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Mortlock Terrace Catchment Study

Flood Mitigation Options Report

City of Port Lincoln

July 2017

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Document History and Status

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1 Introduction

1.1 Background

The Liverpool Street catchment is approximately 27 ha in size and situated within the primarily commercial sector of the town centre (refer Figure 1.1). Ground levels within the catchment vary from approximately 1 mAHD to 10 mAHD with the slope of the land typically less than 1%. The majority of the catchment drains to an existing pump station situated at the low point within Liverpool Street. This pump station comprises three pumps with an approximate combined duty of 0.76 m^3/s. Two of these pumps run on mains power. A generator is used when all three pumps are required to operate. The pump station discharges via a DN600 RCP rising main into the Mortlock Terrace gravity drain which then discharges into Boston Bay.

Previous investigative work, undertaken by Tonkin Consulting as part of the Port Lincoln Stormwater Management Plan (SMP) project, estimated that the existing pump station has less than a 2 year Average Recurrence Interval (ARI) standard (Tonkin Consulting, 2014). High intensity, short duration rainfall events during November 2015 and February 2016, resulted in flooding and damage to surrounding businesses that brought the operation of the pump station into the public eye. As such the City of Port Lincoln has undertaken to address the issue. Tonkin Consulting was engaged in mid-2016 to undertake highly detailed 2D flood modelling of the Port Lincoln township. In late-2016, Tonkin Consulting was engaged to undertake a flood mitigation options study for the Mortlock Terrace catchment, with particular focus on the Liverpool Street low spot.

1.2 Study Intent and Scope

Given the interconnectivity of the Liverpool Street catchment with surrounding catchments, and the uncertainty as to the capacity and reliability of the existing pump station the City of Port Lincoln have engaged Tonkin Consulting to undertake an options study to determine the optimal solution to reduce flood risk in the vicinity of the Liverpool Street pump station. This study will aim to quantify the impact of surrounding catchments and assess the cost-benefit ratio of different upgrade options. Recommendations as to the optimal upgrade(s) to reduce the impact, and frequency of flooding within Liverpool Street will be provided.

This study will also develop a better understanding of the performance of the existing Liverpool Street Pump Station and identify options to improve the pump station performance.

Ultimately, this study will better inform the optimal solution(s) for detailed design.

As part of this study the following key tasks were undertaken:

- Detailed 2D floodplain modelling including critical analysis of results to quantify the impact of upstream catchments on flooding within the Liverpool Street low spot based on a “long term” development scenario.
- Review of the hydraulic and electrical capacity and condition of the existing pump station.
- Undertook a high level options analysis to quantify the performance of different options to reduce the flooding risk within Liverpool Street. Options investigated included:
- Modifications to the Mortlock Terrace splitter box and increasing the capacity of the Mallee Park basin while limiting any increase in downstream flood risk.
- Increasing the capacity of the Mortlock Terrace gravity outfall drain.
- Construction of a new gravity outfall from the Liverpool Street pump station to sea.
- Diversion of flows from the upstream Brougham Place and Stevenson Street catchments by construction of a levee within the railway yard and/or upgrade to the Stevenson Street drain.

- Construction of a new rising main from the Liverpool Street pump station to the sea to relieve pressure on the existing gravity outfall within Mortlock Terrace.
- Increasing the discharge capacity of the pump station, including options to utilise components of the existing pump station, full pump station replacement, and options to increase buffer storage.
- Undertook a desktop Geotechnical investigation to determine the likely subsurface conditions – soil and groundwater.
- Identification of a preferred option and undertaking of a cost benefit assessment of the preferred option including assessment of the trade-off between reduction in damages and construction cost of the preferred scheme to various ARI design standards.

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0 100 200 300 400 500 m

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MORTLOCK TERRACE CATCHMENT STUDY
Mortlock Terrace catchment and surrounds

Figure 1.1

2 Existing infrastructure

2.1 Existing systems and flood behaviour

2.1.1 Liverpool Street catchment

The Liverpool Street catchment drains to an existing pump station situated at the low point within Liverpool Street. This pump station comprises three pumps with an approximate combined duty of 0.76 m^3/s. Two of these pumps run on mains power. When all three pumps are required to operate a generator is used. The pump station discharges into the Mortlock Terrace drain via a DN600 rising main which in turn discharges to Boston Bay.

The pump station is served by two main underground pipe systems: a DN750 RCP trunk main along Liverpool Street and a smaller DN600 RCP trunk system in Napoleon Street. Details of the underground system were determined by the Port Lincoln Flood Mapping Study using field survey and drawings from Council archives. Smaller lateral drains feed stormwater into the trunk system from the surrounding inlet pits. Five side entry pits above the storage chamber discharge directly into the storage chamber. A storage chamber adjacent the pump chamber provides approximately 115 m^3 of balance storage during flood events. In comparison to the rainfall runoff volume (approximately 20,000 m^3 in the 100 year ARI event) the balance storage is quite limited.

Recent mapping of the 5 year ARI flood event show ponding up to 400 mm deep at the Liverpool Street low spot; indicating that the pump station provides less than a 5 year ARI standard of protection (see Figure 2.3). Previous investigative work, undertaken by Tonkin Consulting as part of the Port Lincoln SMP project, estimated that the existing pump station has less than a 2 year ARI standard (Tonkin Consulting, 2014). Significant flooding occurs in the 100 year ARI flood event, with stormwater ponding up to 900 mm deep (refer Figure 2.5). Figure 2.1 shows the peak flows arriving at the pump station from key overland flow paths as well as the underground drainage system during the 100 year ARI flood event. It is clearly shown that the inflow to low spot exceed the capacity of the pump station.

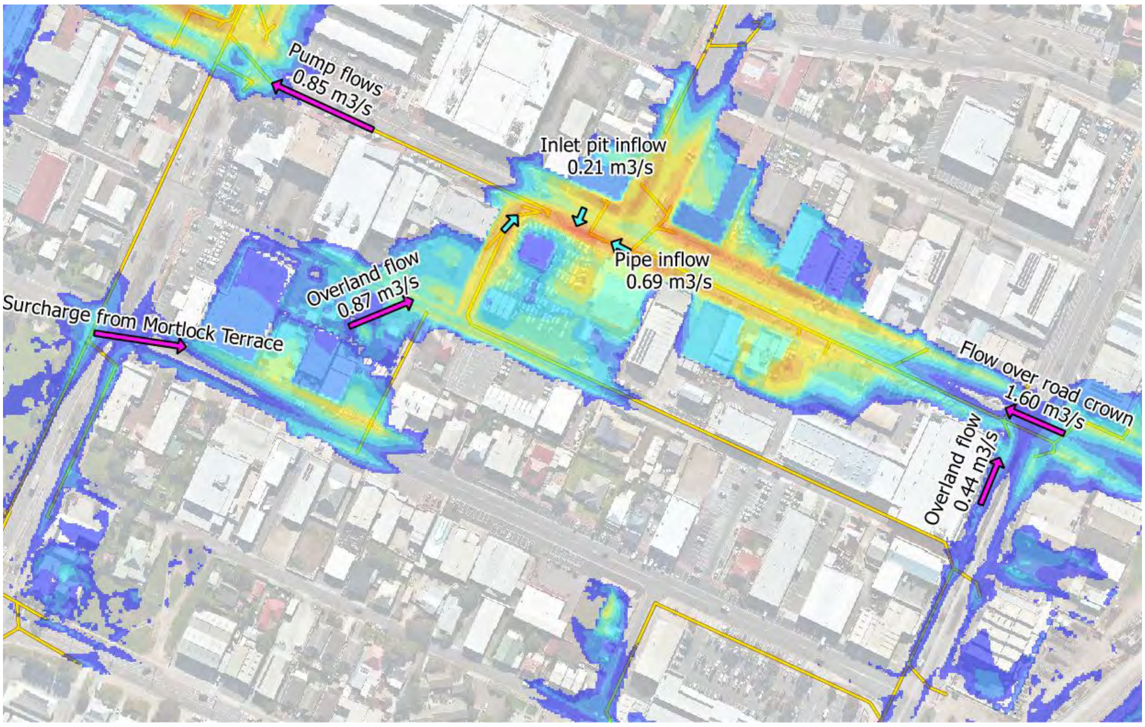

Figure 2.1 100 year ARI peak flowrates arriving at Liverpool Street pump station

A key feature of the Liverpool Street catchment is that the catchment drains to a trapped low spot; there are no overland flow paths that allow water to escape before significant flooding has occurred. Elevations within the trapped low spot range from 1.1 mAHD to 2.7 mAHD, a difference of 1.7 metres. Figure 2.2 demonstrates the limited storage available at low elevations within the low spot. No appreciable storage is available until 1.5 mAHD at which point storm water is up to 400 mm deep and beginning to inundate areas outside of the road corridor.

A wet system exists between Edinburgh Street and Napoleon Street and is a primary cause of flooding in Edinburgh Street. Figure 2.3 shows the layout of the drainage system in the Liverpool Street and Mortlock Terrace catchments.

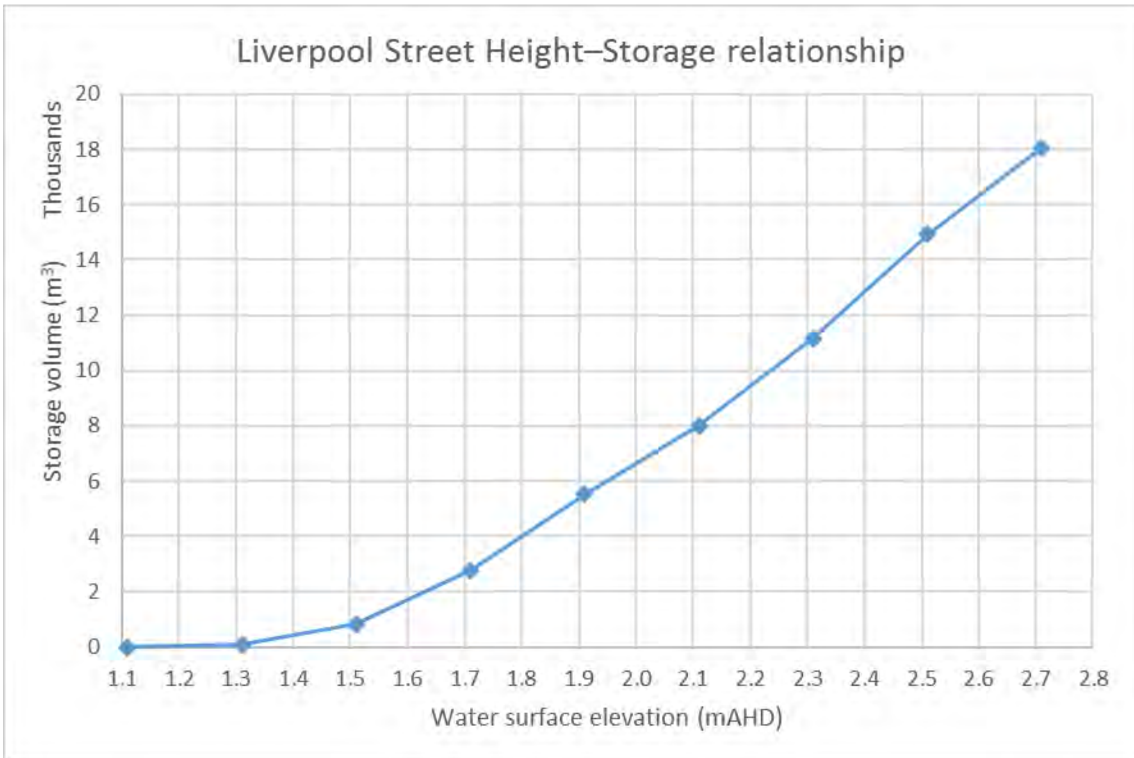

Figure 2.2 Liverpool Street Height–Storage relationship

2.1.2 Mortlock Terrace catchment

Previous investigations have posited that the Liverpool Street catchment receives overland runoff from the 350 ha Mortlock Terrace North catchment. This behaviour was confirmed during the Port Lincoln Flood Mapping Study and occurs through two mechanisms. Firstly, runoff arriving at Park Terrace exceeds the inlet capacity of the Park Terrace drainage system. Consequently, excess stormwater flows across the oval of the Port Lincoln Primary School to the intersection of Mortlock Terrace and Lincoln Place. Secondly, the limited capacity of the Mortlock Terrace system causes water to surcharge from the inlet pits, located at the intersection of Mortlock Terrace and Lincoln Place, and flow into the Liverpool Street catchment (Tonkin Consulting, 2017). Due to the interconnection of the pump station and Mortlock Terrace drain, surcharge from the Lincoln Place inlet pits is increased during operation of the pump station. This in turn increases the volume of stormwater that flows towards Liverpool Street from the Mortlock Terrace catchment.

A flow split exists on the Mortlock Terrace drain near the intersection with Sinclair Street (refer Figure 1.1). Stormwater enters the splitter box from the south via twin DN1350 pipes. During small rainfall events, base flows will pass into a single DN900 pipe, which runs north along the length of Mortlock Terrace, discharging into Boston Bay. During rainfall events in which the flowrate exceeds the capacity of the DN900 pipe, stormwater is directed over an weir into twin DN1275 pipes (see Figure 2.6) that discharge into the Mallee Park detention basin.

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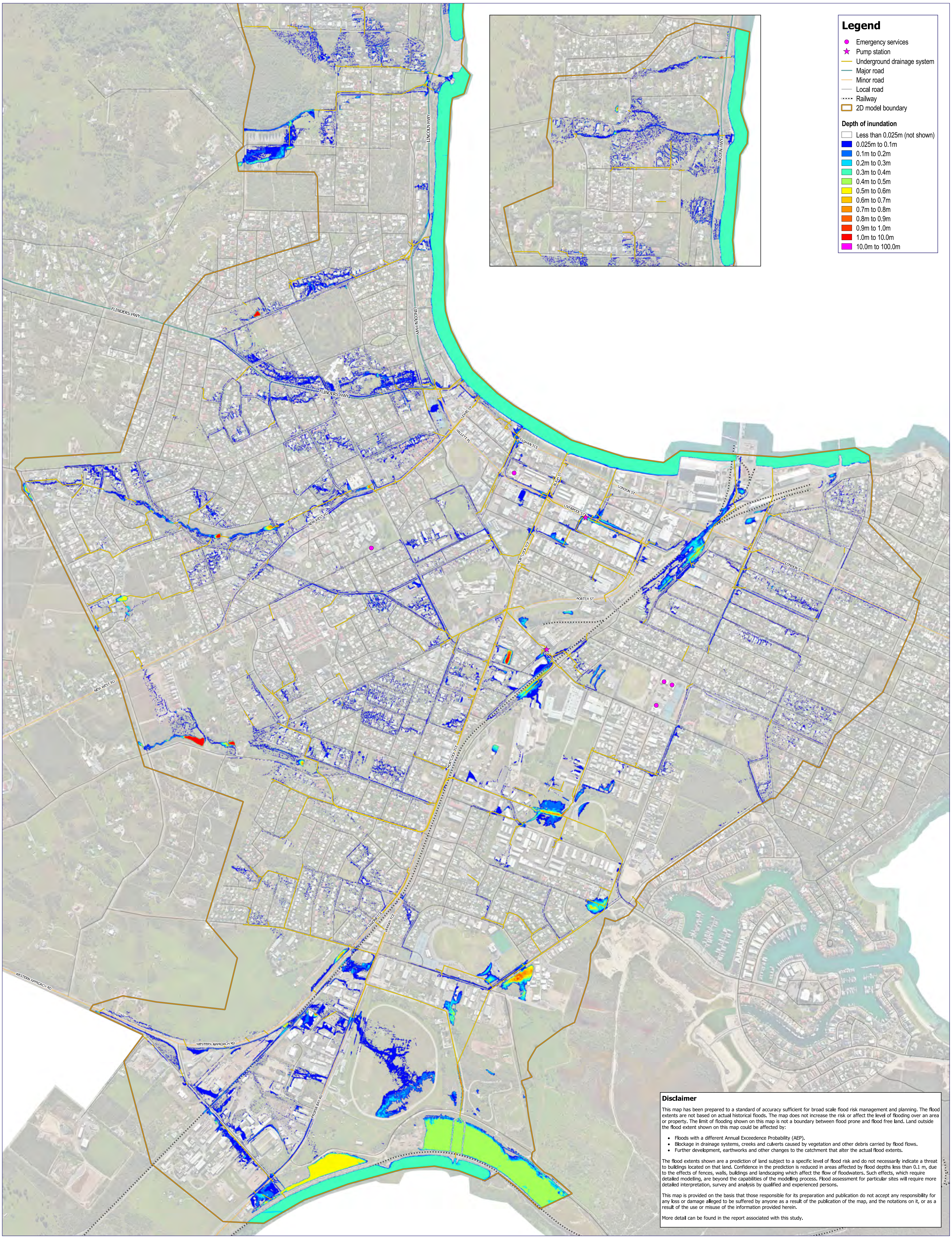
MORTLOCK TERRACE CATCHMENT STUDY
Liverpool Street drainage system layout

Figure 2.3



Disclaimer

This map has been prepared to a standard of accuracy sufficient for broad scale flood risk management and planning. The flood extents are not based on actual historical floods. The map does not increase the risk or affect the level of flooding over an area or property. The limit of flooding shown on this map is not a boundary between flood prone and flood free land. Land outside the flood extent shown on this map could be affected by:

- Floods with a different Annual Exceedence Probability (AEP).
- Blockage in drainage systems, creeks and culverts caused by vegetation and other debris carried by flood flows.
- Further development, earthworks and other changes to the catchment that alter the actual flood extents.

The flood extents shown are a prediction of land subject to a specific level of flood risk and do not necessarily indicate a threat to buildings located on that land. Confidence in the prediction is reduced in areas affected by flood depths less than 0.1 m, due to the effects of fences, walls, buildings and landscaping which affect the flow of floodwaters. Such effects, which require detailed modelling, are beyond the capabilities of the modelling process. Flood assessment for particular sites will require more detailed interpretation, survey and analysis by qualified and experienced persons.

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More detail can be found in the report associated with this study.

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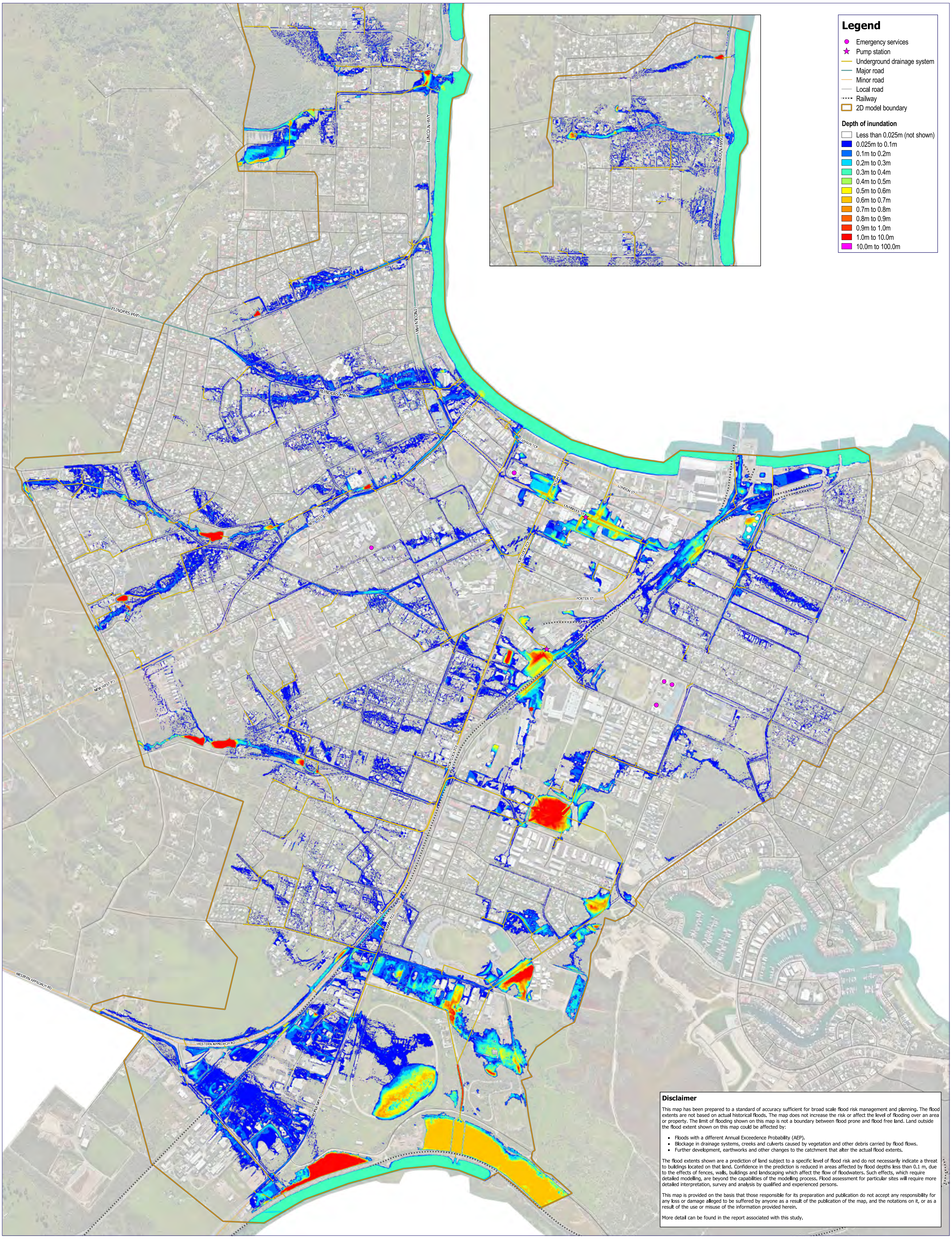
PORT LINCOLN FLOOD MAPPING STUDY
Existing development 5 year ARI flood inundation

Map 3



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PORT LINCOLN FLOOD MAPPING STUDY
Existing development 100 year ARI flood inundation

Map 1

2.1.3 Stevenson Street and Brougham Place

These two systems collect stormwater flows from west facing catchments of Kirton Point (refer Figure 1.1). Both systems act to divert stormwater north and away from the Liverpool Street catchment low spot.

The Stevenson Street system is a DN1050 pipe system with close to a 5 year ARI standard. Due to the gradient of east-west roads, some stormwater bypasses inlets on Stevenson Street and flows into the Brougham Place catchment.

The Brougham Place is a DN450 pipe system with very limited capacity which runs north through the wharf facilities. In a 5 year ARI event ponding up to 0.45 m deep occurs in the rail corridor and approximately 0.08 m^3/s flows from the railway corridor into the Liverpool Street catchment. In a 100 year ARI event, ponding up to 0.6 m deep occurs in the rail corridor and approximately 1.0 m^3/s flows into the Liverpool Street catchment. The flows from the rail corridor into Liverpool Street is the most significant external contribution to the Liverpool Street catchment.

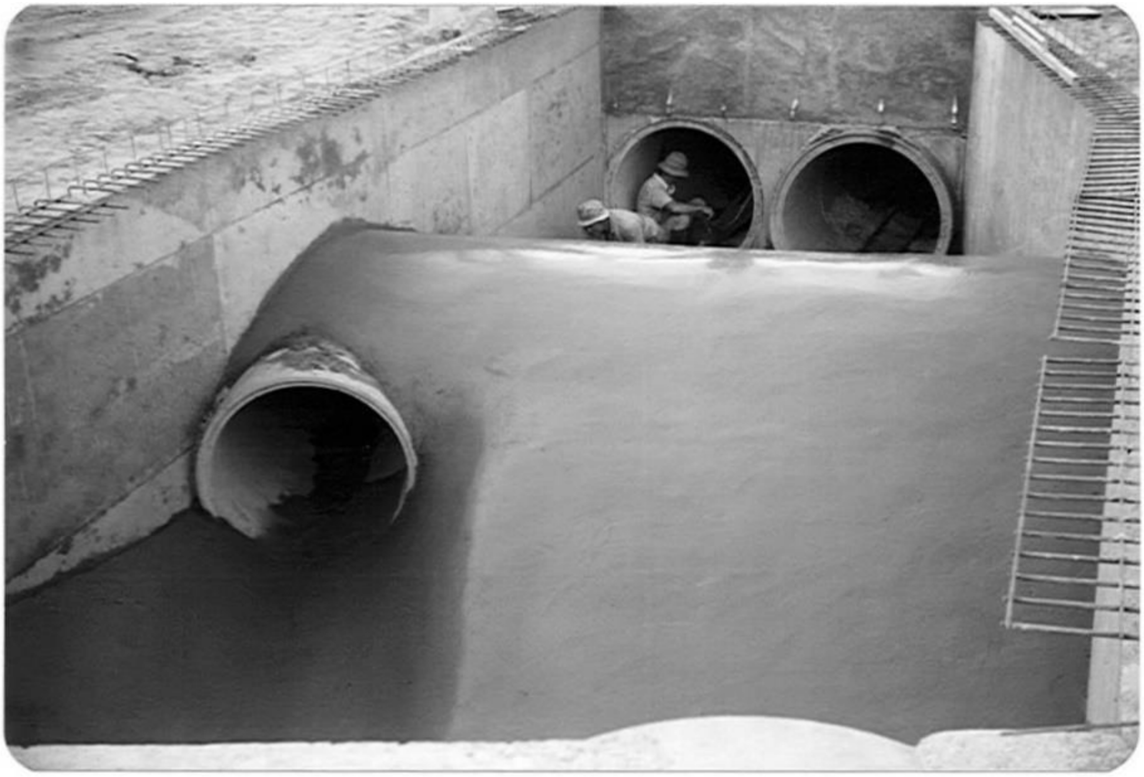


Figure 2.6 Construction of the Mortlock Terrace splitter box

Photo is facing downstream. Note the DN900 primary outlet on the left and secondary DN1275 outlet pipes in the background beyond the weir crest. (Image source: City of Port Lincoln)

2.2 Liverpool Street Pump Station

The Liverpool Street pump station was commissioned in 1975. There are three pump units which pump from the balance storage chamber. The original design discharge of the pump station was 10,000 gpm (0.76 m^3/s) at 25 ft (7.62 m) head. Council records indicate that a single Flygt Model CP3200 LT pump (with No. 605 impeller) and two Flygt Model CP3300 LT pumps (with No. 614 impeller) were installed. Each pump is incorporated into the flood model

2.2.1 Pump station condition assessment

An inspection of the existing pump station chamber was undertaken by Tonkin Consulting in November 2016. The purpose of the inspection was to determine the condition of the existing infrastructure and assess the feasibility of retrofitting the pump station chamber with new, larger capacity pumps.

At the time of inspection, the standing water level (SWL) was approximately 800 mm above the invert of the incoming drains, which is approximately 1.5 m above the floor of the pump sump. Review of the pump station SCADA records indicates that this SWL is typical and commensurate with the ground water table surrounding the pump station. The SWL also highlights that the stormwater network in the area has a high rate of ground water infiltration. Given the proximity to the coastline, the groundwater is thought to be highly saline; however, no testing of the water was undertaken to confirm this.

Inspection of the pump chamber was limited to a visual assessment of the internal concrete surfaces. Inspection of the floor required frequent draw down of the residual water in the chamber. The pump chamber floor was covered in a thick layer of sand and sediment that had accumulated over time which obstructed a full inspection of the floor (refer Figure 2.7). An inspection of the valve chamber was not undertaken due to access issues.

Given the aggressive nature of the environment—coastal proximity, saline water conditions and constant immersion—the concrete structure was considered to be in good condition. There was no obvious signs of deterioration or spalling of the concrete. There was little to no staining or other defects adjacent the pipe and conduit penetrations (refer Figure 2.8) that suggests the water tightness of the structure has been compromised.

The concrete surface finish is a hard, tight and predominately smooth surface, commensurate with an off-form cast in situ concrete pour. The off-form casting marks were still evident on the vertical wall faces (refer Figure 2.9). Joints in the concrete were visible suggesting that the construction of the box structure was undertaken with a number of concrete pours. Some minor honeycombing and pock marks were evident. However, these defects are considered minor and have not affected the structural integrity of the chamber. The concrete inlet has a smooth finish with no signs of erosion due to water flows from the incoming stormwater drains.

The condition of the pump sets varies. Pump Unit 3 had recently been refurbished prior to the inspection (see Figure 2.10 and Figure 2.11). During refurbishment the external coating had been reapplied. Pump Unit 1 and 2 showed signs of corrosion to the external surfaces and based on the external coating condition. Pump Unit 2 has also been serviced, although not as recently as Unit 3. The discharge pipework and vertical supports show a greater degree of corrosion (see Figure 2.12).

The valve chamber (located within the road carriageway), non-return valves (NRV), and discharge manifold were not inspected due to restricted access. Discussions with Council's contractor revealed that the NRV for Pump Unit 1 was scheduled for replacement as it had been identified that the valve was leaking.

An inspection of the electrical switch room was undertaken in April 2016. This inspection noted that the electrical infrastructure was serviceable but quite dated.

Figure 2.7 View looking west, note the layer of sand and debris on pump station base slab

Figure 2.8 View of pump unit discharge pipework

Figure 2.9 View of northern wall of pump station, with off form casting marks still evident

Figure 2.10 Pump Unit 2 (foreground) and 3 (background)

Figure 2.11 Pump Unit 3 and discharge pipe work

Figure 2.12 Pump Unit 2 support and guide rail corrosion

2.2.2 Implications of pump station condition assessment

Based on the inspection carried out, the pump station chamber structure is in good condition and suitable for continued use. As such, reuse of the chamber structure could form part of a preferred mitigation option. It should be noted, however, that there are a number factors that would need to be considered if this approach was adopted. These include:

- Any option to refurbish and reuse the existing pump chamber would require removal of the existing systems. Whilst the station is inactive the risk of a flood event would require effective mitigation which may involve the use of a temporary pump system to cater for any large rainfall events during construction.
- The dimensions of the existing pump chamber would limit the size of any new pump set that could be installed. Based on the original drawings and the recorded dimensions, it is considered that the largest pump unit that could physically fit within the chamber has a capacity of 0.40 m^3/s. Three of these pumps could be installed side-by-side leading to a maximum upgrade to the pump station capacity of 1.20 m^3/s.
- Any upgrade of the existing pump capacity would likely trigger a need to upgrade the electrical supply and controls of the pump station. This would include the need to replace electrical cables between the pump station and the switch room located on Napoleon Street. The upgrade may also require significant alterations to the main electrical supply, which could result in a significant cost for augmentation works. Additionally, the capacity of the existing generators would need to be assessed to ensure sufficient redundancy of supply to the pump station in the event of a mains supply outage.
- If the pump station capacity is increased, it is likely that a new rising main would be required to prevent excessive flow velocities within the rising main. Preliminary estimates suggest a DN900 pipe would be required for a pump rate of 1.20 m^3/s. The existing manifold and pipe penetrations would need modification to suit.
- Retention of the existing balance storage is possible as it is in good condition. Expansion may be possible but difficult due to site conditions.

3 Hydrodynamic model setup

This study utilises the 1D–2D hydrodynamic flood model developed during the Port Lincoln Flood Mapping study (Tonkin Consulting, 2017).

3.1 Changes to hydrology

A long-term development scenario was created to ensure that the proposed mitigation measures would be adequately sized to accommodate the additional runoff that increase development within the contributing catchments will produce.

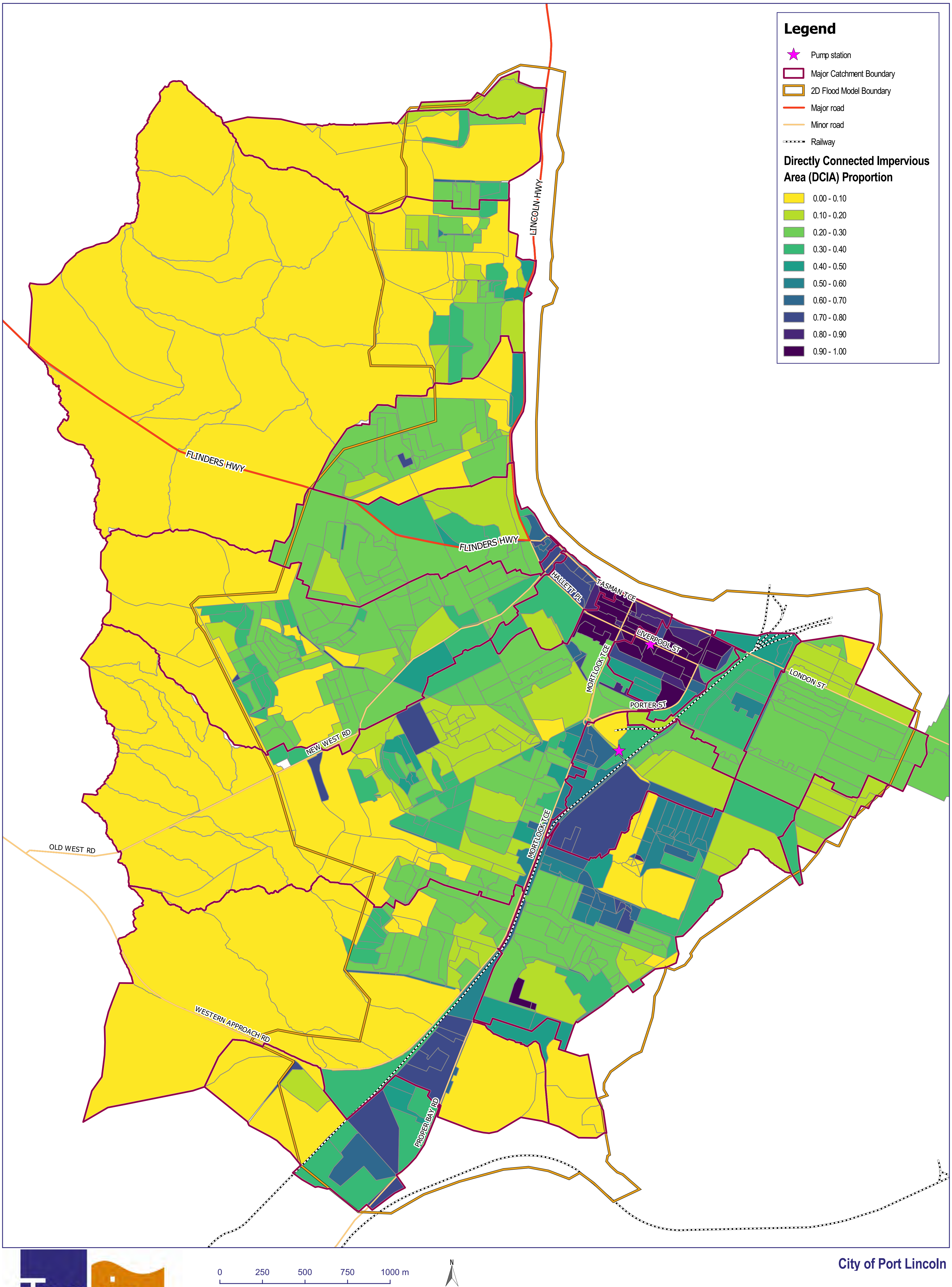
The long-term development scenario involved estimating future development levels within the township and the corresponding imperviousness of the catchment. The estimation of future development levels was based on the long-term development scenario used by the *Port Lincoln Stormwater Management Plan* (refer Tonkin Consulting, 2014). The imperviousness of the catchment was adjusted where current development had exceeded that predicted by the SMP. Figure 3.1 illustrates the adopted imperviousness of the long-term development scenario.

Across all catchment in the township the average increase in catchment imperviousness was close to 20%. Liverpool Street catchment is already highly developed. Consequently, there is little change in the imperviousness of the Liverpool Street catchment between the existing and long-term development scenarios. The Stevenson Street, Brougham Place and Mortlock Terrace catchments have moderate increase in imperviousness in the range of 15-20%.

No changes in rainfall intensity due to climate change were considered, nor any change in sea level.

3.2 Hydraulic model refinements

To improve the estimates of which buildings were subject to flooding in the vicinity of the Liverpool Street low spot, finished floor levels (FFLs) were surveyed for buildings shown to be at risk of inundation in the Port Lincoln Flood Mapping Study. The FFLs were integrated into the 2D flood model so that the depth of any above floor flooding could be better assessed.



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MORTLOCK TERRACE CATCHMENT STUDY
Long-term catchment DCIA proportion

Figure 3.1

4 Options Assessment

This section of the report outlines each of the upgrade options investigated and summarises the performance of each option in mitigating flooding within the Liverpool Street low spot. For the most part each option has been assessed independently. Assessing the impacts of combined options was outside the scope of this study.

4.1 Mortlock Terrace Flow Split Reconfiguration

4.1.1 Description of Upgrade

The existing flow split directs low flowrates through a DN900 pipe into the Mortlock Terrace system. Higher flowrates are directed over a four metre wide weir into the Mallee Park Basin (part of the Mortlock Terrace South system).

It was thought that flow from the DN900 contributes to overloading of the Mortlock Terrace system, thereby exacerbating flooding in Liverpool Street (via the mechanisms detailed in Section 2.1).

The upgrade concept was to alter the splitter box configuration so that flow was first directed into the Mallee Park Detention basin rather than Mortlock Terrace. This could result in a number of benefits:

- Reduced peak flow in the Mortlock Terrace system would potentially lead to less surcharging from that system into the Liverpool Street catchment. A reduction in flood volumes arriving at Liverpool Street would reduce the peak pumping rate required to mitigate flooding.
- If the reduction in peak flow was substantial, it could lead to a situation whereby spare capacity was created in the Mortlock Terrace system. This capacity could then be used to offset any increase in pumping from Liverpool Street thus avoiding a net increase in peak flow in the lower section of the Mortlock Terrace drain. If no net increase in peak flow could be achieved, it may be possible to upgrade the pump station without also constructing a new rising main.

4.1.2 Options Analysis and Assessment

To assess this option, the DN900 outlet pipe was removed from the splitter box and the weir height lowered such that all flows were diverted into the Mallee Park detention basin. The modelling shows that the peak flow rate in the Mortlock Terrace system (near Liverpool Street) was reduced by 0.2 m^3/s as a result of the reconfiguration. In turn, this reduced the flows that surcharge into Edinburgh Street by 0.060 m^3/s. Ponding in Liverpool Street was reduced from 0.90 m deep to 0.87 m deep; a reduction of 30 mm. The modelling shows that despite an additional 0.6 m^3/s being diverted into Mallee Park Basin, the spare capacity created in the Mortlock Terrace system becomes filled by other lateral systems connecting to Mortlock Terrace drain between the splitter box and Liverpool Street.

One added benefit of this option was that ponding at the Bligh–Liverpool Street intersection was reduced by 50 mm. Although the greatest depth of flooding was still up to 0.70 m deep at this location.

Due to the minimal reduction of flood depth in Liverpool Street and the risk of exacerbating flooding downstream of the Mallee Park Basin this option was not investigated further.

4.2 Mortlock Terrace Gravity Outfall Upgrade

4.2.1 Description of Upgrade

This option focussed on increasing the capacity of the Mortlock Terrace system by upgrading a portion of the outfall to Boston Bay.

Upgrading the Mortlock Terrace outfall has the potential to prevent stormwater surcharging from the Mortlock Terrace drainage system into the Liverpool Street catchment and the potential to allow higher discharge rates from the Liverpool Street pump station without adversely affecting flooding in Mortlock Terrace.

Additionally, flooding at the intersection of Bligh Street and Liverpool Street could be reduced by this option by improving the hydraulic conditions for the minor lateral drains that feed into the Mortlock Terrace trunk system.

4.2.2 Options Analysis and Assessment

To assess this option the following changes were made to the Mortlock Terrace system:

1. The section of 2400×1200 RCBC between Liverpool Street and the system outlet was replaced with a 3600×1200 RCBC. A 3600 mm width was assumed to be the widest possible box section that would be practical to use due to service conflicts.
2. The section of DN1675 RCP between Lincoln Place and Liverpool Street was replaced with a DN2400 RCP. A DN2400 pipe was assumed to be the largest possible diameter that would not require lowering the invert of the current drain.
3. Seven additional SEPs were added to collect water at the intersection of Lincoln Place and Mortlock Terrace.

The alterations from this upgrade succeeded in eliminating surcharge flows from Mortlock Terrace into Liverpool Street; this eliminates up to 0.60 m^3/s of stormwater flowing into Liverpool Street. The peak flow in the Mortlock Terrace outfall was increased by 1.0 m^3/s. Ponding in Liverpool Street was reduced by 55 mm, however this is insufficient to reduce the number of properties affected by flooding. Ponding in the Bligh–Liverpool Street intersection was reduced by 120 mm.

Although upgrades to the Mortlock Terrace outfall reduce flooding at the Bligh–Liverpool Street intersection, the benefit such an upgrade provides to Liverpool Street is not considered significant enough to warrant the substantial construction costs of the outfall upgrade.

4.3 Liverpool Street Gravity Outfall Option

4.3.1 Description of Upgrade

This option considered construction of a new gravity outfall along Eyre Street from the low point in Liverpool Street to Boston Bay. The intent for this new outfall was to supplement the existing or a new pump station and provide additional discharge capacity. This option was analysed using 1D modelling techniques.

4.3.2 Options Analysis and Assessment

Analysis of this option showed that a new gravity outfall along Eyre Street would need to navigate several underground service crossings at Liverpool Street, Washington Street and Tasman Terrace, including optic fibre, high and low voltage electrical, telecommunication cables, water and sewer services.

Investigation showed that the top level of the sewer main, which runs east-west along Washington Street, would likely govern the maximum depth of the new gravity outfall. This level was estimated to be approximately -0.50 mAHD. The existing pump chamber invert is approximately -1.34 mAHD. Therefore, a gravity outfall option would not fully drain the existing pump chamber. Therefore, pumps would be required to remove water below a level of approximately -0.35 mAHD.

As this option is highly sensitive to the outlet water level, a sea level of 1.01 mAHD was adopted in the analysis of this option. This level is composed of the mean high water spring (MHWS) tide level plus an additional 300 mm allowance for sea level rise. In contrast, the lowest road surface level within Liverpool Street is 1.10 mAHD.

Preliminary estimates indicate stormwater in Liverpool Street would need to build up to a level of 1.31 mAHD (approximately 200 mm deep) in order to overcome friction and box losses along the outfall. In storm events that coincide with higher tide events (e.g. storm tides), stormwater would be required to reach an even greater depth of ponding due to the increase in outlet water level. Stormwater will breach the confines of the roadway at a level of approximately 1.40 mAHD. The lowest FFL surveyed in Liverpool Street is approximately 1.70 mAHD. Given the above, there is little margin for error in the system. If the predicted performance of the system were adversely affected by sea level rise or blockage then the system could fail to adequately protect properties.

To protect properties from flooding requires a net outflow from the Liverpool Street low spot of 2.8 m^3/s. To achieve this with the adopted tide level would require construction of a twin DN1200 system.

A new gravity outfall would need to incorporate a check-valve to protect the outfall from blockage and prevent sea water flow into Liverpool Street. An adequate outlet structure and maintenance schedule would also be required to reduce the extent and frequency of sand deposition at the outlet.

As this option will only reach maximum potential once flooding reaches a depth of approximately 300 mm within the roadway, even during small rainfall events, and there is a high likelihood that system performance will be reduced due to blockage or rises in sea level, Tonkin Consulting do not recommend that Council pursue this option.

4.4 Eastern Levee Bank

4.4.1 Description of Upgrade

During analysis of the flood maps, it was noted that a substantial volume of water was entering the Liverpool Street catchment from the Brougham Place catchment (east of Liverpool Street); the peak inflow in the 100 year ARI event was 1.5 m^3/s. It was expected that there would be a reduction in flooding in Liverpool Street, and particularly at the intersection of Liverpool Street and Porter Street, if this water could be prevented from draining into the Liverpool Street catchment. Additionally, if the reduction in flooding was substantial this option could lead to a reduced pump upgrade requirement. To investigate this option, a levee was inserted into the flood model to direct water from the Brougham Place catchment towards King Street and the wharf area.

An alternate approach suggested, but not investigated as it was outside the scope of the study, was the interception of flows from Brougham Place and Stevenson Street catchments prior to arrival at the rail yard. This would require upgrades to upstream pipe systems, or installation of entirely new pipe systems, to minimise surface runoff flowing through the railyard and then into Railway Place.

4.4.2 Options Analysis and Assessment

An artificial levee was placed on the western side of the rail yard to direct water west beneath London Street bridge and towards King Street.

The model showed a substantial decrease in flooding (160 mm) in Liverpool Street as a result of the levee. However, this is not sufficient to prevent above floor flooding in the 100 year ARI event. Conversely, flooding in the railyard is increased by 170 mm. Construction of a levee would require works in private property and would require careful consideration to ensure operation of the railway yard and railway museum were not adversely affected.

Given the substantial decrease in flooding in Liverpool Street this option was also considered in combination with an upgraded pump station (refer Section 4.6 below). In discussion with Council, Tonkin Consulting were advised that the eastern levee option in any form would be unacceptable that due to the increase in flooding within the rail corridor.

4.5 Liverpool Street Pump Station Rising Main Realignment

4.5.1 Description of Upgrade

This option involved directing discharge from the Liverpool Street pump station into Boston Bay via a new rising main rather than the Mortlock Terrace drain. It was thought that this would potentially eliminate surcharge flows from the Mortlock Terrace drain into the Liverpool Street catchment. This option could also potentially reduce flooding in Mortlock Terrace at the Bligh–Liverpool Street intersection.

4.5.2 Options Analysis and Assessment

The flood model was reconfigured to direct flows from an unaltered pump station into Boston Bay via a new rising main. As a result, in the 100 year ARI event, the peak flowrate in the Mortlock Terrace drain (downstream of the current junction with the rising main) is reduced by 0.5 m^3/s.

By reducing the peak flowrate in the Mortlock Terrace drain, flooding at the Bligh–Liverpool Street intersection is reduced by 40 mm. Discharge into Edinburgh Street is reduced by 0.06 m^3/s but not completely eliminated. However, flooding in Liverpool Street is virtually unchanged because the peak discharge rate of the Liverpool Street pump station is unaltered.

Therefore, whilst this option manages to reduce flooding at the Bligh–Liverpool Street intersection, it has minimal impact on flooding in Liverpool Street. In order for this option to reduce flooding in Liverpool Street, it will need to be combined with an increase in the capacity of the pump station.

4.6 Liverpool Street Pump Station Discharge Capacity Upgrade

4.6.1 Description of Upgrade

This option investigated the management of flooding in Liverpool Street via increased pump discharge rates. In addition to increased pump rates this option involved construction of a new rising main along Eyre Street to eliminate the effects of the pump station on flooding of the Bligh–Liverpool Street intersection.

Field inspection of the existing pump station revealed that it would be possible to install three new pumps with a combined design discharge of 1.2 m^3/s within the existing pump chamber. Larger design discharges would require pumps that would require enlarging the chamber. Various new pump rates were simulated, ranging from 1.2 m^3/s through to 3.2 m^3/s.

This option was also considered in combination with the Eastern Levee bank option to assess sensitivity of the design discharge requirements.

4.6.2 Options Analysis and Assessment

To achieve no above floor flooding of existing buildings the following pump rates are required:

- 1.2 m^3/s in the 20 year ARI flood event
- 2.8 m^3/s in the 100 year ARI flood event

In the 100 year ARI event with a 2.8 m^3/s pump rate, flooding in Liverpool Street is significantly reduced; from 900 mm deep down to 350 mm deep. Ponding of water along Liverpool Street and

Eyre Street is not entirely eliminated, however, the majority of above floor flooding is averted. Flooding is very similar when a 1.2 m^3/s pump rate is used in the 20 year ARI event. Figure 4.1 shows the effect of each upgrade option.

It is important to note that the intersection of Porter Street and Liverpool Street is inundated to the same extent regardless of the simulated pump rate upgrade. This occurs because the eastern side of this intersection is isolated from the Liverpool Street pump station by the crown of Porter Street. The only paths for stormwater to move from this intersection to the pump station are through the underground system or over the crown of Porter Street. The underground system beneath Porter Street is not capable of conveying the 100 year ARI flowrate. As a result, regardless of the pump station upgrade the intersection will pond to the height of the Porter Street crown (approximately 2.3 mAHD).

If combined with the eastern levee option the following pump rates are required:

- 1.2 m^3/s in the 20 year ARI flood event
- 2.0 m^3/s in the 100 year ARI flood event

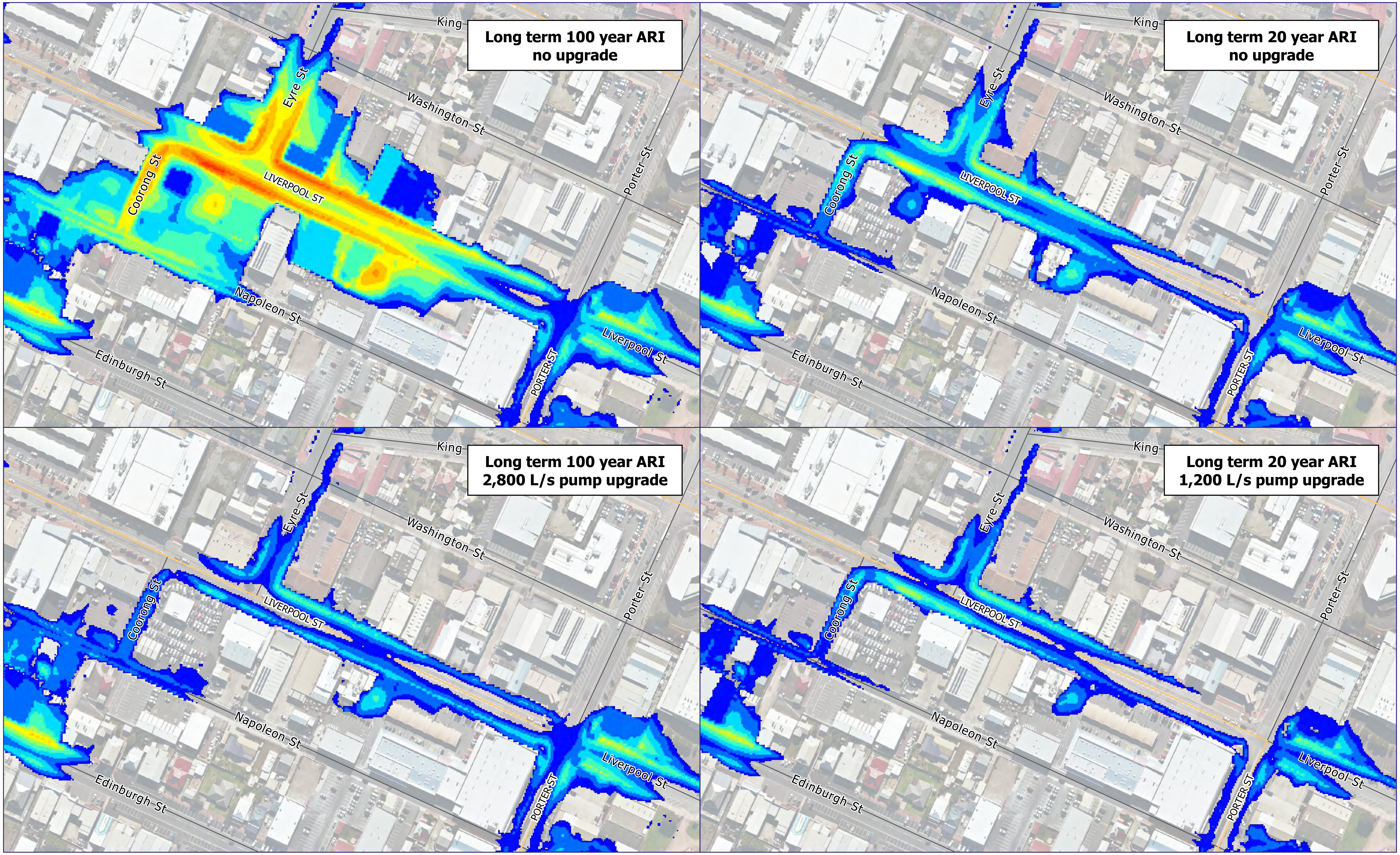
As 1.2 m^3/s was the smallest discharge rate simulated in the 2D model, the same flow rate is required for both the levee and non-levee arrangements. With further analysis a smaller pump rate may be found to be sufficient in combination with the eastern levee, however, this was outside of the scope of this study.

When combined with the eastern levee option, flood depth in the Porter Street–Liverpool Street intersection is reduced by approximately 60 mm and flow over the Porter Street crown is reduced from 1.4 m^3/s to 0.10 m^3/s. By eliminating flows over Porter Street into Liverpool Street the net flow of stormwater into the pump station is significantly reduced. In turn, a lower pump station discharge of 2.0 m^3/s is possible whilst still achieving a 100 year ARI level of protection.

Balance storage increase

After simulation of the various pump upgrades the option to increase the balance storage of the pump station was considered. Added balance storage can be used to reduce the required peak pump rate and thus lower costs associated with the pump station construction. The minimum additional balance storage required to reduce the pump rate from 2.8 m^3/s to 2.4 m^3/s is approximately 1,500 m^3. Accommodating this amount of additional storage will prove difficult. Assuming that ground water would limit the depth of any storage basin to 1 metre, then a 1,500 m^2 footprint would be required. Examining the surrounds of the pump station reveals that a footprint of this magnitude would likely require locating a basin within private property. An underground system contained within the road corridor would require 1,300 metres (or 3×450 metres) of DN1200 RCP to be installed under the roadway which would be impractical due to conflicts with other services.

The additional cost of providing an increase balance storage is considered to be in excess of the reduced pump station construction costs and as such was not considered further.



0 50 100 150 200 m

N

Job Number: 20160179
Filename:
Revision: Rev. B
Date: 2017-07-04
Drawn: JDN

Data Acknowledgement:
Aerial imagery by AAM Pty Ltd, 2016, used with permission of City of Port Lincoln.
Roads data by DPTI, 2016.

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MORTLOCK TERRACE CATCHMENT STUDY

Pump station upgrade options

Flood inundation map

Figure 4.1

5 Concept design and site selection

5.1 Concept design

Based on the findings of Section 4, three main options have been identified for further consideration:

- **Option 1**: An entirely new pump station providing a 100 year ARI level of protection. This pump station would have a peak discharge rate of 2.8 m^3/s. This option considers the construction of a new underground pump station, switch room and generator building. Modification of the gravity stormwater system is also included.
- **Option 2**: As for Option 1, but also includes construction of an eastern levee combined with smaller pumps to achieve a peak discharge rate of 2.0 m^3/s.
- **Option 3**: Refurbishment of the existing pump station to provide a 20 year ARI level of protection. This option allows reuse of existing infrastructure, including the original pump chamber, balance storage, and the existing switch room and generator at Napoleon Street. The maximum possible discharge rate from this option has been determined to be 1.2 m^3/s. This solution would provide partial protection in a 100 year ARI flood.

Tonkin Consulting has developed concept designs for the three different pump station options. Each option includes construction of a new rising main along Eyre Street to an ocean outfall located adjacent the Port Lincoln Yacht Club. A sketch of the various concepts is presented in Figure 5.1.

Cost estimates for each concept have been developed to give a high level, order of magnitude measure of costs for budget purposes.

Table 5.1 Indicative Cost Estimates

Pump Station Options	Indicative Cost (ex GST)
Option 1 – 100 year protection, Q= 2.8 m^3/s	$ 5.5 M
Option 2 – 100 year protection, Eastern levee & Q= 2.0 m^3/s	$ 4.9 M
Option 3 – 20 year protection, Q= 1.2 m^3/s	$ 3.2 M

A detailed breakdown of costs is provided in Appendix A. The cost estimates are also used to inform the cost–benefit ratio of each option (refer Section 6).

It has been assumed that the existing pump station will be decommissioned if a new pump station is constructed. This ignores the possibility of retaining the existing pump station to augment or complement the capacity of a new pump station. There are some challenges associated with achieving this in a practical manner as two pump stations operating simultaneously adds complexity to the control systems. During detailed design there may be potential to investigate a twin pump station solution.

5.2 Site selection desktop assessment

A desktop assessment was performed to identify suitable locations for the construction of a new pump station. The following selection criteria were adopted to assess possible construction sites:

- **Proximity to the existing gravity network**: this ensures that a stormwater gravity connection can be readily made to the new pump station;
- **Availability of land**: the footprint of a new pump station is estimated to require a 9×8 m underground pump chamber, a 9×3 m above ground switch room and a 5×2 m above ground diesel generator housing.

OPTION	FLOW (L/s)	PIPE DIAMETER (mm)		COMMENTS
		RISING MAIN	GRAVITY OUTFALL	
EXISTING	750	600	SHARED RCBC	EXISTING PUMP SUMP 4.3M x 3.0M x 2.7M DEEP
1	1200	900	900	EXISTING PUMP SUMP TO BE USED
2	2000	1050	1050	NEW PUMP SUMP MIN. 7.5M x 7.0M x 3.5M DEEP
3	2800	1200	1200	NEW PUMP SUMP MIN. 9.0M x 7.5M x 3.5M DEEP

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0 10 20 30 40 50 m

Job Number: 20160179
Filename: 20160179GQ004
Revision: REV D
Date: 2017-07-04
Drawn: JDN

Data Acknowledgement:
Roads data from PBI, 2015.
Aerial imagery from CPL, 2016.

City of Port Lincoln

MORTLOCK TERRACE CATCHMENT STUDY
Concept design options

Figure 5.1

- **Constructability**: consideration on the construction techniques that will be employed and difficulties associated with access, existing services, traffic management and public safety.
- **Flood risk during construction:** management of the existing flood risk during construction, particularly if the existing pump station is taken offline at any point during the construction period. Ensuring that there is some level of protection against a flood events during the construction activities will be critical to success of any option.

Five possible locations were identified by the desktop assessment and are shown in Figure 5.2 below. A site inspection of each of the identified sites was undertaken to determine any additional constraints or issues that may impact construction or operation of the pump station.

Figure 5.2 Possible pump station locations

5.3 General site conditions

The general site conditions for each location are similar. The area is low lying, with elevations in the range of 1.0-3.0 mAHD. The sites are all developed in some form, with the majority covered with a hot-mix wearing course seal of some description.

The groundwater levels in the area have not been measured, but anecdotal evidence has indicated that the groundwater table is tidally influenced. Groundwater has been assumed to be approximately 1.0 m below ground level in these locations.

The soil conditions in this area are expected to be predominately sand and grit given the proximity to the coastline. Based on historical knowledge of the area and regional geology profiles these sands are expected to be poorly graded and result in collapse when disturbed.

5.4 Detailed site selection assessment

A description of each of site and the advantages and disadvantages of each is provided below.

5.4.1 Site 1

Site 1 is located within the northern carriageway of Liverpool Street opposite the existing pump station. Figure 5.3 shows the existing layout of the site. This location would mimic the configuration of the existing pump station. It is proposed that a new kerb protuberance would be created, with the pump station chamber located beneath the ground surface. The road corridor of Liverpool Street is owned by the Department for Planning, Transport and Infrastructure (DPTI). Use of this site would require negotiation with DPTI for access. It is proposed that this site would be serviced by the current switch room located in Napoleon Street.

5.4.2 Site 2

Site 2 is located within currently unoccupied private property. The rear of the site consists of an unsealed car parking area (see Figure 5.4). An easement or land acquisition could be negotiated for this site to enable the construction of a new pump station and an extension of the existing Liverpool Street stormwater system to provide connection to the pump station.

Figure 5.3 Liverpool Street road reserve

Figure 5.4 Unsealed car parking area of untenanted commercial site

Figure 5.5 Carpark at Napoleon and Coorong Streets

5.4.3 Site 3

Site 3 is situated within the privately owned carpark located on the corner of Napoleon Street and Coorong Street (refer Figure 5.5). The carpark services commercial businesses facing towards Liverpool Street. An easement or land acquisition could be negotiated for this site to enable the construction of a new pump station and an extension of the existing Liverpool Street stormwater system to provide connection to the pump station. This site is located relatively close to the existing switch room and generator that services the existing pump station.

5.4.4 Site 4

Site 4 is located within the Council owned carpark area bounded by King Street, Eyre Street and London Street. This area forms part of Council's road reserve. The elevation of the site is significantly higher than the other sites (approximately 3.0 mAHD). This would help protect the switch room and generator from inundation during a flood but will make connecting the pump chamber with the existing stormwater system more complex. The proximity of the site to the coast significantly reduces the length of rising main required, although the extension of the gravity stormwater system from Liverpool Street is increased proportionately. This site would be serviced by a new switch room and generator area. In addition, there is a SA Power Networks transformer that may be used for a new grid supply (see Figure 5.6Figure 5.5).

5.4.5 Site 5

Site 5 is located within the western verge of Eyre Street (see Figure 5.7), directly adjacent the unoccupied commercial premises on the corner of Eyre Street and Liverpool Street. This location would mimic the configuration of the existing pump station and it is proposed that a new kerb protuberance would be created to accommodate the pump station and associated infrastructure. The Eyre Street road reserve is owned by Council, unlike Site 1 located in Liverpool Street.

Figure 5.6 Entrance to Council carpark at Eyre Street

Figure 5.7 Eyre Street verge area

5.5 Selection of preferred site

Each site was assessed against the site selection criteria to identify the benefits and challenges of each site. Table 5.2 summarises the assessment against the site selection criteria.

Based on the site selection assessment it is recommend that Site 5 (Eyre Street verge) be considered the most suitable site for a new pump station and associated infrastructure. Site 5 provides the best compromise between land availability, accessibility and constructability issues.

We recommend that the assumptions and selection criteria used be confirmed during detailed design.

Table 5.2 Assessment against site selection criteria

Site	Proximity to existing pump station	Land availability	Constructability	Preference
1	High	No.	• Proximity to shop frontage undesirable. • Requires DPTI approval to construct in Liverpool Street. • High disruption of local traffic during construction. • Easily connected to existing pump station and stormwater system. • Requires upgrade of cables and refurbishment of existing switch room to service the site.	2
2	Low	Yes, however privately owned and requires land acquisition/easements. Installation compromises future development opportunities of the site.	• Minimal traffic control and management of public required. • Considerable augmentation of existing stormwater system required to connect to new pump station. Requires deeper construction to suit.	5
3	Low	Yes, however privately owned and requires land acquisition/easements. Minimal impact carpark use once installed.	• Minimal traffic control and management of public required. • Considerable augmentation of gravity stormwater required to connect to new pump station, resulting in greater depths, Coorong Street congested with underground services, risks of large excavation and service locations is high. • Minimal cable runs to existing switch room required.	4
4	Low	Yes, Council owned. Minimal impact to carpark use once installed.	• Considerable augmentation of gravity stormwater required to connect to new pump station, resulting in greater depths.	3
5	High	Yes, Council owned.	• Proximity to commercial shop frontage undesirable. • Traffic controls can be easily implemented to minimise disruption during construction • Easily connected to existing pump station and stormwater system • New switch room and generator can be installed within Council's road reserve to service the pump station	1

6 Economic assessment

6.1 Potential flood damages

A flood damages assessment was undertaken to determine the financial impacts of each pump station concept. The flood damages assessment uses the Rapid Appraisal Method (RAM) developed by the Victorian Department of Natural Resources and Environment (DNRE, 2000). Full details of the methodology as applied to Port Lincoln are given in the Port Lincoln Flood Mapping Study report (20150098R001).

The RAM relies on classifying land-use into categories that describe the relative damage potential of properties thereby simplifying the damages assessment process. Four flood damages categories were used in this study: residential, low, medium and high.

Two types of damages are determined during the analysis. Direct damages relate to physical or functional damages incurred from direct interaction with flood waters. Indirect damages consist of damages incurred indirectly from flooding, such as loss of revenue during clean-up or lost wages whilst businesses are closed for repair. Indirect damages are calculated as a proportion of direct damages. Table 6.1 lists the proportions used for each damage category. Damage to vehicles, damage to roads, and economic costs due to injury or loss of life have not been included as part of the flood damages assessment.

Table 6.1 Indirect damage factors

Potential damage category	Indirect factor
Residential	15%
Low	15%
Medium	60%
High	60%

6.2 Actual flood damages

The potential direct and indirect damages are distinct from realised damages due to mitigating factors such as how prepared the community is to respond to flooding. The more prepared a community is, the more damages they can offset with their preparations. Therefore, potential damages must be adjusted to actual damages based on mitigating factors the communities experiences responding to floods. Another mitigating factor is the warning time prior to flooding.

Given that the community has responded to multiple flood events in the last five years, they are considered to be experienced with flooding. Additionally, the Liverpool Street catchment has a response time typically less than two hours. As such the an adjustment factor of 0.8 for conversion of potential damages to actual damages has been adopted. This value is based on Table 3.5 of the *Rapid Appraisal Method for Floodplain Management* (DNRE, 2000).

Figure 6.1 shows the difference in actual damages within the Liverpool Street catchment incurred during flood events with and without new pump stations. Each flood is plotted using the Annual Exceedance Probability (AEP) of the event. All three concept designs achieve roughly the same reduction in damages in the 20 year ARI event (5% AEP). Differences in the concept designs are move obvious in the 100 year ARI event (1% AEP).

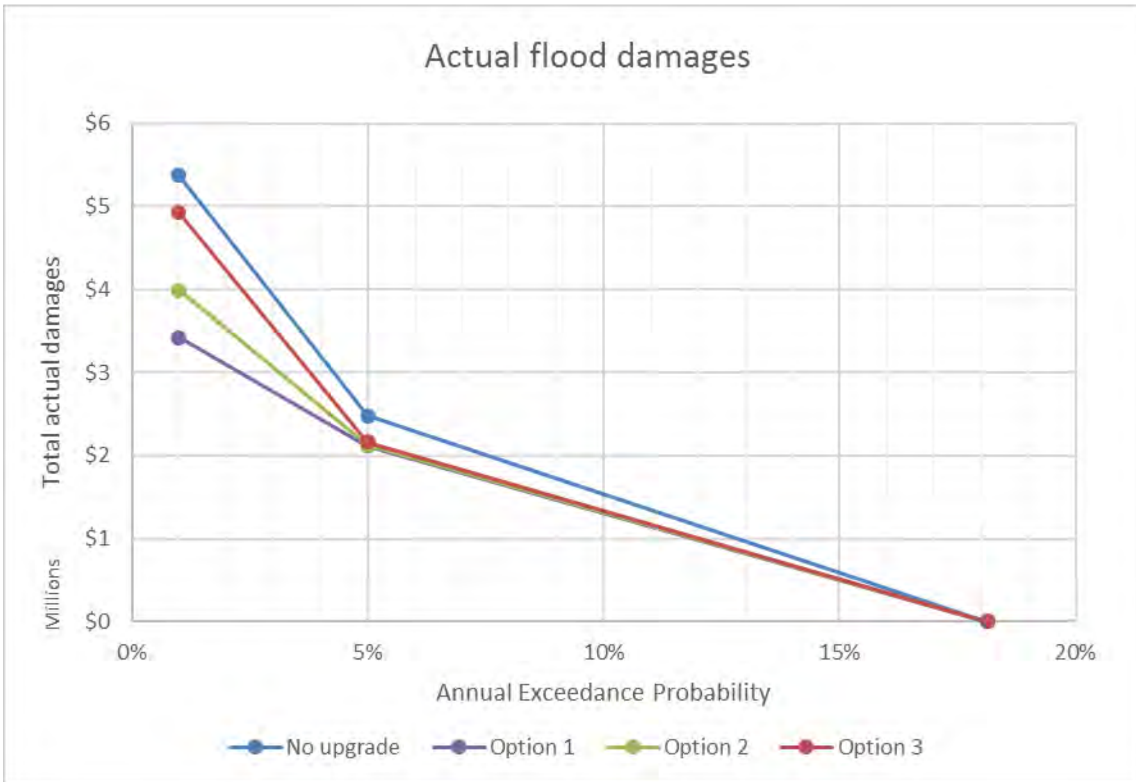

Figure 6.1 Actual flood damages (long term scenario with and without new pump stations)

6.3 Annual average damage

The annual average damage (AAD) is an estimate of the expected annual cost of flood damages averaged over a long period of time. AAD balances low but more frequent flood damages with high but less frequent flood damages and provides a convenient way to compare different floodplain management measures across all magnitudes of flooding. It is a probability-weighted mean of the actual flood damages and is equivalent to the area beneath the flood damage-probability curve. In calculating AAD it was assumed that there are no flood damages for events that have an ARI less than or equal to 5 years. Table 6.2 lists the AAD for three pump station upgrade options.

Table 6.2 Annual average damage of upgrade options

Option	AAD	Reduction in AAD from base case
No upgrade (base case)	$320,000	N/A
Option 1	$249,600	$70,400
Option 2	$261,400	$58,600
Option 3	$283,900	$36,100

6.4 Benefit–cost ratio

The benefit–cost ratio (BCR) of each option was calculated to assess the value for money of each option. Options with a BCR greater than 1.0 indicate good value for money.

The BCR of each upgrade option was calculated assuming a 50 year service life for the pump station. The cost of the pump stations was estimated using the construction costs only. The benefit of the pump station was estimated using the reduction in AAD over the 50 year service life expressed as a discounted present value. A 4.4% discount rate was used. Sensitivity of the BCR was tested using discount rates of 3.1% and 5.7% (i.e. ±30% from 4.4%).

Table 6.3 Cost–benefit ratios for pump upgrade options

Option	BCR (4.4%)	BCR (3.1%)	BCR (5.7%)
No upgrade (base case)	-	-	-
Option 1	0.257	0.324	0.210
Option 2	0.240	0.303	0.196
Option 3	0.227	0.286	0.185

Based on the BCRs, none of the options could be considered good value for money based on the reduction in flood damages. With consideration of other social and environmental factors the BCR for each option may become more favourable. Consideration of other factors however was outside the scope of this study.

7 Conclusion

The Mortlock Terrace and Liverpool Street Catchment Study has confirmed the interconnectivity of the Mortlock Terrace, Stevenson Street, Brougham Place and Liverpool Street catchments and highlights the need to manage stormwater from these catchments in a holistic manner through strategic upgrade of the existing stormwater systems.

Modelling of the Liverpool Street catchment with an upgraded pump station has identified the likely flow rates required to reach a 100 year ARI flood protection standard. The costs associated with providing a 100 year ARI level of protection were found to be significant and as such alternate standards of protection were also investigated.

In all cases, economic assessment of the proposed options undertaken to date suggests the capital costs of construction far exceed the expected reduction in flood damages.

This may warrant further discussion on the alternative scenarios for flood protection and the community expectation on the cost to achieve an "acceptable" level of flooding protection for the area.

Tonkin Consulting is happy to discuss the findings of this report with Council to assist them in their deliberations.

8 References

DNRE, 2000, *Rapid Appraisal Method (RAM) for Floodplain Management*, Melbourne, Australia.

Tonkin Consulting, 2014, *Port Lincoln Stormwater Management Plan*, Reference No. 20070307RA2I, Adelaide, Australia.

Tonkin Consulting, 2017, *Port Lincoln Flood Mapping Study – Hydrologic and Hydraulic Modelling Report*, Reference No. 20150098R001A, Adelaide, Australia.

Appendix A

Cost Estimates

INDICATIVE CONSTRUCTION COST ESTIMATE

Liverpool Street Pump Station Upgrade - City of Port Lincoln

Project Element: **Summary of Options**
Job No: 20160179
Date: 29/06/2017

Estimated by: DGS
Review by: JT

Note: Costs are inclusive of Port Lincoln locality allowance

Item No	Description	ESTIMATE 1200L/s	2000L/s	2800L/s	Comments
1	PRELIMINARIES, ESTABLISHMENT, ONGOING SITE AND PROJECT MANAGEMENT	$ 300,000	$ 410,000	$ 410,000	Additional works and longer duration for construction of 2000L/s and 2800L/s option
2	HANDLING OF INFLOWS	$ 140,000	$ 50,000	$ 50,000	1200L/s option assumes some existing PS capacity retained during construction, existing PS off line for 2000L/s and 2800L/s options
					Cost shown is an allowance only and no consideration has been given to how flows are to be managed during construction at this stage
3	DEMOLITION	$ 10,000	$ 40,000	$ 40,000	Greater demolition allowance for 2000L/s and 2800L/s options
4	PUMP SUMP STRUCTURE				
4.1	New Pump Sump Structure	$ 20,000	$ 540,000	$ 600,000	Assumes existing sump retained for 1200L/s with only minor safety improvements. No remedial works to existing sump
4.2	New Valve Pit Structure	$ -	$ 120,000	$ 130,000	New valve pit required for 2000L/s and 2800L/s options
5	PUMP SUPPLY AND INSTALLATION (3 x 400L/s Pumps, No Jockey Pump)	$ 170,000	$ 340,000	$ 390,000	Based on Xylem quote
6	VALVE AND MANIFOLD SUPPLY AND INSTALLATION	$ 180,000	$ 260,000	$ 300,000	Based on costs for Wellington Street Port Adelaide project
7	ELECTRICAL SUPPLY	$ 340,000	$ 510,000	$ 640,000	Assumes generator located at Napoleon Street with new cabling
8	NEW RISING MAIN AND GRAVITY DRAIN				
8.1	New Rising Main and Break Pressure Junction Box	$ 440,000	$ 530,000	$ 610,000	DN900 for 1200L/s option, DN1050 for 2000L/s and DN1200 for 2800L/s
8.2	New Gravity Drain and Outfall Structure	$ 430,000	$ 530,000	$ 570,000	DN900 for 1200L/s option, DN1050 for 2000L/s and DN1200 for 2800L/s
8.3	Dewatering and Service Relocation Allowance	$ 330,000	$ 370,000	$ 400,000	
8.4	Road Sealing	$ 30,000	$ 30,000	$ 30,000	
9	SYSTEM COMMISSIONING, AS CONTRUCTED DRAWINGS, MANUALS ETC	$ 60,000	$ 60,000	$ 60,000	
	Subtotal (exc. GST)	$ 2,450,000	$ 3,790,000	$ 4,230,000	
	Contingency at 30%	$ 740,000	$ 1,140,000	$ 1,270,000	
	TOTAL (exc. GST)	**$ 3,200,000**	**$ 4,900,000**	**$ 5,500,000**	

ASSUMPTIONS

Estimate based on providing pump station to similar basic standard to existing
All land acquisition costs excluded
Assumes adequate working areas available throughout construction period and for operation thereafter
Assumes corridor available for new rising main and gravity drain along Liverpool Street and Eyre Street with outfall adhacent Yacht Club
Assumes existing PS sump to be used with adequate working room for 1200L/s option. Assumes land available for new pump station (2000L/s and 2800L/s option) on road reserve opposite existing PS site. If the existing PS site or immediately adjacent/opposite side of road to the site is not available, additional costs for carrying inflows to a new PS site and additional rising main and power length will apply
No consideration as to ongoing inflow management method during works, nominal cost allowance only
Assumes standard excavation, dewatering and shoring methods will be used to allow for insitu concrete construction. Alternative methods e.g. piling for the sump structure due to restricted space have not been costed and methods such as this will likely result in additional costs
No allowance for any building works (excuding for new switchroom for 2000L/s and 2800L/s option), amenities, sheltered work areas etc
No allowance for new screens, hoists, monorails
No allowance for any increase in size of or any remediation to existing buffer storage, inlets, screens etc
Assumes existing sump and valve pit are in a suitable condition for ongoing use for 1200L/s option. No condition assessment has been completed on the existing sump, valve pit and storage
Based on initial assessment, pumps for 1200L/s can be located within the existing sump. However, the pump layout in the existing sump does not conform with pump supplier's recommendations for hydraulic purposes and requires confirmation from the pump supplier
Refer to individual cost estimate sheets for specific allowances for each option

Note: Indicative construction estimates are prepared for general information only. We recommend that an appropriately qualified quantity surveyor be consulted to provide detailed advice regarding construction costs. In particular, without developed design, geotechnical and services information, actual construction costs are subject to significant variation from the values shown. Rates have been developed using a combination of Rawlinsons 2016/2017, previous tendered rates, rates developed in-house and some nominal allowances.

INDICATIVE CONSTRUCTION COST ESTIMATE
Liverpool Street Pump Station Upgrade - City of Port Lincoln

Project Element: 1200 L/s Pump Option (Nominal 180kW New PS), 370m DN900 pipe
Job No: 20160179
Date: 29/06/2017

Estimated by: DGS
Review by: JT

Item No	Description	Quantity	Unit	Rate	Cost	Comments
1	**PRELIMINARIES, ESTABLISHMENT, ONGOING SITE AND PROJECT MANAGEMENT**					
	Mobilisation	1	Item	$50,000	$50,000	Based on Disher Creek (Renmark) project, value $1.5M
	QA, PM, JSEA - initial and ongoing	20	weeks	$5,000	$100,000	Based on 20 weeks, reduced rates based on Hargraves Street stormwater pipelay ($15 000/week)
	Survey, setout, service locations	1	Item	$40,000	$40,000	Based on Hargraves Street stormwater pipelay (450m, $50 000)
	Site security and facilities	20	weeks	$1,500	$30,000	Based on 20 weeks, reduced rates based on Hargraves Street stormwater pipelay ($1 500/week)
	Demobilisation	1	Item	$25,000	$25,000	Allowance
	Subtotal				**$250,000**	
2	**HANDLING OF INFLOWS**					
	Establishment of equipment	1	Item	$40,000	$40,000	Nominal allowance, pump station to remain partially functional
	Daily hire / operation of equipment	140	days	$500	$70,000	Allow for $500/day
	Disestablishment of equipment	1	Item	$10,000	$10,000	Nominal allowance, pump station to remain partially functional
	Subtotal				**$120,000**	
3	**DEMOLITION**					
3.1	Demolition of redundant works	1	Item	$10,000	$10,000	Nominal allowance only, assumes existing PS and RM kept in place
	Subtotal				**$10,000**	
4	**PUMP SUMP STRUCTURE**					
4.1	**New Pump Sump Structure**					
	i) Excavate volume of sump structure and make good to subgrade level					Retain existing PS => Item not applicable
	ii) Base blinding layer					Retain existing PS => Item not applicable
	iii) Sump walls					Retain existing PS => Item not applicable
	iv) Sump base					Retain existing PS => Item not applicable
	v) Sump cover slab and beams					Retain existing PS => Item not applicable
	vi) Sump access	1	Item	$20,000	$20,000	Allow for modifications to improve access / egress
	vii) Allowance for shoring					Retain existing PS => Item not applicable
	viii) Allowance for dewatering					Retain existing PS => Item not applicable
	ix) Allowance against flotation					Retain existing PS => Item not applicable
	x) Connection to existing storage and pipework					Retain existing PS => Item not applicable
	xi) Make good - site surface pavements and surrounds					Retain existing PS => Item not applicable
	Subtotal				**$20,000**	
4.2	**New Valve Pit Structure**					
	i) Excavate volume of sump structure and make good to subgrade level					Retain existing sump => Item not applicable
	ii) Base blinding layer					Retain existing PS => Item not applicable
	iii) Pit walls					Retain existing sump => Item not applicable
	iv) Pit base					Retain existing sump => Item not applicable
	v) Pit cover slab and beams					Retain existing sump => Item not applicable
	vi) Pit access					Retain existing sump => Item not applicable
	vii) Allowance for shoring					Retain existing sump => Item not applicable
	viii) Allowance for dewatering					Retain existing sump => Item not applicable
	ix) Allowance against flotation					Retain existing sump => Item not applicable
	x) Connection to existing storage and pipework					Retain existing sump => Item not applicable
	xi) Make good - site surface pavements					Retain existing sump => Item not applicable
	Subtotal				**$0**	
5	**PUMP SUPPLY AND INSTALLATION (3 x 400L/s Pumps, No Jockey Pump)**					
	I) Modification of existing supports for new pumps	3	Item	$1,500	$4,500	Nominal allowance only
	ii) Supply and installation of new supports					Existing supports to be modified +> Item not applicable
	iii) Supply of new duty pumps 400L/s	3	No.	$41,000	$123,000	Supply and delivery of NP3301.180 LT 812 Imp Code 37kW + 15% Contractor Fee
	iv) Installation of new duty pumps 400L/s	3	No.	$3,000	$9,000	Based on Hargraves Street stormwater PS large pump install ($3 800 each)
	v) Supply of jockey pump					Item not applicable due to space limitations
	vi) Installation of new jockey pump					Item not applicable due to space limitations
	Subtotal				**$140,000**	
6	**VALVE AND MANIFOLD SUPPLY AND INSTALLATION**					
	i) Removal of existing valve pit cover slab and make good after	1	Item	$15,000	$15,000	Allowance only to provide access for installation of new manifold and replacement of slab
	ii) Supply and install new DN900 manifold with 3 x DN350 branches	1	Item	$100,000	$100,000	Based on Wellington Street manifold, DN1000 with 3 x 600 branches, $130000
	iii) Supply and install new DN350 non return valves	3	No.	$7,000	$21,000	Based on internet price list of $6000 for DN300
	iv) Connecting DN350 pipework from pumps to manifold	3	No.	$5,000	$15,000	Nominal allowance only
	Subtotal				**$150,000**	
7	**ELECTRICAL SUPPLY**					
	i) Supply new generator - low flows - assume 50kVA	1	No	$20,000	$20,000	Nominal allowance based on quoted price for 220kVA generator
	ii) Install and commission new generator - low flows - assume 50kVA	1	Item	$10,000	$10,000	Nom. allow. inc. site prep, controls, auto-switching. Total sup+inst cost R/insons = $40K to $60K
	iii) Supply new generator - duty flows 220kVA generator	1	No	$43,000	$43,000	Quoted price for 220kVA generator from MacFarlane Generators + 15% contractor markup
	iv) Install and commission new generator - duty flows	1	Item	$40,000	$40,000	Nom. allow. inc. site prep, controls, auto-switching, security. Total sup+inst cost R/insons = $80K to $100K
	v) New power supply cabling 260A from generator to PS site including excavation, laying, reinstatement	130	m	$260	$33,800	Rate built up based on 4 x 120 sqmm cables and Rawlinson rates
	vi) New VSD - 50kW	1	No	$17,000	$17,000	From Danfoss price list 2012 + 20% for CPI and Contractor markup
	vii) Harmonic filter on VSD	1	No	$10,000	$10,000	Nominal allowance - Hargraves St PS PC allowance of $17000
	viii) New controls, automation, SCADA	1	Item	$45,000	$45,000	Nominal allowance only $15 000 SCADA (as per Hargrave St) + $30000
	ix) New switchboard and control panel	1	Item	$75,000	$75,000	Nominal allowance
	Subtotal				**$290,000**	
8	**NEW RISING MAIN AND GRAVITY DRAIN**					
8.1	**New Rising Main and Break Pressure Junction Box**					
	i) Connection to manifold	1	Item	$30,000	$30,000	Nominal allowance only
	ii) Supply and install new DN900 rising main	250	m	$1,300	$325,000	Rate developed through Rawlinsons and interpolation of Hargrave Street rates
	iii) New 1800 square JB break pressure box	1	No	$20,000	$20,000	Hargraves St S/W - 1800x900 = $14000
8.2	**New Gravity Drain and Outfall Structure**					
	ii) Supply and install new DN900 gravity drain	120	m	$1,300	$156,000	Rate developed through Rawlinsons and interpolation of Hargrave Street rates
	ii) New ocean outfall adjacent yacht club (100m buried gravity drain, screen and steel pile with hazard sign)	1	Item	$210,000	$210,000	Based on ALB estimates
8.3	**Dewatering and Service Relocation Allowance**					
	i) Dewatering of trenches	220	m	$600	$132,000	Nominal length. Assumes trenches below 2.5mAHD to be dewatered.
	ii) Service relocation allowance	300	m	$500	$150,000	Nominal allowance only. Hargraves St 460m, $350K, $760/m, likely fewer services at Liverpool Street
8.4	**Road Sealing**					
	I) Allowance for new spray seal / AC surface over 5m width	1500	m^2	$15	$22,500	Hargraves St SW $18/m2 for profiling and 30AC
	Subtotal Item 7				**$1,050,000**	
9	**SYSTEM COMMISSIONING, AS CONTRUCTED DRAWINGS, MANUALS ETC**					
	i) System commissioning - assume 3 persons x 3 weeks	3	Weeks	$15,000	$45,000	Assume 3 persons x 3 weeks
	ii) As constructed drawings	1	Item	$10,000	$10,000	Nomnial allowance only
	iii) Compilation of manuals - assume 1 person x 1 week	1	Week	$5,000	$5,000	Assume 1 person x 1 week
					$60,000	

Subtotal 1		**$2,080,000**	
Locality Allowance	18%	$370,000	From Rawlinsons
Project Size Allowance			
Subtotal 2		**$2,450,000**	
Contingency	30%	$740,000	
TOTAL (exc. GST)		**$3,200,000**	

ASSUMPTIONS
All land acquisition costs excluded
Assumes adequate working areas available throughout construction period and for operation thereafter
Assumes corridor available (Eyre Street) for new rising main and gravity drain
Assumes land available for new pump station (2000L/s and 2800L/s option) adjacent existing PS site (within road reserve) with no allowance for piping flows to an alternative site
No consideration as to ongoing inflow management during works, nominal cost allowance only
No allowance for any building works, amenities, sheltered work areas etc
No allowance for new screens, hoists, monorails
No allowance for any increase in size of or any remediation to existing buffer storage, inlets, screens etc
No allowance made for new SAPN customer supply charge
No allowance made for any fees or charges with service authorities or governement agencies
Assumes existing switch room is utilised with no provision for refurbishment of building structure, space available for new switchboard
Assumes one VSD only on single 400L/s pump

Note: Indicative construction estimates are prepared for general information only. We recommend that an appropriately qualified quantity surveyor be consulted to provide detailed advice regarding construction costs. In particular, without developed design, geotechnical and services information, actual construction costs are subject to significant variation from the values shown. Rates have been developed using a combination of Rawlinsons 2016/2017, previous tendered rates, rates developed in-house and some nominal allowances.

INDICATIVE CONSTRUCTION COST ESTIMATE
Liverpool Street Pump Station Upgrade - City of Port Lincoln

Project Element: 2000 L/s Pump Option (Nominal 180kW New PS), 370m DN1050 pipe
Job No: 20160179
Date: 29/06/2017

Estimated by: DGS
Review by: JT

Item No	Description	Quantity	Unit	Rate	Cost	Comments
1	**PRELIMINARIES, ESTABLISHMENT, ONGOING SITE AND PROJECT MANAGEMENT**					
	Mobilisation	1	Item	$70,000	$70,000	Based on Disher Creek (Renmark) project, value $1.5M, plus additional allowance for structural works
	QA, PM, JSEA - initial and ongoing	30	weeks	$5,000	$150,000	Based on 20 weeks, reduced rates based on Hargraves Street stormwater pipelay ($15 000/week)
	Survey, setout, service locations, as constructed drawings	1	Item	$50,000	$50,000	Based on Hargraves Street stormwater pipelay (450m, $50 000) plus additional building setout
	Site security and facilities	30	weeks	$1,500	$45,000	Based on 20 weeks, reduced rates based on Hargraves Street stormwater pipelay ($1 500/week)
	Demobilisation	1	Item	$30,000	$30,000	Allowance
	Subtotal				**$350,000**	
2	**HANDLING OF INFLOWS (Minor allowance only as new pump sump being constructed)**					
	Establishment of equipment	1	Item	$20,000	$20,000	Nominal allowance, existing pump station may lose functionality
	Daily hire / operation of equipment	1	Item	$10,000	$10,000	
	Disestablishment of equipment	1	Item	$10,000	$10,000	
	Subtotal				**$40,000**	Nominal allowance only
3	**DEMOLITION**					
3.1	Demolition of redundant works	1	Item	$30,000	$30,000	Nominal allowance only
	Subtotal				**$30,000**	
4	**PUMP SUMP STRUCTURE**					
4.1	**New Pump Sump Structure**					
	i) Excavate volume of sump structure and make good to subgrade level	500	m^3	$60	$30,000	Based on new PS internal size of 7.2x6.9x3.3 high + 0.4 thick walls + blind layer + 20%. Use trench rate - 25%
	ii) Base blinding layer	100	m^2	$100	$10,000	Based on new PS internal size of 7.2m x 6.9m + 0.4 thick walls + 1m perimeter x 0.5 thick
	iii) Sump walls	50	m^3	$2,000	$100,000	Based on 7.2x6.9x3.3 high, 0.4 thick walls + 25% for internal walls. R/son $1400/$m^3$, quoted rates have been greater
	iv) Sump base	25	m^3	$750	$18,750	Based on 7.2x6.9, 0.4 thick base. R/son $250/$m^3$, quoted rates have been greater
	v) Sump cover slab and beams	70	m^2	$500	$35,000	Assume precast, Rawlinson rate of $250/sqm x 2 to allow for beams
	vi) Sump access	1	Item	$20,000	$20,000	Nominal allowance for access locations and safety
	vii) Allowance for shoring	1	Item	$120,000	$120,000	Based on initial installation $70,000 +$5,000/week during construction and removal $15,000
	viii) Allowance for dewatering	1	Item	$60,000	$60,000	Based on nominal $20 000 establishment + $5000 disestablishment + $1000/day x 5 weeks
	ix) Allowance against flotation	10	m^3	$500	$5,000	Provide additional 0.5 wide toe to base slab
	x) Connection to existing storage and pipework	1	Item	$50,000	$50,000	Nominal allowance only, assumes new PS adjacent existing
	xi) Make good - site surface pavements and surrounds	130	m^2	$100	$13,000	Assume 3m wide perimeter to pump sump
	Subtotal				**$460,000**	
4.2	**New Valve Pit Structure**					
	i) Excavate volume of sump structure and make good to subgrade level	85	m^3	$60	$5,100	Based on dimensions (5.2x3.3x1.8 nom. equal to Wellington Street, 3 pumps, DN1000 manifold)
	ii) Base blinding layer	30	m^2	$100	$3,000	Based on 5.2x3.3 + 0.3 thick walls + 0.5m perimeter x 0.4 thick
	iii) Pit walls	8.2	m^3	$2,000	$16,400	Based on 5.2x3.3x1.8 high, 0.25 thick walls + 10% for manifold support
	iv) Pit base	6.5	m^3	$750	$4,875	Based on 5.2x3.3, 0.3 thick base. R/son $250/$m^3$, quoted rates have been greater
	v) Pit cover slab and beams	27	m^2	$500	$13,500	Assume precast, Rawlinson rate of $250/sqm x 2 to allow for beams
	vi) Pit access	1	Item	$10,000	$10,000	Nominal allowance for access locations and safety
	vii) Allowance for shoring	1	Item	$21,000	$21,000	Based on $20/m2/day (trench rate) x 50 sqm x 3 weeks. Establishment included in 3.1
	viii) Allowance for dewatering	1	Item	$21,000	$21,000	Based on $1000/day x 3 weeks. Establishment included in 3.1
	ix) Allowance against flotation	4	m^3	$500	$2,000	Provide additional 0.5 wide toe to base slab
	x) Connection to existing storage and pipework		Item			N/A
	xi) Make good - site surface pavements	55	m^2	$100	$5,500	Assume 2m wide perimeter to valve pit
	Subtotal				**$100,000**	
5	**PUMP SUPPLY AND INSTALLATION (3 x 670L/s Pumps plus Jockey Pump)**					
	I) Modification of existing supports for new pumps					N/A, new sump being installed
	ii) Supply and installation of new supports	4	No.	$2,000	$8,000	Nominal allowance
	iii) Supply of new duty pumps 670L/s	3	No.	$81,000	$243,000	Supply and delivery of NP3531/736 1270 60kW + 15% Contractor Fee
	iv) Installation of new duty pumps 670L/s	3	No.	$3,800	$11,400	Based on Hargraves Street stormwater PS large pump install ($3 800 each)
	v) Supply of jockey pump	1	No.	$29,000	$29,000	Supply and delivery of NP3202.185 LT 617 Imp Code 22kW + 15% Contractor Fee
	vi) Installation of new jockey pump	1	No.	$2,000	$2,000	Based on Hargraves Street stormwater PS large pump install ($3 800 each)
	Subtotal				**$290,000**	
6	**VALVE AND MANIFOLD SUPPLY AND INSTALLATION**					
	i) Removal of existing valve pit cover slab and make good after					N/A as new pit to be provided
	ii) Supply and install new DN1050 manifold with 3 x DN500 branches	1	Item	$140,000	$140,000	Based on Wellington Street manifold, DN1000 with 3 x 600 branches, $130000
	iii) Supply and install new DN350 non return valves	1	Item	$52,000	$52,000	Extrapolated based on internet price list of $6000 for DN300
	iv) Connecting DN350 pipework from pumps to manifold	4	No.	$7,500	$30,000	Nominal allowance only
	Subtotal				**$220,000**	
7	**ELECTRICAL SUPPLY**					
	i) Supply new generator - low flows - assume 50kVA	1	No	$20,000	$20,000	Nominal allowance based on quoted price for 220kVA generator
	ii) Install and commission new generator - low flows - assume 50kVA	1	Item	$10,000	$10,000	Nominal allowance including site prep, controls, auto-switching. Total cost Rawlinsons = $40K to $60K
	iii) Supply new generator - duty flows 275kVA generator	1	No	$67,000	$67,000	Quoted price for 275kVA generator from MacFarlane Generators + 15% contractor markup
	iv) Install and commission new generator - duty flows	1	Item	$50,000	$50,000	Nom. allow. inc. site prep, controls, auto-switching, security. Total sup+inst cost R/insons = $80K to $100K
	v) New power supply cabling 430A from generator to PS site including excavation, laying, reinstatement	130	m	$400	$52,000	Rate built up based on 4 x 240 sqmm cables and Rawlinson rates
	vi) New switch room (9m x 3m x 2.4m high) prefabricated hut, inclusive of foundation and underfloor vault	1	Item	$40,000	$40,000	Based on Williams Prefabricated building and concrete underfloor vault for cable entry
	vii) New switchboard and control panel	1	Item	$100,000	$100,000	Nominal allowance
	viii) New VSD - 75kW	1	No	$26,000	$26,000	From Danfoss price list 2012 + 20% for CPI and Contractor markup
	ix) Harmonic filter on VSD	1	No	$15,000	$15,000	Nominal allowance - Hargraves St PS PC allowance of $17000
	x) New controls, automation, SCADA	1	Item	$50,000	$50,000	Nominal allowance only $15 000 SCADA (as per Hargrave St) + $35000
	Subtotal				**$430,000**	
8	**NEW RISING MAIN AND GRAVITY DRAIN**					
8.1	**New Rising Main and Break Pressure Junction Box**					
	i) Connection to manifold	1	Item	$35,000	$35,000	Nominal allowance only
	ii) Supply and install new DN1050 rising main	250	m	$1,550	$387,500	Rate developed through Rawlinsons and interpolation of Hargrave Street rates
	iii) New 1800 square JB break pressure box	1	No	$25,000	$25,000	Hargraves St S/W - 1800x900 = $14000 with benching allowance
8.2	**New Gravity Drain and Outfall Structure**					
	ii) Supply and install new DN1050 gravity drain	120	m	$1,550	$186,000	Rate developed through Rawlinsons and interpolation of Hargrave Street rates
	ii) New ocean outfall adjacent yacht club (100m buried gravity drain, screen and steel pile with hazard sign)	1	Item	$210,000	$210,000	Based on ALB estimates
	iii) Connection from existing PS sump to new PS sump (15m DN1200 + break into existing)	1	Item	$50,000	$50,000	Nominal allowance only
8.3	**Dewatering and Service Relocation Allowance**					
	i) Dewatering of trenches	250	m	$600	$150,000	Nominal length. Assumes trenches below 2.5mAHD to be dewatered.
	ii) Service relocation allowance	300	m	$550	$165,000	Nominal allowance only. Hargraves St 460m, $350K, $760/m, likely fewer services at Liverpool Street
8.4	**Road Sealing**					
	I) Allowance for new spray seal / AC surface over 5m width + pump sump	1650	m^2	$15	$24,750	Hargraves St SW $18/m2 for profiling and 30AC
	Subtotal Item 7				**$1,230,000**	
9	**SYSTEM COMMISSIONING, AS CONTRUCTED DRAWINGS, MANUALS ETC**					
	i) System commissioning - assume 3 persons x 3 weeks	3	Weeks	$15,000	$45,000	Assume 3 persons x 3 weeks
	ii) As constructed drawings	1	Item	$10,000	$10,000	Nomnial allowance only
	iii) Compilation of manuals - assume 1 person x 1 week	1	Week	$5,000	$5,000	Assume 1 person x 1 week
					$60,000	
		Subtotal 1			**$3,220,000**	
		Locality Allowance		18%	$580,000	From Rawlinsons
		Project Size Allowance				
		Subtotal 2			**$3,800,000**	
		Contingency		30%	$1,140,000	
		TOTAL (exc. GST)			**$4,900,000**	

ASSUMPTIONS
All land acquisition costs excluded
Assumes adequate working areas available throughout construction period and for operation thereafter
Assumes corridor available (Eyre Street) for new rising main and gravity drain
Assumes land available for new pump station (2000L/s and 2800L/s option) in road reserve opposite existing PS with no allowance for piping flows to an alternative site
No consideration as to ongoing inflow management during works, exisitng PS remains in service throughout construction
No allowance for any building works, amenities, sheltered work areas etc
No allowance for new screens, hoists, monorails
No allowance for any increase in size of or any remediation to existing buffer storage, inlets, screens etc
No allowance made for new SAPN customer supply charge or upgrade to SAPN supply
No allowance made for any fees or charges with service authorities or governement agencies
Assumes one VSD only on single 670L/s pump

Note: Indicative construction estimates are prepared for general information only. We recommend that an appropriately qualified quantity surveyor be consulted to provide detailed advice regarding construction costs. In particular, without developed design, geotechnical and services information, actual construction costs are subject to significant variation from the values shown. Rates have been developed using a combination of Rawlinsons 2016/2017, previous tendered rates, rates developed in-house and some nominal allowances.

INDICATIVE CONSTRUCTION COST ESTIMATE

Liverpool Street Pump Station Upgrade - City of Port Lincoln

Project Element: 2800 L/s Pump Option (Nominal 375kW New PS), 370m DN1200 pipe
Job No: 20160179
Date: 29/06/2017

Estimated by: DGS
Review by: JT

Item No	Description	Quantity	Unit	Rate	Cost	Comments
1	**PRELIMINARIES, ESTABLISHMENT, ONGOING SITE AND PROJECT MANAGEMENT**					
	Mobilisation	1	Item	$70,000	$70,000	Based on Disher Creek (Renmark) project, value $1.5M, plus additional allowance for structural works
	QA, PM, JSEA - initial and ongoing	30	weeks	$5,000	$150,000	Based on 20 weeks, reduced rates based on Hargraves Street stormwater pipelay ($15 000/week)
	Survey, setout, service locations, as constructed drawings	1	Item	$50,000	$50,000	Based on Hargraves Street stormwater pipelay (450m, $50 000) plus additional building setout
	Site security and facilities	30	weeks	$1,500	$45,000	Based on 20 weeks, reduced rates based on Hargraves Street stormwater pipelay ($1 500/week)
	Demobilisation	1	Item	$30,000	$30,000	Allowance
	Subtotal				**$350,000**	
2	**HANDLING OF INFLOWS (Minor allowance only as new pump sump being constructed)**					
	Establishment of equipment	1	Item	$20,000	$20,000	Nominal allowance, existing pump station may lose functionality
	Daily hire / operation of equipment	1	Item	$10,000	$10,000	
	Disestablishment of equipment	1	Item	$10,000	$10,000	
	Subtotal				**$40,000**	Nominal allowance only
3	**DEMOLITION**					
3.1	Demolition of redundant works	1	Item	$30,000	$30,000	Nominal allowance only
	Subtotal				**$30,000**	
4	**PUMP SUMP STRUCTURE**					
4.1	**New Pump Sump Structure**					
	i) Excavate volume of sump structure and make good to subgrade level	600	m^3	$60	$36,000	Based on new PS internal size of 8.8x7.5x3.3 high + 0.4 thick walls + blind layer + 20%. Use trench rate - 25%
	ii) Base blinding layer	120	m^2	$100	$12,000	Based on new PS internal size of 7.2m x 6.9m + 0.4 thick walls + 1m perimeter x 0.5 thick
	iii) Sump walls	56	m^3	$2,000	$112,000	Based on 8.8x7.5x3.3 high, 0.4 thick walls + 25% for internal walls. R/son $1400/$m^3$, quoted rates have been greater
	iv) Sump base	32	m^3	$750	$24,000	Based on 8.8x7.5, 0.4 thick base. R/son $250/$m^3$, quoted rates have been greater
	v) Sump cover slab and beams	90	m^2	$500	$45,000	Assume precast, Rawlinson rate of $250/sqm x 2 to allow for beams
	vi) Sump access	1	Item	$20,000	$20,000	Nominal allowance for access locations and safety
	vii) Allowance for shoring	1	Item	$130,000	$130,000	Based on initial installation $80,000 +$7,500/week during construction and removal $15,000
	viii) Allowance for dewatering	1	Item	$60,000	$60,000	Based on nominal $20 000 establishment + $5000 disestablishment + $1000/day x 5 weeks
	ix) Allowance against flotation	10	m^3	$500	$5,000	Provide additional 0.5 wide toe to base slab
	x) Connection to existing storage and pipework	1	Item	$50,000	$50,000	Nominal allowance only, assumes new PS adjacent existing
	xi) Make good - site surface pavements and surrounds	150	m^2	$100	$15,000	Assume 3m wide perimeter to pump sump
	Subtotal				**$510,000**	
4.2	**New Valve Pit Structure**					
	i) Excavate volume of sump structure and make good to subgrade level	95	m^3	$60	$5,700	Based on dimensions (5.2x3.3x1.8 nom. equal to Wellington Street, 3 pumps, DN1000 manifold), increased for DN1200
	ii) Base blinding layer	36	m^2	$100	$3,600	Based on 5.2x3.6 + 0.3 thick walls + 0.5m perimeter x 0.4 thick
	iii) Pit walls	8.5	m^3	$2,000	$17,000	Based on 5.2x3.6x1.8 high, 0.25 thick walls + 10% for manifold support
	iv) Pit base	7	m^3	$750	$5,250	Based on 5.2x3.6, 0.3 thick base. R/son $250/$m^3$, quoted rates have been greater
	v) Pit cover slab and beams	30	m^2	$500	$15,000	Assume precast, Rawlinson rate of $250/sqm x 2 to allow for beams
	vi) Pit access	1	Item	$10,000	$10,000	Nominal allowance for access locations and safety
	vii) Allowance for shoring	1	Item	$23,100	$23,100	Based on $20/m2/day (trench rate) x 55 sqm x 3 weeks. Establishment included in 3.1
	viii) Allowance for dewatering	1	Item	$21,000	$21,000	Based on $1000/day x 3 weeks. Establishment included in 3.1
	ix) Allowance against flotation	4	m^3	$500	$2,000	Provide additional 0.5 wide toe to base slab
	x) Connection to existing storage and pipework		Item			N/A
	xi) Make good - site surface pavements	60	m^2	$100	$6,000	Assume 2m wide perimeter to valve pit
	Subtotal				**$110,000**	
5	**PUMP SUPPLY AND INSTALLATION (3 x 930L/s Pumps plus Jockey Pump)**					
	I) Modification of existing supports for new pumps					N/A, new sump being installed
	ii) Supply and installation of new supports	4	No.	$2,000	$8,000	Nominal allowance
	iii) Supply of new duty pumps 400L/s	3	No.	$93,000	$279,000	Supply and delivery of NP3531/736 870 125kW + 15% Contractor Fee
	iv) Installation of new duty pumps 400L/s	3	No.	$3,800	$11,400	Based on Hargraves Street stormwater PS large pump install ($3 800 each)
	v) Supply of jockey pump	1	No.	$29,000	$29,000	Supply and delivery of NP3202.185 LT 617 Imp Code 22kW + 15% Contractor Fee
	vi) Installation of new jockey pump	1	No.	$2,000	$2,000	Based on Hargraves Street stormwater PS large pump install ($3 800 each)
	Subtotal				**$330,000**	
6	**VALVE AND MANIFOLD SUPPLY AND INSTALLATION**					
	i) Removal of existing valve pit cover slab and make good after					N/A as new pit to be provided
	ii) Supply and install new DN1200 manifold with 3 x DN500 branches	1	Item	$160,000	$170,000	Based on Wellington Street manifold, DN1000 with 3 x 600 branches, $130000
	iii) Supply and install new DN350 non return valves	1	Item	$52,000	$52,000	Extrapolated based on internet price list of $6000 for DN300
	iv) Connecting DN350 pipework from pumps to manifold	4	No.	$7,500	$30,000	Nominal allowance only
	Subtotal				**$250,000**	
7	**ELECTRICAL SUPPLY**					
	i) Supply new generator - low flows - assume 50kVA	1	No	$20,000	$20,000	Nominal allowance based on quoted price for 220kVA generator
	ii) Install and commission new generator - low flows - assume 50kVA	1	Item	$10,000	$10,000	Nominal allowance including site prep, controls, auto-switching. Total cost Rawlinsons = $40K to $60K
	iii) Supply new generator - duty flows 580kVA generator	1	No	$105,000	$105,000	Quoted price for 275kVA generator from MacFarlane Generators + 15% contractor markup
	iv) Install and commission new generator - duty flows	1	Item	$50,000	$50,000	Nom. allow. inc. site prep, controls, auto-switching, security. Total sup+inst cost R/insons = $80K to $100K
	v) New power supply cabling 600A from generator to PS site including excavation, laying, reinstatement	130	m	$580	$75,400	Rate built up based on 4 x 300 sqmm cables and Rawlinson rates
	vi) New switch room (9m x 3m x 2.4m high) prefabricated hut, inclusive of foundation and underfloor vault	1	Item	$40,000	$40,000	Based on Williams Prefabricated building and concrete underfloor vault for cable entry
	vii) New switchboard and control panel	1	Item	$125,000	$125,000	Nominal allowance
	viii) New VSD - 150kW	1	No	$40,000	$40,000	Extrapolated from Danfoss price list 2012 + 20% for CPI and Contractor markup
	ix) Harmonic filter on VSD	1	No	$20,000	$20,000	Nominal allowance - Hargraves St PS PC allowance of $17000
	x) New controls, automation, SCADA	1	Item	$55,000	$55,000	Nominal allowance only $15 000 SCADA (as per Hargrave St) + $40000
	Subtotal				**$540,000**	
8	**NEW RISING MAIN AND GRAVITY DRAIN**					
8.1	**New Rising Main and Break Pressure Junction Box**					
	i) Connection to manifold	1	Item	$35,000	$40,000	Nominal allowance only
	ii) Supply and install new DN1200 rising main	250	m	$1,800	$450,000	Rate developed through Rawlinsons and interpolation of Hargrave Street rates
	iii) New 2000 square JB break pressure box	1	No	$30,000	$30,000	Hargraves St S/W - 1800x900 = $14000 with benching allowance
8.2	**New Gravity Drain and Outfall Structure**					
	i) Supply and install new DN1200 gravity drain	120	m	$1,800	$216,000	Rate developed through Rawlinsons and interpolation of Hargrave Street rates
	ii) New ocean outfall adjacent yacht club (100m buried gravity drain, screen and steel pile with hazard sign)	1	Item	$210,000	$210,000	Based on ALB estimates
	iii) Connection from existing PS sump to new PS sump (15m DN1500 + break into existing)	1	Item	$60,000	$60,000	Nominal allowance only
8.3	**Dewatering and Service Relocation Allowance**					
	i) Dewatering of trenches	270	m	$600	$162,000	Nominal length. Assumes trenches below 2.5mAHD to be dewatered.
	ii) Service relocation allowance	300	m	$580	$174,000	Nominal allowance only. Hargraves St 460m, $350K, $760/m, likely fewer services at Liverpool Street
8.4	**Road Sealing**					
	I) Allowance for new spray seal / AC surface over 5m width + pump sump	1700	m^2	$15	$25,500	Hargraves St SW $18/m2 for profiling and 30AC
	Subtotal Item 7				**$1,370,000**	
9	**SYSTEM COMMISSIONING, AS CONTRUCTED DRAWINGS, MANUALS ETC**					
	i) System commissioning - assume 3 persons x 3 weeks	3	Weeks	$15,000	$45,000	Assume 3 persons x 3 weeks
	ii) As constructed drawings	1	Item	$10,000	$10,000	Nomnial allowance only
	iii) Compilation of manuals - assume 1 person x 1 week	1	Week	$5,000	$5,000	Assume 1 person x 1 week
					$60,000	
		Subtotal 1			**$3,580,000**	
		Locality Allowance		18%	$640,000	From Rawlinsons
		Project Size Allowance				
		Subtotal 2			**$4,220,000**	
		Contingency		30%	$1,270,000	
		TOTAL (exc. GST)			**$5,500,000**	

ASSUMPTIONS

All land acquisition costs excluded
Assumes adequate working areas available throughout construction period and for operation thereafter
Assumes corridor available (Eyre Street) for new rising main and gravity drain
Assumes land available for new pump station (2000L/s and 2800L/s option) in road reserve opposite existing PS with no allowance for piping flows to an alternative site
No consideration as to ongoing inflow management during works, exisitng PS remains in service throughout construction
No allowance for any building works, amenities, sheltered work areas etc
No allowance for new screens, hoists, monorails
No allowance for any increase in size of or any remediation to existing buffer storage, inlets, screens etc
No allowance made for new SAPN customer supply charge or upgrade to SAPN supply
No allowance made for any fees or charges with service authorities or governement agencies
Assumes one VSD only on single 930L/s pump

Note: Indicative construction estimates are prepared for general information only. We recommend that an appropriately qualified quantity surveyor be consulted to provide detailed advice regarding construction costs. In particular, without developed design, geotechnical and services information, actual construction costs are subject to significant variation from the values shown. Rates have been developed using a combination of Rawlinsons 2016/2017, previous tendered rates, rates developed in-house and some nominal allowances.