

BRISBANE CITY COUNCIL

Brisbane Water

2400 mm S1 Interceptor Sewer Operational Manual



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2400-MM S1 INTERCEPTOR SEWER

STAGE 1

OPERATIONAL & MAINTENANCE MANUAL

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PART 1 INTRODUCTION & BACKGROUND INFORMATION

1 Introduction

Brisbane is a city of more than 840,000 people at the mouth of the Brisbane River on the east coast of Australia. The city is served by six sewerage reticulation areas, the largest of which is designated the S1 and covers an area of 16,000 hectares and serves a population of 370,000. The S1 sewerage system includes the city's northern suburbs, where redevelopment is increasing population density, and the Central Business District (CBD) where high-rise development has proceeded rapidly in recent years.

The existing main spine sewer serving the S1 catchment comprises a tunnel some 11 kilometres long draining eastward from Toowong to a pumping station at Eagle Farm, from where the sewerage is pumped a further 10 kilometres to Luggage Point Waste Water Treatment Works.

The S1 Main Sewer was built over 75 years ago and is now overloaded, particularly during wet weather when overflows can occur to the Brisbane River. A critical lack of capacity exists in Fortitude Valley, which lies midway between the CBD and Breakfast Creek.

The purpose of this project is to design and construct an augmented section of the existing Main Sewer to alleviate the load on the existing sewer through the Brisbane CBD and Fortitude Valley areas, and to provide an alternative route for sections of the existing Main Sewer that are at the limit of their capacity. A cross connection between the new S1 Interceptor Sewer and existing Main Sewer is provided near Perry Park.

The 2400-mm S1 Interceptor Sewer will be used to transfer flows from the existing Main Sewer at North Quay to the Main Sewer at Kingsford Smith Drive, Hamilton. This will relieve the excessive loads on the old sewer and help manage surcharge caused by the lack of capacity of the original Main Sewer. In wet weather or during maintenance of the existing Main Sewer, flows from the central business district can also be diverted back to North Quay and into the new 2400-mm S1 Interceptor Sewer.

The S1 Interceptor Sewer was constructed under a Design and Construct contract by Peabody Obayashi Joint Venture which changed its name during the course of the contract to EROC Obayashi Joint Venture (EOJV). The contract was signed on 21 June, 1999. Practical Completion was granted on 5 July, 2001 for the Soft Ground Section from Booroodabin to Perry Park to Albion Park to Kingsford Smith Drive. Sewage began to flow in the Soft Ground Section in July, 2001. Practical Completion was granted on 2 October, 2001 for the Hard Rock Section from North Quay to Perry Park. Sewage began to flow in the Hard Rock Section on 15 December, 2001.

2 Description of Asset

The 2400mm S1 Interceptor Sewer comprises of a uPVC lined mass concrete tunnel that extends some 4,600 metres, driven mainly beneath road reserves in central Brisbane extending from North Quay to Cooksley Street Hamilton.

Access shafts to provide flow interception and maintenance access facilities have been constructed at North Quay, Perry Park, Albion Park and Kingsford Smith Drive to connect the S1 Interceptor Sewer and existing Main Sewer. Further access shafts at a spacing of 1 kilometre and an internal diameter of 1.8 metres have been provided at Turbot St, Barry Parade, and Best Street. All access shafts are lined with uPVC to resist attack from H₂S. The

North Quay, and Albion Park access shafts have been built to facilitate the entry of small skid steer haulage plant (bobcat or similar).

A 1350mm internal diameter cross connection between maintenance hole 94 on the Main Sewer and the maintenance hole located at Perry Park allows for the transfer of flows between the two mains.

The section from Albion Park to Kingsford Smith is 1350mm internal diameter and this connects the 2400mm Stage 1 of the S1 Interceptor Sewer to the existing Main Sewer. In the future Stage 2 of the S1 Interceptor Sewer, there will be a 3800mm internal diameter sewer from Albion Park to Eagle Farm and this 1350mm section will become a cross connection. The Albion Park maintenance hole has been constructed to allow the future Stage 2 to be readily connected with some temporary unlined benching installed to smooth the flow in the meantime.

Isolation of the system is via five (5) stainless steel knife gate valves, which allow different operational modes of the Main Sewer and the S1 Interceptor Sewer, and in particular allows complete isolation of the S1 Interceptor Sewer, which is a precondition for this design to allow man entry.

The Perry Park shaft has been positioned to be close to the change in geological conditions of the tunnel and this area comprised the main working area for the project.

The tunnel upstream from Perry Park to North Quay is in hard rock for a length of 3,600 m and suited construction using a tunnel boring machine which excavated a 3.0m diameter tunnel. The tunnel is lined with mass concrete with an internal uPVC lining to reduce H₂S attack.

The tunnel downstream from Perry Park to Albion Park is in soft ground for a length of 900 m and suited construction using a different type of tunnel boring machine. The machine used was an Earth Pressure Balance Machine which excavated a 3.0m diameter tunnel and the tunnel was immediately supported structurally by 1 metre long pre-cast concrete segments 175mm thick and external grouting. The tunnel was completed by placing the uPVC liner and grouting the annulus with high strength cement grout.

The cross connection tunnels were excavated with road header machines in rock and lined with cast in situ concrete with an internal uPVC lining. The internal diameter of these cross connection tunnels is 1350mm.

An odour treatment system with mechanical and electrical equipment incorporated has been provided to ventilate the sewer and treat the expelled air. The purpose of this system is to prevent nuisance odors and not as a ventilation system for man entry procedures.

3 Design Details

3.1 Tunnel

The 2400mm diameter, 4,600 metre length of tunnel from North Quay to Albion Park raceway has been constructed with mass concrete inside of the excavated rock tunnel with a liner of uPVC material to ensure that the main is resistant to sulphide attack, with the bonus of little restoration maintenance needed. The grade of the new S1 sewer main is approximately 1 in 1200.

The tunnel has been designed to allow a small skid steer haulage plant (bobcat or similar) to operate without damage occurring to the liner under normal operating conditions.

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The section of main between the access shaft at Albion Park raceway and Kingsford Smith Drive is 1350mm diameter. The S1 interceptor sewer is designed to be extended from the access shaft at Albion Park raceway to Eagle Farm pumping station when stage two is built.

The cross connection between maintenance hole 94 on the Main Sewer and the S1 Interceptor sewer maintenance hole, located at Perry Park allows for the transfer of flows between the two mains and is laid at a grade that allows for self-cleaning velocities.

3.2 Maintenance Holes

All maintenance holes have been lined during construction with uPVC to ensure resistance to H₂S attack. Maintenance holes at Breakfast Creek Road, Turbot Street, Barry Parade & Markwell Street are 1800mm internal diameter.

The maintenance hole at Kingsford Smith Drive is 2400mm internal diameter (with a 4000mm internal diameter section near the bottom), Perry Park is 2400mm internal diameter, and Albion Park raceway is 5600mm internal diameter. The Albion Park top slab is fitted with an eight-part Gatic cover in addition to the normal cover to allow for a skid steer (Bobcat) equipment access into the sewer. This Gatic cover will also allow removal of the knife gate valve should major maintenance be required.

The maintenance hole at North Quay has 2 chambers. The upstream chamber is 3500mm x 3600mm and houses the isolation knife gate valves. The top slab of this chamber has a Gatic cover in addition to the normal cover to allow removal of the knife gate valves should major maintenance be required. The downstream chamber is 1850mm x 3600mm and has been provided to allow personnel and equipment access into the S1 Interceptor Sewer when it is off-line for maintenance. The top slab of this chamber has a large ten-part Gatic cover to allow for a skid steer (Bobcat) equipment access into the sewer.

Every maintenance hole is fitted with a permanent ladder made of 316 Stainless Steel.

3.3 Valves

All valves are complete 316 Stainless Steel knife gate valves with cast iron gearboxes located beneath the top cover of the maintenance hole. All spindles will be rising between the valve and the oil bath drive nut arrangement just below the gearbox. These spindles have stainless steel spindle supports incorporating vesconite bushes. The gearbox input spindle is non-rising.

The valve seating material is nitrile with stainless steel wire reinforcement and the valve has been designed to allow for the 3 piece seals to be replaced with the valves in situ.

The valves are as follows:

- ◆ 1 * 750mm SS KG located in Maintenance Hole 235401 - North Quay. Asset No SID 500.
- ◆ 1 * 1500mm SS KG located in Maintenance Hole 235401 - North Quay. Asset No SID 501.
- ◆ 1 * 1200mm SS KG located in the Maintenance Hole 235406 - Perry Park. Asset No SID 502.
- ◆ 1 * 1350mm SS KG located in Maintenance Hole 235405 - Albion Park. Asset No SID 503.
- ◆ 1 * 1350mm SS KG located in Maintenance Hole 235410 - Kingsford Smith Drive. Asset No SID 504.

The pressure ratings of the valves are as follows

Max. Operating Pressures	16 metres
Design Pressure	20 metres
Test Pressure for Body & Gate	25 metres

The valves are designed to be operated with the full rated pressure applied to either side of the valve. As it is possible for the valves to have pressure on either side, the valves have been designed for bi-directional sealing. They have been installed such that the preferred seating direction of the valve coincides with the normally expected situation.

3.4 Odour Units

3.4.1 General

The S1 Interceptor Sewer has no reticulation sewer connections and therefore is unable to ventilate naturally as with most sewers.

Odour Treatment Plants with mechanical fans and activated carbon filters are located beside the maintenance holes at Best Street and North Quay. Both plants have similar equipment with some control logic differences. Each plant has 2 skid mounted fan & filter units operating in parallel with variable speed drives on the fans. The variable speed has to be set manually in the switchboard. The initial settings have the fans delivering 2,000 m³/hr each for a total of 4,000 m³/hr at each plant. The maximum flow rate is 3,000 m³/hr each fan.

At the times when the fans are not operating, gas is able to pass either way through the units with some corresponding pressure loss. This achieves odour removal whenever gas is expelled - fans operating or not.

The skid mounted units contain Activated Carbon beds to remove 95% of the odourous gases to alleviate odour nuisances to the local areas.

3.4.2 North Quay

Initial studies have indicated that under normal dry weather flows, air will be drawn into the sewer at North Quay. Therefore, the odour treatment plant at North Quay has been designed to operate only during wet weather events when the existing 750mm diameter Main Sewer becomes flooded and the air in the 2400mm diameter S1 Interceptor Sewer has to be evacuated as the sewer floods. A radar level sensor located in the downstream chamber in the North Quay maintenance hole continuously records the depth of flow in the sewer and a PLC uses this to control the fan units. The control system operates as follows

0m – 0.7m	Both fans OFF.
0.7m – 2.4m	Both fans ON. A rise of 50mm in 5 mins. will start fans while a fall of 50mm in 5 mins. will stop the fans.
2.4m+	Both fans OFF.
2.4m – 0.7m	Both fans OFF. A rise of 50mm in 5 mins. will start fans while a fall of 50mm in 5 mins. will stop the fans.
0.7m – 0m	Both fans OFF.

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3.4.3 Best Street

The Best Street odour treatment plant has been designed to operate to cater for normal dry weather conditions and also for wet weather conditions which override the dry weather conditions.

In dry weather conditions, the PLC is programmed to operate the fans twice per day as the level rises during each peak. The times are able to be adjusted and initially have been set as follows

ON 7.30am
OFF 11.30am
ON 5.00pm
OFF 8.00pm

It is expected that following connection of the telemetry, Sewer Network Services will examine the level patterns of normal dry weather flows and adjust the timers. The principle would be that the fans would operate during periods of significant rising of the depth of flow in the two daily peak flows and would be off during static and falling depths of flow.

During wet weather conditions the radar sewer level sensor located in the maintenance hole will detect the higher than normal depth of flow. The PLC uses this to control the fan units. The control system operates as follows

0m – 1.2m Both fans OFF but they operate to the timer.
1.2m – 2.4m Both fans ON. A rise of 50mm in 5 mins. will start fans while a fall of 50mm in 5 mins. will stop the fans.
2.4m+ Both fans OFF.
2.4m – 1.2m Both fans OFF. A rise of 50mm in 5 mins. will start fans while a fall of 50mm in 5 mins. will stop the fans.
1.2m – 0m Both fans OFF.
1.2m – 0m Both fans OFF but they operate to the timer.

3.4.4 Activated Carbon

The activated carbon is a special grade GC1PH which is designed to, firstly, adsorb 95% of the H₂S in the sewer gas as well as mercaptans and, secondly, to react with the odourous contaminants to form non-obnoxious products. The activated bed has a design contact time of 2 seconds with a pressure drop across the unit of 1.2 kPa at a flow rate of 3,000 m³/hr. The minimum life of the activated carbon is 1 year based on an average H₂S concentration of 20 ppm.

Replacement of the activated carbon is a specialist activity which requires removal of the roof panels, vacuuming out the spent activated carbon, correct disposal of the spent carbon, and replacement of new carbon using correct handling and safety precautions.

3.4.5 Telemetry

Telemetry of the Odour Units was not provided as part of the Design and Construct Contract but is being provided by Brisbane Water as part of the Project. Operating data and alarms will be telemetered to Cullen Ave Control Room. Following operating experience, the set points can be changed to provide more effective and efficient use of the facility. Parameters that are able to be altered include

- dry weather operating times at Best Street
- speed of variable speed drives
- wet weather levels for starting and stopping fans

There are opportunities for further automation of the system to provide ventilation at these sites linked to other events such as a shutdown of Eagle Farm Pump Station, a wet weather event, etc.

3.5 Secondary Ventilation

3.5.1 General

The following maintenance holes are fitted with Secondary Ventilation.

- Kingsford Smith Drive
- Albion Park
- Perry Park
- Barry Parade
- Turbot Street

These are the maintenance holes not connected to the Odour Units. The philosophy of the secondary ventilation is that under normal dry weather conditions, no sewer gases are to escape or enter the sewer through this secondary ventilation. However, under wet weather conditions when the sewer becomes flooded, the air in the maintenance hole is compressed as the level rises above the pipe. To prevent excess pressure lifting covers or top slabs, the secondary ventilation is to release this pressure through a pressure relief valve. Likewise when the level falls, the secondary ventilation is to allow air to enter the maintenance hole through a vacuum relief valve to prevent excess low pressure within the maintenance hole.

The secondary ventilation system consists of

- 150 mm pressure relief valve set to release at 1.5 kPa
- 150 mm vacuum relief valve set to release at -0.5 kPa
- These valves are fitted to a 150mm flanged tee with the pressure relief valve being vertically above the tee and the vacuum relief valve vertically below the tee. This arrangement allows any water from condensation or rain in the external vent pipework to drain through the vacuum relief valve into the sewer.
- 150 mm ventilation pipework in uPVC from the flanged tee in the maintenance hole to the lower part of the galvanised support pole. Inside the tapered support pole the pipework reduces to 100 mm.
- The support pole is approx. 12 m high and the 100 mm UPVC pipe extends a further 0.5 m above the support pole.

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The vacuum and pressure relief valves are made from polyethylene and are made to order as Fumes Release Valves by

GFR Industries

8 Artello Bay Road

Midvale WA 6056 Attention Geoff Herlihy.

3.5.2 Albion Park

The diameter at Albion Park MH is 5.6 m compared to 1.8 m at most of the other MH's with secondary ventilation. This means that the system described above requires additional pressure relief capacity during the flooding of the sewer which can happen suddenly when there is a pump failure at Eagle Farm. Vacuum relief is always a slow process as it relies on the pumping rate at Eagle Farm and does not require any additional capacity.

To cater for this additional pressure relief, an additional 225mm uPVC ventilation line and a 1.8 m high support pole have been provided. On the end of the pipe at the top of the pole is a polyethylene pressure relief flap (like a diesel exhaust flap). This flap has a rubber seal and is weighted with a stainless steel chain weighing 7.5 kg inside the pipeline. This keeps the flap closed until a pressure of 2.0 kPa is reached.

The details of the relief flap are

Flood Flap – Part No 180250V available from

RI Plastics

19 Valente Close

Chermside Qld 4032

4 Operational Modes

Several modes of operation can be applied for the 2400mm S1 interceptor sewer.

4.1 Normal operational mode

In Normal operational mode, the S1 Interceptor Sewer is used to augment the capacity of the existing Main Sewer by transferring some of the flow from North Quay directly to Kingsford Smith Drive, bypassing the existing Main Sewer in the central business district.

The cross-connecting sewer between MH 94 on the existing Main Sewer in Breakfast Creek Rd. (Booroodabin) and Perry Park MH will allow for further transfer from the existing Main Sewer to the S1 Interceptor Sewer.

This will be achieved by all valves being in the open position and flows at North Quay and Booroodabin choosing the route of least resistance.

4.2 Maintenance mode

Maintenance mode will be when the new 2400mm S1 Interceptor Sewer is isolated from the network to allow maintenance to be carried out.

This will be achieved by the 1500mm diameter North Quay valve, the 1200mm diameter Perry Park valve and the 1350mm diameter Albion Park valve being in the closed position. These are to be closed in sequence from North Quay to Albion Park raceway to ensure a low level of sewer in the S1 Interceptor Sewer.

4.3 Duty mode

Duty mode will be when flows from the central business district are diverted to flow back into the new 2400mm S1 Interceptor Sewer to allow maintenance work on the existing Main Sewer.

This will be achieved by normal operational mode with other valves on the Main Sewer being closed.

PART 2 COMMISSIONING

5 Pre-commissioning Procedure.

5.1 Safety Checks

Prior to commissioning the new 2400mm S1 Interceptor Sewer a safety check is to be carried out with attention to the following points:

- ◆ All equipment that could cause damage to the pumps at Eagle Farm pumping station is to be removed from the pipe.
- ◆ All personnel are to be out of the main.
- ◆ All maintenance hole covers are to be in place and secure.
- ◆ The ventilation systems are to be operable.
- ◆ All valves have been serviced and correctly adjusted.

5.2 Notifications

Notification is given to Manager, Sewer Network Services, Brisbane Water. (MSNSBW).

5.3 Valve Arrangements

5.3.1 Non Surge conditions.

- ◆ Under non surge conditions the following valve arrangement is to be used for commissioning the 2400mm S1 interceptor sewer and should be opened in this order:
- ◆ The 1350mm SS KG valve No SID 503 in Maintenance Hole 235405 Albion Park raceway is to be fully opened.
- ◆ The 1200mm SS KG valve No SID 502 in Maintenance Hole 235406 Perry Park is to be fully opened.
- ◆ The 1500mm SS KG valve No SID 501 in Maintenance Hole 235401 North Quay is to be fully opened.

5.3.2 Surcharged Conditions

Under surcharged conditions, the valve arrangements for commissioning (or re-commissioning) the 2400 mm S1 Interceptor Sewer will be different to that in 5.3.1 because of the need to deal with trapped air. Sewer Network Services will develop a procedure for valve operations and timing after the initial commissioning as this procedure will have to be developed under actual operating conditions.

5.4 Weir Boards

One weir board 150mm high should be placed into the weir board slots in Maintenance Hole 235401 North Quay to help direct the flow into the 2400mm S1 interceptor sewer. This height can be checked and altered if needed to restrict flows over the top and into the Main Sewer through the central business district. The weir board must be secured in place and attached via a cable to prevent accidental damage at Eagle Farm pumping station in the event of it becoming loose.

PART 3 APPROPRIATE RECORDS

6 Training

Records of training in the following areas are to be kept and produced upon request:

- ◆ Training on the correct operation of the valves. During the installation and site testing of the valves, Brisbane Water Sewer Network Services personnel were actively involved in providing air operated actuators. This involvement included training on the correct operation of the valves.
- ◆ Odour plant equipment operation.
- ◆ Repair methods for the uPVC liner. During the construction process, the Contractor and the BW Project Team made frequent requests to Sewer Network Services to provide teams for training of on-site uPVC repair methods. This involvement did not occur therefore, training did not occur. The basic repair method is described later. Sewer Network Services personnel obtained contact details of some subcontract plastic welders should plastic welding repairs be required at some later stage.
- ◆ Inspection methods.
- ◆ Inspection equipment.
- ◆ Man Entry Sewer access permits.

7 Inspection & Test Plans

7.1 Inspection

There will be a hard copy of the inspection plans signed by Brisbane Water's representative for the contract stating:

- ◆ Inspection date
- ◆ Inspector
- ◆ Faults
- ◆ Date of fault rectification
- ◆ Accurate location of fault
- ◆ Repair method applied to each fault

This will be an accurate record of any defects found and a copy of this kept with the contract record for further reference if defects reoccur.

These records were generated and kept by the Contractor, EROC Obayashi Joint Venture, and copies have been provided in both hard copy and electronic forms in their Operation and Maintenance Manual – Part 3.

7.2 Test Plans

Test Plans were developed by the Contractor, EROC Obayashi Joint Venture detailing the methodology to be used to test the operation of the:

- ◆ Valves

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- ◆ Odour Control Units
- ◆ And general flow in the 2400mm S1 Interceptor Sewer

These test plans have been provided by the Contractor, EROC Obayashi Joint Venture in their Operation and Maintenance Manual - Part 3.

7.3 "As Constructed" Drawings

The "As Constructed" Drawings have been provided by the Contractor and have been entered into Brisbane Water's system for inclusion on Bimap. The "As Constructed" Drawings are included in the electronic form with the Operational & Maintenance Manual provided by EROC Obayashi Joint Venture. The drawings are in both DXF and PDF formats.

The As Constructed Drawings listing on Microsoft Excel runs to 11 A4 pages so has not been included.

The first drawing in the series is Brisbane Water Drawing Number 486/5/6-SM02/250 and this Drawing is the Drawing Index.

The electronic copies were provided on CD together with the Operating & Maintenance Manual.

These CD's are distributed within Brisbane Water as follows

Original	Project Management
Copy 1	Project Management – Spare
Copy 2	Projects – PSE
Copy 3	Sewer Network Services
Copy 4	Mechanical & Electrical
Copy 5	Systems & Information Management

PART 4 OPERATION & MAINTENANCE

8 Operating Modes

8.1 General

These procedures have been developed to suit the existing Main Sewer conditions around the S1 Interceptor Sewer.

In the near future (1-2 years) another project (Heroes Ave Pumping Station Redirection) is planned with additional sewage flows being discharged to the North Quay maintenance hole. This will impact on the Modes shown below but these changes will be developed during the Heroes Ave Pumping Station Redirection Project.

8.2 Normal Operational Mode

The normal operating mode for the 2400mm S1 Interceptor Sewer is for the 1350mm stainless steel knife gate valve in Maintenance Hole 235405 Albion Park Raceway to be fully opened. The 1200mm stainless steel knife gate valve in Maintenance Hole 235406 Perry Park is to be fully opened. The 1500mm and 750 mm stainless steel knife gate valves in Maintenance Hole 235401 North Quay are to be fully opened.

All Odour Control Units are to be operating and the weir board is to be in place in Maintenance Hole 235401 North Quay.

The average dry weather flows for the central business district will travel via the existing Main Sewer in this mode. Excessive flows in the central business district caused by wet weather or peak flows will be able to backup and overflow into the 2400mm S1 Interceptor Sewer as levels exceed the weir board.

8.3 Maintenance Mode

This mode of operation is to be used when man entry access into the 2400mm S1 Interceptor Sewer is required e.g.: inspection of the liner. Eagle Farm pumping station is to be contacted and an operator is to be advised that the station is to be placed into maintenance mode to lower the levels in the wet wells.

The 1500-mm stainless steel knife gate valve in Maintenance Hole 235401 North Quay is to be fully shut. The 1200-mm stainless steel knife gate valve in Maintenance Hole 235406 at Perry Park is to be fully shut. The 750mm stainless steel knife gate valve in Maintenance Hole 235401 North Quay is to remain open and the weir boards are to be removed.

Isolation of the Roma Street connection is to be carried out.

The 1350-mm stainless steel knife gate at Albion Park raceway is to be fully shut after enough time to allow for any run off that might occur to drain into the Main Sewer.

In this mode, all sewer flows are carried through the existing Main Sewer. The system is then subject to daily flooding in peak periods and is likely to overflow in wet weather. Therefore care must be taken to program this mode in the winter time to avoid likely wet weather periods.

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8.4 Duty mode

This mode allows the central business district to flow back to the 2400-mm S1 interceptor sewer when maintenance on the existing Main Sewer is required. Doors at either Ann or Adelaide Streets are shut causing the flows to backup up to Maintenance Hole 235401 North Quay and flow into the 2400mm S1 Interceptor Sewer. If this is a long term project the weir board can be removed to lower the backup level required for flows to divert into the S1 Interceptor Sewer.

If work is to be carried out between Maintenance Hole 94 Breakfast Creek Road and Maintenance Hole 235410 Kingsford Smith Drive, then the Eagle Farm pumping station is to be contacted and an operator is to be advised that the station is to be placed into maintenance mode to lower the levels in the wet wells. The 1200mm stainless steel knife gate in Maintenance Hole 235406 Perry Park is to be fully opened. The 1350mm stainless steel knife gate in Maintenance Hole 235405 Albion Park is to be fully opened. The Booroodabin Door in Maintenance Hole 94a is to be closed. The 1350mm stainless steel knife gate valve in Maintenance Hole 235410 Kingsford Smith Drive is to be closed after no further run off is likely from the existing Main Sewer.

8.5 Roma Street Connection

During the construction of the S1 Interceptor Sewer – Stage 1, a sewer rising main from the Roma Street Parklands was connected into the sewer between the North Quay and Turbot Street Maintenance Holes. This was part of another project and the operating details of this arrangement are not known. However, this arrangement must be considered during the operation of the S1 Interceptor Sewer.

“Details to be developed by Sewer Network Services”

9 Isolation & Restoration**9.1 Isolation**

The isolation of the 2400mm S1 Interceptor Sewer is as follows:

- ◆ Eagle Farm pumping station is contacted and a person trained to operate the Eagle Farm pumping station is advised that the station be to be placed into maintenance mode to lower the levels in the wet wells.
- ◆ The 1500mm stainless steel knife gate valve in Maintenance Hole 235401 North Quay is to be fully shut.
- ◆ The 1200mm stainless steel knife gate valve in Maintenance Hole 235406 at Perry Park is to be fully shut.
- ◆ The 1350mm stainless steel knife gate in Maintenance Hole 235405 at Albion Park Raceway is to be fully shut after enough time to allow for any run off that might occur to drain into the Main Sewer.
- ◆ Roma Street Connection isolation details are to be added by Sewer Network Services.
- ◆ For long term isolation and personnel entry, the total dewatering of the 2400mm S1 Interceptor Sewer will be required. This can be achieved by a pump located at the lowest point (generally Albion Park) to remove any trapped sewage in the main.

This pump is also required to deal with the anticipated groundwater inflow of approximately 2 l/sec.

- ◆ To prevent sewer gas from the Main Sewer entering the S1 Interceptor Sewer at North Quay, the ventilation cross connection pipe between the two chambers in the North Quay Maintenance Hole 235401 must be isolated by shutting the 500mm stainless steel gate valve in the upstream chamber.
- ◆ Following this, the Odour Units are to be switched to Manual and switched OFF. These units are not designed as a ventilation system for personnel entry to the sewer and other temporary systems are to be provided by Sewer Network Services personnel in accordance with Sewer Entry Requirements.

9.2 Restoration

9.2.1 Non surcharge conditions

The restoration of the main is as follows –

- ◆ The Odour Units are to be switched to Automatic.
- ◆ The 500mm stainless steel gate valve on the ventilation cross connection pipe between the two chambers in the North Quay Maintenance Hole 253401 is to be fully opened.
- ◆ The 1350mm SS KG valve in Maintenance Hole 235405 Albion Park Raceway is to be fully opened.
- ◆ The 1200mm SS KG valve in Maintenance Hole 235406 Perry Park is to be fully opened.
- ◆ The 1500mm SS KG valve in Maintenance Hole 235401 North Quay is to be fully opened.
- ◆ Roma Street Connection may then be activated in accordance with its Operating Procedures.

9.2.2 Surcharged Conditions

Under surcharged conditions, the valve arrangements for restoration will be different to that in 9.2.1. Sewer Network Services will develop a procedure for valve operations and timing following experience with actual operating conditions.

PART 5 MAINTENANCE

10 Fault Identification & Restoration

10.1 Tunnel

The identification and restoration of faults in the uPVC lining system will be as per the manufacture recommendations.

10.2 Valves

Faults in the valves will become evident during opening and closing operations. To prevent unnecessary damage the input torque to the gearbox must not exceed 100 Nm. If high input torques are encountered when attempting to open or close the valves, a close inspection of the valve is necessary and this must be carried out in accordance with Live Sewer Entry Procedures.

10.3 Odour Units

Faults in the Odour Units are identified by the PLC and displayed in the control cabinet. Details of the alarms, displays, etc are provided in the Operation & Maintenance Manual provided by EROC Obayashi Joint Venture. Initially, an inspection of the Odour Units is suggested on a fortnightly basis. The frequency may be altered based on experience.

In the near future, telemetry connection will be provided and the faults identified by the PLC will be transferred to the Control Room. Response to the problem will then be arranged.

It is unlikely but it may be possible that an odour complaint may be received through the Contact Centre. This may indicate that there is a fault at an Odour Unit. This would be investigated as a normal part of Sewer Network Services operations.

10.4 Secondary Ventilation

The usual result of a fault in the secondary ventilation would be an odour complaint from the vicinity of a secondary ventilation pole at one of the maintenance holes. Any close inspection of the valves requiring entry into the live sewer must be carried out in accordance with Live Sewer Entry Procedures.

11 Preventative Maintenance

11.1 Sewer

Preventative maintenance in the 2400mm S1 Interceptor Sewer is minimal due to the design and construction techniques. All internal surfaces are corrosion resistant to prevent loss of structural integrity through gas attack. The main area of concern would be grit build up in the pipe, although this is not thought to be a problem because of the self cleansing grade of the main. There were some parts of the line with unfavourable grades and in some cases up to 75 mm of backfall. These areas have been logged and closely inspected during construction. Details of these areas are included in Appendix B. It was thought that given the smooth profile, a wet weather event would be likely to flush along any grit accumulation. An inspection of the 2400mm S1 Interceptor Sewer after a period of operation will audit this thinking.

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Regular grit removal will be required at maintenance holes where valves are located. This is because 300mm deep sump arrangements have been provided to allow for access for bolts and nuts when valve removal is required. Details are as follows.

North Quay.	The whole floor (temporary) of the valve chamber (upstream) is 300mm lower than the outlet invert levels.
Perry Park	A small sump 300mm deep is provided under the 1200mm valve.
Albion Park	A small sump 300mm deep is provided under the 1350mm valve.
Kingsford Smith Drive	The whole floor of the maintenance hole is 300mm lower than the outlet invert levels.

11.2 Valves

The valves are to be exercised regularly and included in Sewer Network Services programs for exercising of other sewer valves in the network. Initially this is suggested as a yearly frequency and subsequently modified based on experience.

The oil level in the Oil Baths just below the gearboxes should be monitored to ensure that proper lubrication is maintained. Initially this is suggested as a yearly frequency and subsequently modified based on experience.

11.3 Odour Units

The odour units are provided with water traps which should be drained regularly until accumulated water is removed. Operating experience will determine the frequency. An initial suggestion is weekly in cold weather when the warm moist sewer gas is likely to condense on the cold stainless steel pipework and fortnightly in warm weather.

Pre-filters are provided in each skid mounted unit. These will require cleaning and the suggested time is when the main activated carbon filters are being replaced. Spare pre-filter frames are kept at Eagle Farm Pumping Station (contact officer code FM1ESBW).

The activated carbon in the main filters is rendered inactive over time as the contaminants in the sewer gas are adsorbed. The minimum guaranteed life of the activated carbon is 12 months at an average H₂S level of 20 ppm. Early tests have indicated an average of 8 ppm., therefore the life of the activated carbon may be more than 2 years. Gas takeoff points (threaded and plugged) are provided in the activated carbon beds at the 25%, 50%, and 75% points. Gas analyses should be taken at six monthly intervals to monitor the progress of the exhaustion of the beds. Once the bed is exhausted at the 75% point, arrangements should be made for the replacement of the activated carbon based on the life to 75% projected to a point near 100% but avoiding breakthrough. Each site has 2 skid mounted units operating in parallel. Therefore, one unit at a time may be isolated at the switchboard and by closing the inlet and outlet butterfly valves. The normal positions are marked on the valve position indicators to ensure they are correctly positioned on return to service.

The replacement of the activated carbon is a specialist activity which may be carried out by the installation subcontractor – B.L. Camteck Technology Pty. Ltd. or others experienced in this work. The work requires the roof sections of the building to be removed. The spent carbon is removed by vacuum truck and disposed of at a hazardous landfill. The fresh carbon is lowered in bulk bags through the removed roof panels and carefully placed the beds. Correct safety precautions are required during this operation and care must be taken to ensure the carbon is correctly compacted to prevent short circuiting in use.

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Further details of the activated carbon grade and quantities are provided in the contractors Operation & Maintenance Manual.

Each building has a floor sump which drains through a 50 mm. pvc pipe to the sewer. To prevent sewer gases entering the building this line is fitted with 3 devices. A reflux valve (frog flag) is fitted within the maintenance hole, the line has a 250 mm. deep water trap, and there is a ball valve fitted within the sump with a actuating handle just above the grate. There were some concerns that the water trap may dry out in use and that was the reason for the provision of the ball valve. On each visit to the site it is suggested that the water tap be operated sufficiently to replenish the water trap. Should this prove to not prevent odours within the buildings, the ball valve should be left closed. The sump is fitted with a level alarm which will ultimately be connected to telemetry. When this alarms someone will be sent to site and the sump is readily drained by opening the valve, and again closed.

11.4 Secondary Ventilation

Pressure relief and vacuum relief valves are fitted on a polyethylene tee in the following maintenance holes,

- Kingsford Smith Drive
- Albion Park
- Perry Park
- Barry Parade
- Turbot Street.

These valves are made of plastic materials with stainless steel springs. The spring settings were set in the factory and should not require any adjustment. The materials should not require any preventative maintenance. Adjustment of the stainless springs in the valves is possible but not likely to be required as they were set in the factory.

The Albion Park additional pressure relief flap may in extreme events (fast restoration of flow, wet weather failure of Eagle Farm pump Station) become stuck open. The result of this is likely to be an odour complaint in the vicinity of Albion Park. The solution is to simply push the flap back with a stick into a position where it will fall into its normally closed position. The rubber seal may require replacement and it should be possible to replace this in situ from a suitable height temporary platform. The 316 stainless steel chain should be checked periodically to ensure it is still attached with the 316 stainless steel welding wire.

12 Corrective Maintenance**12.1 Sewer**

Corrective maintenance in the 2400mm S1 Interceptor Sewer should be minimal due to the design and construction techniques. Any corrective maintenance to the lining systems will be as per the manufacturer recommendations.

Repair of the lining is a difficult procedure particularly after the sewer has been on line. The basic process is as follows.

- Cut the outline of the area to be repaired through the liner and under lying grout or concrete back at an angle so the repair material will be wedged into the original material after it sets.
- Remove the damaged liner from within the outline and any underlying grout or concrete necessary for an effective repair.
- Cut a patch of liner material from the spare pipes held at Luggage Point 50mm larger than the area removed. Remove the ribs from the 50mm overlap area.
- Place the patch in position and fit suitable grout delivery lines near the bottom and air release (and grout overflow) lines at the top.
- Weld the patch around all edges of the patch.
- Fit a 2.4m diameter (or other as necessary) wooden form against patch and brace against the opposite side of the pipe.
- Pump cement and water grout into the void until grout comes out of the top lines and seal off all lines. Allow grout to harden. Additives may be used in the grout to improve pumping and early setting.
- Grind off lines and repair these areas with plastic welding.
- Check the patch for drumminess and spark test the whole patch for continuity.

12.2 Valves

The only parts of the 316 stainless steel knife gate valves likely to wear appreciably are the rubber seat in the body, the gate stuffing seal, and the rising stem guide bushes in the wall brackets.

Spare parts for these were provided under the original contract and are kept at Eagle Farm Pumping Station. These are under the control of officer code FM1ESBW.

The rubber valve seat is in 3 pieces – the bottom semi-circle and 2 straight side pieces. The rubber is stiffened with a stainless steel rod and these extend from the straight side sections about 50 mm into the semi-circular section. The approximate rectangular sections are held into their recesses by a thin strip of stainless steel secured with allen keyed small bolts. The valve seats are able to be replaced with the valves in situ and the gate in the open position.

The gate stuffing seal can be tightened in situ but may require removal of the observation panels in the light weight bonnet. Access to these in situ will require some careful planning given the height above the invert and the slippery nature of the surroundings in the live sewer situation.

The replacement of the stem guide bushes in the brackets is a straight forward procedure with the bushes being in 2 halves. However access to the bushes is a matter requiring planning and care.

Major failures of the valve body, stem, guide brackets, oil bath, or gearbox are major exercises requiring planning to address the particular circumstances presenting at the time.

12.3 Odour Units

Failures on the Odour Units are standard Mechanical and Electrical issues related to the PLC, Switchboard, Pipework, Motors, and Fans. Telemetry to be installed soon is also an issue. Most repairs anticipated are standard M&E repairs or replacements. Not all components are standard M&E components but these components are generally readily available.

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The Allen Bradley PLC software is being purchased for this project and the operating program has been supplied by the contractor in the Operation & Maintenance Manual.

12.4 Secondary Ventilation

A failure of a pressure relief valve, vacuum relief valve, or the flap valve at Albion Park is best corrected by replacement of the defective item. Replacement of the pressure relief and vacuum valves requires Brisbane Water - Sewer Tube Entry Procedures to be followed as they are situated about 0.5 m below the top slab in the maintenance hole. A bosun's chair is also required to allow for correct positioning to remove these valves.

13 List of Manufacturers & Suppliers

Equipment	Subcontractor / Propriety Equipment	Contact Details	
		Phone	Fax
Liner	EROC Pty Ltd	07 3307 8100	07 3268 3734
Valves	JohnValves Pty Ltd	03 5333 0777	03 5338 1771
	Pipeline Supplies Pty Ltd	07 3267 7399	07 3267 7646
Auma Gearbox	Barronage Pty Ltd	03 9561 9960	03 9561 9980
Odour Control Units	B.L. Camtek Technology Pty Ltd	02 4628 2989	02 4628 5884
Pre-filter Panels	B.L. Camtek Technology Pty Ltd	02 4628 2989	02 4628 5884
Fan Units	Speedlock Industries Pty Ltd	02 9757 1233	02 9757 3799
Activated Carbon	Lormar Pacific Pty Ltd	03 9592 3700	03 9592 3711
Differential Pressure Gauges	Ambit Instruments Pty Ltd	02 9891 1222	02 9891 1260
Electrical			
Variable Speed Drives	Control Logic	07 3252 9611	07 3252 8776
Micrologix 1500	A-P Controls	07 3841 1586	07 3841 1676
Real Time Clock	A-P Controls	07 3841 1586	07 3841 1676
Analog Input card	A-P Controls	07 3841 1586	07 3841 1676
Panelview 300 Micro	A-P Controls	07 3841 1586	07 3841 1676
Panelview Operating Cable	A-P Controls	07 3841 1586	07 3841 1676
Pushbuttons	NHP	07 3891 6008	07 3891 6139
MCCB's	NHP	07 3891 6008	07 3891 6139
MCB's	NHP	07 3891 6008	07 3891 6139
Load Break Switches	NHP	07 3891 6008	07 3891 6139
Contactors	NHP	07 3891 6008	07 3891 6139
Thermistor Relays	NHP	07 3891 6008	07 3891 6139
Control Relays	NHP	07 3891 6008	07 3891 6139
Power Supplies	Control Logic	07 3252 9611	07 3252 8776
Surge Protection	Power House	07 3216 0560	07 3250 4944
Vegapuls Level Sensor	VEGA	02 9542 6662	02 9542 6665

RECOMMENDED SPARE PARTS AND SPECIAL TOOLING

Equipment Description	Make	Part Number	Special Tooling
Liner	EROC Pty Ltd	RosLok	Not required
Valves Seat – 3 piece Packing Oil Bath Rod Seal Oil Bath Rod Wiper Oil Bath 'O' Ring Oil Bath Radial Dual Lip Oil Seal (Ref. JV P/No.s 70894, 70895, 70896 and 70897)	 Ludowici Ludowici Ludowici or equivalent Ludowici or equivalent	 76148 – North Quay 750mm 76149 – Perry Park 1200mm 76150 – Albion / KSD 1350mm 76151 – North Quay 1500mm Luprene SA L35 Lurene W44 BS270 Nitrile Nitrile OD 76.2 x ID 57.15 x 9.5 (NQ 750mm only) Nitrile OD 101.6 x ID 76.2 x 12.7 (PP 1200mm, KSD 1350mm, AP 1350mm)	 Thrust nut tightening tool Not required
Odour Control Units	Pre-filter panels	1200 x 1050 x 25	Not required
	Activated Carbon	Caustic Impregnated Carbon	Not required
Electrical			
Variable Speed Drives	ABB	ACS401-0004-3-2	Not required
Micrologix 1500	Allen Bradley	1764-L28BXB	Not required
Real Time Clock	Allen Bradley	1764RTC	Not required
Analog Input card	Allen Bradley	1769-IF4	Not required
Panelview 300 Micro	Allen Bradley	2711M3A18L1	Not required
Panelview Operating Cable	Allen Bradley	2711CBLHM02	Not required
Pushbuttons	Cutler Hammer	30.5mm series	Not required
MCCB's	Sprecher + Schuh	KTB7-25H-6.3A	Not required

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MCB's	Terasaki	Din-T10 curve 'C' series	Not required
Load Break Switches	Stromberg	OT125A3	Not required
Contactors	Sprecher + Schuh	CA7-9-10-24Vdc	Not required
Thermistor Relays	Sprecher + Schuh	RT3-A-24Vdc	Not required
Control Relays	Finder	60.13	Not required
Power Supplies	PULS	SL10-100	Not required
Surge Protection	HPS	DR4P80K400DC	Not required

PART 6 ENTRY REQUIRERMENTS

14 Entry Requirements

Entry requirements for S1 Interceptor Sewer are to be in accordance with

- ◆ Brisbane Water – Entry to Confined Spaces
- ◆ Brisbane Water – Sewer Tube Entry
- ◆ Brisbane Water – S1 Interceptor Sewer Tube Entry

The Brisbane Water – S1 Interceptor Sewer Tube Entry procedures are being developed by Sewer Network Services. These procedures are based on Sewer Tube Entry procedures but are modified to account for differences in the S1 Interceptor Sewer. These differences include:

- ◆ Longer distance between maintenance holes
- ◆ Deeper maintenance holes
- ◆ Sewer line is not straight
- ◆ Ventilation requirements may be different

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APPENDIX "A"**Valve Specifications****1500mm SS KG located in maintenance hole 235401 North Quay**

Direction to open clockwise
 Turns to fully open 963
 Bearing and spindle oil type Castrol Optimol Optigear 460 Grade

750mm SS KG located in maintenance hole 235401 North Quay

Direction to open clockwise
 Turns to fully open 335
 Bearing and spindle oil type Castrol Optimol Optigear 460 Grade

1200mm SS KG located in the maintenance hole 235406 Perry Park

Direction to open clockwise
 Turns to fully open 760
 Bearing and spindle oil type Castrol Optimol Optigear 460 Grade

1350mm SS KG located in maintenance hole 235405 Albion Park

Direction to open clockwise
 Turns to fully open 856
 Bearing and spindle oil type Castrol Optimol Optigear 460 Grade

1350mm SS KG located in maintenance hole 235410 Kingsford Smith Drive

Direction to open clockwise
 Turns to fully open 852
 Bearing and spindle oil type Castrol Optimol Optigear 460 Grade

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The following spreadsheet table indicates the positions where back falls greater than 40mm were identified but were not repaired after careful consideration by the Project Team. Reasons for not repairing these were based on the length of the pool, the length of repairs necessary (and the subsequent loss of flow integrity), and the general shape of the profile indicating that solids were likely to be readily moved on in high flow conditions.

High Point Liner No	Approx. Chainage	Length (m.) of Pool >40mm	Max. Pool Depth mm.	Remarks	Length (m.) of Repair to limit ponding to 40mm.
124	1116	6	56		12
199/201	1791/1809	3	51		4
209-211	1181-1899	4	49		21
298	2682	2	46		1
330/332	2970/2988	21	73		21

The following spreadsheet table indicates the positions where back falls greater than 40mm were identified and were repaired.

High Point Liner No	Approx. Chainage	Length (m.) of Pool >40mm	Max. Pool Depth mm.	Remarks	Length (m.) of Repair to limit ponding to 40mm.
103	927	14	72		4
104/105	936/945	8	68	Sep. by pool 4m long 17 min. depth	8
117/118	1053/1062	11	51		3
312/313	2808/2817	10	62		8
338	3042	15	68		
338	3042	28	68	Sep. by pool 2.4m long 30 min. depth	3
381	3429	40	75		12

Note These pools were repaired by cutting out the floor and installing a 1.2 m.dia. channel at a level to leave a pool of maximum depth of 40 mm.upstream.

