pond of the wetland.

The inlet pond of the wetland is set at the highest levels of the wetland and is used to collect coarse sediments (any passing through the GPT). It is mainly open water with edge vegetation. The inlet pond will also serve to regulate flows into the macrophyte area of the wetland with two equal length weirs controlling the outflows and dividing the flows into two 'arms' of the wetland evenly.

The inlet pond has a hard base and a manual valve to allow dewatering for sediment removal, this is likely to be required on a 2-5 year frequency with annual inspections indicating the likely timing.

The main macrophyte (or vegetated) areas of the wetland are divided into two levels to work with the site topography. The wetlands are to remain extensively vegetated and will require regular inspections to assess weed ingress and for any damage to hydraulic structures. A dewatering system is incorporated into the wetland design to allow for water level manipulation as well as emptying the system if fish require removal or for other maintenance activities.

Outflows from the wetland pass through an outlet pit that has a screen to prevent material reaching the pump station. The screen requires regular inspections and cleaning. This pit also provides the main overflow system for the wetland (into Drain 6) and therefore requires checking to ensure there is no blockage of the structures.

Filtered outflows pass from the pit into an underground pump chamber (PS2) from where a submerged pump delivers flows to the wells (if water quality is good) or to either recirculation or directly to Drain 6 if water quality is not sufficient for aquifer injection. The pump station requires regular inspections and testing.

The ASR wells are spaced approximately 150m apart and are between 100- 120m deep. Each well head is installed to accommodate scouring if the well pressures excessively build up. The scour water can be delivered to the inlet pond of the wetland to be recirculated through the system. The operation of the well heads for scour based on pressure readings with probes in the well. Alarms will alert of breakdowns. Maintenance is more related to inspections for leaks and damage of the headworks as well as taking spot checks of pressures in the well to check if the in-well probe is working.

Regular (e.g. 2 times each year) manual water sampling will be required and the results reported to EPA. These requirements are outlined in the EPA operational licence.

An extraction pump in each well transfers recovered water to a buffer tank located adjacent to PS3. The tank will require route inspections for damage and vandalism but does not require maintenance per se.

The buffer tank connects to a distribution pump station within a shed (PS3). The distribution pump station supplies water through a network of reticulation pipes to nominated council reserves. Maintenance of the pump station includes annual inspections. The control system has built in alarms to detect any breakdowns in the system.

The distribution network that delivers flows to the council reserves will require inspections of valves and air release points.

Figure 1 shows an overview of the layout of the system and the flow paths for water movement. Figure 2 shows a flow chart of the components of the reuse system and maintenance of each component is further explained in the remainder of this document.

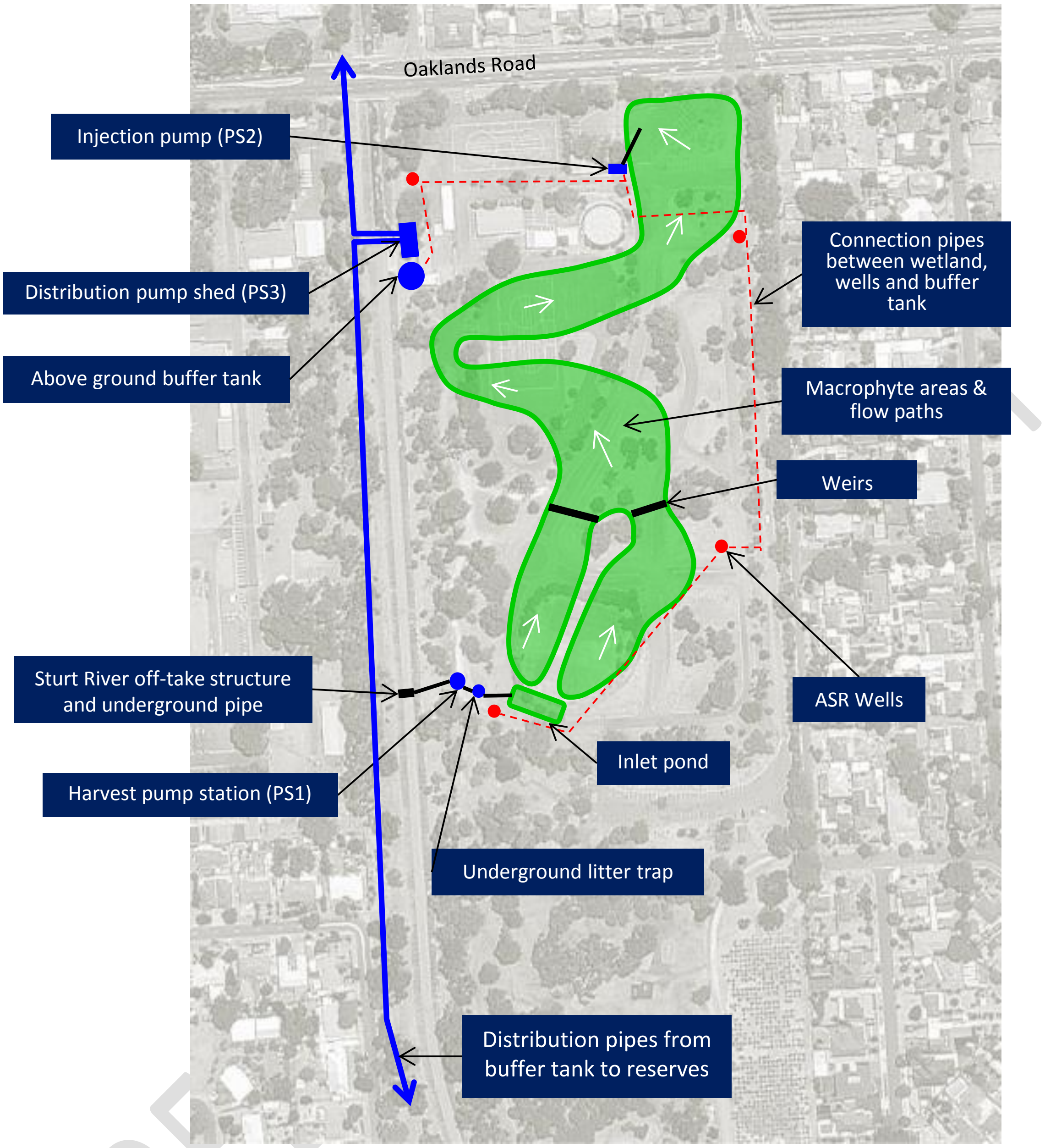


Figure 1 Layout of the main components of the Oaklands Park stormwater harvesting system

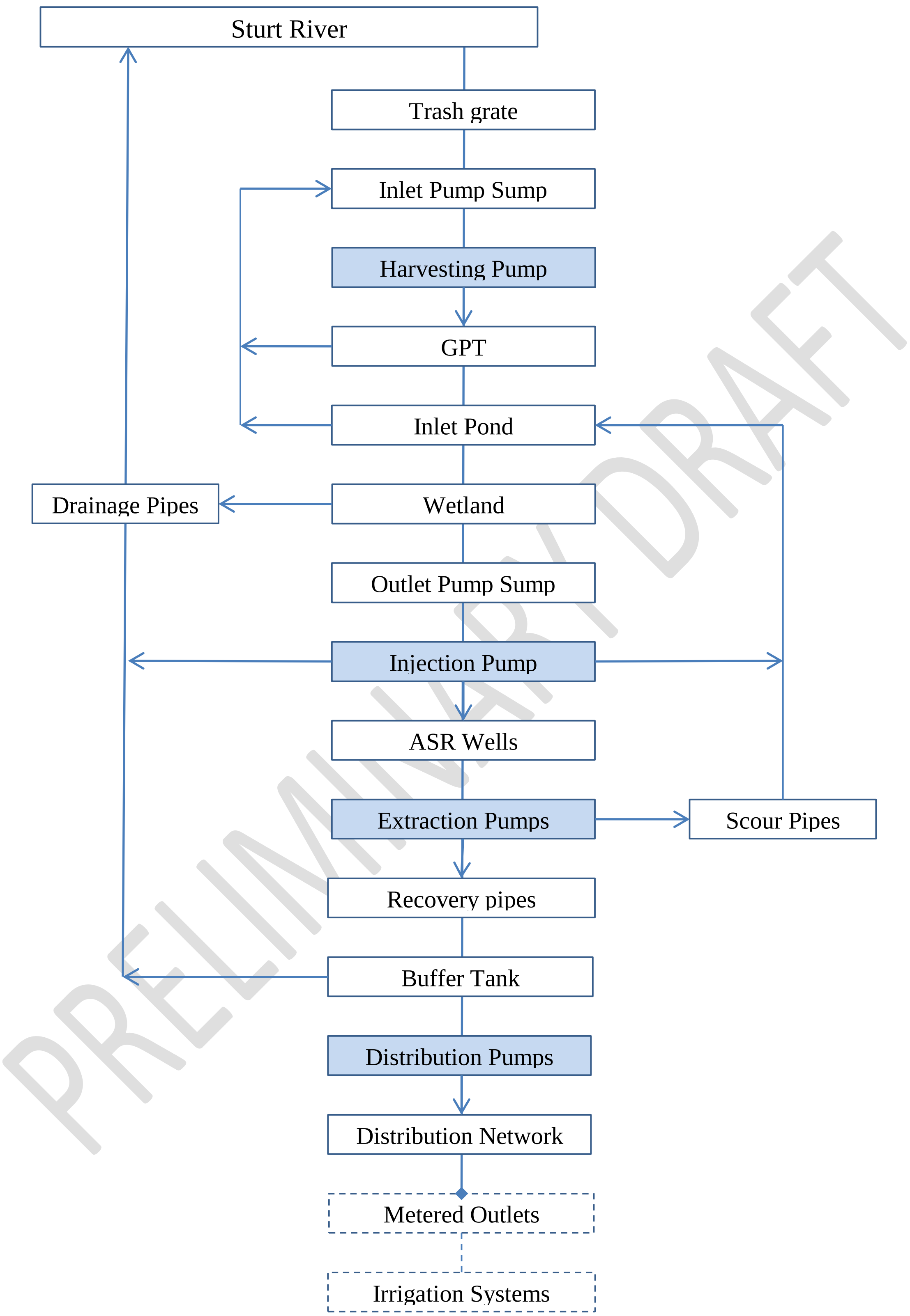


Figure 2 Schematic and names of system components (dashed boxes are outside of the current scope)

1.1 Components covered by this manual

This document describes required maintenance for the system to operate effectively. It also describes the start-up protocols to operate the pumping systems. Other supporting information such as product information and detailed plans are included elsewhere.

Specific components that are covered in this manual are:

1. Sturt River off take structure
2. Harvest pump - Pump station 1
3. Gross pollutant trap
4. Inlet pond
5. Wetland
6. Injection pump - Pump station 2
7. ASR well heads
8. Distribution pumps - Pump station 3 and tank
9. Distribution network
10. Monitoring & control systems

<u>Items not covered by this manual</u>

The operational licence requirements are not covered by this document. Specific requirements for water sampling and reporting are outlined in the particular licences.

There is a network of paths throughout the Oaklands Park site. These provide for maintenance access, pedestrian circulation and community shared paths. This document doesn't describe specific maintenance requirement for these paths.

In a similar way there are many landscape components of the park area surrounding the wetlands including seats, tables and shelters. These components are not covered here.

3 DEFINITIONS

Operation of the ASR scheme is separated into the following distinct modes:

- **Harvesting Mode** – Water transfer from Sturt River to wetland.
- **Injection Mode** – Transfer of water from the wetland into the wells, includes re-circulation and rejection modes.
- **Extraction Mode** – Transfer of water from the wells to the distribution tank, this also includes scouring and low water mode.
- **Distribution Mode** - Transfer of water from the distribution tank to irrigation system.

Other definitions include:

- **Turbidity** – Turbidity is the degree of cloudiness of a liquid due to suspended solid particles. This is primarily caused by human land use, including construction, mining and agriculture. It is an important parameter of water quality, because it can catalyze the growth of phytoplankton which increase the risk of virus and disease transmission. This is because the bacteria are able to attach themselves to the suspended solids and become shielded from disinfection. High levels of turbidity impact on the amount of light reaching the lower depths of water bodies, inhibiting the growth of aquatic plants and hence the entire ecosystem, plus they decrease the ability of fish to absorb dissolved oxygen through their gills. Turbidity is measured in Nephelometric Turbidity Units (NTU).
- **pH** – In water treatment, pH is an indicator of the acidity or alkalinity of a liquid. It is a measure of the hydronium ion concentration. Liquids with a pH less than 7 are acidic and those with a pH greater than 7 are alkaline. The pH of potable water should be neutral at a level of 7.
- **Conductivity** – Conductivity is a measure of the ability of water to pass an electrical current. Conductivity in water is determined by the concentrations of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions (ions that carry a negative charge) or sodium, magnesium, calcium, iron, and aluminum cations (ions that carry a positive charge). Conductivity is measured in micromhos per centimeter (µmhos/cm).

4 START-UP PROTOCOLS

The following sections describe the sequence for starting and restarting pumps to operate the system. These are important to follow for many maintenance tasks.

4.1 Harvest pump: Pump station 1

Precautions

1. The pump must be submerged such that it does not run dry
2. Check that the Sturt River grate and channel and fee of debris or blockage
3. Ensure that there is no large debris inside the pump well

Procedure

1. Check that there are no alarms or warnings displayed on the HMI at PS #3
2. Check that the liquid level is above the upper edge of the clamp on the pump. If the level is below the clamp, add water to the pit until the minimum level is obtained
3. Start the pump and let the pump run briefly, check if the liquid level is falling. A correctly ventilated pump will quickly lower the liquid level

4.2 Injection pumps: Pump station 2

Precautions

1. Visually inspect the water level of the pump to ensure that the pump will not run dry
2. Visually inspect Well #2 near PS #2 for algae and organic matter build up by physically opening the lid and looking inside
3. If there is a large amount of organic matter build up, a drain valve can be opened manually, located in the well to release the matter back into the river

Procedure

1. Start the pump via the HMI located in PS #3

RESTART PROTOCOL

When starting up the system after it has been dormant for an extended period of time, it is necessary to flush the air and stagnating water out of the system. This should be conducted annually, preferably at the end of summer. This is achieved by the following steps:

1. Using the HMI at PS #3, switch the system to maintenance mode
2. Under manual control, close the actuated drain and scour valves at PS #2
3. Under manual control, open the actuated injection and scour valves and close the inlet valve at ASR #6
4. Start up the PS #2 pump and allow it to run for approximately 60 minutes
5. Repeat the process, at ASR #1 for approximately 30 minutes

After these flushes have finished, turn the system back onto automatic mode, selecting the appropriate mode

4.3 ASR well pumps

Precautions

1. Ensure that the voltages and frequencies are correct and applicable to this model
2. Ensure that before proceeding, that all connections are voltage free

Procedure

1. Start the pump via the HMI screen at PS #3
2. Ensure that required set points are reached upon start up

4.4 Distribution pumps: Pump station 3

Precautions

- The motor protectors can cause the motor to restart unexpectedly, which could result in serious injury
- Never open the pump without the coupling guard correctly installed
- The outer surfaces of the pump and motor can exceed 40˚C during operation, do not touch the body of the pump without personal protective equipment
- Do not place combustible material near the pump

- Never operate the pump below the minimum rated flow, when dry or without prime
- Never operate the pump with the suction ON-OFF valve closed
- To prevent overheating of the internal pump-components, make sure that a minimum water flow is always guaranteed when the pump is running. Refer to the nominal flow rates given in the appendix
- Do not expose an idle pump to freezing conditions, drain all liquid that is inside the pump
- Do not use the pump if cavitation occurs, as it will damage the internal components

Pump Priming Procedure

1. Close the ON-OFF valve located downstream from the pump
2. Loosen the fill and vent plug and open the ON/OFF valve up-stream until the water flows out of the hole
3. Tighten the fill and vent plug.

Rotation Direction Check Procedure

1. Locate the arrows on the adaptor or the motor fan cover to determine the correct rotation direction
2. Start the motor
3. Quickly check the direction of rotation through the coupling guard or through the motor fan cover
4. Stop the motor
5. If the rotation direction is incorrect, a certified electrician may complete the following steps:

5 STURT RIVER OFF TAKE STRUCTURE

Off-take structure maintenance tasks:

- Remove debris from within the grate
- Remove sediments from below the grate
- Check and calibrate the salinity probe.

5.1 Purpose

The purpose of the off take structure in the Sturt River is to provide primary screening and deliver up to 50 L/s into the harvest pump chamber (PS1).

The challenge for this system is to extract a relatively small flow rate from a large channel yet screen debris from the system. There is also expected to be large bed loads of gravel and sediments that make keeping the off-take operational challenging.

The screen is made with galvanized steel bars manufactures in a T shape with 40mm bar spacings, 500 mm long and it spans the full width of the channel base (Figure 3). Beneath the grate, the floor of a chamber is shaped so it slopes towards the pump chamber at a minimum of 2.5% slope and has side slopes to direct flows to the pump chamber. A 300 mm diameter pipe connects the collection sump to the pump chamber (Figure 4).

The trash grate is capable of withstanding traffic loads from maintenance trucks that commonly travel along the Sturt River channel bed.

Figure 3 Sturt River off-take grate

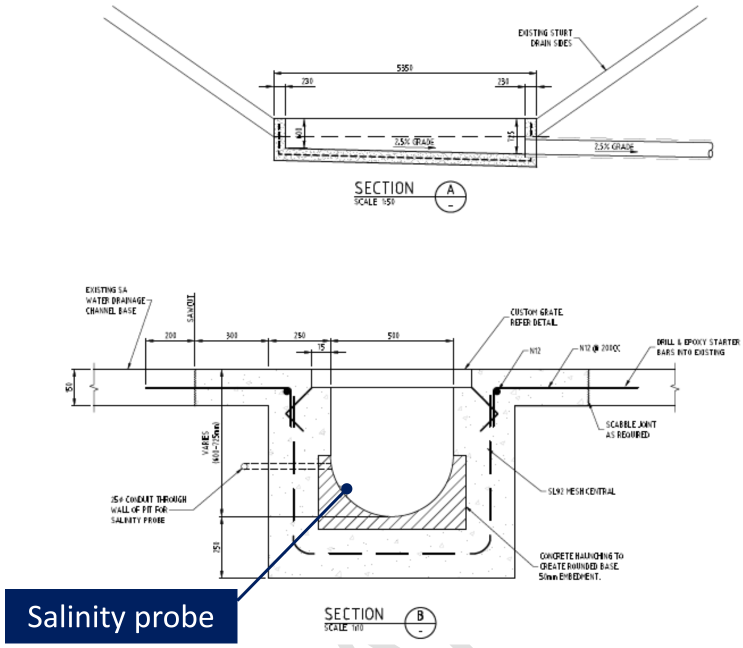


Figure 4 Section through the off take structure channel

5.2 Skills and equipment required

The skills required to inspect and maintain the Sturt River off-take include:

- an understanding of OH&S requirements and approvals to access the Sturt River for inspections (i.e. by foot access) and for cleaning (i.e. with vehicles)
- ability to handle potential hazardous wastes such as sharps.

Required equipment includes:

- miscellaneous items such as gloves. shovels, rakes, etc. to hand remove debris from on top of the screen
- suitable tools to remove the grate (e.g. spanners and lifting tools)
- a means to remove collected sediments form below the grate (e.g. vacuum machinery)
- a means to block off the connection to the Harvest Pumps (if required).

5.3 Maintenance tasks

5.3.1 Access to the grate

Pedestrian access to the grate is via a dedicated ladder immediately downstream of the grate. To enter the Sturt River channel approval is required form SA Water. THE PROCESS FOR THIS IS BEING DEVELOPED BY SA WATER AND WILL BE INSERTED.

Vehicle access for cleaning is via a ramp on the northern side of Oaklands Road with approval required form SA Water to access the channel. THE PROCESS FOR THIS IS BEING DEVELOPED BY SA WATER AND WILL BE INSERTED.

5.3.2 Debris removal from grate surface

Debris removal from the grate can be done by hand with rakes and shovels. In some case it will require removal from between the bars. The material should be collected and disposed of from site.

5.3.3 Sediment removal from below the grate

If sediment build up under the grate is restricting sufficient flows reaching the harvest pump (e.g. on-off sequence from the pumps when there is sufficient channel flows) the sediment and debris will need to be removed. This can either be done by hand (i.e. shovel) or by using a vacuum eductor truck.

The frequency of this cleaning needs to be monitored using the data collection sheets.

Cleaning should commence on the Oaklands Park side of the grate (eastern). The procedure is to remove the grate and then physically extract the collected sediment. If vacuum machinery is used it may be possible to reach further along the channel under the grates, thus not needing to lift all of the grate panels. Depending on the machine it may also be possible for the machine to be located on the top of the channel.

Sediment removal is most likely to be required at the start of a harvest season or after a prolonged times when the harvest pumps are not operating. The system is designed to 'self scour' but if the pumps have not being operational it is likely sediment will accumulate in the trench.

It is very difficult to estimate the likely loads of material requiring cleaning, or the cleaning frequency so this will need to be monitored and methods adjusted as experience increases.

5.3.4 Clean and recalibrate conductivity probe

The salinity probe is located at the eastern end of the off-take structure, mounted on the south wall (Figure 4). Refer to Appendix B for the cleaning and recalibration procedure. This is required every three months.

5.4 Monthly requirements

- Inspect the grate for debris accumulation and any structural damage, if the debris is blocking more than 50% of the screen surface, hand remove by raking debris from the screen
- Inspect accumulation below the screen using a stick or similar probe (it should be minimum 600mm deep) and check for blockages into the pipe leading to the harvest pumps. If the channel is blocked sufficiently to restrict flow reaching the harvest pumps then sediment removal will be required.
- Inspect the conductivity cells and their corresponding meter only if contamination is expected, for example in the event of abnormal sensor outputs.

5.5 Three Monthly requirements

- Clean and recalibrate the conductivity cells. The removal, cleaning and recalibration protocols are detailed in Appendix B.

5.6 Annual requirements

- Clean below the grate to ensure it is clear before a harvest season.

6 HARVEST PUMP: PUMP STATION 1

Harvest pump maintenance tasks:

- Inspect integrity of the components
- Check and calibrate the water quality instruments
- Service the pump.

6.1 Purpose

The role of Pump Station 1 is to pump water from Sturt River into the start of the gross pollutant trap at the initial stage of the wetland system.

6.2 Monthly Requirements

- Physically inspect the pump station, paying particular attention to the main components. These components include the pump, centrifuge, and flow meter.

- The two conductivity cells and their corresponding meter are to be inspected only if contamination is expected, for example in the event of abnormal sensor outputs. One cell is located in the pump tank and the other below the inlet grate in the Sturt River (refer to Section 5).

- Cabling should be inspected for damages, ensuring that all wires correspond and that there are no exposed leads.

- The structural integrity of the system should then be inspected i.e. the pipework and bolts to ensure no bolts are loose or that corrosion is visible.

- Finally, the integrity of the infrastructure itself, should be inspected to ensure no tampering or vandalism has occurred.

6.3 Three Month Requirements

- Every three months, the conductivity cells require cleaning and recalibration (this can be done with the Sturt River off-take probe). It located under the grate in the Sturt River and in the PS #1 Pump Well. The removal, cleaning and recalibration protocols are detailed in appendix B.

6.4 Annual Requirements

- The Grundfos pump in use at PS #1 requires a service, every 3000 hours of operation by a certified Grundfos technician. This service should include scrutiny of the internal working parts of the pump, including but not limited to ball bearings, impeller, seals and rings. The oil should be changed, the insulating resistance of the electrical components should be measured and any dysfunctional parts should be replaced.

7 GROSS POLLUTANT TRAP (GPT)

GPT maintenance tasks:

- Monitor material accumulation
- Dewater the unit and removal debris
- Disposal of collected material

7.1 Purpose

The purpose of the GPT is to provide screening of material larger than approximately 2mm. Flow from PS1 enters a circular screening chamber which has a fine screen around the perimeter. Filtered water passes through the screen and then flows on to the inlet pond. Screened pollutants collect in the GPT sump either by settling to the bottom or as floating material.

7.2 Skills and equipment required

Staff are required to have:

- an understanding of council's OH&S requirements
- an understanding of how the GPT operates (see product information on the Rocla CDS unit)
- Comply with confined space entry procedures should the unit require access (only required if damage is detected within the unit).

Equipment required to maintain the GPT:

- Lid removal lifter (Gatic lifters)
- Staff for checking material accumulation in the chamber
- Valve opening tools
- Vacuum eductor truck to removing collected material.

7.3 Maintenance tasks

7.3.1 Inspections

Regular inspections are required to check for damage and to assess the debris accumulation and whether cleaning the unit is required.

<u>Inlet chamber and overflow weir</u>

The inlet chamber and overflow weir can be inspected through 600x600 Gatic covers (Figure 5). Each is checked every 3 months for signs of debris build up, blockages or any damage.

Note whether the system has overflowed (a chalk mark on the crest of the overflow weir can help determine this). The Oaklands Park GPT should not overflow unless it has become blocked. If it has overflows then either the unit needs cleaning or the screen will need an inspection for defects.

<u>Main chamber and material build up</u>

The main chamber of the GPT is accessed via a manhole at the centre of the circular unit. It should be inspected every month (during harvesting) and measurements taken on debris accumulation.

A staff should be used to measure the top surface of the material build up inside the sump. A measurement should be taken between the water surface (when not flowing) and to the top of the debris build up in the sump (from say three points, one including the middle).

When the accumulation is within 1.8m from the water surface (i.e. the top of the material is less than 1.8m deep) it is a trigger for routine cleaning of the unit. This level represents approximately 1.5m build up on material in the sump.

The level of accumulated material should be recorded on the checklists to log the accumulation and to allow for future planning for cleaning operations.

Once the trigger has been reached for cleaning then dewatering and material clean out is required as discussed below.

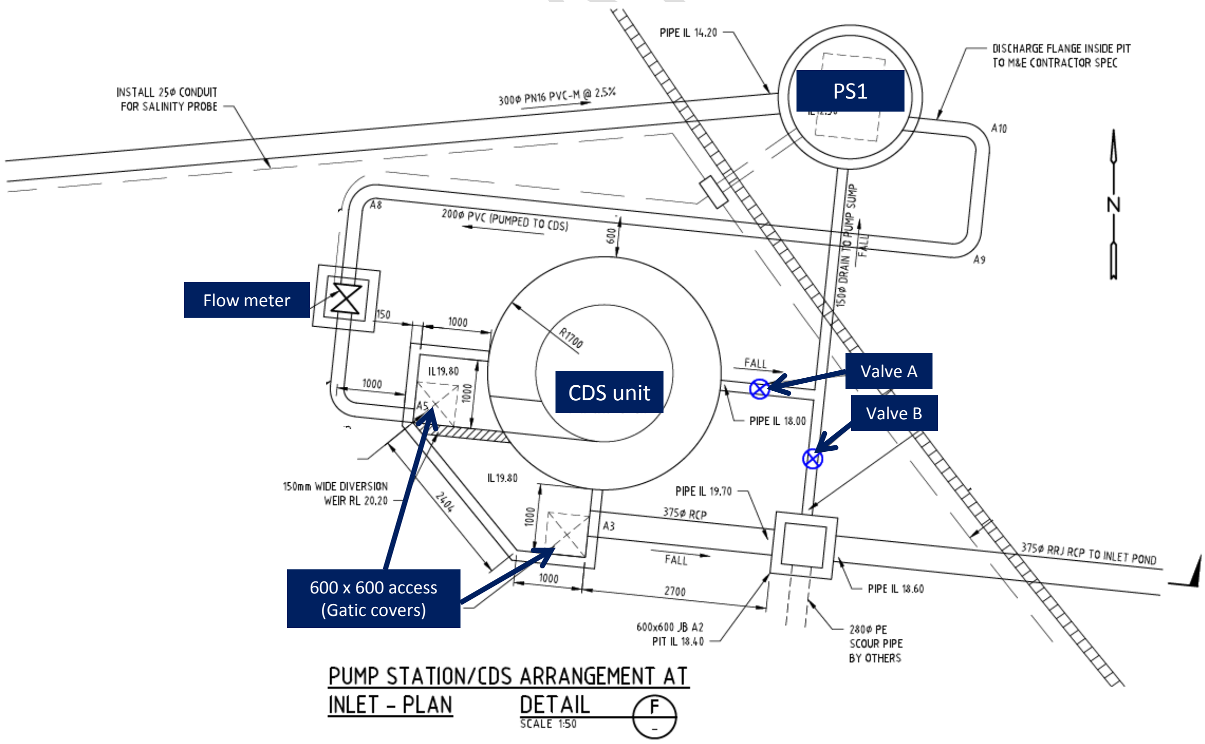


Figure 5 Layout of the GPT

7.3.2 Dewatering the GPT

The system is configured to allow the GPT to be dewatered by gravity. A pipe is installed at the base of the screen on the outside. Opening maintenance Valve A (Figure 5) will enable the GPT to drain to the top of the sump. When the valve is open water from the outside of the screen drains back to PS1 and then back to the Sturt River via the off-take structure connection.

Draining the GPT should be done at least 12 hours before cleaning.

The valve is a standard SA Water direct buried valve (see the product information for more information).

7.3.3 Material removal

Once the CDS unit has been drained down to the level of the top of the sump the remaining material can be vacuumed out. This will be done with a large vacuum eductor truck and a (typically) 150mm hose.

Access the CDS unit is from the car park, past the inlet pond and adjacent to the CDS unit on the down side of the retaining wall. From here the eductor hose can reach into the unit via an access hatch above the sump.

A contract for GPT cleaning should also include disposal of the collected material.

7.4 Monthly requirements

- Inspect the level of material build up in the sump

7.5 Three Monthly requirements

- Inspect the inlet and out of the CDS unit for blockages (via the Gatic pits)
- Cleaning is likely to be required of the CDS unit (but will be informed by the level of material build up in the sum (if shallower than 1.8 m, then clean).

8 INLET POND

Inlet pond maintenance tasks:

- Monitor sediment accumulation and system integrity
- Note water levels
- Dewater and remove sediments when triggered
- Monitor weed and algal growth.

8.1 Purpose

The purpose of the inlet pond is to settle out and collect coarse to medium sediments that have passed through the GPT. It also acts to regulate flows from the GPT and divide them evenly into the two arms at the head of the wetland.

8.2 Skills and equipment required

The skills required for inspecting and maintaining the inlet pond include:

- an understanding of council's OH&S requirements
- an understanding of how the inlet pond is meant to operate
- an appreciation of the performance indicators for sediment basins
- some horticultural experience with edge vegetation and possibly algae.

Required equipment for maintenance includes:

- pump to dewater the lower part of the pond
- excavator, possibly with a long-reach, or a heavy vacuum loader unit with a 150mm hose
- drying pad (provided adjacent the inlet pond, immediately to the south)
- equipment to access the water body such as waders or a small boat
- miscellaneous items such as shovels, rakes, waders etc. to hand remove litter and weeds.

8.3 Maintenance tasks

The main treatment mechanism for inlet ponds is through sedimentation. The inlet pond has a permanent pool of water (1.5- 2m deep), to enhance sediment capture. Vegetation is provided on edges to improve amenity and safety and reduce erosion.

The inlet pond receives flows from the GPT and regulates the flows to divide it evenly into the two ‘arms’ of the wetland by transferring flows through culverts of the same size and set at the same level.

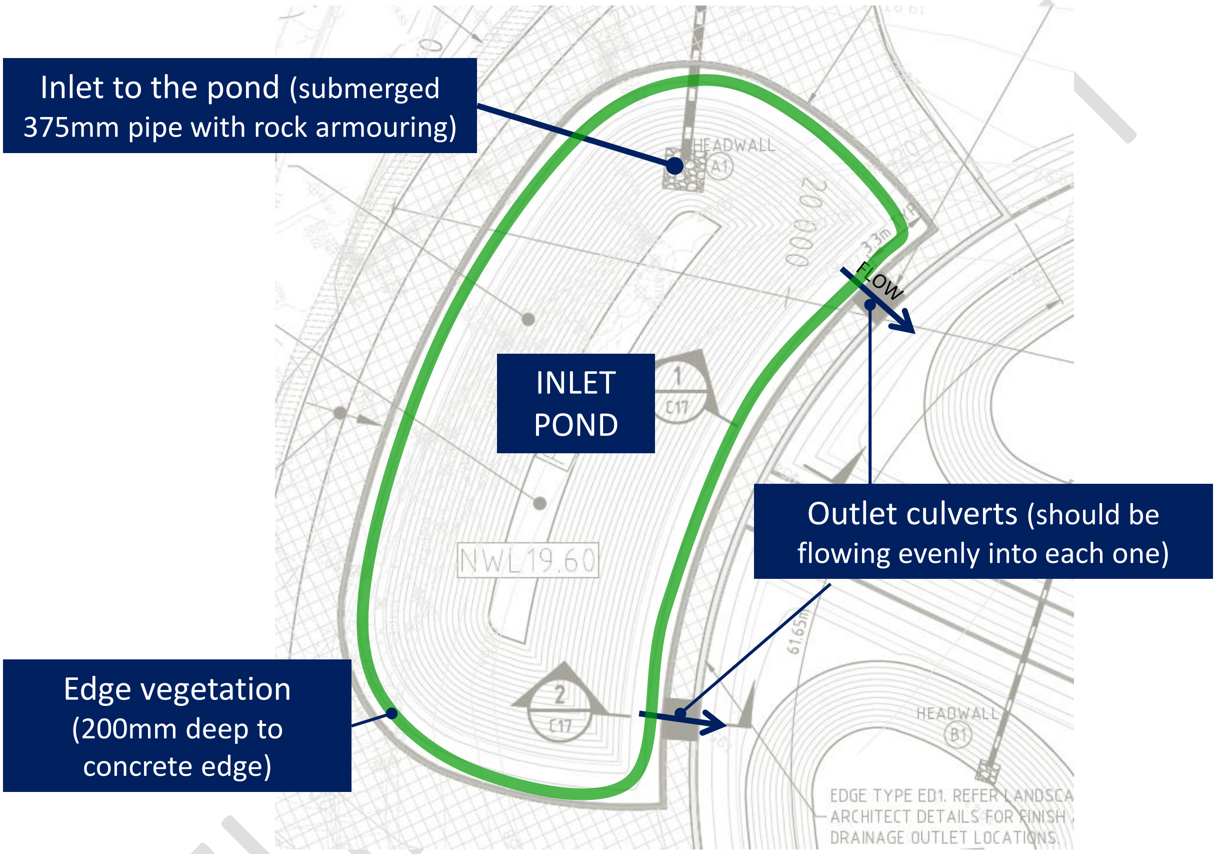


Figure 6 Main component of the inlet pond

8.3.1 Inspect hydraulic structures

Inspect the inlet area for signs of erosion and program maintenance for rock armouring if required (note the inlet pipe is submerged).

Inspect the two culverts that transfer flows to the wetland. They should be free of blockages. If more than 20% of the entrance is blocked then arrange for cleaning. Inspect during flow and note if there seems to be even flow into the two arms of the wetland.

Note the water level in the inlet pond. It should be within 100mm height of the connecting culverts to the wetlands. If lower consider topping up from the ASR system. If water levels are consistently significantly lower than the culvert inverts it suggests a leak and the system needs to be thoroughly investigated.

8.3.2 Monitor for litter

Note the presence of litter either floating or within the edge vegetation. If there is persistent litter establish whether it is likely to have blown in or has come through the CDS unit. An inspection of the CDS unit to establish whether it has overflowed or not where the litter has come from (and if it is the CDS it requires maintenance and or repair).

If unacceptable litter accumulation is observed arrange for removal (typically by hand).

8.3.3 Monitor sediment accumulation

Sediment accumulation in the inlet pond is not expected to occur very quickly if the CDS unit is maintained appropriately (i.e. at least 5 years between inlet pond cleans). Nevertheless, measuring accumulation of sediments should be undertaken each year and the build-up monitored over years.

It can be difficult to accurately measure the sediment accumulation. If possible a small boat would be used to take depth measurements at various locations around the inlet pond (including near the inlet). The locations and depths should be marked on a plan.

Alternatively a visual inspection of sediment levels can be performed. While not as useful or accurate it will provide an indication as to when maintenance is required. The area just downstream of the inlet should be inspected.

When sediment accumulation is within 1.0m of the surface a clean out should occur (see Section 8.3.5).

8.3.4 Inspect vegetation

The inlet pond has a perimeter ring of vegetation around the main water body. This needs to be inspected and notes taken on the evenness of growth, extent of weeds and general condition.

Excessive growth around the outlet culverts also needs to be noted as the design intent is for even flow distribution into both wetlands. Should the vegetation tend to block flow from entering one culvert, trimming or removal is required to achieve even flow into each culvert.

If weeds are present or there are areas of poor growth then vegetation maintenance for weed removal and replanting should occur. Refer to the design plans for suitable species.

8.3.5 Dewatering and clean out

If a clean out is required, the inlet pond is configured to allow for gravity draw down of the pond to approximately 1 m below the normal water level. If further draw down is required to expose the sediments a portable submersible pump is required.

To manually draw down the inlet pond, open Valve B in Figure 5. This will draw water back through the inlet pipe and drain into the harvest pump chamber (PS1). From there is will flow back to the Sturt River via the off-take structure. This will reduce the water levels to the upstream invert of the inlet pipe (RL 18.6m, or about 1m above the base of the inlet pond, see the section in Figure 7).

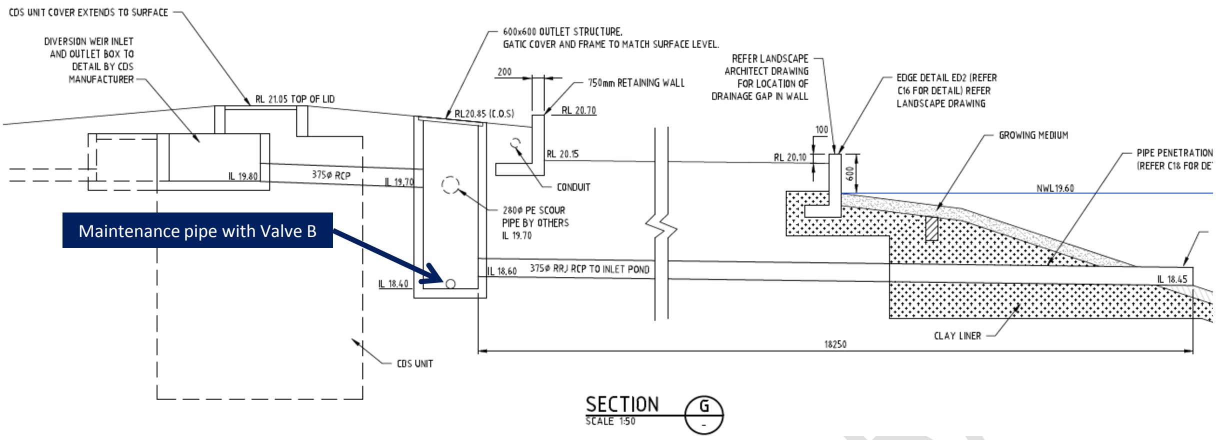


Figure 7 Section through inlet pond inlet and maintenance drain

Once the inlet pond has been dewatered (e.g. valve left open overnight) the sediment can be removed. The system is designed to use a long reach excavator to remove sediments. A cement treated rubble base is installed and this provides a reference depth the excavator operator can dig down to (i.e. know they have reached the base and not damage the clay liner underneath).

Excavated sediments will still be wet and sloppy. These should be stored on site and allowed to drain for up to a week before removal. This will make the material easier to handle and less expensive for disposal. Possible dewatering areas are shown in Figure 8.

The dewatering areas should be boarded off from pedestrians and sounded with hay bales to minimise sediment laden water spreading over the surrounding pavements. The pile should also be located such that draining water flows back into the inlet pond.

Once the sediments have been removed the inlet pond should be refilled, either using the Harvest pumps (if there is water in the Sturt River or from the ASR wells.

Testing may also be required to determine the level of contamination of the sediments prior to disposal. A procedure to follow for doing this is presented in Appendix D.

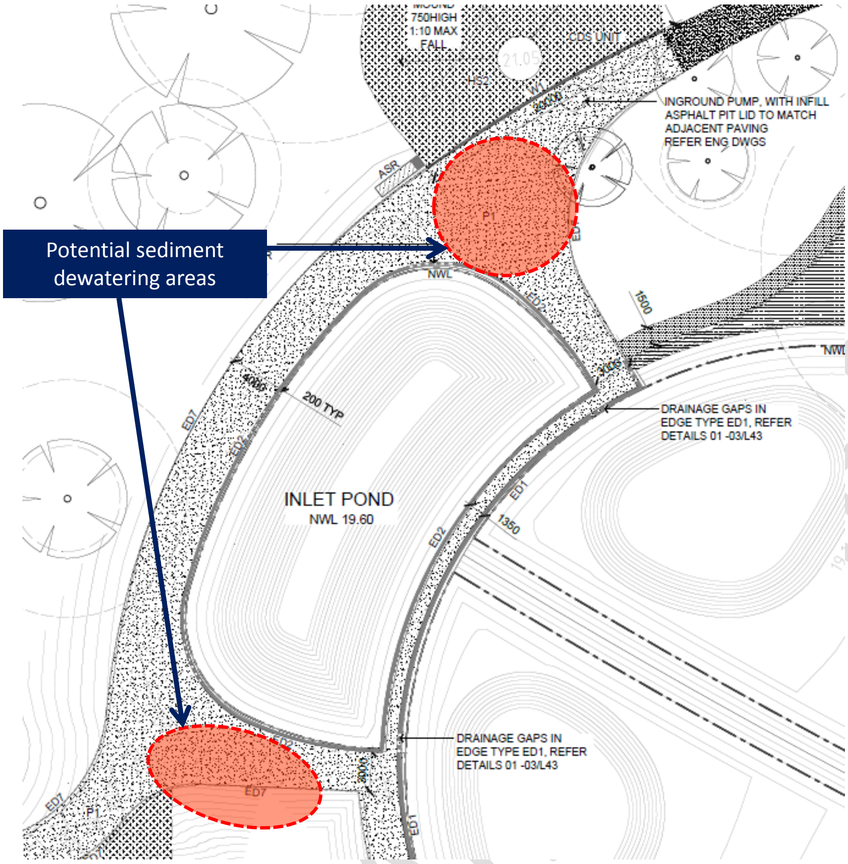


Figure 8 Potential areas for sediment dewatering

8.4 Monthly requirements

- Note the water level and top up if sufficiently low (>100mm below culvert inverts)
- Inspect the inlet pipe area and the transfer culverts
- Note the presence of weeds and litter in the edge vegetation – arrange for removal if sufficient
- Note algal growth (during summer) - refer to discussion wetland section, Section 9.3.6

8.5 Annual requirements

- Check the operation of the maintenance valve
- Monitor and note sediment accumulation level (arrange sediment removal if within 1m of normal water level)

9 WETLAND

Wetland maintenance tasks:

- Maintain good vegetation coverage and health with minimal weeds & litter
- Check hydraulic structures and water levels
- Check for impact of fish, birds, erosion and algal growth

9.1 Purpose

The role of the wetland is to treat the stormwater to a suitable level to allow for aquifer injection. Primarily fine sediments and nutrients will be removed. The key to a well functioning wetland is an extensive coverage of healthy aquatic vegetation, free of weeds.

The wetland at Oaklands Park is also community feature and includes two cascades, three pedestrian bridges and a set of stepping stones to cross the wetland. These landscape elements are not the focus of this maintenance manual. This document focuses on maintaining the water treatment function of the wetland.

The biggest threats to the functionality of the wetland are:

- Weed invasion and/or plant die off
- Fish invasion and resultant plant damage and turbidity increases
- Damage to hydraulic structures that alter flow paths or block entrances
- Leaking clay liner resulting in large water losses and plant die off.

Figure 9 shows examples of good coverage of healthy wetland vegetation and the main components of the wetland and the water flow paths are shown in Figure 10.

Figure 9 Example of good coverage of healthy wetland vegetation

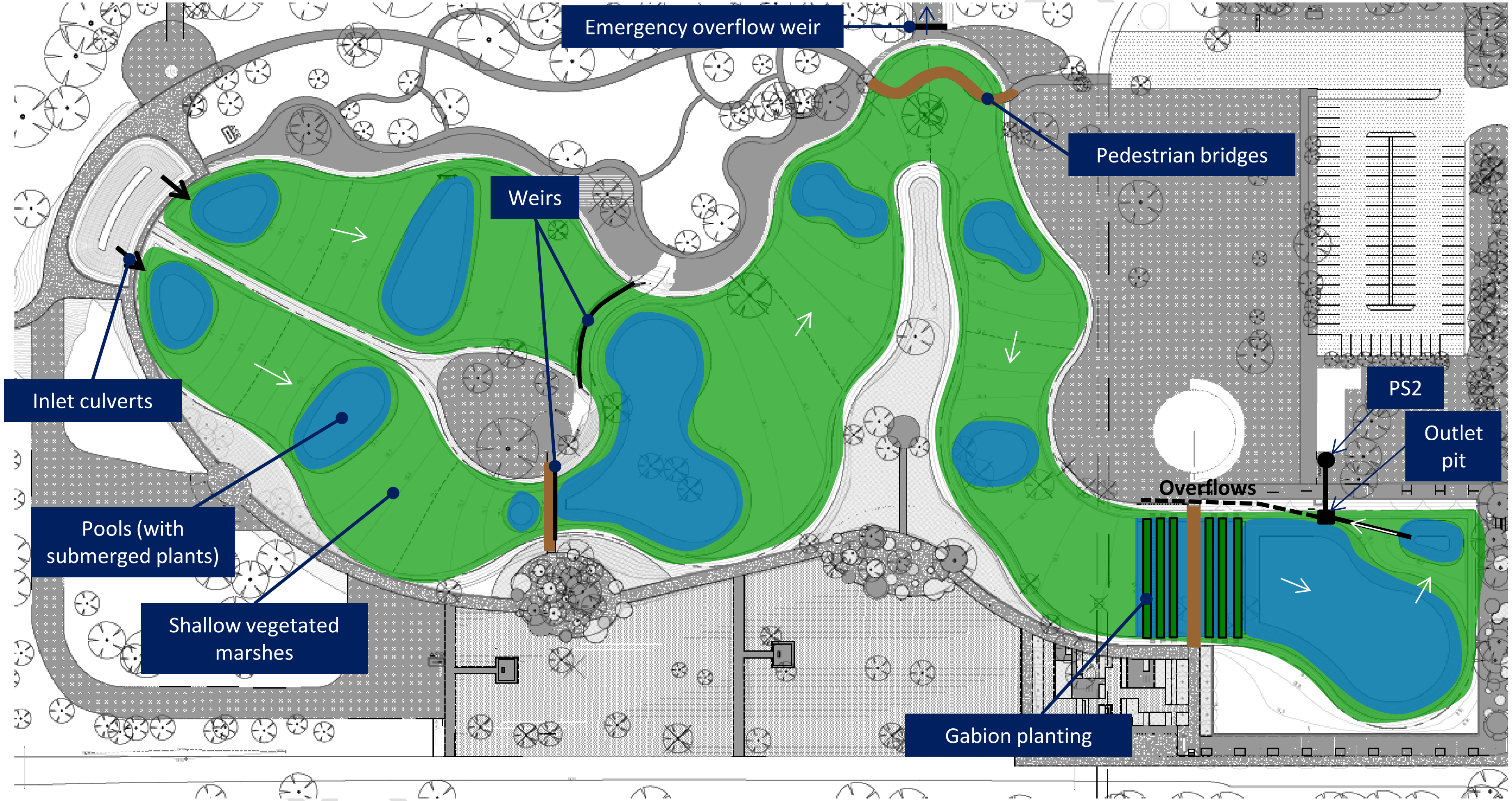


Figure 10 Main components of the wetland for maintenance

9.2 Skills and equipment required

The skills required to inspect and maintain the wetland include:

- an understanding of council or the asset owners OH&S requirements
- an understanding of how the wetland operates
- an appreciation of water plants and weed identification and management

Specialist equipment required includes:

- equipment to access the water body such as waders or a small boat
- replacement plants if large areas of water plants need replanting, use specialist aquatic plant contractors
- valve opening tools if manipulating the water levels for planting
- miscellaneous items such as gloves. shovels, rakes, etc. to hand remove weeds, litter and sediment

Access to the water body may be required for inspections and maintenance. Waders or even a small boat may be required to perform inspections and maintenance. .

9.3 Maintenance tasks

The majority of the maintenance tasks to maintain the wetland operation involve vegetation checks – to ensure weeds are under control and there is generally good plant coverage. Water plants are vital for the effective functioning of a constructed wetland. Water plants strip nutrients from the water and compete with bloom forming algae for nutrients.

Plant coverage and health will be a good indicator that a system is functioning well.

In addition, the hydraulic structures all need to be routinely checked to ensure there are no blockages and are all functioning correctly.

Less regular maintenance involves checking for damage by pest birds and fish, particularly fish (e.g. carp). This may require draining of the wetland and physical removal of the fish.

9.3.1 Vegetation and weeding

<u>Plant health</u>

Diversity of plantings ensures the wetland is robust and not dependent on the survival of individual species. Plant diversity also encourages macro invertebrates which provide a key role in mosquito control.

Things to check for during routine inspections are:

- Evenness or patchiness of plant coverage (at least 80% of the wetland)
- Density of plants (4-6 plants/m^2 minimum).
- Diversity of plants i.e. no one species dominating
- Plants healthy, free from disease and growing vigorously.

When poor vegetation cover is found the procedure is to remove any dead vegetation to allow for regrowth or replanting.

For individual bare patches that are less than 5% of the area, allow regrowth from existing vegetation.

For individual bare patches greater than 5% of the area use either new stock or transplant using existing stock to encourage regrowth. Consult with an aquatic vegetation specialist if required.

Weeding

Weeds compete with or displace native plant species, reduce biodiversity, impact on ecosystem function, alter natural habitats, restrict natural processes, reduce amenity and can cause blockage to hydraulic structures

Inspections are routinely conducted to identify any weeds in the wetland and batter zones (which may require specialist input until sufficient skills are gained).

The performance target is less than 5% weed coverage in the macrophyte zones.

While the performance target is 5% of coverage, regular weeding should be programmed as part of routine maintenance. It is very important to remove weeds as soon as they are discovered to prevent rapid colonisation, particularly for species such as Typha and Phragmites. Seek specialist botanical input if significant numbers of weeds persist.

Persistent weed cover may mean scheduled maintenance activities are not sufficient to manage weeds. In this case increased maintenance frequency for a season and reassess weed management.

9.3.2 Water levels

The wetland is planted in different zones to create a diversity of planting and improve treatment performance. The different plant species are particularly suited to the depths they are panted in at normal water level. Maintaining the water level close to the design operating levels is vital for the continued health of the zone plantings in the wetland.

Water level should remain within 150mm below of the normal water level during extended dry conditions (for plant health). The ASR network can be used to put water into the wetland, using the scour mode for example (directly from the wells) which will transfer flows to the inlet pond and then to the remainder of the wetland.

Top up water can be also be used to increase water levels for improved aesthetics – e.g. to have the weir flowing during a community event.

9.3.3 Dewatering, water level manipulation & refilling

The water levels at Oaklands Park wetland can be manipulated with a network of maintenance pipes and valves. The network allows the system to be drained to allow for inspections or for fish removal.

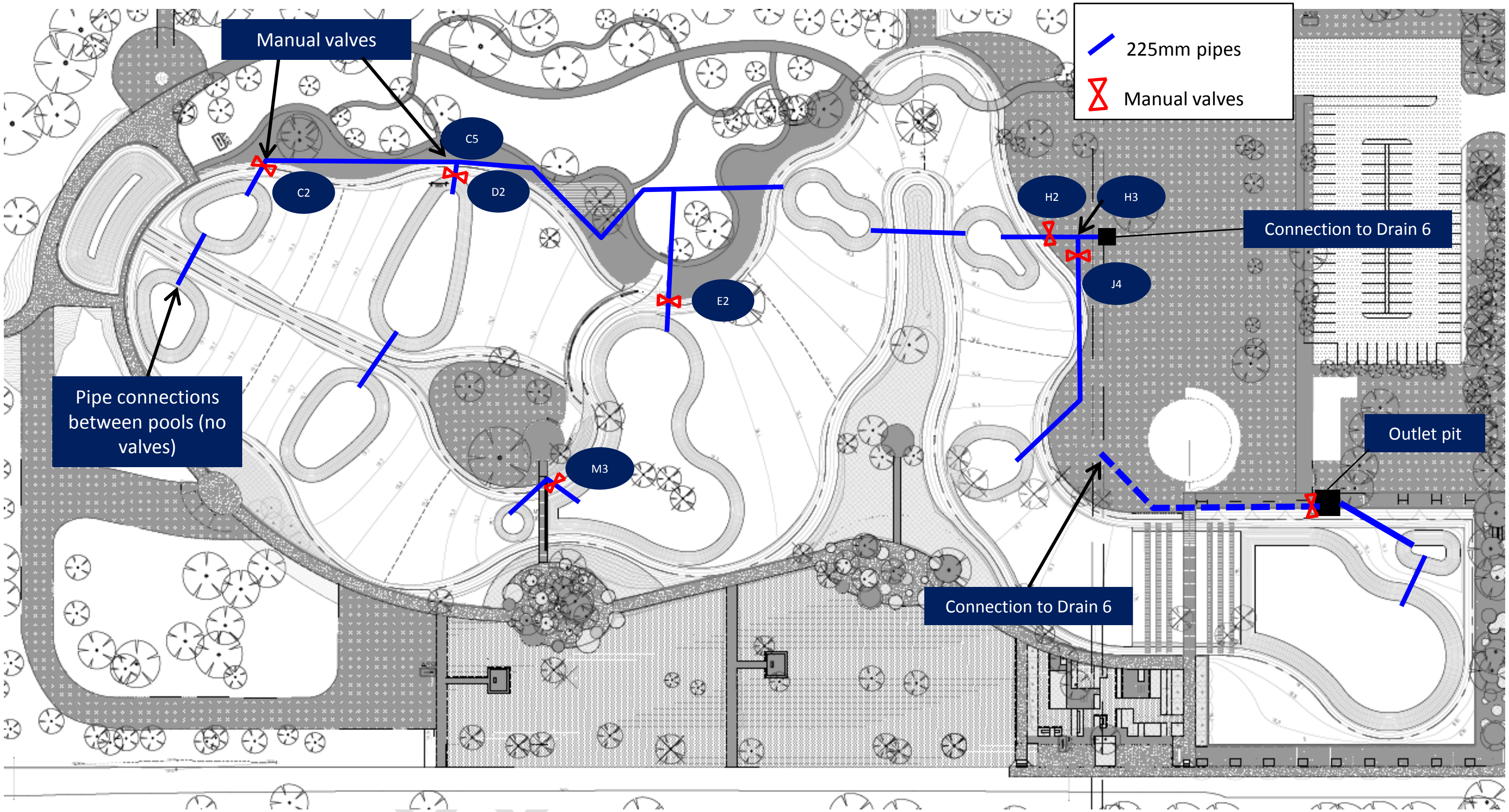


Figure 11 Wetland maintenance pipes for manipulating water levels

Water levels can also be made intentionally lower to aid with plant establishment if areas of the wetland are replanted.

Lowering water levels or dewatering

The wetland is constructed of a number of shallow marsh areas with a minimum depth of 100mm and then a series of deeper pools in between the shallow marsh areas. Therefore, water can only drawdown at the outlet by 100mm before it is retained by each shallow marsh area. To overcome this, a network of connecting 225mm pipes connects the deeper pools and ultimately allows the systems to drain to Drain 6 (Figure 11).

Figure 11 shows the valve locations that allow the top wetland area to drain into the lower wetland area. The lower area is then connected to Drain 6 (via valves H2 & J4) and through the wetland outlet pit (Figure 12).

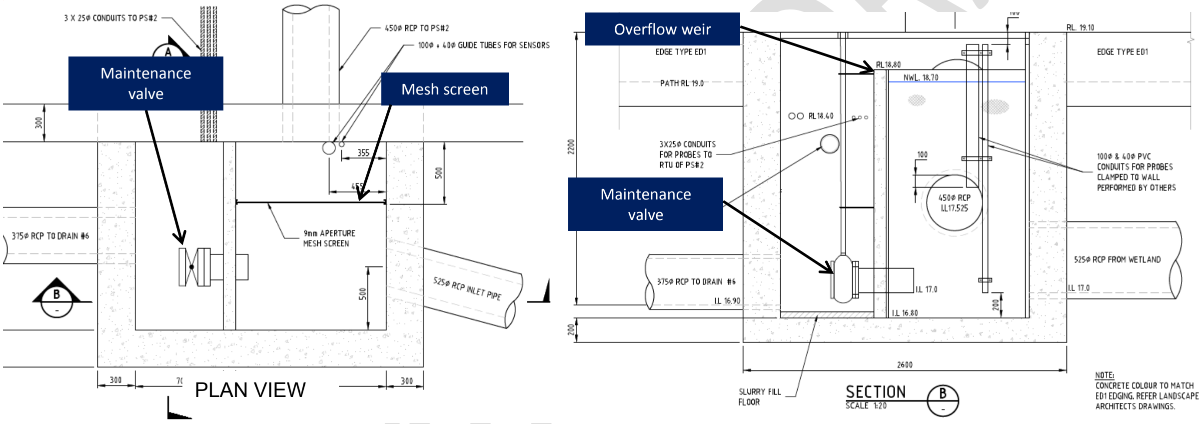


Figure 12 Wetland outlet pit

This configuration allows the wetland to be drained to within approximately 400mm of the base of the deep pools. Should more water need to be removed a manual pump will be required.

It is also possible to lower the wetland by smaller amounts to aid plant growth (say 100mm) by opening valves, monitoring water levels and then turning the valves off before full dewatering.

In addition, isolated pools can be drained with the confines of the valve arrangement in Figure 11.

When the wetland is fully dewatered it is also prudent to check the integrity of underwater components of the system. These include:

- Inlets and outlets of maintenance drains (check for blockage)
- Inlet to the wetland outlet pit (the grate isn't blocked)
- Erosion at the entrances from the inlet pond (check for rilling and scour).

<u>Refilling the wetland</u>

The dewatering pipes can also assist in refilling the wetland to allow for improve even filling and reduce the incidence of one deep pool 'spilling' into the next and causing erosion at the upstream end of pools.

The valves in Figure 11 can be opened to allow the deep pools to be connected when refilling. NOTE that valves C2 and D2 cannot be open when refilling the upper wetland ponds as water will drain to the lower ponds. However, a temporary block into the pipe leaving from the junction pit C5 (e.g. a sand bag lowered on a rope, or a sewer bung) will prevent water flowing into the lower ponds and allow the upper pools to be connected.

In a similar manner a temporary block can be put into the pipe leaving pit H3 allowing the downstream pool to evenly fill.

The pipe network is not capable of connecting to the outlet pool for refilling. Water will flow through the gabion planting and into the deep pool.

9.3.4 Structures (weirs and pits)

Regular inspections (3-monthly) of the hydraulic structures of the wetland are important to ensure even flow through the wetland and that there are no blockages causing overflows from the system. The key structures to inspect include:

- Inlet culverts (2)
- Weirs (2)
- Emergency overflow spillway
- Outlet pit.

<u>Inlet culverts</u>

Inspect the inlets to the wetland from the inlet pond (i.e. the culverts) for erosion and program maintenance or rock armouring if required. They should be free of blockages. If more than 20% of the entrance is blocked then arrange for cleaning. Inspect during flow and note if there seems to be even flow into the two arms of the wetland.

Check for signs of erosion at the inlets. Arrange for rectification works or add rock armouring if regularly eroded.

<u>Weirs</u>

The two long weirs require checking for debris build up and even flow across their face.

Debris is to be removed to allow for clear flows and ensure even flow across the wetland leading to the weirs.

If the weirs are flowing preferentially at one location across the weir, then the weir plates require adjustment. The weirs are fixed with bolts in slotted holes that will allow some adjustment.

The integrity or the rockwork at the base of the weirs should also be inspected and rectified if required. Any erosion is to be backfilled with rocks of similar character to the existing rock work.

Emergency overflow spillway

The emergency overflow spillway (see Figure 10) should never flow. It is a safeguard against system failure of other components. The weir should be inspected and be free of any potential blockages. It is also important to note if the flow path from the weir to the Sturt River is clear.

Arrange for clearing work if there are obstructions to (potential) flow.

Outlet pit

The outlet pit serves many purposes (refer to Figure 12). Required checks include:

- The mesh screen is free from blockage
- The overflow weir is free of blockage
- The sensors are operational (refer to Section 10)
- The maintenance valve is not leaking
- The pit is generally in good condition with no damage and minimal debris accumulation.

9.3.5 Fauna management (fish & birds)

Excessive populations of fish (e.g. carp) graze on plants and cause turbid water and can be a threat to the wetland plants and water quality. Evidence of fish invasion should be checked during each visit to the wetland such as turbid water and fish splashing.

Should fish numbers be considered too great (e.g. causing water quality above triggers at the outlet) the fish will require removal. Generally this will require dewatering (see Section 9.3.3) and physical removal.

The frequency of fish removal needs to be monitored during operation and is difficult to predict. Fish pathways can be from deliberate introduction to eggs via pumps. Experience will determine whether fish removal needs to be an annual maintenance activity or is rarer.

Birds such as swamp hens can be a problem around wetlands as they can eat or trample vegetation. Signs of damage from birds include smothered vegetation and bare areas form grazing. Fauna specialist should be consulted if it becomes a significant risk.

Other birds in high numbers, such as ducks, can impact on water quality. If these become an issue for the wetland water quality it will require a public education program to discourage feeding. Signage and other measures can be used.

9.3.6 Algae

Algae can be a management issue in constructed wetlands. It can be visible floating or submerged algal mats (filamentous algae) which has an aesthetic impact and in extreme cases a smothering effect on water plants and block hydraulic structures.

Generally no action is required unless blockage of inlets/outlets is occurring or for amenity reasons.

Algae can be removed physically by rakes or through specialist machinery if required and typically would not occur unless there is more than 20% of the wetland area covered with algae.

Typically the highest risk for filamentous algae is during establishment. Once a good coverage of water plants have established these will out compete the algae for nutrients in most cases.

Flushing the wetland with ASR water (and discharging to Drain 6) can also serve reduce algal counts if it is a persistent problem.

Planktonic algae (evidence by green coloured water) can be a larger management issue with the presence of cyanobacteria presenting a significant public health hazard. Testing (weekly) for cyanobacteria may be required if identified at Oaklands Park. If identified refer to the recommended actions in the national guidelines for managing risk in recreational waters (NHMRC, 2008).

9.3.7 Bank erosion

There is little water level fluctuation in the Oaklands Park wetland nor are there high flows passing through the system. Therefore, it is unlikely there will be significant bank erosion.

Nevertheless evidence of scour from local inlets to the wetland should be monitored and rectified. If areas persist with local erosion, rock armouring should be used.

9.4 Monthly Requirements

- Check and record water levels in various parts of the system

9.5 Three Month Requirements

- Inspect all vegetation and note presence of weeds or bare areas. Arrange for routine weeding and replanting as required.
- Check for any litter accumulation and arrange removal
- Perform an inspection of all hydraulic structure to ensure they are free of blockage and free of damage.

9.6 Annual Requirements

- Check the operation of the maintenance valves
- Monitor for the presence of fish and associated impacts (plant loss and high turbidity) – arrange for removal is required
- Inspect for impacts of other fauna (e.g. ducks or dogs) and arrange public education if required (e.g. signage)
- Check for bank erosion and any trip hazards around the perimeter
- Monitor any algae growth.

10 INJECTION PUMP: PUMP STATION 2

Injection pump (PS2) maintenance tasks:

- **clean & calibrate sensors (pressure & water quality)**
- **replace turbidity lamp**
- **test actuated vales**

10.1 Purpose

The role of this pump station is to pump treated water from the wetland into the aquifer via the four ASR wells.

10.2 Monthly Requirements

- Physically inspect the pump station, paying particular attention to the main components. These components include the pump, three actuators, and flow meter.
- The turbidity, conductivity and pH meters and their corresponding three sensors are also very important and must be scrutinized.
- Other components include the pressure gauges and transducers, valves and cabling which should be inspected for damages, ensuring that all leads correspond and there are no exposed wires.
- Any buildup of unknown matter on any of the surfaces should be cleaned off with a damp cloth, with the addition of a mild detergent in the case of tenacious deposits. All surfaces, particularly those containing electrical controls must be cleaned thoroughly of all buildup including dust, by vacuum if required.
- The structural integrity of the system should then be inspected i.e. the pipework and bolts to ensure no loose bolts or corrosion.
- Finally, the integrity of the cabinet and the locking nuts securing it to the slab as well as the nearby electrical control box are to be inspected ensuring that they are functioning and no tampering or vandalism has occurred.

10.3 Three Month Requirements

Every three months, the following sensors in the system require cleaning and recalibration. They include the conductivity cell, turbidity sensor, and pH/temperature sensor. The removal, cleaning and recalibration protocols are detailed below.

10.4 Annual Requirements

Every year, each actuator must be scrutinized whilst under operation to ensure that the unit is fully functional, if it is not, additional lubrication could rectify the problem. However if the problem persists, a service may be required by a certified technician from iTork.

The lamp in the turbidity sensor is to be replaced.

The Lowara pump in use at PS #2 does not require routine maintenance and servicing apart from a detailed annual inspection and testing of insulating resistance of the electrical pump components. In the event of a pump failure or electrical outputs indicating that a pump failure is imminent, a service will be required and a record of the service details will need to be obtained.

11 ASR WELLS

ASR wells maintenance tasks:

- **inspections of all components and ensure structural integrity**
- **check for air valve leaks**
- **manual pressure gauge readings and routine water sample collection**

11.1 Purpose

The main purpose of the four ASR well heads are to pump water out of the respective wells and into the distribution tank.

11.2 Monthly Requirements

- Physically inspect each of the four ASR stations across the site. The main components to be checked include the pump, four actuators and flow meter.
- The smaller components include the air release valve, level sensor, and pressure transmitter. Valves, gauges and cabling should be inspected for damages, ensuring that all leads correspond and that there are no exposed wires.
- Any buildup of unknown matter should be cleaned off with a damp cloth, with the addition of a mild detergent in the case of tenacious deposits. All surfaces, particularly those containing electrical controls must be cleaned thoroughly of all buildup including dust, by vacuum if required.
- The structural integrity of the system should then be inspected i.e. the pipework and bolts to ensure no loose bolts or corrosion.
- Note the manual pressure gauge readings to cross check with automatic readings.
- Finally, the integrity of the cabinet and the locking nuts securing it to the slab are to be inspected ensuring that they are functioning and that no tampering or vandalism has occurred.

11.3 Annual Requirements

Every year, each actuator must be scrutinized whilst under operation to ensure that the unit is fully functional, if it is not, additional lubrication could rectify the problem. However if the problem persists, a service may be required by a certified technician from iTork.

The Lowara ASR pumps do not require routine maintenance and servicing apart from a detailed annual inspection and testing of insulating resistance of the electrical pump components. In the event of a pump failure or electrical outputs indicating that a pump failure is imminent, a service will be required and a record of the service details will need to be obtained.

In addition, as part of the EPA licence requirements manual water sample will need to be taken and test for a suite of water quality parameters. Details of the frequency of sampling and the parameters to test for are outlined in the licence conditions.

12 DISTRIBUTION PUMPS: PUMP STATION 3

Distribution pumps (PS3) maintenance tasks:

- **Analyses outputs to ensure within expected range**
- **Run various modes to test operation**
- **Inspect and clean pump controllers and tank**

12.1 Purpose

The four pumps located as Pump Station 3 distribute water to various irrigation sites in the area including parks and ovals, from the distribution tank.

12.2 Monthly Requirements

- Ensure that all outputs from the various sensors and electronic monitors in the system have been consistent and within their expected ranges of values. If they are unexpected, the component in question must be investigated and the problem rectified, for example in the case of a pH reading of extremely high alkalinity, the sensor must be inspected, cleaned and recalibrated which should resolve the issue

- The electrical outputs from the various pumps across the system should be analyzed to ensure that they have been consistent within their expected ranges of values. These outputs include operating voltage, current consumption and flow data. This will allow for early warning in the case of a pump failure as the electrical values will decline with respect to the amount of hours of operation

- Test run the various modes of operation, i.e. Harvesting, Injection, etc. to ensure that the system is fully functional. Whilst doing so, physically inspect the various system components to ensure that they are in acceptable condition

- These components include the four pumps and attached Hydrovar pump controllers, actuators and flow meters

- Valves, gauges and cabling should be inspected for damages, ensuring that everything corresponds and there are no exposed wires

- The pump controllers and pumps should be inspected in detail to ensure that dust and other matter does not build up and clog cooling and vent sites along the system

- This will cause abnormally high temperatures and vibrations from these components during operation, which should be indicated by flashing red lights from the i-ALERT Control Monitors attached to the pumps

- All surfaces, particularly those containing electrical controls must be cleaned thoroughly of all buildup including dust, by vacuum if required

- The structural integrity of the system should then be inspected i.e. the pipework and bolts to ensure no loose bolts or corrosion

- The storage tank outside the pump station should also be inspected to ensure no tampering or vandalism has occurred. The components to be inspected include the pipework, outlet valves, tank wall, ladder and the roof of the tank

- Finally, the integrity of the pump station building should be inspected to ensure no tampering or vandalism has occurred

12.3 Annual Requirements

- Every year, each actuator must be scrutinized whilst under operation to ensure that the unit is fully functional, if it is not, additional lubrication could rectify the problem. However if the problem persists, a service may be required by a certified technician from iTork.

- The four Lowara pumps in use at PS #3 do not require routine maintenance and servicing apart from a detailed annual inspection and testing of insulating resistance of the electrical pump components. In the event of a pump failure or electrical outputs indicating that a pump failure is imminent, a service will be required and a record of the service details will need to be obtained.

13 DISTRIBUTION NETWORK

SABD input ….

13.1 Purpose

13.2 Annual requirements

14 MONITORING & CONTROL SYSTEMS

APC input….

14.1 Purpose

14.2 Water Quality Parameters

The following water quality parameters will be monitored to ensure that the quality of water being injected into the aquifer is compliant with SA Water standards.

14.2.1 Water Quality Set Points

Description	Device	Unit	Low Low SP	Low SP	High SP	High High SP
Creek Conductivity	MTP101	µS/cm	N/A	N/A	1500	2000
Well 1 Conductivity	MTP102	µS/cm	N/A	N/A	1500	2000
Well 2 Conductivity	MTP201	µS/cm	N/A	N/A	1700	2200
Well 2 pH	PHP201	Integer	5	6	8	9
Well 2 Turbidity	UTP201	NTU	N/A	N/A	15	20
Well 2 Temperature	TPP201	Degree C	N/A	N/A	22	25

Table 2 – Water Quality Set Points

Definitions

- Low Low SP: Critical
  Alarm Level, (Redundancy) Complete Process Stop and Alarm Raise
- (Also for Instrument Failure)
- Low SP: Alarm Level, Change Process and Alarm Raised (IE, Change from Injecting to Re-circulating)
- High SP: Alarm Level, Process Stop and Alarm Raise
- High High SP: Critical Alarm Level, (Redundancy) Process Stop and Alarm Raise
- Well 1 (Wetlands Inlet)
- Well 2 (Wetlands Outlet)

(what about the extracted water from wells – salinity?)

APPENDIX A - CHECKLISTS

This Appendix contains checklists to be used on site for each element of maintenance as described in this document.

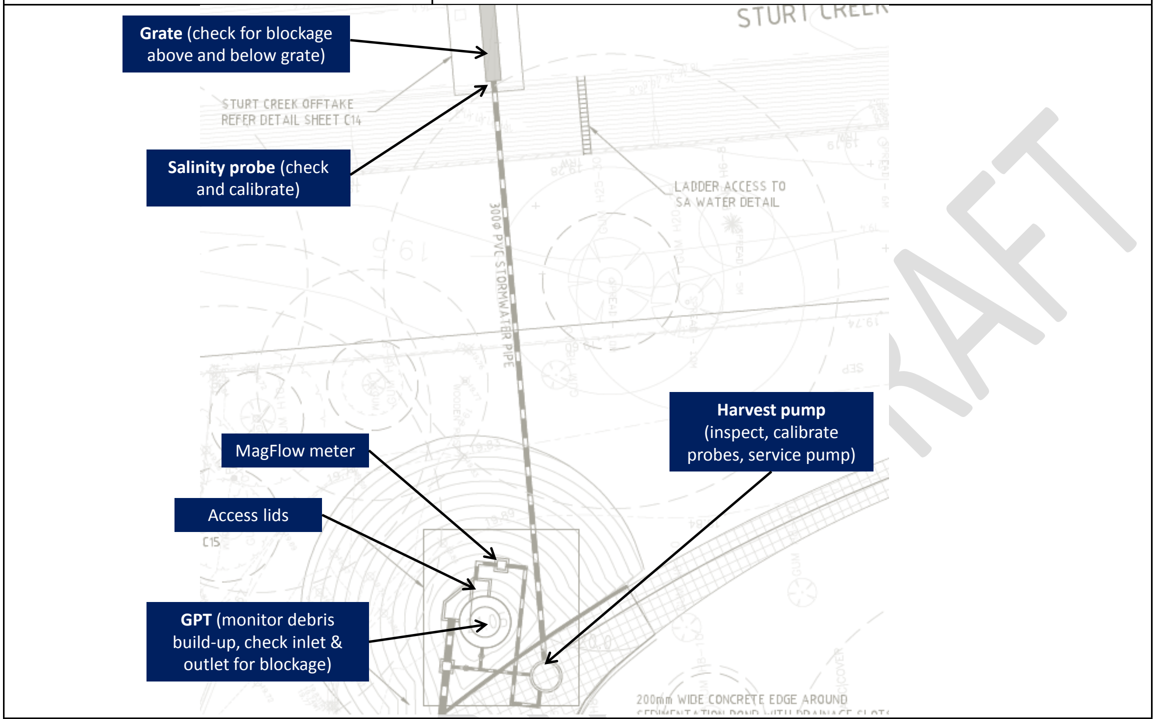
Checklists can be used to ensure that appropriate inspections are conducted and be used to record information on conditions from each visit as a historic record and a way to plan future maintenance (e.g. frequency of inlet pond cleaning).

1. Sturt River off take, Pump station 1 and GPT
2. Inlet pond
3. Wetland
4. Pump station 2
5. ASR well heads
6. Pump station 3 and tank
7. Distribution network (TO COME)
8. Monitoring & control systems (TO COME)

OAKLANDS PARK - MAINTENANCE INSPECTION FORM

STURT RIVER OFFTAKE, HARVEST PUMP & GPT

NAME:	WEATHER:
DATE:	INSPECTION TYPE (monthly / 3-monthly / annual)



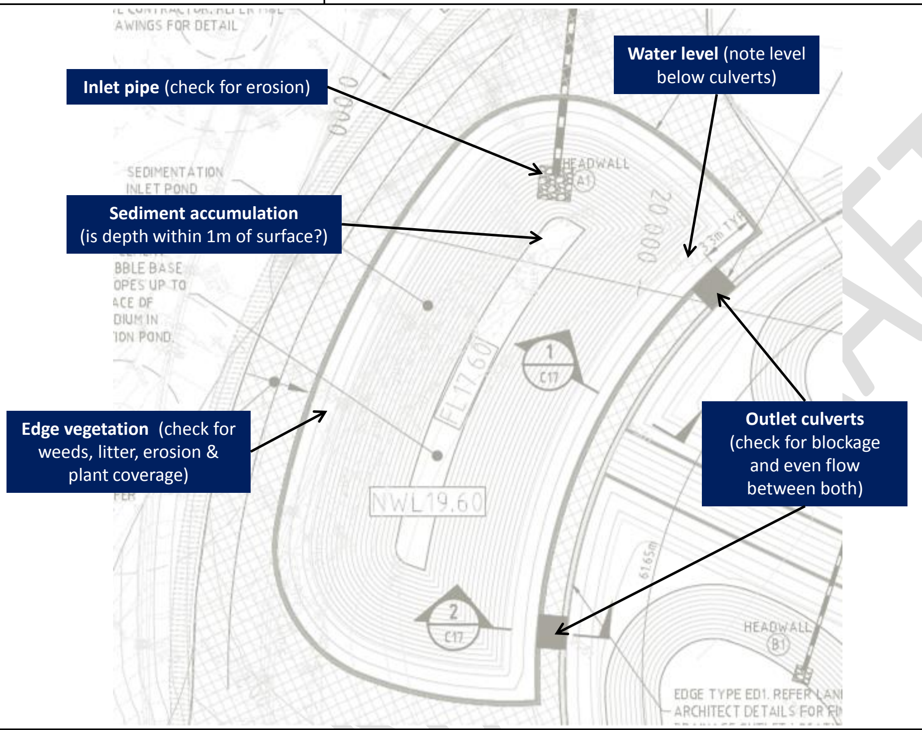
STURT RIVER GRATE	Yes - No - N/A	COMMENT
Inspect grate for debris		
Inspect under grate		
Clean grate		
Clean conductivity cell		
Calibrate conductivity cell		
Check sensor outputs		
HARVEST PUMP - PS1	Yes - No - N/A	COMMENT
Inspect pump		
Measure insulating resistance		
Check pump outputs		
Inspect MagFlow meter		
Inspect cabling		
Clean conductivity cell		
Calibrate conductivity cell		
Check sensor outputs		
Inspect structural integrity		
GPT	Yes - No - N/A	COMMENT
Depth to debris accumulation (below water surface)		
Clean required? (if within 1.8m of surface)		
Amount of floating material (% coverage)		
Any odours?		
Inlet and outlet free of debris?		

NOTES

OAKLANDS PARK - MAINTENANCE INSPECTION FORM

INLET POND

NAME:	WEATHER:
DATE:	INSPECTION TYPE (monthly / 3-monthly / annual)



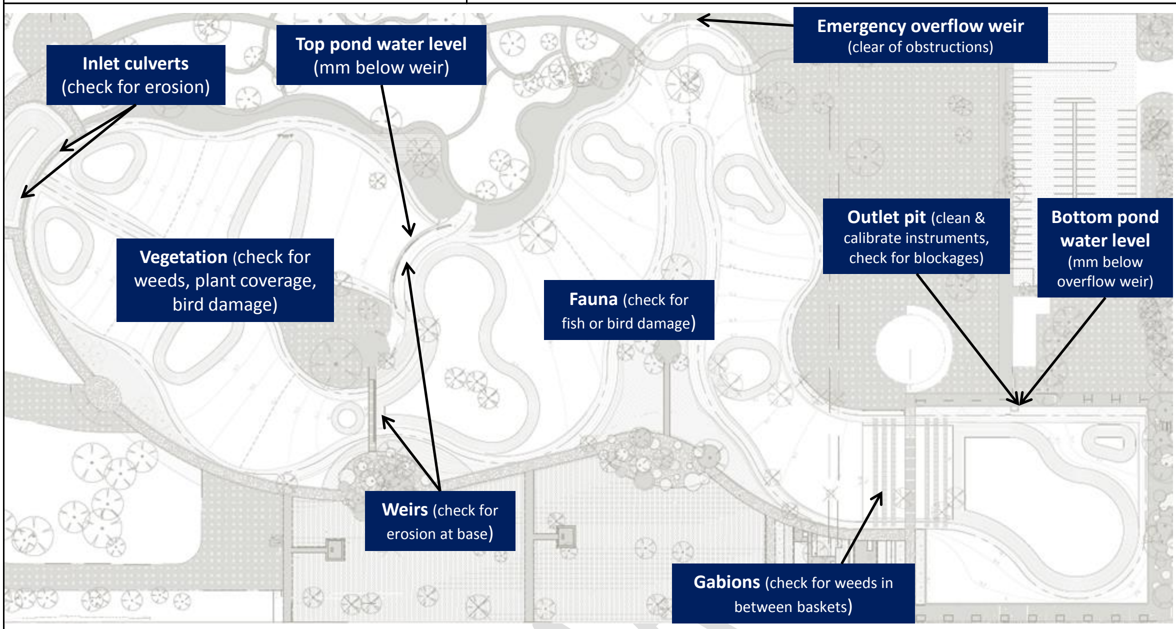
INLET POND	Yes - No - N/A	COMMENT
Note water level (mm below outlet culvert)		
Evidence of erosion at inlet		
Check even flow between both outlet culverts		
Less than 20% blockage of either culvert?		
Presence of litter and likely source		
Sediment accumulation depth (mark sediment accumulation areas on the plan)		
Is sediment within 1.0m of surface (yes = clean out required)		
VEGETATION: more than 90% of perimeter is completely vegetated		
WEEDS - less than 10% coverage of perimeter		
Presence of algae - more than 20%? (note the type)		
Erosion around batters		
Fauna (e.g. fish)		
Unusual odours, colours or substances (oils)		

NOTES

OAKLANDS PARK - MAINTENANCE INSPECTION FORM

WETLAND

NAME:	WEATHER:
DATE:	INSPECTION TYPE (monthly / 3-monthly / annual)



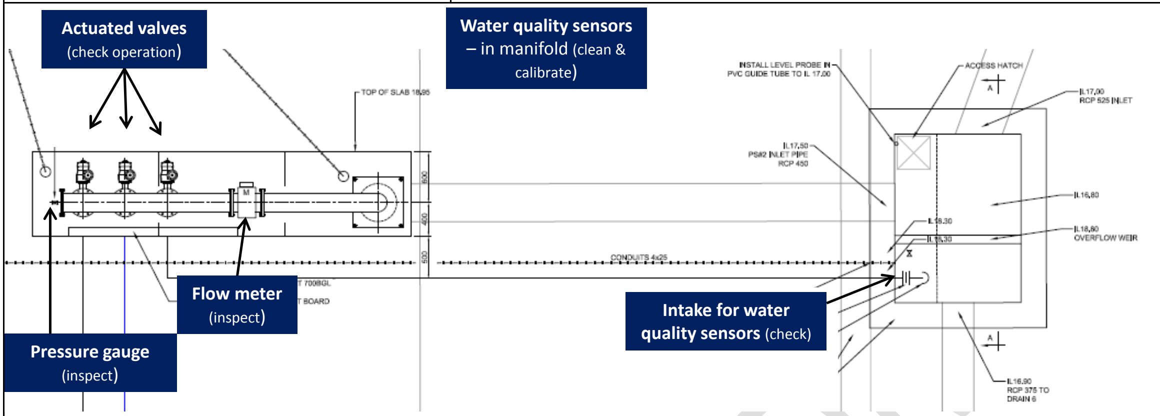
WETLAND	Yes - No - N/A	COMMENT & REQUIRED WORKS
WATER LEVELS		
Water level in TOP POND (mm below weirs)		
Water level in BOTTOM POND (mm below overflow weir)		
Is water level within 150mm of normal water level?		
STRUCTURES		
Evidence of erosion at culverts from inlet pond		
Presence of litter and likely source		
Are the weirs flowing evenly? Signs of blockage		
Emergency overflow weir clear of obstructions		
Outlet pit screen - does it require cleaning? (>20% blocked)		
Any blockages in outlet pit		
Clean sensors & calibrate (refer to PS2 Checklist)		
VEGETATION		
Edge vegetation - more than 90% coverage		
Edge weeds - less than 10% - do they need removal		
Water plants - diversity & health - more than 80% coverage		
Water weeds - are there more than 5% of area		
Presence of algae - more than 20%? (note the type)		
Presence of litter and likely source		
OTHER		
Erosion around batters		
Fauna (e.g. fish) - are works required		
Unusual odours, colours or substances (oils)		

NOTES

OAKLANDS PARK - MAINTENANCE INSPECTION FORM

INJECTION PUMP (PS2)

NAME:	WEATHER:
DATE:	INSPECTION TYPE (monthly / annual)



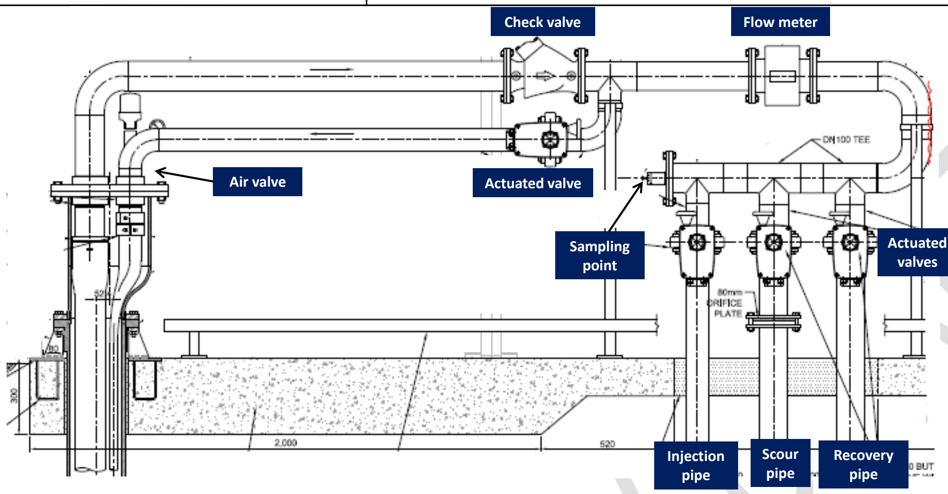
DRAIN PIPE	Yes - No - N/A	COMMENT
Inspect 160mm actuated valve		
Check operation of valve in automatic & manual mode		
INJECTION PIPE		
Inspect 160mm actuated valve		
Check operation of valve in automatic & manual mode		
RECIRCULATION PIPE		
Inspect 350mm actuated valve		
Check operation of valve in automatic & manual mode		
MANIFOLD		
Inspect 200mm MagFlow meter		
Inspect conductivity meter		
Clean conductivity cell		
Calibrate conductivity cell		
Inspect turbidity meter		
Replace turbidity meter bulb		
Clean turbidity sensor		
Calibrate turbidity sensor		
Inspect Sensor Controller Unit		
Clean pH/Temp sensor		
Calibrate pH/Temp sensor		
Check sensor outputs		
WELL HEAD		
Inspect pressure gauge		
Inspect pressure transducer		
Inspect 3 x 15mm ball valves		
MISCELLANEOUS		
System structural integrity - secure fasteners - no corrosion		
Inspect the integrity of the cabinet		
Inspect the integrity of the nearby electrical control cabinet		
Clean all surfaces if necessary		

NOTES

OAKLANDS PARK - MAINTENANCE INSPECTION FORM

ASR WELL HEADS

NAME:	WEATHER:
DATE:	INSPECTION TYPE (monthly / annual)



SCOUR PIPE	Yes - No - N/A	COMMENT
Inspect 100mm actuated valve		
Check operation of valve in automatic & manual mode		
INJECTION PIPE		
Inspect 80mm actuated valve		
Check operation of valve in automatic & manual mode		
RECOVERY PIPE		
Inspect 100mm actuated valve		
Check operation of valve in automatic & manual mode		
MANIFOLD		
Inspect 100mm MagFlow Meter		
Inspect 100mm wafer check valve		
Inspect 80mm actuated valve		
Check operation of valve in automatic & manual mode		
WELL SAMPLING POINT		
Inspect pressure gauge		
Inspect 3 x 15mm ball valves		
Inspect 25mm air release valve		
WELL HEAD		
Inspect the pump		
Check pump outputs		
Test insulating resistance of pump		
Inspect 25mm air release valve		
Inspect 25mm brass ball valve		
Inspect pressure gauge		
Inspect LH-20 pressure sensor		
MISCELLANEOUS		
System structural integrity - secure fasteners - no corrosion		
Inspect the cabling		
Inspect the integrity of the cabinet		
Clean all surfaces if necessary		

NOTES

OAKLANDS PARK - MAINTENANCE INSPECTION FORM

DISTRIBUTION PUMPS - PS3

NAME:	WEATHER:
DATE:	INSPECTION TYPE (monthly / annual)

HMI	Yes - No - N/A	COMMENT
Check sensor outputs		
Check pump outputs		
Test Operation Modes		
Ensure that other set points & predicted outputs are maintained		
Clean all surfaces if necessary		
NORTH SLEW EXIT PIPE		
Inspect 350mm actuated valve		
Check operation of valve in automatic & manual mode		
Inspect 200mm MagFlow meter		
Inspect pressure vessel		
SOUTH SLEW EXIT PIPE		
Inspect 500mm actuated valve		
Check operation of valve in automatic & manual mode		
Inspect 250mm MagFlow meter		
Inspect pressure vessel		
NORTH PUMP SLEW		
Inspect pump 1		
Inspect Hydrovar controller 1		
Inspect pump 2		
Inspect Hydrovar controller 2		
Inspect control monitors		
Clean all surfaces if necessary		
Inspect cabling		
Inspect 100mm butterfly valves		
Inspect pressure gauge		
MANIFOLD		
Inspect 300mm butterfly valve		
Inspect 25mm ball valve		
Inspect 80mm butterfly valve		
Inspect pump 5		
SOUTH PUMP SLEW		
Inspect pump 3		
Inspect Hydrovar controller 3		
Inspect pump 4		
Inspect Hydrovar controller 4		
Inspect control monitors		
Clean all surfaces if necessary		
Inspect cabling		
Inspect 100mm valves		
Inspect pressure gauge		
MISCELLANEOUS		
System structural integrity - secure fasteners - no corrosion		
Test insulating resistance of the four distribution pumps		
Inspect the integrity of the nearby distribution tank		
Inspect the integrity of the pump station building		

NOTES

APPENDIX B - WATER QUALITY SENSOR MAINTENANCE

pH/Temperature Sensor Cleaning and Calibration Procedure

1. This procedure is initially conducted at the HMI screen located at PS #3
2. Turn the system to maintenance mode
3. Ensure that the Injection and Recirculation valves are closed and in manual operation
4. Manually open the drain valve at PS #2 to release any water left in the manifold
5. Ensure that the pressure level in the manifold on the HMI screen has reduced to a negligible level
6. The sensors can now be unscrewed by hand from the PS #2 manifold
7. Before cleaning, ensure that you are wearing adequate personal protective equipment
8. Clean the exterior of the sensor with a stream of water. If debris remains, remove loose contaminate build up by wiping the entire measuring end of the sensor with a soft clean cloth. Rinse the sensor again with warm, clean water
9. Prepare a mild soap solution of warm water and dish detergent or other non-abrasive soap that does not contain lanolin as lanolin will coat the glass electrode and will skew the measurements taken by the sensor
10. Soak the sensor for 2 – 3 minutes in the soap solution
11. Use a small soft-bristle brush and scrub the entire measuring end of the sensor, thoroughly cleaning the electrode and reference junction surfaces. If surface deposits cannot be removed by detergent solution cleaning, hydrochloric acid can be used to dissolve them, however the hydrochloric acid concentration should not be higher than 3% in the solution
12. Soak the entire measuring end of the sensor in the dilute acid for no more than 5 minutes. Rinse the sensor with clean, warm water then place the sensor back into the mild soap solution for 2 – 3 minutes to neutralize any remaining acid.
13. Remove the sensor from the soap solution and rinse the sensor again in clean, warm water

14. The sensor must be recalibrated after cleaning which is done by accessing the control unit
15. From the Main Menu, select SENSOR SETUP and confirm
16. Select the appropriate sensor if more than one is attached and confirm
17. Select CALIBRATE and confirm
18. Select 2 POINT AUTO. Select the available Output Mode (Active, Hold or Transfer) from the list box and confirm
19. Move the clean probe to Buffer 1 and confirm
20. Confirm when stable
21. Move the clean probe to Buffer 2 and confirm
22. Confirm when stable. A screen will display 2 Point Calibration Complete and the slope (XX.X mV/pH)
23. The sensor can now be returned back into the PS #2 manifold, the actuators can reopen the injection and recirculation valves and the system can resume it's automatic operation

Conductivity Cell Cleaning and Calibration Procedure

1. Locate the three conductivity cells in the system:
2. The first is located under the grate in the Sturt River, which can be accessed by referring to OHS practices enforced by SA Water to enter the river
3. The second is located in the PS #1 Pump Well, which can be accessed by opening the lid and pulling the cell out by its cable
4. The third is located in the PS #2 manifold and can be accessed by following the procedure detailed previously for the Hach pH/Temp sensor
5. Do not touch the cell bore by hand or use sharp implements whilst cleaning the cell.
6. Do not wet the electrical connection terminals.
7. Thoroughly clean the electrode with a 1:1 solution of water and non ionic detergent using the bottlebrush provided.
8. For more tenacious deposits, a 2% hydrochloric acid solution may be used

9. After cleaning, rinse the cell several times in distilled water and then examine it.
10. Looking through the bore towards a source of illumination, the surface should have an evenly wetted appearance. If the surface has dry patches where the water has 'peeled' away, this is an indication of the presence of grease and repeated cleaning and rinsing is required until the cell bore is wetted evenly.
11. The calibration protocol is detailed in the component documentation folder provided by Alano Water. The reference ABB document is IM/AX4CO Rev. O, Single and dual input analyzers for low level conductivity.

Turbidity Sensor Calibration Procedure

This protocol is detailed in the component documentation folder provided by Alano Water. The reference Hach document is 6010018, edition 7, 1720E Low Range Turbidimeter, USER MANUAL.

APPENDIX C - ACTUATOR TESTING PROCEDURE

1. All actuated valves in the system must be tested to ensure that they are fully functional in both automatic and manual modes

2. When testing the different modes that the system is capable of performing (harvesting, injection, extraction), they will open and close the actuated valves automatically as required when transitioning between modes. This is the automatic test and so inspection of the actuated valves will need to be conducted whilst they operate.

3. The actuated valves can be manually tested by accessing the HMI and opening and closing each individual valve by following the procedure outlined in the manual provided by APC. Inspection will need to be carried out whilst the actuated valves operate.

APPENDIX D - ASSESSING SEDIMENT CONTAMINATION AND DISPOSAL NEEDS

Figure D-1 shows the steps involved in testing and disposing of sediment from a WSUD system e.g. inlet pond clean out.

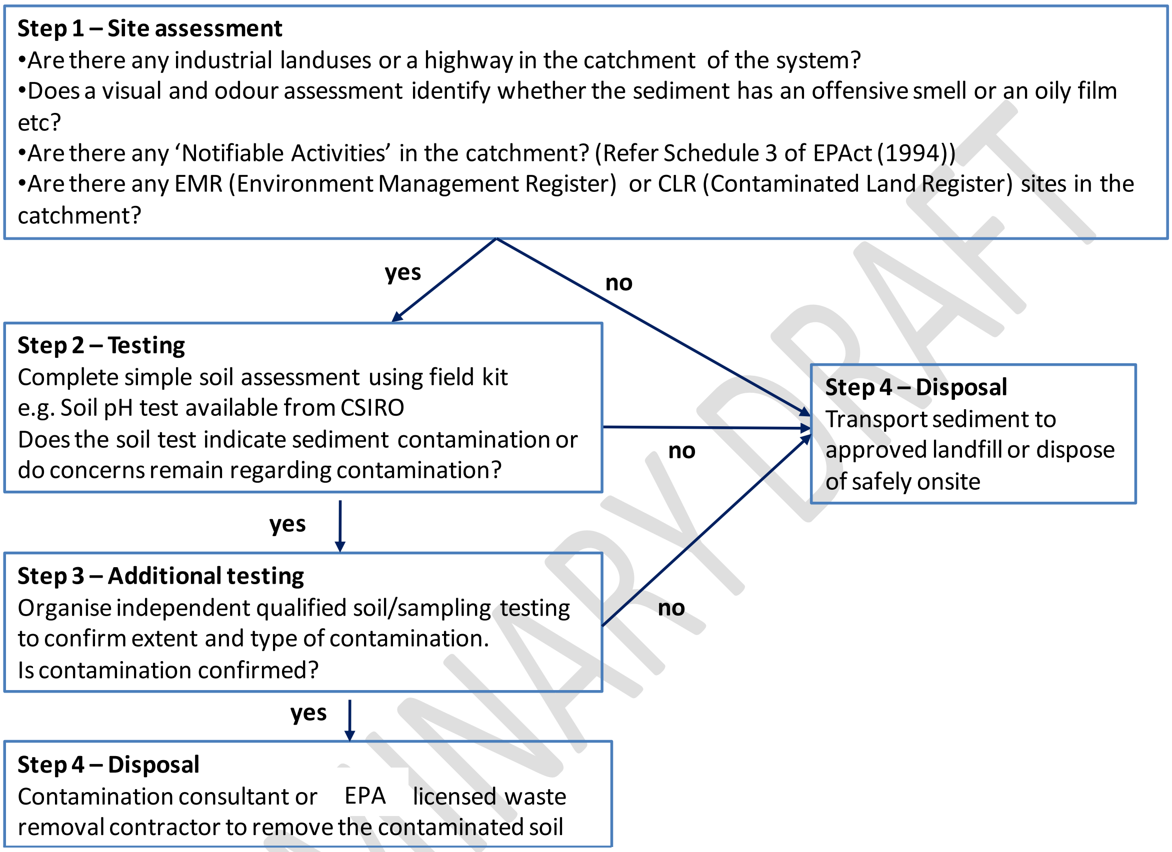


Figure D-1 Testing and disposing of sediment from WSUD systems

For additional information on sediment contamination and disposal please refer to the references, in addition to any locally relevant guidelines:

- www.epa.sa.gov.au for information on waste management and waste tracking.