Citycare Water

Christchurch City Council
Below Ground Water Well Head
Repair Recommendations




For: *Christchurch City Council - Reticulation Manager [Robert Meek]*

By: *Citycare Group [Water] Christchurch*

Date: *21 August 2017*

Version: *For Approval*

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1. Background

1.1 A meeting was held with Council staff[1] on 26 June 2017, with concern raised at the risk to contamination of the untreated drinking water supply via below ground well head assets. It was noted that this was not a new risk, though evidence from the Inquiry [Havelock North Water Contamination Event] identified the risk of contamination via this pathway was likely.

1.2 It was agreed that Citycare Water continue with urgency to assess, review and recommend repairs to below ground well heads. It was also noted by the Head of 3 Waters that this was an unacceptable risk to supply of clean safe to drink water and should be addressed urgently.

1.3 All well heads have been inspected, as below and Appendix One and Two:

- # Station Sites Inspected 47
- # Well heads Inspected at Stations 108

1.4 As a result of several wet weather events [20/7/17 and 14/8/17], some well heads were inspected up to three times. This was considered appropriate as observation of wet well inundation (if any) provided direct evidence of shallow surface water and/or elevated groundwater level ingress.

1.5 This report provides the following information:

i) The scope of works – inclusions/exclusions
ii) A risk profile, which sets the priority order in which well head repair works will be undertaken
iii) A general schematic describing typical well head works
iv) Cost estimates against the works

2. Timeline – Key Points

2.1 An interim report was tabled with the Councils Head of 3 Waters Manager and others[2] on 25 July 2017. At that time, site information from a limited number of wellheads had been reviewed due to the time required to inspect sites and wet weather events disrupting access. Further, Council staff had not yet provided feedback on the risk profile (priority ranking for repairs), and repair scope of works with cost estimates had not been completed.

2.2 At a meeting[3] on 17 August 2017, images of a set of common defects were tabled and typical repair scope of works outlined. Discussion occurred as to whether there was a requirement under the Drinking Water Standards for impermeable plinths to be installed around the below ground wellheads as a part solution to shedding some surface away from the chamber.

2.3 This report is tabled to support immediate commencement of physical works.

[1] 26/6 - Attendance by CCC [J. Mackie, J. Moore, M. Johnson, K. Winkles, R. Meek], CCG-W [H. Blake-Manson, C. Barron]
[2] 25/7 – Attendance by CCC [J. Mackie, J. Moore], CCG-W [H Blake-Manson, B. Triplow]
[3] 17/8 – Attended by CCC [D. Murugesh, R. Meek, K. Winkles, G. Wardman], CCG-W [H. Blake-Manson, C. Barron]

3. Repairs

3.1 Minimum Requirements

3.1.1 The requirement for this work is driven by written and verbal statements Stage 1 and Stage 2 – Havelock North Inquiry; and the requirement to meet the Drinking Water Standards 2005 (amended 2008):

NB Bore head = well head

Section 4.5.3.2 Bore water security criterion 2: bore head must provide satisfactory protection:

a. The bore head must be judged to provide satisfactory protection by a person recognised as an expert in the field.
b. The bore head must be sealed at the surface to prevent the ingress of surface water and contaminants, and the casing must not allow ingress of shallow groundwater.
c. Animals must be excluded from within 5 m of the bore head.
d. The bore construction must comply with the environmental standard for drilling soil and rock (NZS 4411, Standards New Zealand (2001)), including providing an effective backflow prevention mechanism, unless agreed by the DWA.
e. The supply's water safety plan must address contaminant sources and contaminant migration pathways.

3.1.2 With respect to these requirements, it is the writers opinion based on site evidence, industry practice and general discussion with another industry experts that:

i) A person recognised as an expert would not approve the current below ground bore head standard of work. **Outcome**: **Watershed plinths are required**
ii) Bore heads are not currently sealed at the surface – including air release valves, sample taps, infiltration, inflow **Outcome**: **Repair all chamber wall defects**

3.1.3 Citycare are not able to comment on items d. and e. as these are considered to be matters for the Council to respond to at present. Citycare do not hold or have access to this information at the time of this reports issue.

3.2 Priority and Extent of Repair Works

3.2.1 At the meeting of 25 July 2017, Citycare Group – Water were instructed to undertake repair works only. This therefore excludes raising well heads above ground and any barrier based treatment. It is noted that raising well heads is estimated to cost $65,000 with associated exclusions.

3.2.2 At the meeting of 17 August 2017, it was also agreed that significant asset deterioration works would not be included e.g. Grade 4-5 external corrosion on well pipes and fittings

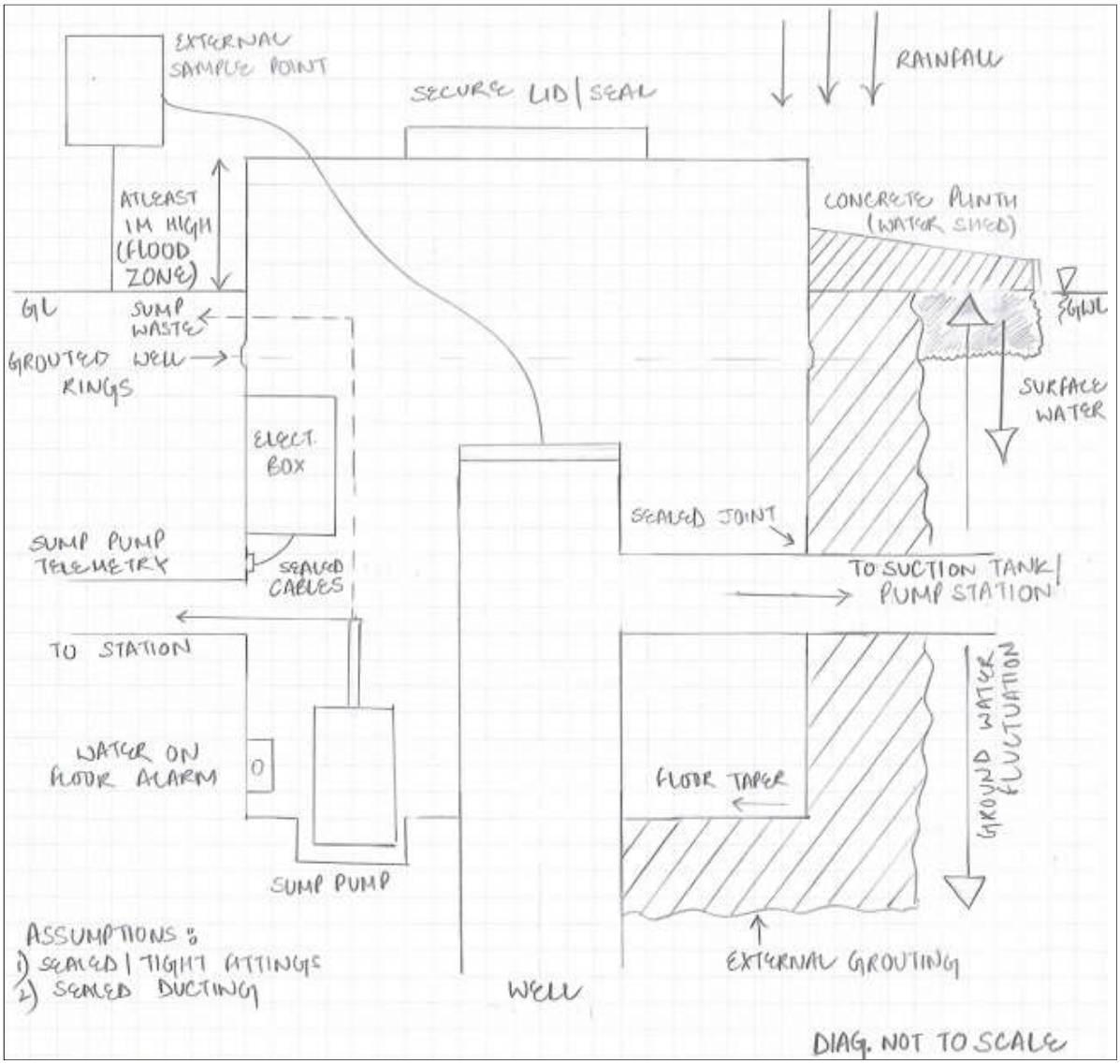
3.2.3 The extent of works would therefore include any of the following:

i) Raised chamber, above any surface flood pathway. Includes rivers (1 in 200 year event 0.2% AEP).
ii) Watertight/vandal proof access hatch. Locked, with ability to remove entirely when servicing is required.
iii) Surface watershed plinth, approximately 2 sq.m. around access lid.
iv) External impermeable grouting around chamber perimeter, and under base to well riser pipe

v) Internal mass major defect removal and grouting e.g. brick/timber packing, riser ring grouting
vi) Sloped internal floor with sump pump and “water on floor” alarm
vii) Removal of all water sampling taps and pipework to above ground secure boxes.
viii) Removal of all air valves where possible, particularly where a suction tank is located downstream of the well head.

3.2.4 Please refer to Figure 2 for a schematic of a repaired below ground well head.

Figure 1 - Schematic of A Repaired Below Ground Well Head



3.2.5 Repairs at well heads will be undertaken against the following risk matrix - Table 1. That is works are well heads with highest overall scores will be undertaken first.

Table 1 - Risk Profile Driving Site Order of Priority

Weighting Factor				
	2	1.5	1	
Risk Item		**Scale**		**Comments**
Surface Water Ingress	Monthly	Annually	>= Five Yearly	Risk of contaminants entering water supply increase as frequency of inundation increases
Shallow Ground Water Ingress	Always	Weekly	Annual	Risk of contaminants entering water supply increase as frequency of inundation increases
Well security designation (secure/unsecure)	Unsecure	-	Secure	Northwest zone wells are not in secure aquifers? Or there is a higher potential risk that contamination may occur from upstream sources
Well Water Supply Zone (CCC # connections)	>50K	49-10K	<10k	If contaminants enter the network, exposure increases with connected population
Chlorination/UV Treatment	None	CL2(g) or UV	Both Cl2(g) & UV	This may only apply to BP
Well Depth to Screen (m)	0-49	50-119	Artesian and/or >120m	As well depth increases, there is an assumed greater protection with more "clean water' above the screen, and less mixing of any potential contaminants down inside/external wall of casing
PS Peak Abstraction Rate (l/s)	>120	119-50	<50	As PS abstraction increases, so does drawdown of potential contaminants

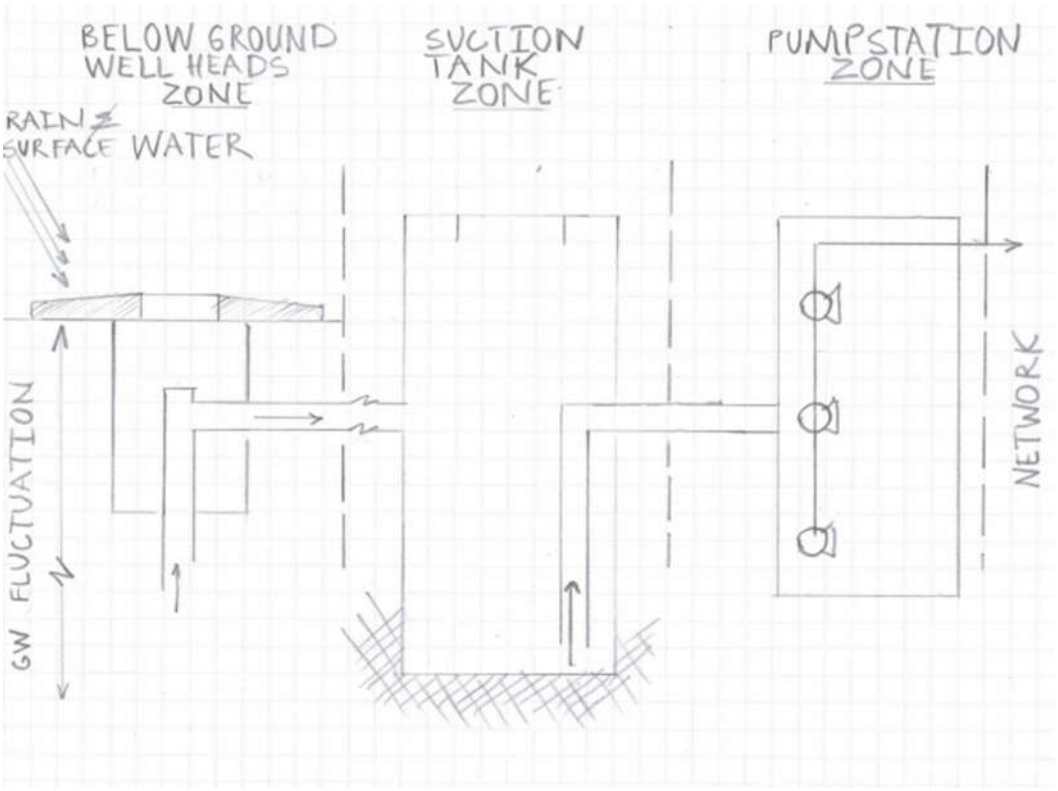
3.3 Residual Risk

3.3.1 During the rainfall event of 20-22 July 2017, river water inundated a number of well heads, contaminating them with sewage wastewater which had been washed in via surcharged sewerage networks/pump stations.

3.3.2 High groundwater (above chamber base) and rainfall seepage are also considered to present the highest risk and therefore drive the most extensive and intensive action

3.3.3 The repair works focus on minimising the ingress of surface water and very shallow unsecure groundwater (~2 m BGL) into the below ground well head chamber/pipework. The extent of works will not however eliminate the potential for pathogen ingress into the water supply via connected pipes eg between the suction tank, deep groundwater and other vectors - Figure 2.

Figure 2 - Focus Area for Repair Work – Below Ground Well Head Zone Only



3.3.4 The Council has not sought advice from, request or authorised Citycare to install a water treatment barrier e.g. ultra violet treatment. If pathogens (in particular viruses) are able to enter the groundwater source and migrate while still functional then contaminated water may enter the network. There is no regular testing for viruses to the writers knowledge.

3.3.5 The Council could consider pathogen monitoring, and the need for barriers.

3.3.6 The residual risks which will remain following completion of the repair works include:

i) Chamber inundation through higher than design rainfall events (river/waterway flooding)
ii) Further chamber wall deterioration resulting in severe acute groundwater ingress
iii) No treatment barrier and monitoring in place for pathogen entry to the network via deep groundwater
iv) Contamination via other connected assets including well head pipes to suction tanks, suction tanks, pipes to pump station, pump casing and mainfolds to the network.

4. Costs

4.1.1 Cost estimates by work item are provided in Table 2

4.1.2 Examples of site costs are provided in Figure 4. Total water supply station cost estimates against the number of well heads is provided in Figure 5.

4.1.3 A complete list of sites, works and costs is provided in Appendix Two.

Table 2 Work Item Cost Estimate

Work Item	ESTIMATED COST (per wellhead)
External Grouting	$4,000
Internal Grouting of Well Rings	$1,000
Sealing of Glands and Open Ducts	$500
Construction of a 2 m Plinth Around Well Cover	$3,500
Install Secure, Accessible Well Cover	$3,000
Raise Wellhead Cover above Ground	$5,000
Seal Tight Wellhead Cover with Well Wall	$600
Sump Pump and Water On Floor Alarm	$3,500
Fix Fittings Leaks	$400
Reconstruct and Seal Wellhead Delivery Pipe In Wall	$1,500
Move Internal sample Point to External Sample Point	$1,500

Figure 3 - Total Cost Estimate by Repair Work Type

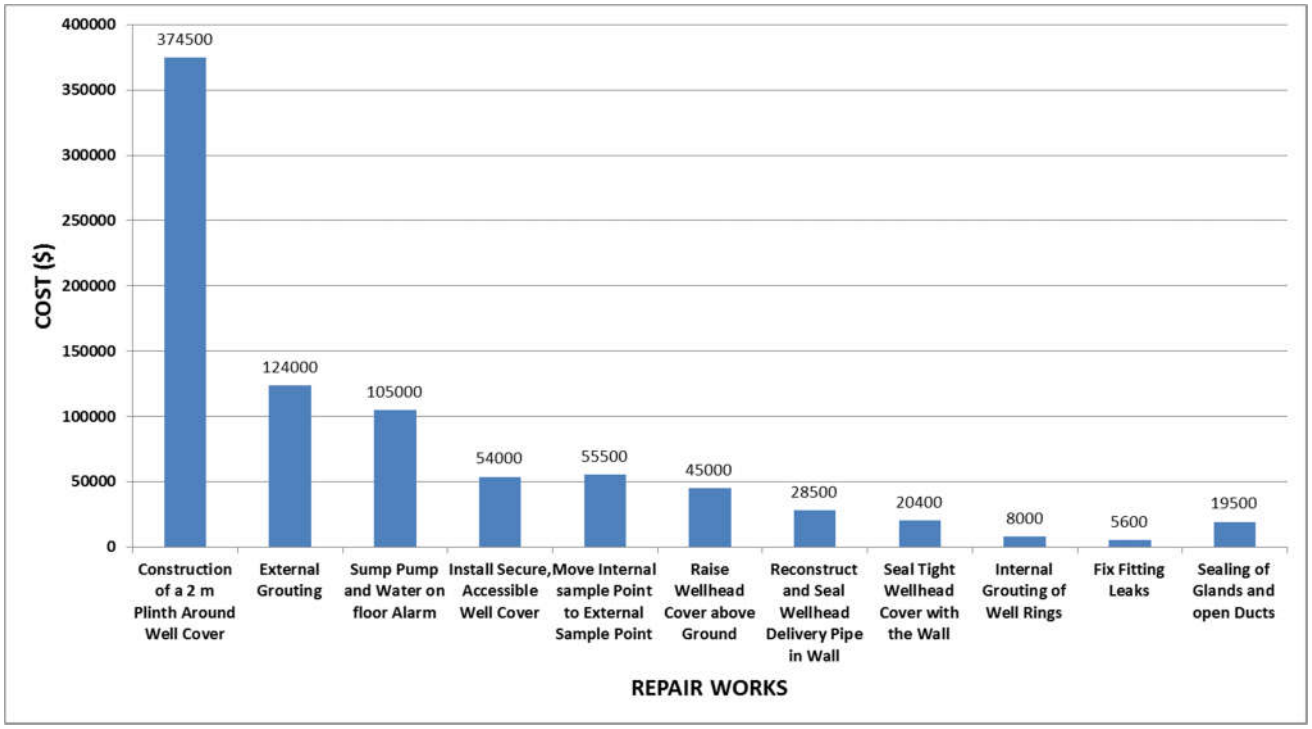


Figure 4 - Typical By Site Distribution of Costs

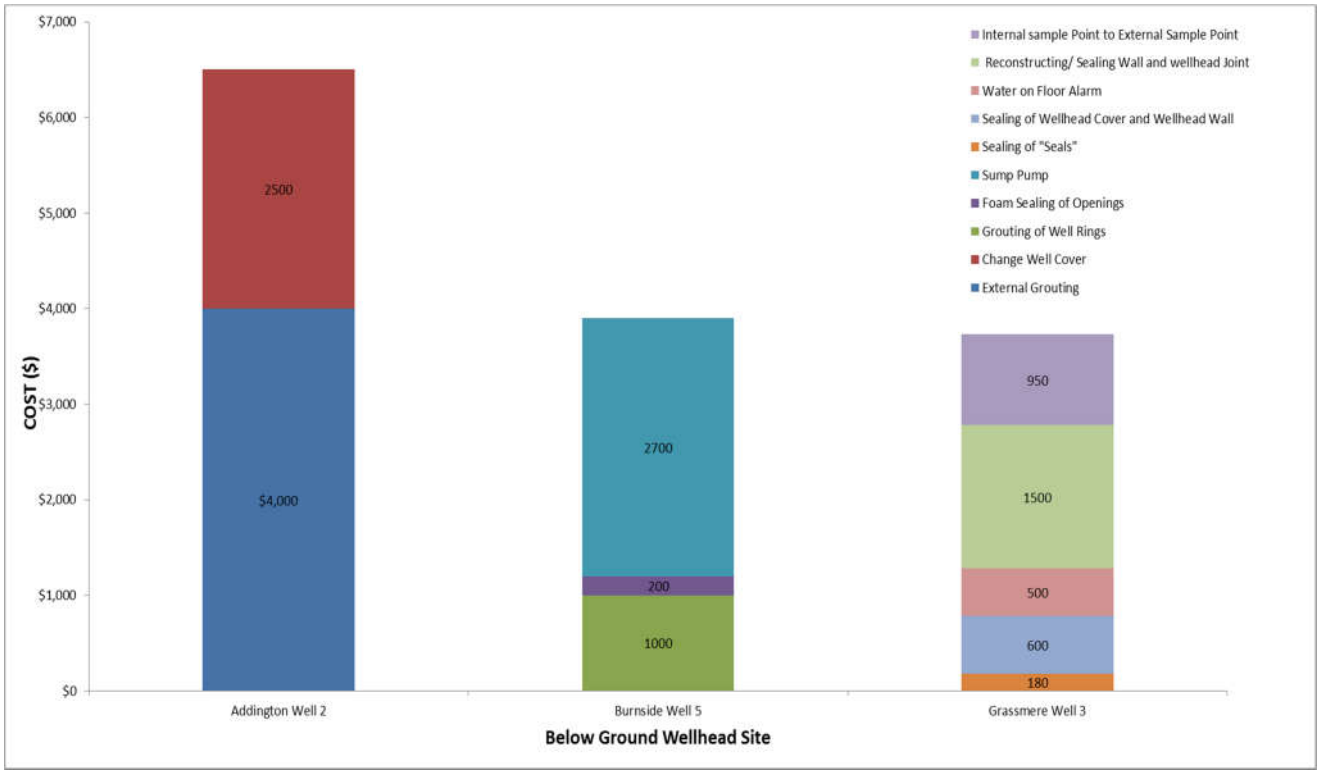
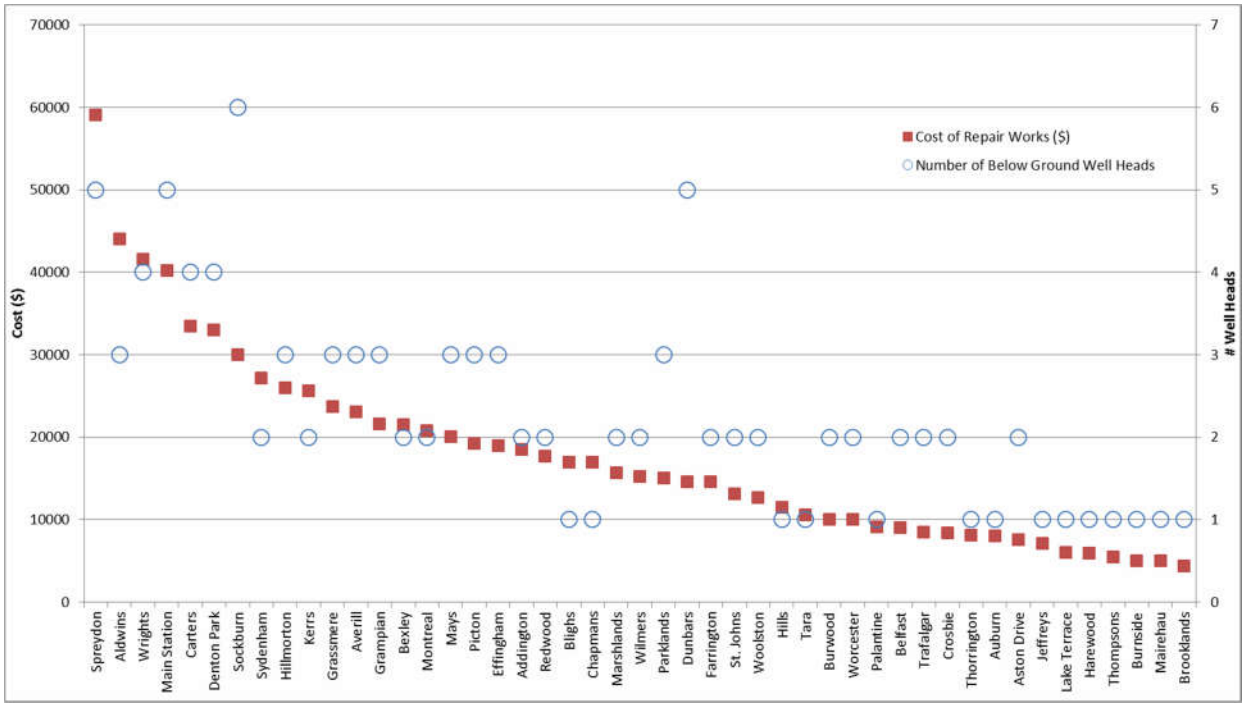


Figure 5 - Station Cost Estimate / # Well Heads



5. Summary

5.1 Criteria for high risk sites have been developed to support determination of appropriate work and the order of prioritisation. Works should either result in minimisation or elimination of the risk of drinking water contamination – refer Risk Weighing Table 1.

5.2 Recommendations for risk reduction works at sites are estimated to cost *$840,000*

6. Quality Assurance

VERSION NO.	1 (For Approval)	**DATE:**	21 August 2017
APPROVED BY:	Bjorn Triplow	**TITLE:**	Southern Regional Manager
PREPARED BY:	Hugh Blake-Manson	**TITLE:**	Contract Manager CPeng, IntPE Nat. Dip. Drinking Water (Assessor) Nat. Dip. Infrastructure Asset Management
CERTIFIED BY:	Alan Gramstrup	**TITLE:**	Operations Manager
INPUT BY:	Neena Parul Sharma	**TITLE:**	Engineer
INPUT BY:	Chris Barron	**TITLE:**	Pumps and Storage Manager

Appendix One – Below Ground Well Head Locations

Figure 4- Map Showing all Below Ground Well heads Inspected

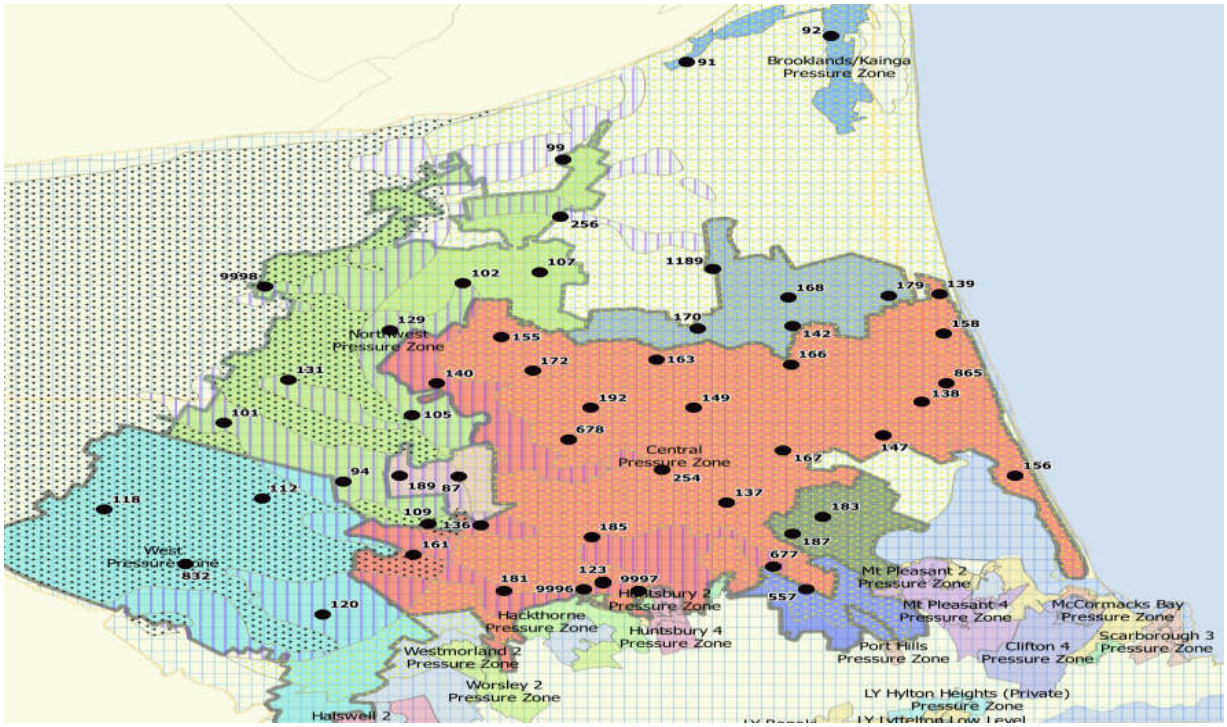
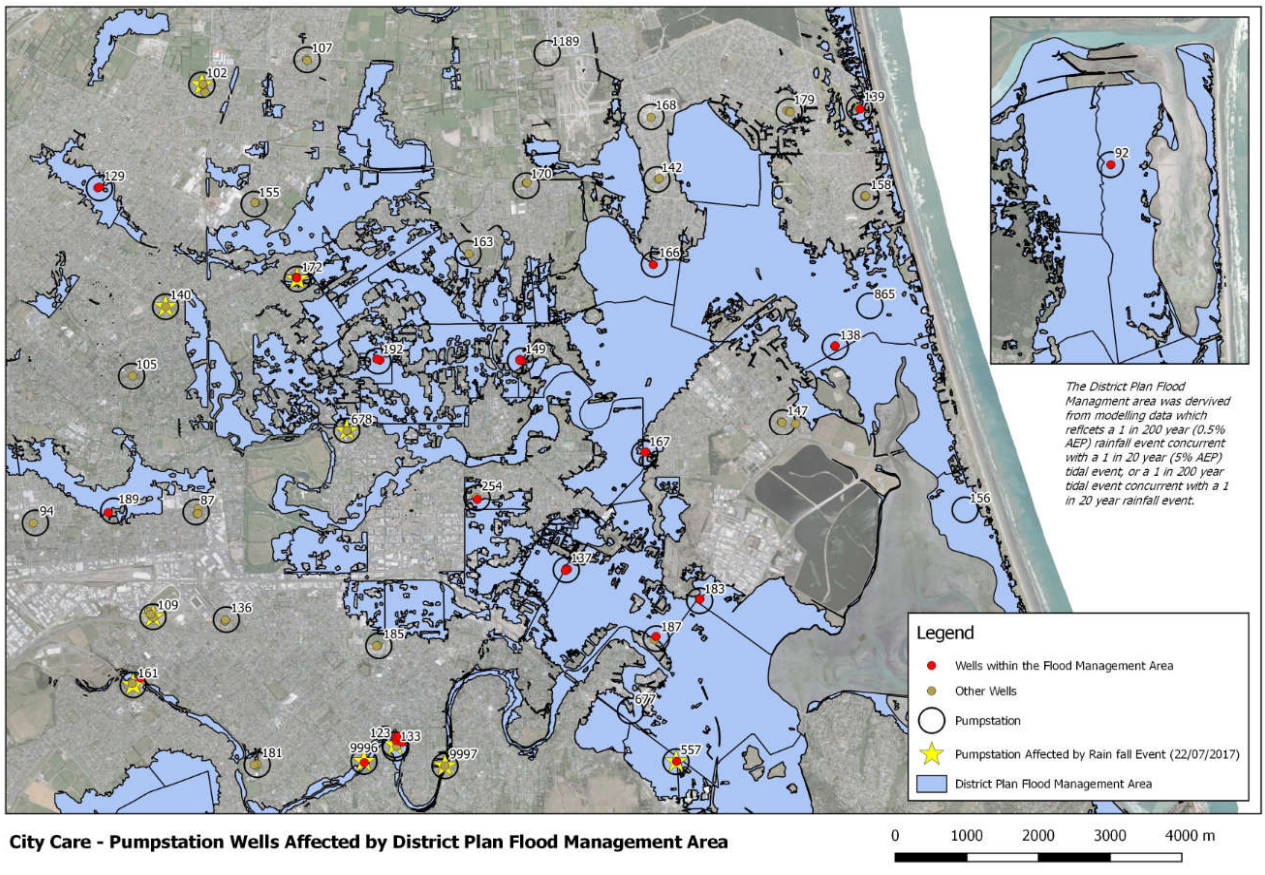


Figure 5- Map Showing Below Ground Wellheads Inspected After 20/07/17 Rainfall



Appendix Two – Total Costs by Site

The following wellheads have been inspected to date:

Belowground Wellheads	Address	Number of belowground wellheads	Cost of Repair Works ($)
Addington	479 Barrington St.	2	18500
Aldwins	54 Aldwins Road	3	44000
Aston Drive	67 Aston drive	2	7600
Auburn	29A Auburn Avenue	1	8000
Averill	57 Averill St.	3	23100
Belfast	38 Darroch St.	2	9000
Bexley	551 Pages Road	2	21500
Blighs	1 Blighs Road	1	17000
Brooklands	1001 Lower Styx Mill Road	1	4400
Burnside	Burnside Park	1	5000
Burwood	160 Burwood Road	2	10000
Carters	4 Carters Road	4	33500
Chapmans	Opposite LPG Tanks	1	17000
Crosbie	22A Woodbury St.	2	8400
Denton Park	58 Kathleen Cres	4	33000
Dunbars	CNR Halswell Road	5	14600
Effingham	72 Effingham St.	3	19000
Farrington	114 Farrington Avenue	2	14600
Grampian	62 Grampian St.	3	21600
Grassmere	21 Grassmere St.	3	23700
Harewood	8 Whitchurch Place	1	5900
Hillmorton	14 Halswell Road	3	26000
Hills	320 Hills Road	1	11500
Jeffreys	30 Jeffreys Road	1	7100
Kerrs	50 Kerrs Road	2	25600
Lake Terrace	5 lake Terrace Road	1	6000
Main Station	54 Colombo St.	5	40200
Mairehau	Burwood Hospital Grounds	1	5000
Marshlands	220 Marshlands Road	2	15700
Mays	107 Mays Road	3	20100
Montreal	447A Montreal St.	2	20800
Palantine	Opposite Number 24	1	9100

Parklands	8A Portnall Place	3	15000
Picton	61-69 Picton Avenue	3	19200
Redwood	54 Prestons Road	2	17700
Sockburn	Service Centre Yard	6	30000
Spreydon	83 Lyttelton St.	5	59100
St. Johns	120 St. Johns Street	2	13100
Sydenham	245 Milton street	2	27200
Tara	In Park	1	10600
Thompsons	Off Blakes Road	1	5500
Thorrington	24 Thorrington Road	1	8100
Trafalgar	Entrance Next to 41 Edgeware Road	2	8500
Wilmers	4 Wilmers Road	2	15200
Woolston	58 Glenroy Road	2	12700
Worcester	325 Worcester St.	2	10000
Wrights	Trotting Club Grounds	4	41600