REDUCING WASTEWATER OVERFLOWS – LESSONS LEARNED IN HUTT CITY

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ABSTRACT

The Waiwhetu area of Hutt City is a residential area that is over 50 years old and sits on alluvial gravels that experience high fluctuating groundwater conditions in wet weather. The wastewater reticulation system is aged and until recently experienced significant infiltration that caused overflows of diluted wastewater to the Waiwhetu Stream. In 2004, the Council obtained resource consents that permitted wet weather overflows from two overflow structures to the Waiwhetu Stream for a period of 5 years.

Those consents required Council to implement an effective upgrading programme that would result in overflows being largely avoided in rainfall events up to a 5-year return period. In early 2010 Council was granted renewals to those consents for a period of 15 years as the programme had demonstrated a significant reduction in the frequency and duration of the overflows.

KEYWORDS

Inflow, infiltration, wastewater, overflow, policy, lateral, community, consent

1.0 INTRODUCTION

In April 2010 Capacity Infrastructure Limited ("Capacity") on behalf of Hutt City Council renewed two resource consents to discharge wastewater overflows from two pumping stations into the Waiwhetu Stream during wet weather for a period of 15 years.

When granting consent the commissioners acknowledged "*the extensive, and costly, improvement works the applicant has undertaken in the past five years*". While Hutt City did commit substantial resources into upgrading the public network to reduce wet whether overflows, it was the participation and commitment of the Waiwhetu community that ultimately lead to the project's success.

The purpose of this paper is to explain why the Council and community embarked on the journey we did, to describe the drivers, issues and outcomes of the programme, and to outline the lessons learned along the way.

2.0 WAIWHETU

Waiwhetu means "*star reflecting in water*" or "starry water", and is the name given to the largely residential area located adjacent to the eastern hills of the Hutt Valley

between the southern end of Naenae and the northern boundaries of the industrial areas of Gracefield and Seaview.

Waiwhetu has a rich Māori history dating back to before the 1820s, and the name 'Waiwhetu' was the name given to the Māori pa that once stood at the intersection of the Hutt River and the Waiwhetu Stream.

The Waiwhetu area is now largely residential, with the bulk of the development in the area occurring in the in the post-war1940's and 50's. Like other areas of New Zealand developed in this period, the landscape is characterised by:

- Housing stock dominated by single level weatherboard villas and ex-state homes, centrally positioned on relatively large geometric lots.
- The incorporation of 'garden city' principles, including wide curvilinear streets, and an abundance of recreational spaces.
- Gravity fed stormwater and wastewater reticulation.

The Waiwhetu Stream is the main drainage channel for much of the eastern side of the Hutt Valley, from Naenae in the north to its outlet to the Hutt River. The stream itself has a checkered history; where it once provided local Māori with an abundance of crayfish, watercress, Inanga and other delicacies, urbanisation and industrialisation left it with the reputation of being one of New Zealand's most polluted streams.

In 2010 Hutt City Council, the Wellington Regional Council and the Ministry for the Environment committed to a $14 million cleanup of the lower reaches of the stream, to clean up contaminated sediments and to reduce flood risk.

3.0 OVERVIEW OF THE WAIWHETU WASTEWATER NETWORK

Hutt City's local wastewater reticulation consists of relatively small diameter (150mm to 225mm) pipes connected to the truck (up to 1,350mm) which conveys wastewater from both Hutt and Upper Hutt to the Seaview treatment plant and then onto the outfall at Pencarrow Head.

The bulk of both Hutt City's local and trunk wastewater system is gravity fed, but in low lying areas such as Waiwhetu (where gravity drainage is simply not practical), pumping is provided.

The Waiwhetu wastewater catchment is approximately 207 hectares in area and is divided into three interconnected sub-catchments – defined by the supporting pump stations and related infrastructure.

- Malone Road ("Area 1"). This sub-catchment is the smaller of the two catchments on the western side of the Waiwhetu Stream, and it comprises over 550 individual properties.
- Whites Line East ("Area 2"). This sub-catchment is straddles the Waiwhetu Stream and comprises over 750 properties.

- Leighton Avenue Gravity catchment ("Area 3"). This sub-catchment is the biggest of the three, and comprises over 1200 properties.

A map showing each of the three sub-catchments is appended (Appendix 1).

Both the Malone Road and Whites Line East catchments pump wastewater into the Leighton Avenue Gravity catchment which then drains to the Barber Grove Pumping Station, and on to the Seaview treatment plant.

During wet weather there is a significant increase in wastewater flow in Area 1. Prior to 2004, the severity of increased inflow, measured as rain induced inflow and infiltration indicator (R.I.I/I) was as high as 20. Flow records indicated that the pumping station pumps ran continuously at a peak rate of 55 litres/second, with a simultaneous peak overflow rate of more than 20 litres/second, for several hours during wet weather. The peak wet weather flow factor (peak wet weather flow/average dry weather flow) was therefore more than 15 in Area 1. It took up to 22 days for the system to return to normal dry weather flow after a rainfall event of 76 mm of rain. Wastewater overflows, to the Waiwhetu Stream at the south end of Malone Road, occurred several times per year and often in rainfall events that had return periods.

Wastewater flows in Area 2 also increases during wet weather flow, albeit to a less extent that the Malone Road catchment. The catchment has a R.I.I/I of 16, and wastewater overflow is triggered when the Whites Line East pump station has to operate with both pumps running at a time when the downstream drains are running full. The overflow structure in this catchment is located at the Hinemoa Street where there is an overflow pipe into the stormwater drain that discharges to the Waiwhetu Stream.

Area 3 does not need to be pumped and it drains to the Barber Grove pump station by gravity. During wet weather, the system becomes fully surcharged due to significant levels of infiltration, and this restricts the ability of Area 1 and Area 2 to pump into it.

4.0 FACTORS TRIGGERING WET WEATHER OVERFLOWS IN THE WAIWHETU AREA

Hutt City Council first obtained consents to operate the overflows during heavy rainfall events in 1999. The conditions of the original committed Council to an investigation and upgrade programme to reduce overflows during wet weather.

Despite replacing several sections of old cracked or leaking public main, and carrying out a house to house survey to find sources of stormwater inflow into the system, the investigation was stepped up in 2002 when it was found that flows had not noticeably reduced.

During the period 2002 - 2004 significant investigations were carried out to assess the capacity of the system, how it operated in wet weather, the degree of flow increase, and the sources of the increase. These investigations included testing the water tightness of the joints in the public mains and testing a trial area of private drains. These investigations concluded that a large number of sections of the public drains that appeared to be in sound structural condition (i.e. not cracked) had leaking joints that allowed groundwater to enter into the drain (infiltration).
The investigation also found that up to 80% of the private drains in Area 1, also allowed groundwater to enter through cracks, holes and leaking joints.

The conclusion drawn from this investigation was that the main issue was simply the aged drainage system, the type of joints in the pipes and the rise of groundwater during heavy or constant rain fall. Groundwater was observed to quickly rise above the level of most of the drains during heavy wet weather, thus providing a source of water to enter the leaking drains.

The other key factor triggering wet weather overflows was the limited capacity of the wastewater reticulation system within Area 3, downstream of the two pump station sub-catchments. The magnitude of the infiltration entering the drains during heavy wet weather greatly exceeded the capacity of the conveyance system in Area 3, limiting the ability to pump all of the flows arriving at the two pump stations to the downstream drains. In fact the flows arriving were potentially so great that it was concluded that it simply was not feasible to design and operate a system to try to deal with this level of flow.

As part of that process Council carried out a trial upgrade of private drains, funded by Council, to assess the degree of reduction achievable if the private drains were upgraded. Construction work was carried out in two trial areas, involving 71 properties, over a six month period.

The trial concluded that the upgrade of private drains is a vital component to any strategy aimed at reducing inflow and infiltration, and would be the key to reducing wet weather overflows in the Waiwhetu catchment.

5.0 STRATEGY FOR REDUCING WASTEWATER FLOWS DURING WET WEATHER

Hutt City Council aims to provide the lowest cost public wastewater service to the community that is consistent with achieving required standards and which is sustainable over the long-term.

Council's key objectives in managing the Waiwhetu overflows, was to ensure that any work incorporated community and cultural expectations with respect to environmental pollution, provided the appropriate level of health protection, meet the requirements of relevant legislation, and ensured that the network would continue to be managed in a cost effective manner.

While Council and the community considered the need to operate overflows, during heavy wet weather undesirable, it was reluctantly accepted that they were unavoidable until such time as the majority of the infiltration could be eliminated. However, Council was, and still is, very conscious that no city in world has yet found a technical solution to totally eliminate wet weather infiltration.

When preparing for the renewal of the overflow consents in 2004, Council adopted a strategy that involved work aimed at reducing infiltration into the Waiwhetu catchment and work aimed at increasing system capacity. This approach recognised that by combining work aimed at reducing infiltration and work aimed at increasing system capacity, an optimum cost-effective balance of works can be obtained. This balance is illustrated in Figure 1.

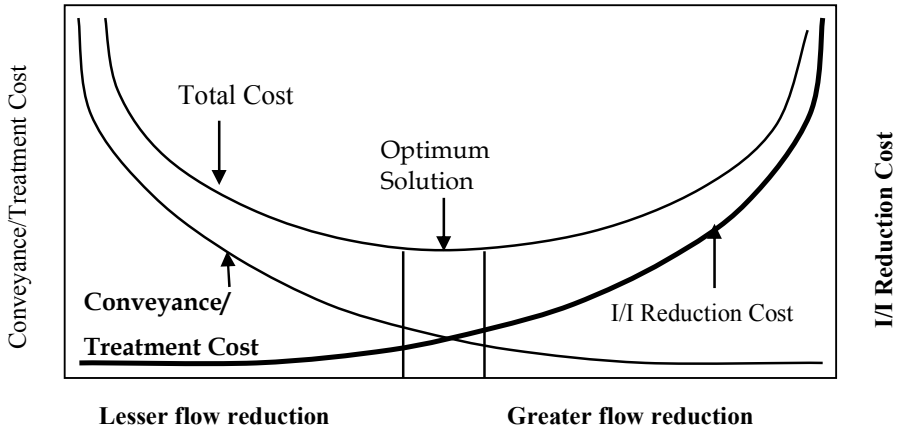

Figure 1: Conveyance / Treatment Cost vs. Inflow / Infiltration Reduction Cost

For the Waiwhetu catchment the judgment of balancing effort and expenditure between flow reduction and increased capacity was influenced by a number of factors including:

- The downstream system included further pump stations, a treatment plant and an aged 18km pipeline from the treatment plant to the coastal outfall – hence increased capacity had severe implications on trunk infrastructure.

- Increased capacity within the catchment would involve increased pumping systems. However, as the reticulation was acting as an extensive groundwater collection system at times of wet weather, the pumping capacity required to avoid overflows would be completely out of scale with the system and would grossly overload the downstream infrastructure.

- Infiltration was so high that the use of storage as the primary solution was simply not cost effective

- Infiltration in the catchment is highly influenced by rapidly rising groundwater in the first few hours of heavy rain. The source of infiltration (the groundwater) could then be expected to continue beyond the end of the rain event.

- The old private laterals are a significant source of infiltration and significant flow reduction simply couldn't be achieved without removing the main source.

- The Waiwhetu stream has high community and cultural value, and the community has committed significant expenditure on other works to improve the quality of these waters.

- The requirement to minimise the frequency and duration of wastewater overflows into the Waiwhetu Stream is highly desirable from a Council, Iwi, community and environmental perspective.

Taking these factors into account an assessment of the likelihood of success in achieving sufficient reduction in wet weather flows was carried out. It was concluded if a comprehensive programme was implemented, then an appropriate reduction in

overflows could be achieved. It was also concluded that the objective of reducing overflows would be best achieved by committing the bulk of expenditure on flow reduction, with the residual being committed to increasing system capacity (in the form of increasing public main capacity and providing additional storage).

The key elements of the overflow reduction work are:

- Develop private drain upgrade policy, carry out consultation and adopt and implement policy if the community is in support.
- Continue to test public drains for water tightness and replace leaking sections.
- Install storage tanks to reduce peak flows to downstream sewers.
- Monitor system performance and review effectiveness of works.
- Obtain new resource consents in 2009.

The programme is committed to improving the performance of the reticulation system such that overflows should not occur during rainfall events with a return period of less than 1 in 5 years. The adoption of a 1 in 5 year design criteria for these overflows is based on the analysis of the wet weather flows during and after a rainfall event, taking into account the results from the work completed prior to 2004 and the trial upgrading of private laterals.

While Council recognised that this design criterion was higher than that adopted by many other local authorities, the consents would have to be renewed, and as such there would be an opportunity to revise the criteria once the post–work system performance was assessed.

6.0 PUBLIC CONSULTATION

Armed with an understanding of the issues and options for reducing overflows Council set out to engage with the community to gain support for:

- The need to take pro-active action to reduce wastewater overflows
- The recommended programme of works.

The proposed private drain policy and upgrade process committed Council to testing all of the private wastewater drains in the Waiwhetu catchment (at Council's cost), and to require property owners to repair their drains if they were found to be leaking.

Two options were provided for the repairs:

- Independently arranging for the upgrade work to be carried out by a registered drain layer – before being re-inspected by Council.
- Allowing Council to take responsibility for managing and carrying out the work on the property owner's behalf.

Council's preference was to take responsibility for administering both the inspection and any required upgrade work as there were several benefits to this approach. The benefits included removing the stress of managing the process from the property owners and efficiency gains that could be achieved with work in the public and private networks programmed together evenly across the catchment. There were also benefits in terms of improved quality assurance and standards of workmanship.

In the proposed upgrade process, Council also offered a variety of re-payment options to help reduce the financial burden on property owners. If the property was found to have a defected lateral and the owner wished to have the work completed by Council appointed contractors then they could chose to pay for the work by:

- Lump sum payment.
- Via a targeted rate paid back over a five year period.
- A combination of lump sum and targeted rates payments.

Consultation was undertaken with a number of groups, including property owners and tenants in the Waiwhetu catchment; local Iwi; a number of local environmental groups the Department of Conservation; the Wellington Conservation Board and Regional Public Health. Information was also distributed to the community though newspaper advertisements, media releases, via the Council's website and brochures displayed in libraries and Council's service centre.

Council also held public meetings, stakeholder group meetings, focus group meetings, and individual interviews with individual residents as required. Council received over 300 written submissions, with 88% of respondents supporting action to reduce wastewater overflows into the Waiwhetu Stream. Almost 66% of respondents found the Council's proposed solution 'very' or 'quite satisfactory' and 77% preferred to have the Council organise and manage the required repairs. The proposed payment options met the needs of 70 % of the respondents.

Council formally adopted the 'Policy for Upgrading Private Sewer Drains' on the 2nd of August 2005. The operational structure of this policy is appended (Appendix 2).

7.0 IMPLEMENTATION OF THE PRIVATE DRAIN UPGRADE PROCESS

7.1 TESTING OF PRIVATE DRAINS

Each property owner and tenant was notified in writing of the proposed programme, method of testing, reason for the testing, and the timing for the carrying out of water tightness testing on their private lateral. An estimate of the total length of drain on each site was recorded, along with a sketch of the property and the assumed alignment of the drain. Where available, this alignment was verified by private drainage plans obtained from Council records.

Two different testing procedures were used. One test method involved cutting into the terminal vent to create sufficient space to push an inflatable bung down the sewer lateral to the junction in the main. The contractor first did a CCTV inspection of the lateral from the access at the terminal vent. This identified any obvious signs of where leaks may occur, the general alignment of the drain to confirm the ability to get the

bung to the public main, and also to establish the distance to the public main. If a large fault was identified then this was recorded and the testing deferred until the fault was corrected, so that the drain could be assessed for other sources of leakage.

If no large fault had been indentified, the inflatable bung was then pushed down the private lateral through the vent pipe or inspection point, to test the full length of the private lateral. The bung was inflated to produce a water tight seal and the lateral was filled with water. Once the lateral was full (assuming it could be filled), the water level was monitored for a period of 5 minutes and the volume of water required to return the water level to the level at the start of the test was recorded. This result, along with the CCTV information and the length of lateral tested was used to determine if the drain was a “pass” or “fail”.

There were cases where the contractor could not get the bung all the way to the public drain because of blockages or very sharp changes of direction. In these cases the length of drain tested was recorded and the “pass/fail” assessment took this into account. If the lateral was found to be leaking, the remaining length was tested when the first section was repaired.

The second method required the contractor to pressure test the public sewer main for leaking joints, and do some of the private lateral testing - as they could position their pressure testing equipment inside the public drain over the junction of the lateral and seal the junction off. They used a dye test during their early CCTV inspection, which they carried out for the pressure testing, to determine which property each lateral connection belonged to for testing later. As with the first method, the private lateral was filled with water through the gully tap at the house and the volume of water required to refill the drain after 5 minutes was recorded, along with an estimate of the length of drain tested, and a sketch of the assumed path of the drain.

The first test method was cheaper but resulted in the cutting of a hole in the terminal vent that the contractor then sealed up with a uPVC sleeve. Although this was generally acceptable, a few property owners complained about the repair method. The first test method also meant that sometimes not all of the drain could be tested on the first test if there was a restriction that prevented the bung being pushed to the public main.

The second test method avoided any work on the private lateral but cost almost $200 per property. It also had the drawback that if the drain served several flats then the leakage of each section of drain could not be assessed. For these reasons the majority of the catchment was tested using the first method.

7.2 CRITERIA FOR PASS AND FAIL AND THE EXTENT OF LATERAL REPLACEMENT

The actual leakage was calculated as a “fail factor” to gain a feel for the degree of leakage of the drain and hence judge how critical it was to replace that section of lateral. The “fail factor” was the actual leakage divided by the NZ Building Code criteria (which requires that the leakage rate shall not exceed 2 millimeters per millimeter diameter per meter length per hour measured over a period of 5 minutes).

In the trial area the average fail factor was approximately 60; which is 60 times more than the leakage rate allowable under the Building Code. A number of drains could not

be given a fail factor as they had such high leakage that they couldn't be filled to begin the test.

As the private laterals in the trial area are generally over 50 years of age, it was expected that drains would either be leaking a lot or would be generally water tight. The Council therefore adopted a "pass/fail" criteria for leakage that allowed a fail factor of 3 before consideration to replace the drain would need to be given.

The actual judgment and decision on the need to replace a specific lateral was not based solely on the degree of leakage unless the leakage was high. If the fail factor was less than 3 then no replacement was required. If it was over 3 but less than about 6 then we would consider whether or not it would be required to be replaced taking into account a number of factors. If it was over 6 then we would require replacement of the lateral but still assess the extent and length / section of lateral to be replaced on site, taking into account the factors listed below:

- The length of the drain – A short drain would have few joints and hence less impact from leakage.

- The depth of the section of lateral – If it was a short section and shallow then the risk/exposure to groundwater infiltration would be less and so replacement may be deemed unnecessary.

- Difficulty / cost of replacement compared to risk of leakage / benefit – If the risk of leakage was low (short and/or shallow) and access to the drain difficult (i.e. under a building, deck or paved area) and hence reinstatement difficult and expensive, Council often did not require replacement.

If the lateral was under a concrete driveway of good quality which would be difficult and expensive to replace even by pipe bursting (say due to shallow cover) then Council looked closely at the degree of leakage, the fail factor, the length and hence potential volume leakage. If the leakage was high then replacement was required, but if moderate Council did not require full replacement.

In addition there were also "special circumstances" that arose on some properties that required another level of judgment before requiring any upgrade or replacement work to be carried out. These included taking into account factors such as: the property owner was planning to develop their property / undertake significant renovations and wanted to delay the upgrade works; the sale and purchase of properties between testing and physical works; health issues of the property owner delaying decision making on their part and, in some cases, some property owners disputed the testing results and wanted more information before accepting the need to do the work.

Of the 2,355 properties tested, 1,027 (43%) passed and required no further action to be taken. 1,350 (57%) failed and required replacement.

7.3 CONTRACTUAL ARRANGEMENTS FOR REPLACEMENT OF PRIVATE DRAINS

The Council needed and desired a high level of acceptance from property owners to replace their leaking private drains. To help achieve this Council offered the option that allowed the property owner to join a Council managed upgrade contract to avoid the property owner having to engage with and deal with a contractor directly. The

Council managed contract was aimed at minimising the burden on the property owner in order to maximise their co-operation. It had several steps as outlined below:

- The property owner was advised by letter that their drain had been tested and it required replacement. The letter outlined the issues and it invited the property owner to contact a Council representative (a Cardno TCB engineering technician) to meet with them to help them decide how they wanted to deal with getting the drain replaced.

- Once a response was received, the representative would meet with the owner to measure up and provide them with a written quote for the work on the spot, based on tendered rates from the preferred contractor. The representative also explained the contract options (joining Council scheme or organise contractor privately), the payment options and this with the owner to consider.

- If the owner joined the Council scheme the job was forwarded to the contractor for action. Before backfilling the trench (or completing reinstatement), the new section of drain was retested for water tightness. Any section of drain not replaced (such as a short section of drain considered to be too difficult or not cost effective to replace) was also tested and the degree of leakage noted.

- An as-built sketch was prepared and placed on the property file held by Council and a notice was placed on the property file that the drain had been upgraded.

- The contractor's claim (which identified each property,) was processed for payment with the cost of the section of drain between the main and the boundary identified – as the property owner was not required to pay for this.

- The value of the work quoted to the property owner was confirmed from the contractor's claim. If the work on site turned out to be less, then the property owner was charged the lower sum. If it was a bit more because perhaps there was some minor additional work then the additional sum was covered by Council.

This process had the advantage of offering the contractor economies of scale as they were awarded packages of over 100 properties. Benefits for the contactor also included certainty of payment direct by Council once claims were certified. Advantages for Council came in the form of competitive tenders, industry contract documentation (NZS 3910) and confidence of compliance to industry construction standards.

The cost of the physical works varies between $2,000 and $4,000 per property. The cost is dependent upon the construction method used, the length of the drain and the nature of the reinstatement. The average cost to date has been approximately $2,500 per property, of which 25% has been met by Council for the section within road reserve. The average cost of $1,875 per property includes a charge for the engineering management of the contract works.

Of the approximately 1,350 properties that required replacement of their drains 92% have committed to completing the required work, and only 112 have either yet to confirm that they in the Council scheme, that they will do the work privately, or they are going to resist doing anything at all.

Of the 1,350 properties who have committed to doing the work, 1,140 (92%) joined the Council managed construction contract. To date 1,016 properties have been upgraded under the scheme and 70 have been completed privately. 124 properties have been handed to the two contractors for completion under the Council contract and 28 property owners are in the process of completing the works privately.

Of the remaining 112 properties who have not yet committed to doing the work some are requesting re-tests, some are just delaying and some are likely to resist altogether.

8.0 UPGRADE OF THE PUBLIC NETWORK

8.1 PRESSURE TESTING OF PUBLIC DRAINS

To assess the overall quality of the public network a programme of pressure testing of pipe joints was implemented to identify the sources of infiltration into public drains. In increase the efficiency of pressure testing the decision was taken to first undertake a CCTV review of all of the public drains in the catchment. This inspection allowed the pipes to be graded on a scale of 1 to 5. Those given a grade of 4 or 5 were identified as needing replacement, and put into Council's renewals list. Those graded 1, 2 and 3 were then pressure tested to further confirm their degree of water tightness.

The pressure tests were carried out at each pipe joint, where an air filled packer was placed either side of the joint and inflated to create a seal around the joint. Air or water was then pumped into the space created around the joint to achieve a pressure of approximately 1.5 – 3m head, to simulate a pressure greater than that created by surrounding ground water conditions. The pressure was measured for a period of 2 minutes and, if it dropped due to leakage, was brought back up to test pressure and the volume of water or air required to bring it back to test pressure was measured and recorded.

The test results were then reviewed and a decision made to either pass the drain or put it on the list for repair or replacement was made. If more than 20 - 30% of the joints were found to be leaking and the extent of leaking was more than minor then the drain was put on the list for complete replacement. If there were only one or two leaking joints then they were added to a list for individual dig up and/or spot repair.

Of the 12.2km of public drains pressure tested (across all 3 Areas) approximately 4.7km of drains were found to be leaking sufficient to require replacement. This equates to a failure rate of almost 40%.

8.2 PUBLIC DRAIN UPGRADE COSTS AND STORAGE TANK INSTALLATION

Prior to pressure testing in 2004 a number of public drains had already been replaced, at a cost of approximately $2 million, during the period 1999 and 2003. Since 2004, approximately 7km of drains have been replaced, at a cost of $3.95 million. Of this length 2.3km was because of a grading of 4 or 5 (which may also have had a high degree of joint leakage) and 4.7km was in grade 1 to 3 with high joint leakage.

The total length of public main in across the three Areas is approximately 23km, of which approximately 50% has been replaced since 1999 as part of the overflow management project.

An offline 224 m^3 storage tank was installed in Area 2 to hold flows within the system until the tank is full or the wastewater is able to be accommodated within the network. The ability of the network to maintain peak flows was further enhanced by the installation of two 200m^3 inline storage tanks in Area 1, underneath the carriage way in Malone Road. The cost of this work was $610,000.

9.0 EFFECTIVENESS OF THE UPGRADE

A detailed assessment of the effectiveness of the upgrade programme has been carried out to comply with the conditions of the resource consent, to refine our judgment of the value of the work, and to form a position for the application for the consent renewal.

In 2009 Council was sought consent renewal to continue the discharge wastewater in very wet weather. The consent application needed to present technical arguments for why the overflows were still needed and why the level of flow minimisation was at an acceptable level.

The assessment was carried out in Area 1 as the upgrade work was largely finished. However the hydraulic assessment of the effectiveness is complex in this catchment because the flows from the pump station can not be fully discharged to the downstream system when both pumps are running (when the downstream gravity system is highly surcharged).

Because dual pump operation triggers surcharge manholes an interim solution (until the downstream system performance had been improved) has been to re-cycle flows back into Area 1. By mid 2010 the majority of the downstream system had been upgraded and so the operation of the re-cycle weir is now less frequent.

When an analysis of historic rainfall events is undertaken it was found that prior to upgrade and post upgrade considered events with a return period of approximately 2 years and 5 years.

For a prior event (28th December 2003) 48mm of rainfall fell over a 24hours period which equates to an event with a 6 month expected return period. This event resulted in an overflow to the Waiwhetu Stream which lasted approximately 6 hours. The estimated overflow volume for this event was approximately 700m^3. The storm induced volume during dual pump operation was estimated to be approximately 2,700m^3.

On 12th February 2009, by which time the majority of the work had been finished in Area 1, but only part of the work in the downstream gravity catchment had been completed, 58.4mm of rainfall fell over a 12 hour period. This event has a return period of less than 2 years. No overflow to the Waiwhetu Stream was recorded, and dual pump operation ran for a total of 1.5 hours. There was also no flow into the storage tank in this event. Throughout the duration of this storm event (being when dual pumps were operating), an estimated pumped storm induced volume of approximately 200m^3 was delivered downstream. This is greater than a 90% reduction of the volume of flow experienced during a slightly smaller rainfall prior to upgrade works starting in December 2003.

On 20th February 2009, 74mm of rainfall occurred over a 12 hour period. This intensity equates to an event with a return period of almost 5 years. Dual pump operation ran for a total of 14 hours, however significant surcharging in the downstream system reduced the outlet capacity of the pumps. The lengthy dual pump operation will also be in part due to the emptying of the storage tank. During this event the storage tank was fully utilised and very close to overflowing. Throughout the duration of the storm event, the total "storm induced" volume was approximately 1,800m³.

On 9th October 2009 52mm of rain fell within the catchment over a 24hour period, which is less than a 2 year return period event. Daily winter flows within the catchment in the days prior to this event were fluctuating between 5.5 – 7.5l/s, which is significantly higher than the flows during February 2009, which were steady at around 3.5l/s. Dual pump operation ran for approximately 9 hours but the downstream gravity system was known to be surcharged prior to dual pump operation in Malone Road. About 50% of the storage tank capacity was utilised during the storm and no overflow occurred. Throughout the duration of the storm event, the total "storm induced" volume was approximately 1,000m³. This event is similar in rainfall to the 28th December 2003, but is a winter event. The reduced "storm induced" flow has been reduced by approximately 63% from pre upgrade works for a winter situation where higher groundwater levels are known to exist.

As at mid 2010 most of the upgrade works have been completed and the downstream gravity system is now operating with much less surcharging. In a recent 2 year rainfall event the system operated without overflow into the storage tank and it is now expected that overflows can be avoided in a 5 year event, except perhaps during winter when prolonged rainfall in the days prior to the bigger event have greatly raised groundwater levels. Such events have yet to be assessed.

10.0 SUMMARY OF COSTS

For the Waiwhetu catchment, Council upgraded approximately 13 kilometers of public drain and installed three storage tanks at a cost of approximately $8 million.

The total cost to property owners of upgrading private drains is approximately $2.3 million Spread over the total 2355 properties across the three Areas this equates to $87 per property per year over the life span of a drain, using a conservative life expectancy of 50 years for a drain.

This compares well with the $17 million project that the Council and the community have recently completed to clean up the heavy metal contamination in the bed sediment of the Waiwhetu Stream. Council has also build other storage facilities in the wider wastewater network – a 10,000 m³ wastewater storage facility in the north of the city which store excess wet weather flows at a cost of $8.3 million.

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11.0 LESSONS LEARNED

Council has received tremendous support from the community in its effort to reduce inflow and infiltration in the Waiwhetu catchment. The implementation of the strategy has taken several years and we have learned a few lessons on our journey. These include:

- The private drain upgrade process is costly, complex, and requires a great deal of time to meet with and discuss options with stakeholders and property owners.

- Although there was very good uptake of the upgrade of private drains, there are inevitably ones who refuse to participate. Pursuing these owners to carry out the repairs will require further time. This has the potential to be a lengthy process.

- The benefits of the upgrade work (measured by reduced number and volumes of overflows) are only observed once the bulk of the work is complete.

- Care needs to be taken when using historic information about the wastewater system. Records are often incomplete or sketchy, and investigations continued to reveal new information about the layout of the system.

- Although a significant amount of effort and cost has been spent the wet weather overloading problem is not easy to resolve. Investigations will continue, but it is inevitable that inflow and infiltration will always be present in the network.

- The difficult owners take up a disproportionate amount of time but without the effort and perseverance a greater number of owners would not have taken action and then the project would have failed as a whole.

12.0 CONCLUSION

The success of the project; measured by the degree of reduction in infiltration, the reduced frequency of overflows, the high level of property owner co-operation, the duration of the new consent is due largely to the extensive consultative and supportive approach taken with programme stakeholders.

This has required an almost full time role for the project engineering technician over the 5 years of implementation as it has involved a lot of interaction with the property owners, the contractors and the Council staff. The difficult owners take up a disproportionate amount of time but without the effort and perseverance greater number of owners would not take action and then the project would fail as a whole.

ACKNOWLEDGEMENTS

We wish to acknowledge and thank Hutt City Council for their kind permission to publish the findings on the Waiwhetu catchment wastewater overflow reduction project.

REFERENCES

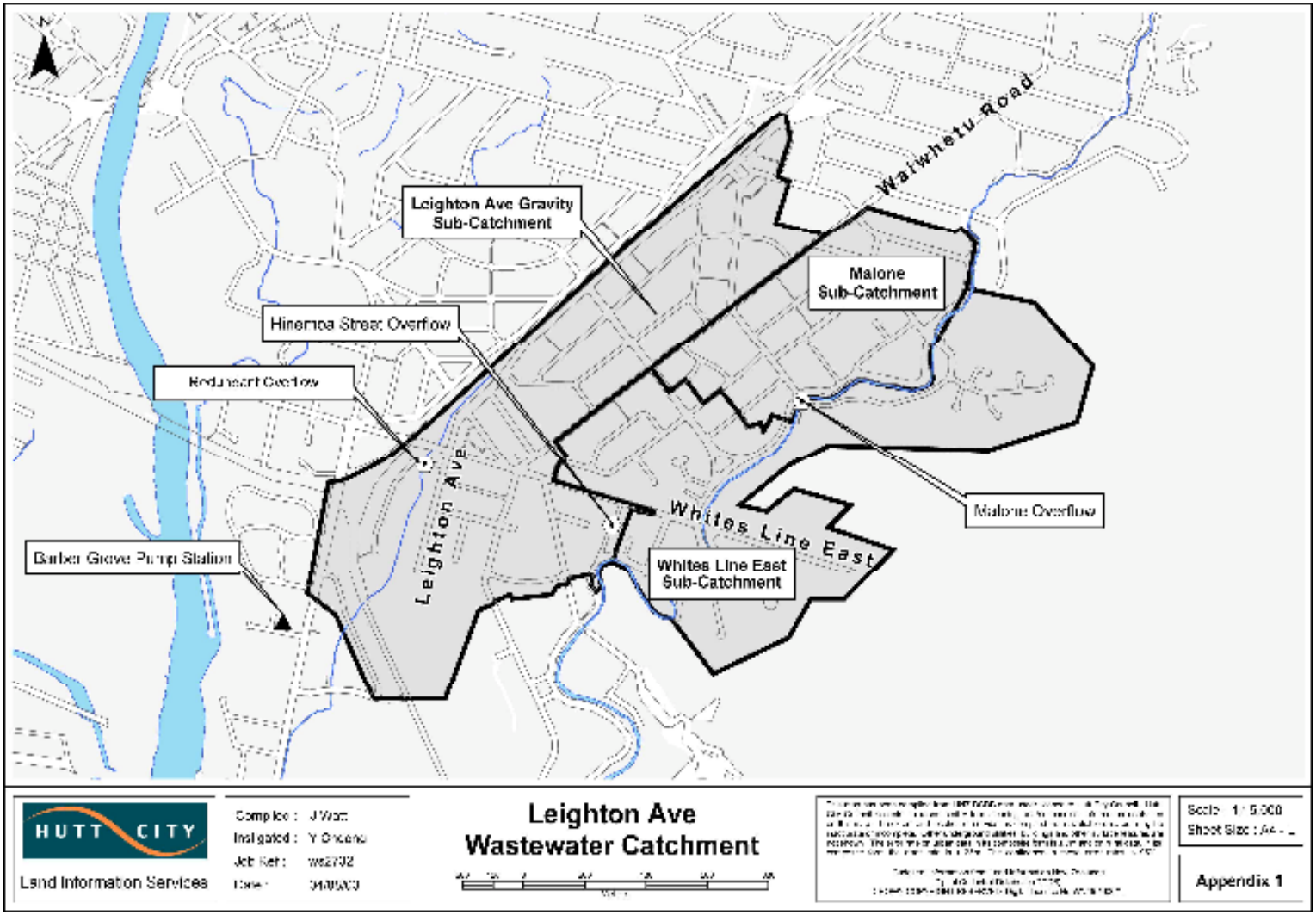
Hutt City Council 'Policy for Upgrading Private Sewer Drains, adopted by Council on 2 August 2005'

Peter Glen Research 'Waiwhetu Private Drains Upgrade Consultation Research – Report prepared for the Hutt City Council June 2005'

Hutt City Council Application for Resource Consents for Malone Road and Hinemoa Street Wet Weather Discharge to Waiwhetu Stream - March 2004

Hutt City Council Application for Resource Consents for Malone Road and Hinemoa Street Wet Weather Discharge to Waiwhetu Stream – April 2009

APPENDIX 1 WAIWHETU SUB-CATCHMENTS



APPENDIX 2 PRIVATE DRAIN POLICY – OPERATIONAL STRUCTURE