Metro Property Development

Canterbury Towers Stage 3 Wastewater Storage

CONCEPT DESIGN REPORT
March 2014

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HydroScience
Strategic Water Solutions

Canterbury Towers Stage 3 Wastewater Storage

Concept Design Report

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1 Introduction

1.1 Background

Canterbury Towers is a residential development in Water Street, Fortitude Valley developed by Metro Property Development.

The sewer in Water Street has limited capacity and Queensland Urban Utilities (QUU) has plans to construct a new sewer to allow additional development in the area. However, the construction of the duplicate sewer is delayed.

Metro is in the process of developing the first three stages of Canterbury Towers. QUU has given approvals to connect Stages 1 and 2 to the existing sewer, and has agreed to consider allowing the connection of Stage 3 if a satisfactory arrangement to limit the impact on the sewer is implemented by Metro. A copy of QUU email listing the requirements is included in Appendix A.

1.2 The Project

Metro commissioned Lambert & Rehbein and HydroScience to develop a solution for the management of wastewater from Stage 3 to meet QUU's requirements.

1.3 This Report

This report describes the concept design. Its purpose is to:

- Present the proposed solution to stakeholders, in particular QUU and Brisbane City Council (BCC)
- Obtain approval from QUU and BCC
- Be a basis for the detailed design

1.4 Meetings with Regulators

As part of preparing this concept design, Metro and its consultants met with:

- David Morrow of QUU on 28 August 2013
- Eddie Denman and Anthony Taber of BCC Plumbing on 17 October 2013

This report addresses the issues raised in these meetings.

2 Design Criteria

2.1 Equivalent Persons Loadings

The following values have been agreed as the equivalent person (EP) loadings for the development:

- Stages 1 and 2: 550 EP — Source: QUU, Email 27 June 2013 (Appendix A)
- Stage 3: <u>341 EP</u> — Source: Report by Robert Bird Group 10 April 2013, based on 200 dwellings and 150 m² of retail space
- Total: 891 EP

2.2 Flow Estimation Parameters

To estimate the flow, the SEQ Code (South East Queensland Water Supply and Sewerage Design and Construction Code) design criteria were used.

Use of this Code was advised by QUU. The flow estimation in the SEQ code is similar to the QUU 2011 Standard. The relevant data is shown in Figure 1.

Figure 1: SEQ Code Flow Estimation

NuSewer - d x SF + GWI
Where:
SF = Sanitary Flow of 150L/EP/d
GWI = Groundwater Infiltration of 30L/EP/d

EP	30	300	600	1.2k	3k	12k
d*	7.8	4.2	3.7	3.2	2.7	2.2

The adopted criteria for calculating the design loadings are as follows:

- Average dry weather flow (ADWF): 150 L/EP/day
- Peak dry weather flow (PDWF) d x ADWF

Groundwater infiltration is excluded from the calculation as all the sewer pipes upstream of the connection to QUU are within the buildings.

2.3 Flow Rate Calculation

2.3.1 Stages 1 + 2

From the table in Figure 1, the peaking factor d for 550 ET is approximately 3.8.

- ADWF: 550 x 0.15= 82.5 kL/day or 1.0 L/s
- PDWF: 3.8 x 1.0 = 3.8 L/s

2.3.2 Stage 1 + 2 + 3

The three stages total 891 EP. The peaking factor is approximately 3.5. The calculated flows are:

- ADWF: 891 x 0.15= 134 kL/day or 1.6 L/s
- PDWF: 3.5 x 1.6 = 5.6 L/s

2.4 Diurnal Flow Curves

2.4.1 Background

Wastewater flows from residential development is characterised by diurnal flow pattern. The pattern typically includes a morning peak, a smaller peak in the early evening and very low flows at night.

For this project, the outcomes of a 2009 research project by the CSIRO were used as the basis for the diurnal flow estimation.

The CSIRO project[1] included plotting diurnal flow pattern for a number of sub-catchments, including one with 163 households. This is estimated to be approximately 500 EP, and is the closest to the proposed Canterbury Towers development. The flow pattern from the SCIRO report is shown in Figure 2.

Figure 2: CSIRO Diurnal Flow Pattern

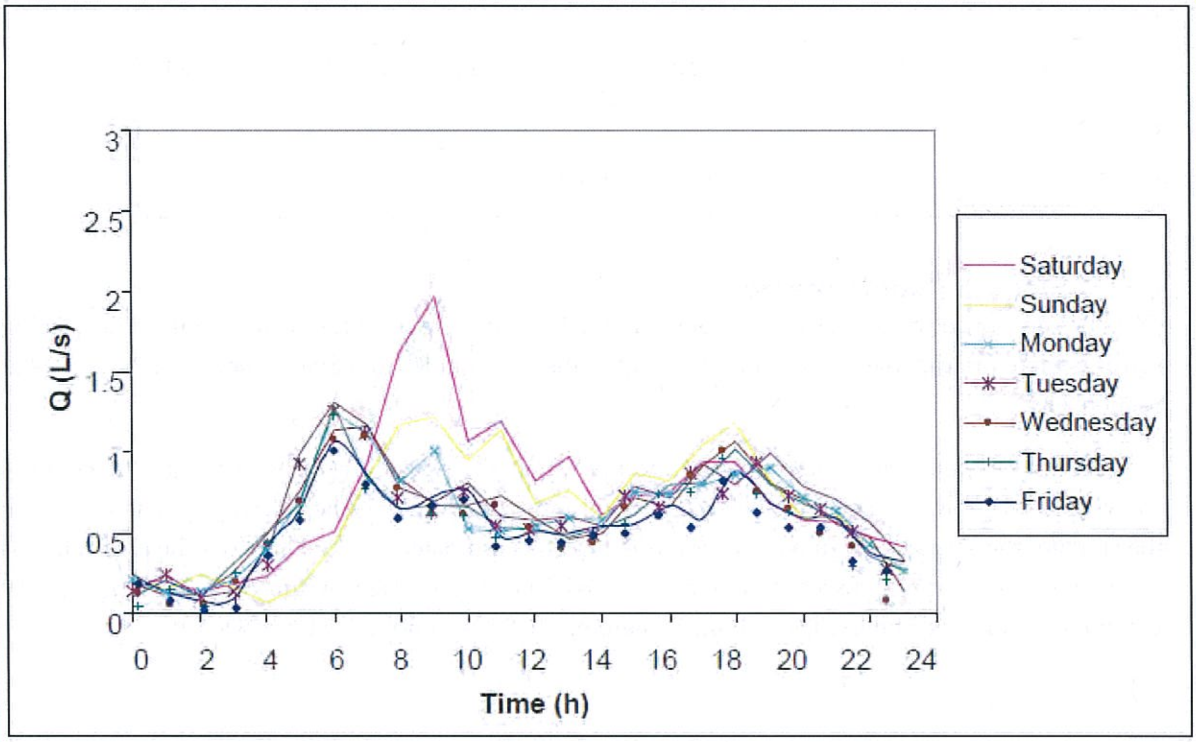

Figure 6: Diurnal flow profile for 163 households (22-28 Feb 2008)

The peak daily flow (other than on Saturday) is approximately 1.5 L/s, indicating a peaking factor of 2.2 (the mean flow rate was 0.67 L/s).

2.4.2 Proposed Diurnal Flow Distribution

Based on the general pattern shown in Figure 2, and using the flow parameters listed in Section 2.3.2, a diurnal flow pattern was developed for the Canterbury Towers development as shown in Figure 3. This flow curve has been calibrated to reflect the Stage 1+2+3 flow and the peaking flow factor discussed in Section 2.3.2. Given that the peaking factor adopted for this development (3.5) is higher

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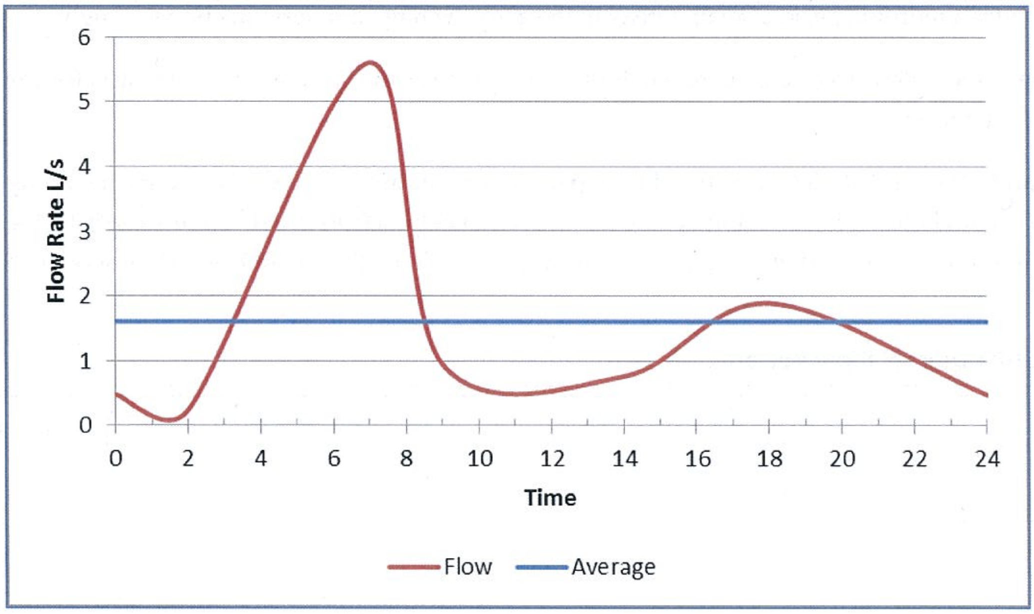
[1] Characterisation of Priority Contaminants in Rresidential Wastewater, SCIRO, August 2009 (http://tinyurl.com/pzb398q)

than the peaking factor calculated by the SCIRO (2.2), the curve in Figure 3 is taller and steeper than the flow pattern shown in Figure 2.

Figure 3: Canterbury Towers Stages 1+2+3 Diurnal Flow Curve

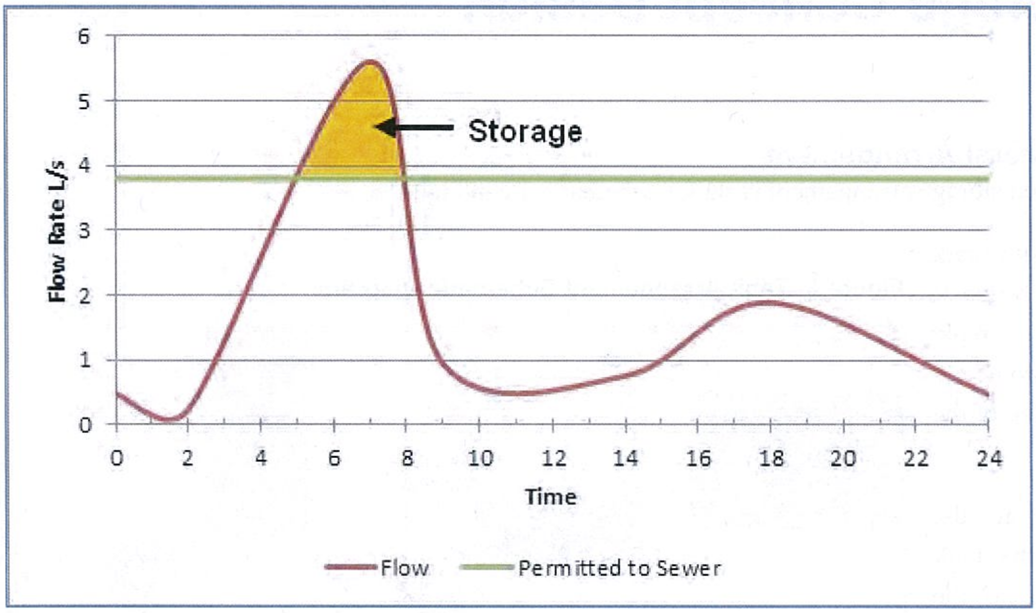


2.5 Storage Requirements

QUU has approved the discharge from Stage 1 and 2 without the need for onsite storage. The existing sewer is therefore capable of receiving flows up to the PDWF rate from Stage 1 and 2, or 3.8 L/s (refer Section 2.3.1).

Wastewater will need to be stored when the flow from the development exceeds 3.8 L/s. Figure 4 shows that this flow is expected to be exceeded for approximately three hours per day. The volume of the storage, shown as the highlighted area in Figure 4, is estimated at 10,000 litres. (The calculation is as follows: The maximum excess flow rate: 5.6-3.8=1.8 L/s. On average, assume half the flow rate (0.9 L/s) for a duration of 3 hours. The volume is therefore 10,800 seconds x 0.9 L/s=9,720 L).

Figure 4: Storage Requirements



3 Storage Concept Design

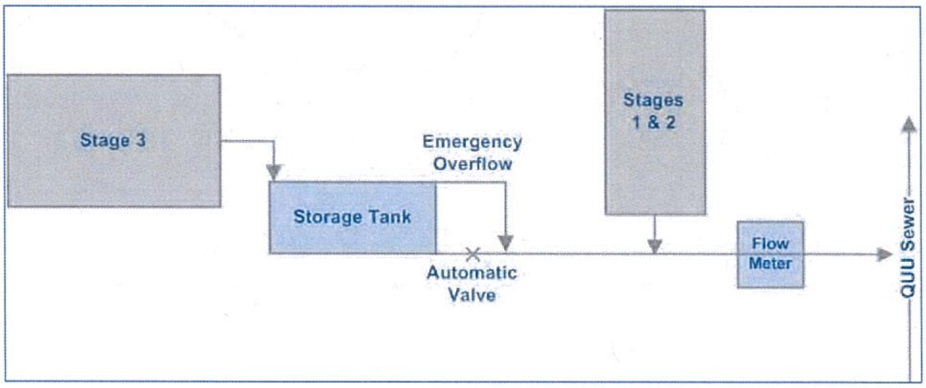
3.1 General Arrangement

The proposed storage arrangement is shown schematically in Figure 5.

All flows from Stage 3 will be diverted to the storage tank, entering through a pipe at the top of the tank.

An outlet at the bottom of the tank will connect to the sewer pipe in Stage 1, directing the flows to the QUU sewer in Water Street.

Figure 5: Tank Arrangement Schematic Diagram



An actuated valve on the outlet pipe will be normally open. When the flow to the QUU sewer exceed the allowed preset flow rate, the valve will close, and the wastewater from Stage 3 will be stored in the tank. When the flow rate to the QUU sewer subsides, the valve will open gradually and allow the tank to empty to the QUU sewer.

3.2 Storage Tank

3.2.1 Capacity

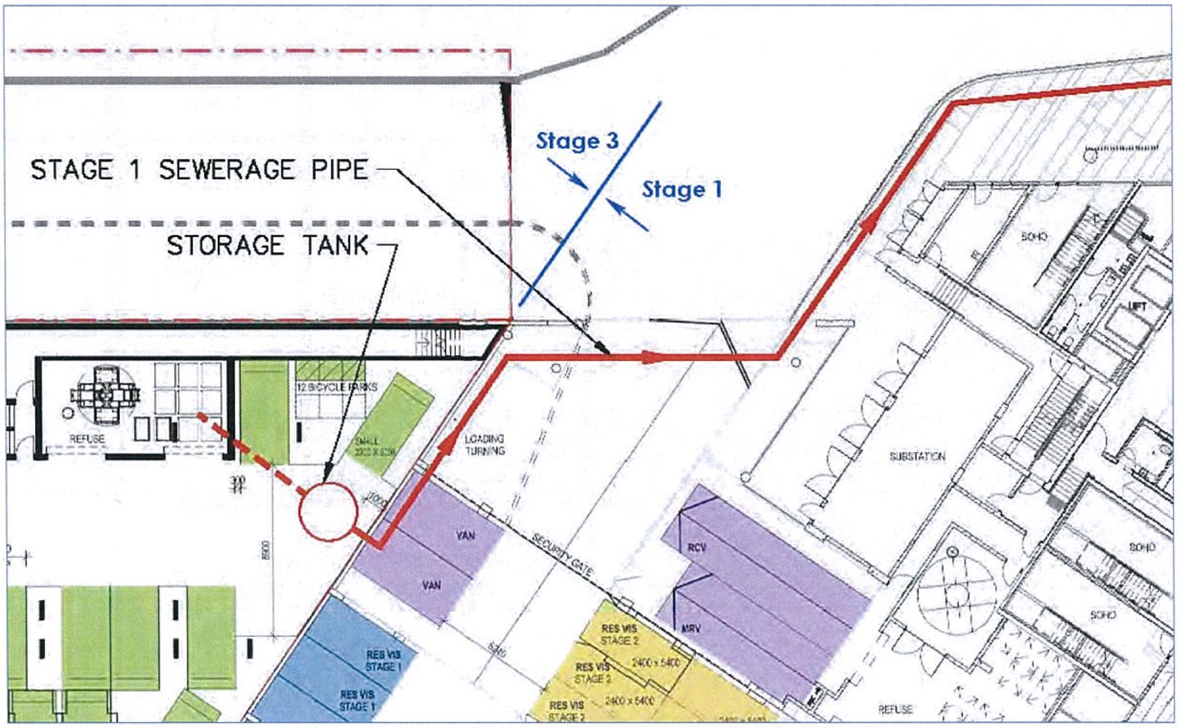
The calculation in Section 2.5 concludes that the required storage is 10 kL.

To allow for variations from the expected pattern, it is proposed to adopt a storage tank of 15 kL capacity.

3.2.2 Location

The storage tank will be located at P1 level, near the boundary between Stage 3 and Stage 1. An approximate location is shown in Figure 6.

Figure 6: Tank Location



Note: The exact location will be decided at the detailed design stage, and will depend on car spaces arrangement and the final layout of Stage 3.

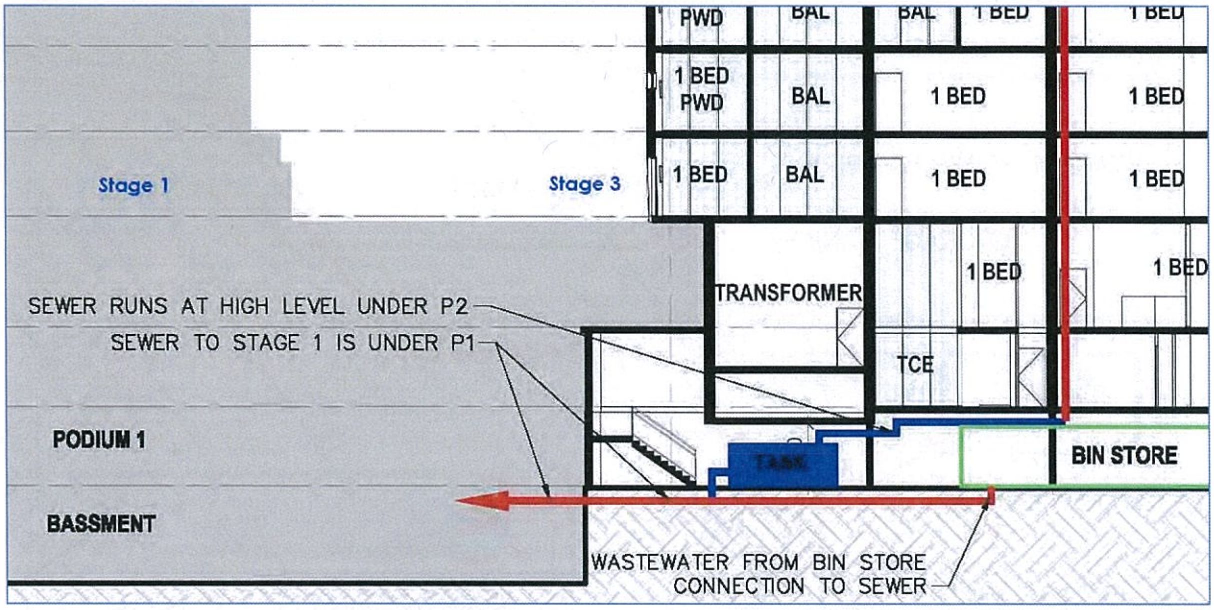
3.2.3 Hydraulics

The proposed arrangement is described in the cross section sketch in Figure 7. The tank will be located at Podium 1 (P1) level of the Stage 3 building.

The sewer pipe in the Stage 1 building is located under the floor slab of P1. The outlet pipe from the storage tank will be connected to this pipe, as shown in Figure 7.

At this time it is not clear if the Stage 3 building will include a basement level. If not (as shown in Figure 7), the pipe downstream of the storage tank will be located under the floor slab of P1, and then connected to the sewer pipe in Stage 1. If a basement level is included in Stage 3, the pipe downstream of the tank will be strapped to the underside of P1 floor slab.

Figure 7: Storage Tank Arrangement Cross Section



3.2.4 Type

A standard circular polyethylene tank is proposed for this application. A typical tank is shown in Figure 8.

Figure 8: Poly Tank

The standard height of a tank of this size is typically 2.4 m. While this would fit within the headroom of 2.5 m, it is preferred to use a shallower tank, approximately 2 m deep, to allow for visual inspection and the occasional flushing with a hose if required. This will likely require a made to order tank.

A 15 kL tank with water depth of 1.8 m (allowing for freeboard) will be approximately 3.4 m in diameter. It is assumed that access for delivery and installation, as well as the subsequent removal of the tank will be available at P1 level.

3.2.5 Signage

The tank will be clearly marked with a sign bearing the following notice:

Stored Wastewater to be drained within 24 hours **in accordance with the Queensland Plumbing and Wastewater Code**

3.3 Odour Control

Based on the data presented in Figure 4, the duration of the stored flow is not likely to exceed 3-5 hours. This is not excessive storage time for fresh wastewater, and the risk of odours is considered low.

This notwithstanding, it is proposed to provide a 100 mm vent pipe from the tank to a vent stack located in the landscaped area on the surface, with an outlet raised at least 3 m above the ground. The vent stack will be equipped with an odour filter and a wind driven extraction fan, to disperse and filter the air extraction.

An air inlet pipe with a one way flap valve will be installed in the tank to allow air into the tank when the water level drops.

3.4 Bin Storage Drainage

The only wastewater in P1 level is the drain from the bin storage area, near the proposed location of the storage tank.

It is proposed to connect this drain to Stage 1 sewer pipe, bypassing the storage tank. The impact on the flows to the QUU sewer is expected to be negligible as this is not a constant flow.

3.5 Emergency Overflow

The storage tank will be equipped with a high level emergency overflow that will connect to the sewer downstream of the automatic valve. This will protect the area around the tank from sewage spill in case of a fault in the operation of the valve, or unusually high flow.

Given that the proposed volume of the tank is 50% larger than the calculated requirement, it is unlikely that overflow will occur.

A water level probe installed in the tank will continuously monitor the water level in the tank. The signal from the probe will feed into the building SCADA system.

The required storage volume is 10 kL, and the tank will have storage volume of 15 kL. It is proposed to set a storage volume of 12 kL as the critical control point. If the tank is filled to this level, the control system will trigger an alarm, alerting the building management. This will allow maintenance personnel to attend to the matter before overflow occurs.

3.6 Impact on Surrounding Properties

In its email of 27 June 2013 (Appendix A), QUU advised that 'a couple of of properties are known to have sewer property connections into their basement', and required that this report addresses this issue.

In the meeting between QUU, Metro, and Metro's consultant, QUU could not provide information on these properties.

As this temporary storage arrangement is designed to limit the flow in the QUU sewer to pre-Stage 3 developments, it is considered that the addition of Stage 3 will not increase the risk of surcharging in the Water Street sewer, and consequently will not affect any surrounding properties.

3.7 Surchage Relief

Overflow relief gullies (ORGs) are provided 150 mm below the lowest fixture level on Stages 1 and 2 Buildings, and thus, surcharge cannot enter the lowest areas of Stages 1 and 2 Buildings.

These will also prevent any backflow to the storage tank.

4 Instrumentation, Control and Reporting

4.1 Instrumentation

4.1.1 Flow Measurement

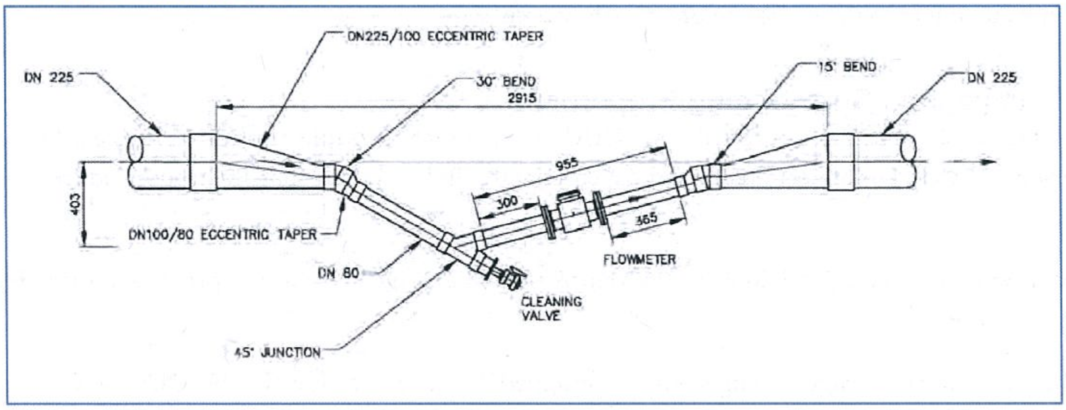
Flow Meter

A magnetic flow meter will be installed on the 225 mm diameter pipe connecting to the QUU sewer in Water Street within the Stage 1 building.

For a magnetic flow meter to operate correctly, the pipe has to flow full. To ensure full pipe flow, the flow meter will be installed with an inverted siphon as shown in Figure 9. The installation will include an outlet for cleaning any solids accumulating in the low point. A weekly maintenance task will include opening the valve and draining and cleaning the syphon. This activity may be done less frequently if supported by operational experience.

Standard installation recommends a length of pipe equivalent to 5 times the pipe diameter upstream of the flow meter. However, in order to reduce the risk of blockage it is proposed to reduce this length. The inaccuracies resulting from a shorter length are expected to be insignificant. A weekly maintenance task will include opening the valve and draining and cleaning the syphon. This activity may be done less frequently if supported by operating experience.

Figure 9: Flow Meter Installation



Notes to Figure 9:

1. The sketch is conceptual only. Dimensions will depend on the type of equipment used
2. It was assumed that the 225 is not yet installed. If it exists, appropriate couplings will be required to insert the flow meter assembly
3. The assembly needs to be securely anchored to a wall and/or roof slab
4. The cleaning valve may have a Camlock fitting, or other fitting consistent with other building fittings

Size

The upflow section of the pipe requires a minimum velocity for self-cleansing and preventing deposition of solids.

The minimum flow for sewer rising mains according to the SEQ Code is 0.75 m/s (Table 10, D7). This criterion is suitable for the proposed installation, as rising mains often flow upwards. The target is to achieve this velocity at least once a day, during peak flow.

For flow of 3.5 L/s (refer Section 4.2 below), a pipe diameter of 80 mm would provide velocity of 0.7 m/s. It is proposed an 80 mm pipe for the upflow section for the following reasons:

- It is impractical, and risky, to use a smaller pipe than 80 mm diameter
- This is a temporary installation and some of the consideration for minimum velocity in rising mains (slime control) is not applicable
- A provision for cleaning will be provided, as shown in Figure 9

The diameter of the sewer pipe in Stage 1 is 225 mm. It is proposed to reduce the size of the pipe to 80 mm for the upflow section, including the flow meter, using appropriate reducers.

Monitoring

The flow rate will be monitored continuously, and the data will be monitored and logged by the building management system.

4.1.2 Water Level

The water level in the tank will be monitored continuously using a level sensing probe, Multitrode or similar. The signal from the probe will be transmitted to the building management system.

4.2 Control

The flow in the pipe to the QUU sewer will be used to control the system using the building management and the SCADA system.

The basis of the operation will be a PID controller that will monitor the flow to the QUU sewer and control the actuated outlet valve. The PID controller will respond to changes in the flow rate, and adjust the valve opening accordingly. For example, if the flow rate is 3.0 L/s, the PID controller will open the valve 10%, but if the flow rate is, say, 1.0 L/s the PID controller will open the valve fully. In other words, the PID will 'hunt' flow rates in the range 3.0-3.5 L/s by gradual opening and closing the outlet valve.

Below is a preliminary functional description of the control system. Typically, actions will have an appropriate delay time to verify that the condition is real.

No.	Condition	Action
1	Flow rate is greater than 3.5 L/s	CLOSE the outlet valve
2	Flow rate is less than 3.0 L/s	Open the diversion gradually, using the PID loop to maintain the measured flow between 3.0 and 3.5 L/s.
3	Water level in the tank rises to pre-set HIGH level (say 0.5 m from the top of the tank)	Raise ALARM 1
4	Water level in the tank rises to the overflow level (say 0.2 m from the top of the tank)	Raise ALARM 2

4.3 Management and Reporting

For the effective management of the system, the operation needs to be monitored by the building management system.

Alarms will be raised as described in the previous section, and also for equipment failures.

Records are to be kept in the SCADA system for the following parameters:

- ❑ Flow measurement (continuous)
- ❑ Outlet valve operation
- ❑ Water level in the storage tank

QUU requested monthly reports on the operation of the system for the first three months, and quarterly reports thereafter. However, QUU also advised that the reporting requirements may change.

4.4 Risk Mitigation

The following mitigation / risk management facilities and procedures are proposed:

- ❑ Continuously monitor the operation of the system and the water level in the storage tank and raise an alarm in case of failure
- ❑ Provide a hand wheel on the tank outlet valve to enable an operator to override the actuator in case of failure
- ❑ Provide access for a mobile tanker in case of emergency
- ❑ Include details of mobile tanker operators in the operations plan / incident management plan to enable the building manager to bring in a tanker on a short notice
- ❑ Scheduled maintenance of the syphon to prevent solids accumulation (refer 4.1.1)
- ❑ Vent stack with extraction fan to prevent gas accumulation in the tank (refer 3.3)

5 Decommissioning

It is expected that QUU will upgrade the sewer in Water Street within a few years from the occupation of Stage 3. This will remove the restrictions on the flow from Canterbury Towers, and require the decommissioning of the wastewater storage system.

The decommissioning will cover two components:

- The removal of the storage tank, and connection of the of Stage 3 wastewater system directly to Stage 1. The proposed arrangement after the removal of the tank is shown in Figure 10
- The removal of the flow meter assembly and restoring the wastewater pipe to a continuous 225 mm pipe using appropriate couplings. This is shown in Figure 10

Figure 10: Future Stage 3 Sewer Connection

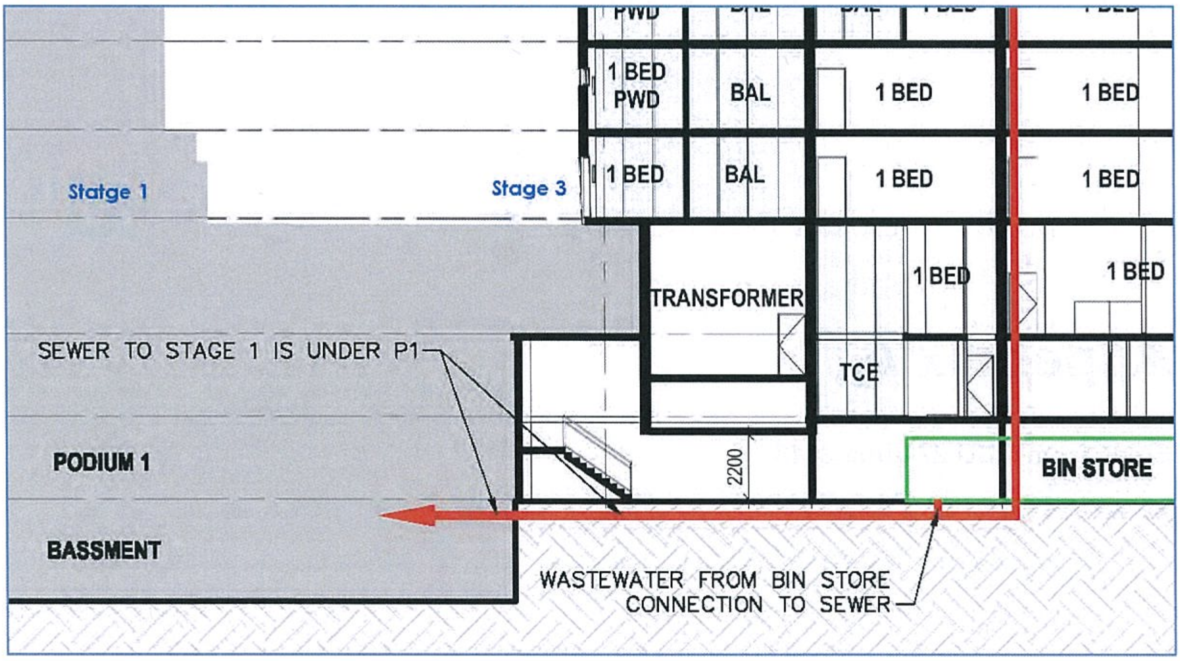
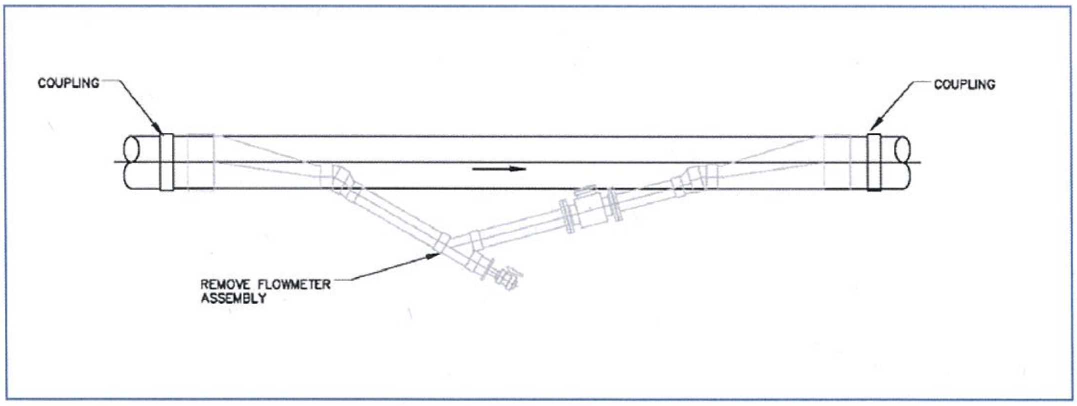


Figure 11: Removal of Flow Meter Assembly



Appendix A

Email from QUU 27 June 2013

From: David Morrow [mailto:David.Morrow@urbanutilities.com.au]
Sent: Thursday, 27 June 2013 5:21 PM
To: Iain Knight; Development Enquiries
Subject: RE: 119/80/979/132/12 Water Street - Cambridge Towers external sewer

Ian

As previously stated in emails to Damien Todd. The Water St sewer is overloaded. RNA development was allowed to develop up to 1496 EP before it must construct the proposed 600/675mm sewer connecting the Water St sewer to the S1 sewer. Stages 1 & 2 of Metro Property Development's Cambridge Towers was allowed to use 550 EP of the 1496 EP allocation. Metro Property Developments has requested could they could utilise the remaining allocated EPs. This has been refused by QUU as they were intended for the builder of the 600/675mm sewer as they should be left something to establish some cash flow to offset construction.

I have looked at various solutions to offset the additional flow from proposed Stage 3 of the development and have not found one that is worthwhile. The options include the developer building the 600/675mm sewer themselves or pumping via private rising main from the site to the S1 sewer in Ann St, the first sewer downstream that had adequate capacity.

Because a large development is being impeded by delays in construction of a large trunk sewer being built by a third party I believe it is unfair that this development should be stopped. Therefore in this instance, as a one off allowance, QUU will permit provided it can be demonstrated to QUU that it is feasible and will not cause any negative impact on the sewer and surrounding property owners the use of temporary on-site storage to offset the additional flow of Stage 3 of the development.

To have QUU approve the use of this option the developer will need to commission a report and have it forwarded to QUU for endorsement. The report will need to address the issues of odour, sewer surcharging and property connection protection of surrounding properties (a couple of properties are known to have sewer property connections into their basement). It will also need to show calculations regarding flows in and out, demonstrate adequate storage, and planned operating regime.

It is assumed the maximum outflow (using pumps with a valved outlet that can drain storage to sewer if required) allowable for the site will be PDWF for approved Stages 1 & 2. Flow that is in excess of this will need to be stored and released once inflow is lower than PDWF. Possible ways to address odour will be Magnesium Hydroxide or aeration of the stored sewage with odour scrubbing of vented air. Note Magnesium Hydroxide coagulates and drops out of suspension when added to still sewage. Other issues to address include WH&S handling and storing of chemicals, approval from BCC plumbing services as well as from EDQ to allow development approval.

The system will need to be on your development premises and maintained and operated by yourself and must be decommissioned and removed once the 600/675mm trunk sewer is built by RNA/ Lend Lease.

You can contact by phone or email if you require further information.

Regards

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