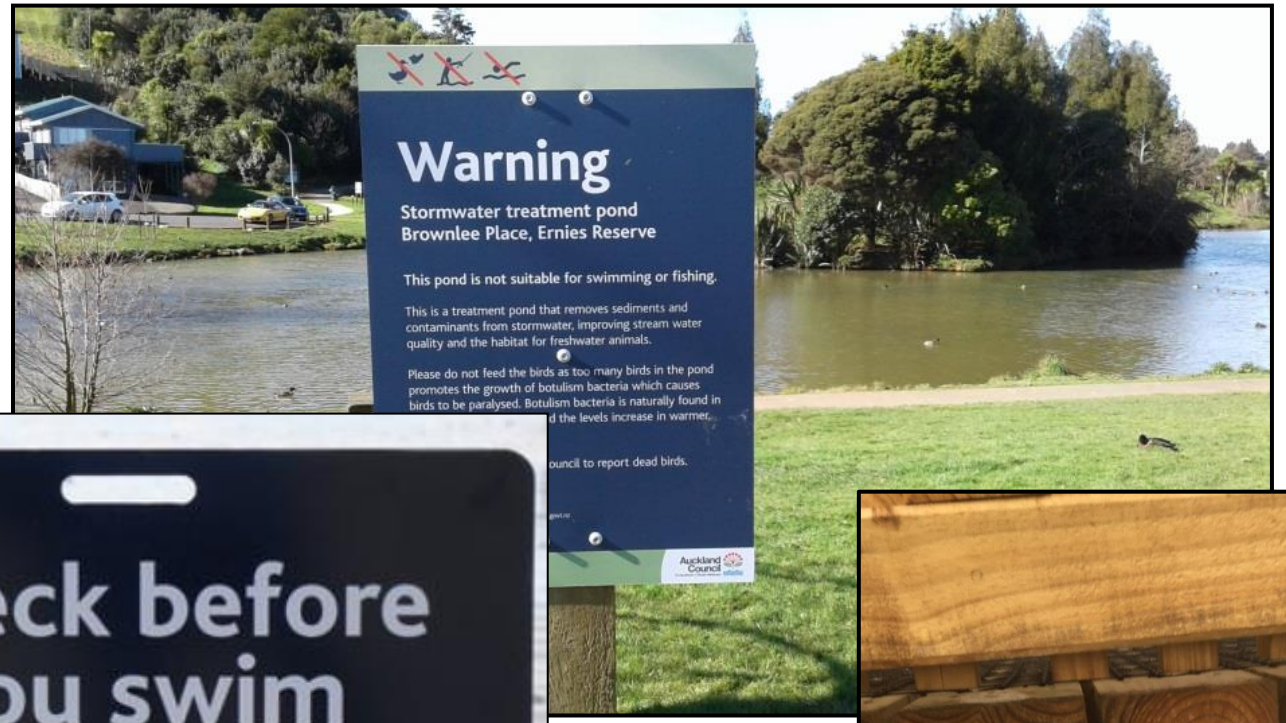
Improving Bathing Water Quality: Auckland Case Studies

Timothy Hopley, Healthy Waters Specialists, Auckland Council.
Presented by Tom Porter.


Warning
Stormwater treatment pond
Brownlee Place, Ernies Reserve
This pond is not suitable for swimming or fishing.
This is a treatment pond that removes sediments and contaminants from stormwater, improving stream water quality and the habitat for freshwater animals.
Please do not feed the birds as too many birds in the pond promotes the growth of botulism bacteria which causes birds to be paralysed. Botulism bacteria is naturally found in
d the levels increase in warmer.
ouncil to report dead birds.
Auckland Council


Check before you swim
Water quality forecast
FAIR
LOW RISK
ALERT
For information on water quality and beach safety, visit safeswim.org.nz
For more information call 09 301 0101
Your guide to the risk of infection from contact with the water

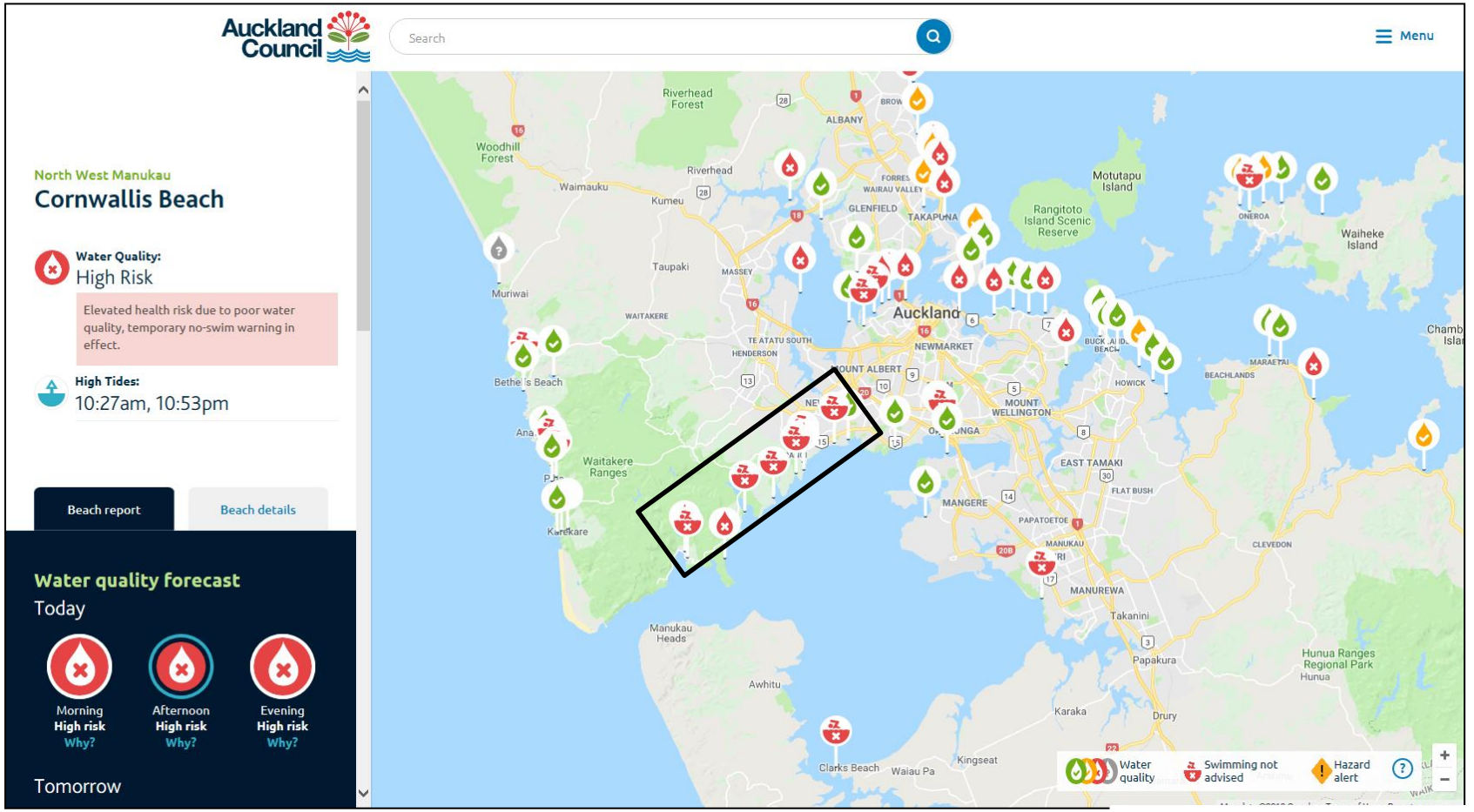

Health warning
Periodic testing indicates this waterway is polluted, especially after rainfall.
Please do not enter the water.
Auckland Council

- Sites with Microbiological Assessment Category grades (MAC grades) of “D” have long term signage in place warning people of the potential health risks associated with swimming at the particular beach.

- Real time monitoring has stopped at these beaches. Until mitigation / fixes are implemented to improve the quality of the beach.

- Increased pressure from communities to improve water quality with the hopes of re-opening the beach.

Case study: Northern Manukau Beaches



French Bay


Legend
Sample type
Freshwater
Intertidal
Marine
FB1, Otitori Bay @ North
FB2, Otitori Bay @ South (also French Bay Safeswim site) (Marine) [440911]
FB3, Otitori Bay Stormwater @ Foreshore Outfall 5564885 [440912]
FB4, Otitori Bay Stormwater @ Drain at 42 Valley Road [440913]
FB5, Otitori Bay Stormwater @ Drain at 22 Valley Road
Stormwater network
Stream / tributary
1. Aerial: Sourced from LINZ and Eagle Technology, CC BY 3.0 NZ.
2. Stream layer and stormwater network layer sourced from Auckland Council data, full legend can be viewed in AC GIS Viewer.
3. Schematic only, not to be interpreted as an engineering design or construction drawing.
4. Drawn by: KC. Reviewed by: RW.
OPOU ROAD
OTITORI BAY ROAD
VALLEY ROAD
TANEKAHA ROAD
KANEKAHA ROAD
MIHA ROAD
FB1
FB2
FB3
FB4
FB5
French Bay (Otitori Bay)
Coordinate System: NZGD 2000 New Zealand Transverse Mercator
0 20 40 60 80
Metres
N

French Bay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FB1
FB2
FB3
FB4
FB5
French Bay (Otitori Bay)
N
0 20 40 60 80
Metres
Coordinate System: NZGD 2000 New Zealand Transverse Mercator
1747800
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1748200
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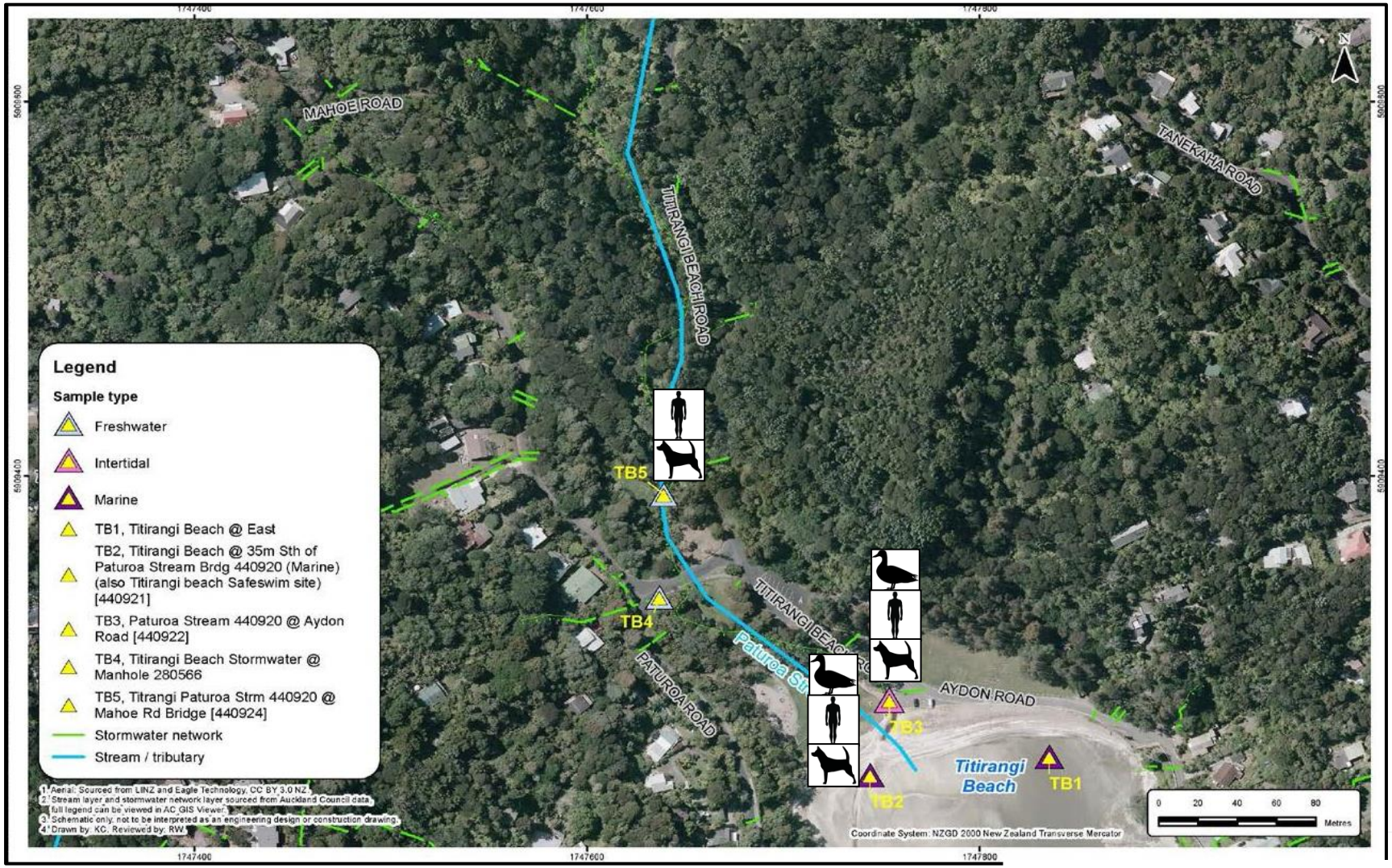
5909400

Titirangi Beach

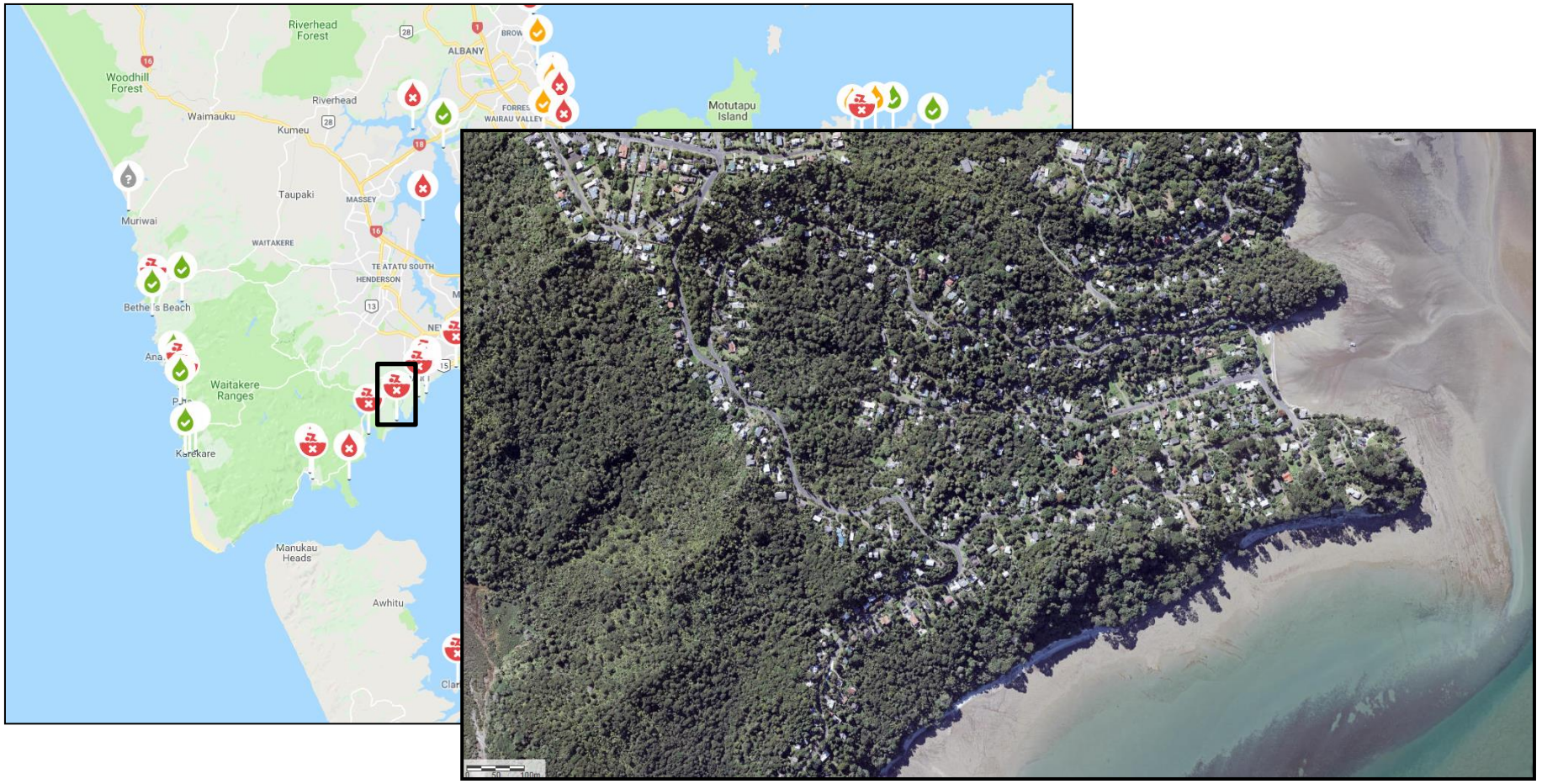
Titirangi Beach



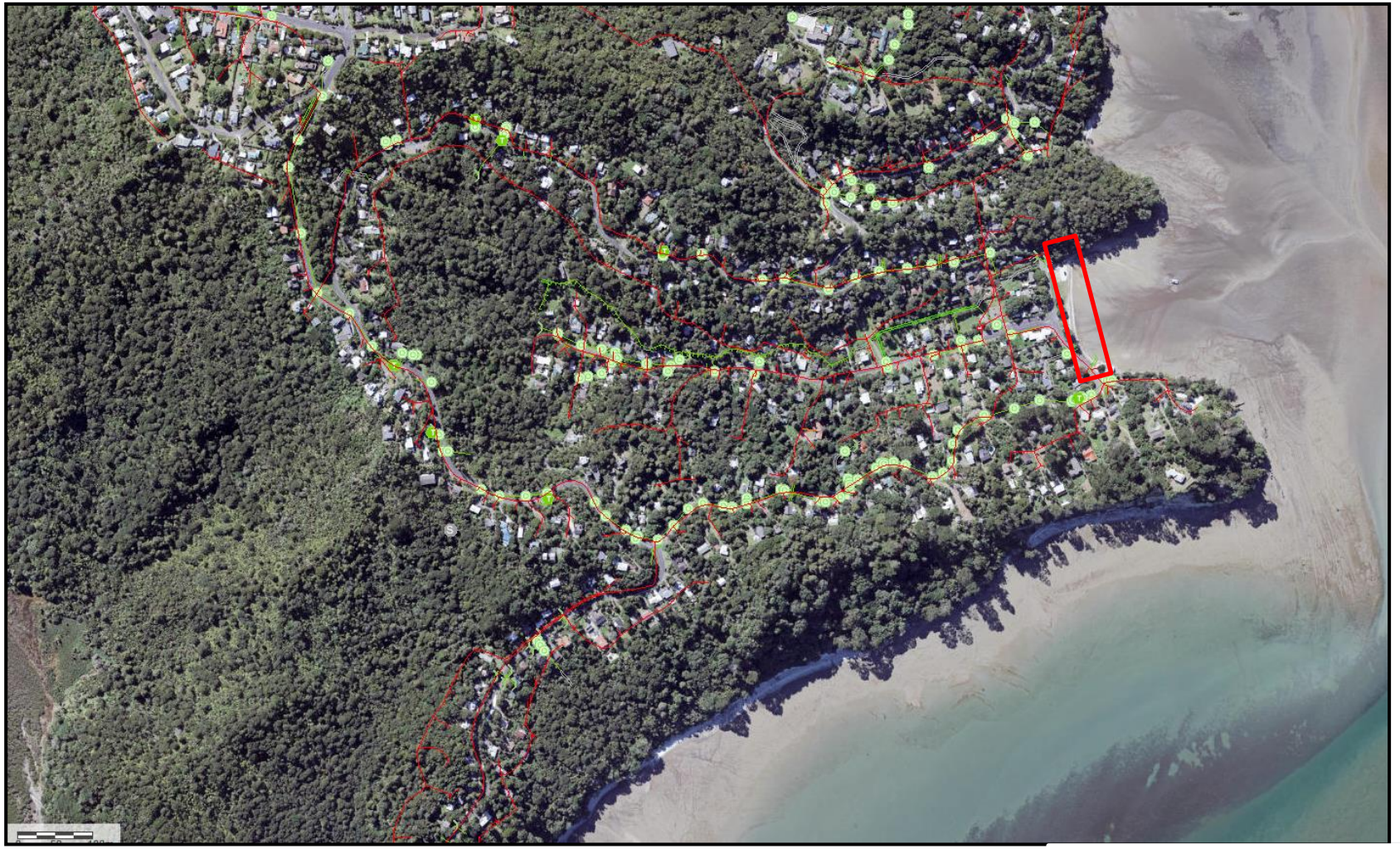
In Summary

- Dog, human and avian faecal contamination at all sites to some extent
- Nine Beaches within the Northern Manukau area have long-term signage in place. These include catchments with reticulated and onsite wastewater systems
- Catchments size varies as does the number of dwellings per catchments.
- Different stages of investigation at different beaches
- Not one catchment / beach is the same

Case study: Laingholm Beach



Method: Stage 1



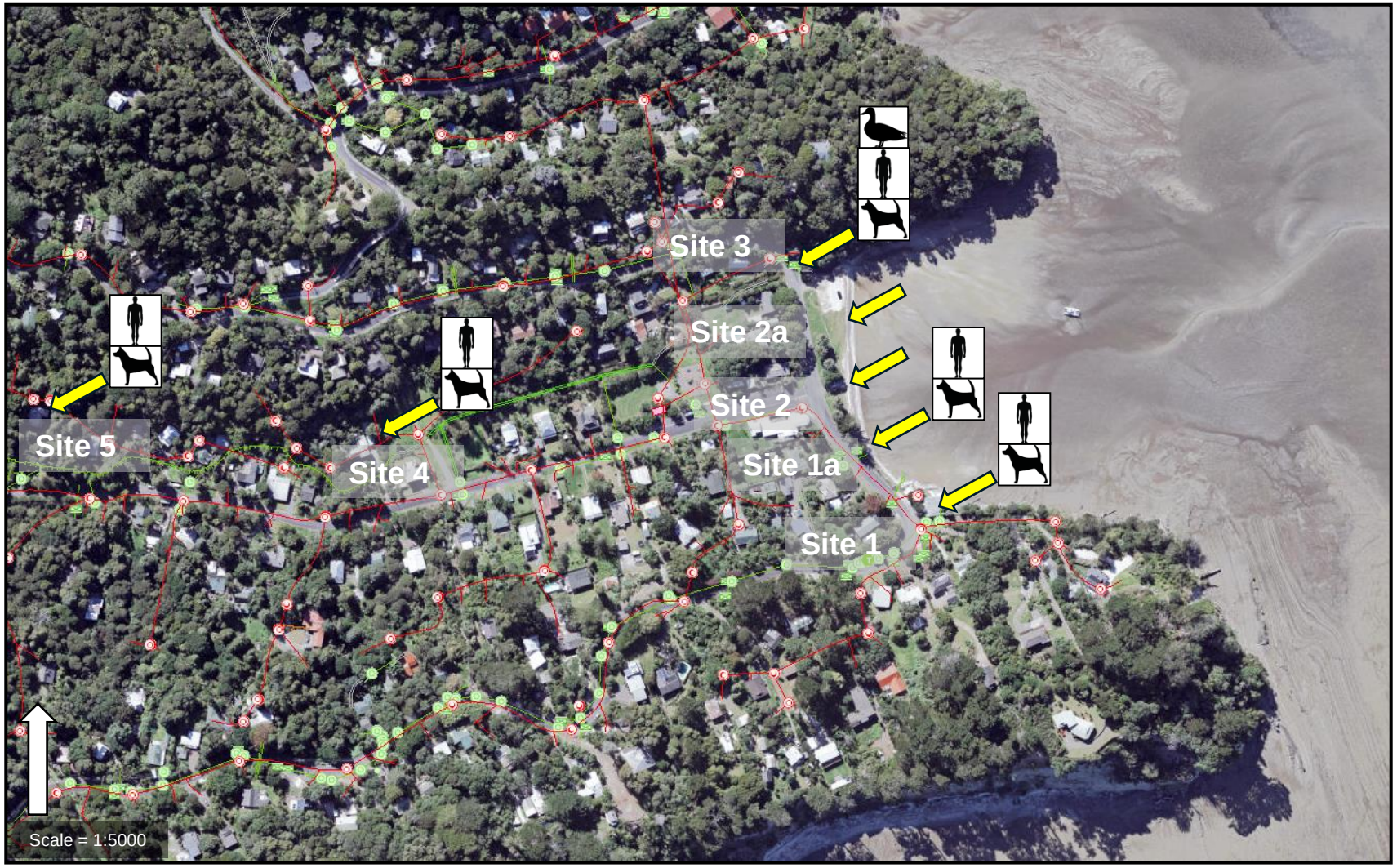
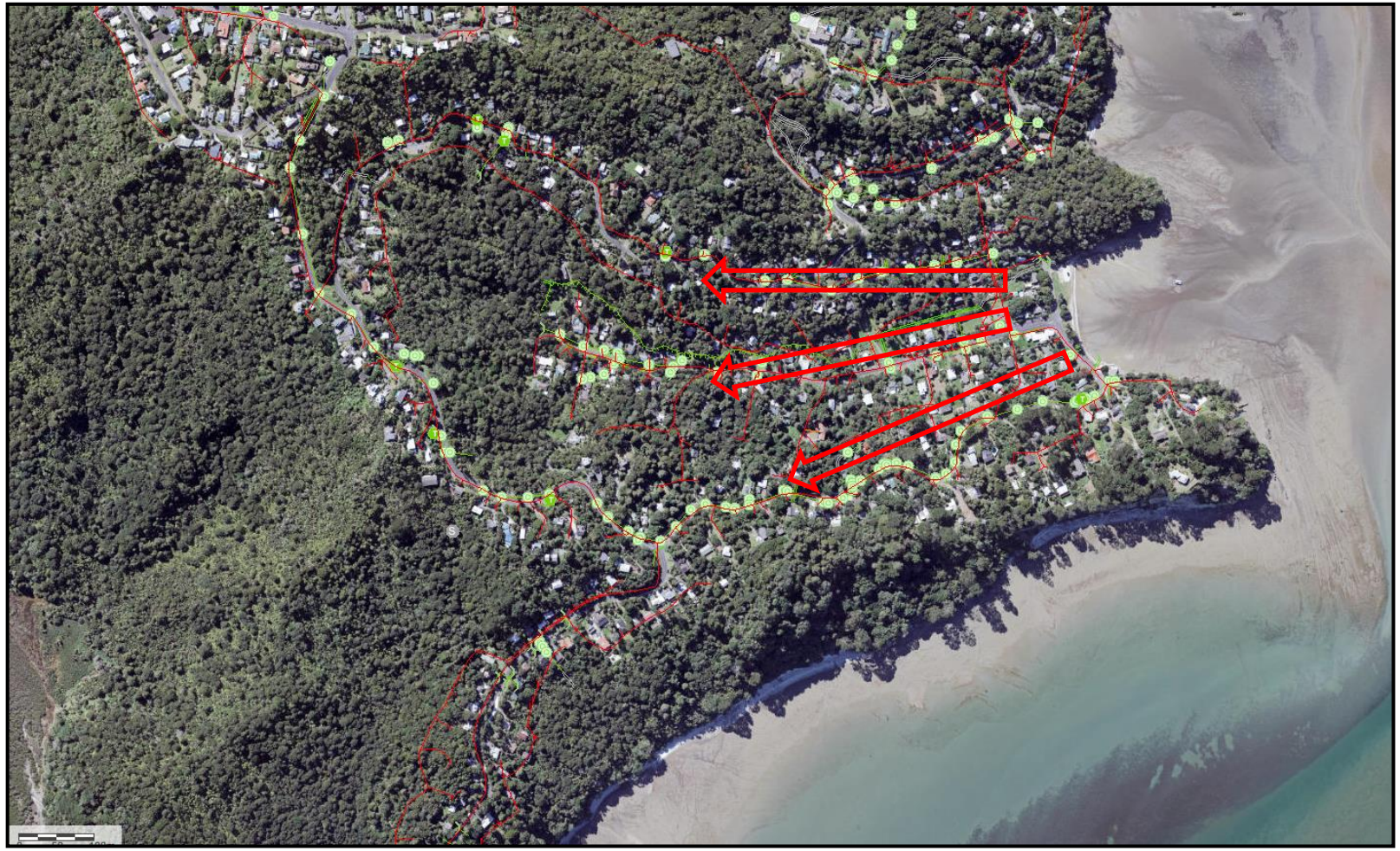

Site 3
Site 2a
Site 2
Site 1a
Site 1
Site 4
Site 5
Scale = 1:5000

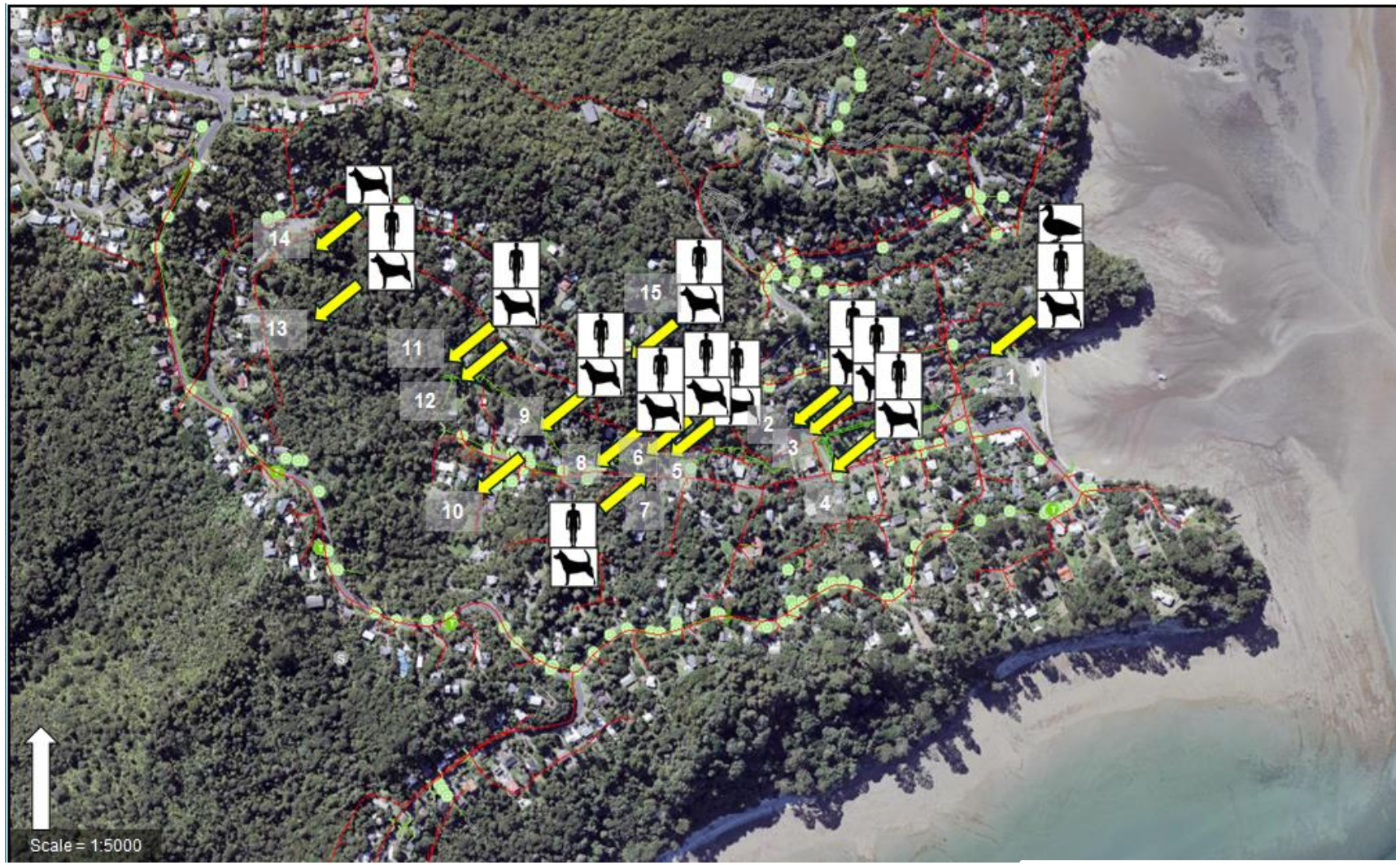
Table 3-3 Faecal source results for Laingholm Beach

Site	Date	*E. coli* (MPN/100mL)	Enterococci (MPN/100mL)	General GenBac	Conclusion
Stormwater pipe					
Site 1	14/04/2014	2500	NA	VSP	Human (BiADO & BacH) & dog
Marine sites					
Site 1a	14/04/2014	NA	4100	P	Unidentified
Site 2	14/04/2014	NA	7700	P	Unidentified
Site 2a	14/04/2014	NA	1200	VWP	Unidentified
Site 3 (stream)					
Site 3	6/03/2014	3600	NA	VSP	Human (BiADO), dog & avian
Site 3	14/03/2014	10500	NA	VSP	Dog & avian
Site 3	4/04/2014	1700	460	VSP	Human (BiADO), dog & avian
Site 3	14/04/2014	16000	>24200	VSP	Human (BiADO & BacH), dog & avian
Site 4 (stream)					
Site 4	6/03/2014	8600	NA	SP	Unidentified
Site 4	14/03/2014	1700	NA	VSP	Human (BacH)
Site 4	4/04/2014	2700	NA	VSP	Human (BiADO & BacH)
Site 4	14/04/2014	12000	NA	VSP	Human (BiADO & BacH) & dog
Site 5 (stream)					
Site 5	6/03/2014	8700	NA	SP	Unidentified
Site 5	14/03/2014	1300	NA	SP	Unidentified
Site 5	4/04/2014	990	NA	VSP	Human (BiADO)
Site 5	14/04/2014	7700	NA	VSP	Human (BiADO & BacH) & dog

NB: no source tracking analysis was undertaken on Day 3. Refer to section 2.4.1 for detail about interpretation of results.

Method: Stage 2

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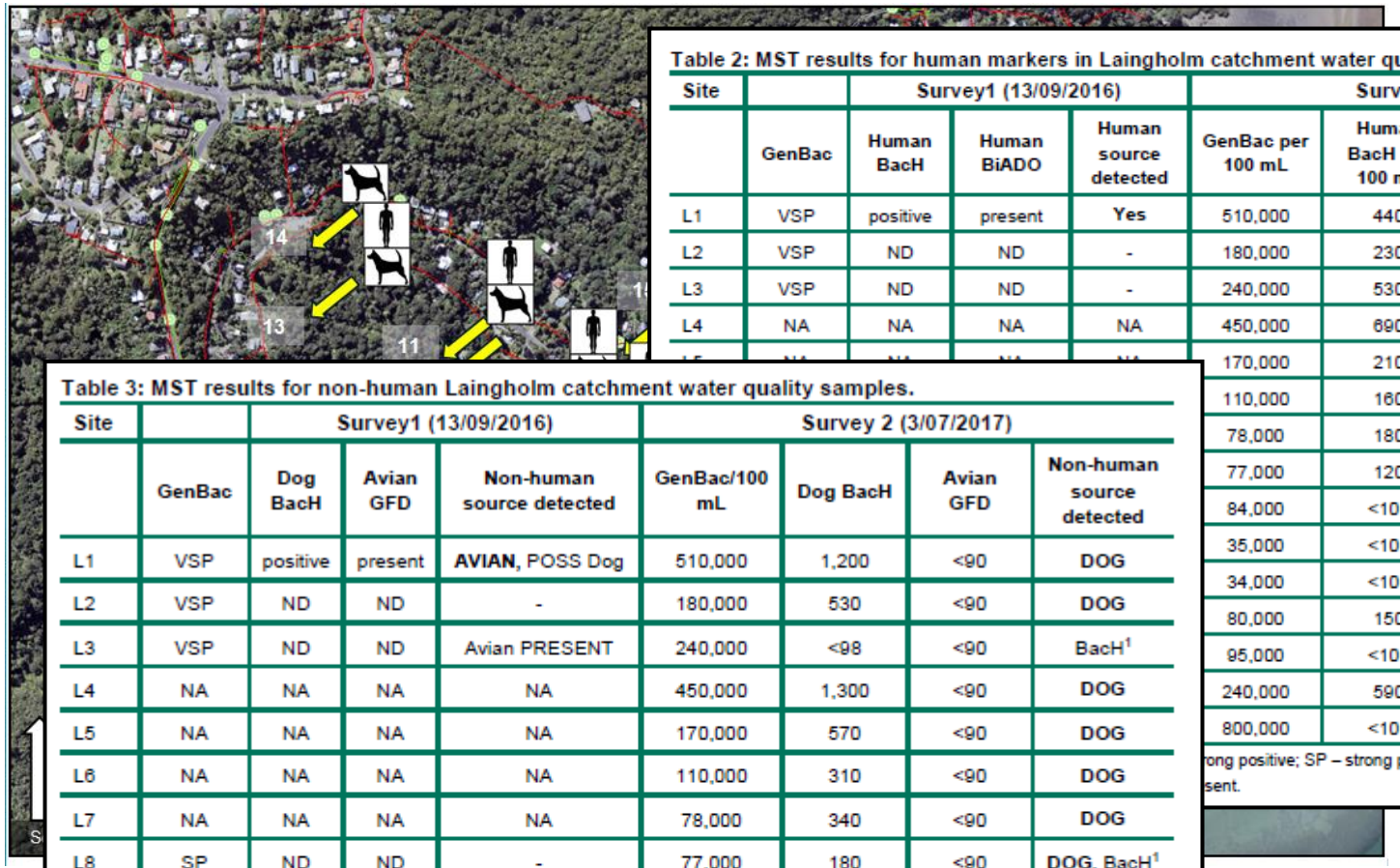


Table 2: MST results for human markers in Laingholm catchment water quality samples.

Site		Survey1 (13/09/2016)			Survey 2 (3/07/2017)			
	GenBac	Human BacH	Human BiADO	Human source detected	GenBac per 100 mL	Human BacH per 100 mL	Human BiADO per 100 mL	Human source detected
L1	VSP	positive	present	Yes	510,000	440	580	Yes
L2	VSP	ND	ND	-	180,000	230	150	Yes
L3	VSP	ND	ND	-	240,000	530	<130	POSS
L4	NA	NA	NA	NA	450,000	690	360	Yes
					170,000	210	<130	PROB
					110,000	160	<130	PROB
					78,000	180	<130	PROB
					77,000	120	<130	POSS
					84,000	<100	150	PROB
					35,000	<100	<130	-
					34,000	<100	<130	-
					80,000	150	<130	POSS
					95,000	<100	<130	-
					240,000	590	1,500	Yes
					800,000	<100	320	PROB

rong positive; SP – strong positive; P – positive; ND – not
sent.

Table 3: MST results for non-human Laingholm catchment water quality samples.

Site		Survey1 (13/09/2016)			Survey 2 (3/07/2017)			
	GenBac	Dog BacH	Avian GFD	Non-human source detected	GenBac/100 mL	Dog BacH	Avian GFD	Non-human source detected
L1	VSP	positive	present	**AVIAN**, POSS Dog	510,000	1,200	<90	**DOG**
L2	VSP	ND	ND	-	180,000	530	<90	**DOG**
L3	VSP	ND	ND	Avian PRESENT	240,000	<98	<90	BacH[1]
L4	NA	NA	NA	NA	450,000	1,300	<90	**DOG**
L5	NA	NA	NA	NA	170,000	570	<90	**DOG**
L6	NA	NA	NA	NA	110,000	310	<90	**DOG**
L7	NA	NA	NA	NA	78,000	340	<90	**DOG**
L8	SP	ND	ND	-	77,000	180	<90	**DOG**, BacH[1]
L9	VSP	ND	ND	-	84,000	340	<90	**DOG**
L10	VSP	ND	ND	POSS Avian	35,000	<98	<90	-
L11	VSP	ND	ND	-	34,000	<98	<90	-
L12	NA	NA	NA	NA	80,000	150	<90	**DOG**, BacH[1]
L13	P	ND	ND	-	95,000	290	<90	**DOG**
L14	NA	NA	NA	NA	240,000	1,400	<90	**DOG**
L15	NA	NA	NA	NA	800,000	3,000	<90	**DOG**

Notes: NA indicates samples not sent for MST analysis. VSP – very strong positive; SP – strong positive; P – positive; ND – not detected; PROB – probably, POSS – possibly. **AVIAN**, **DOG** faecal source present; [1] BacH could potentially be cat, rabbit or possum.

Conclusions for Laigholm Beach

- From 15 dry weather samples 5 exceeded MoH guidelines for *E.coli.*
- All 15 samples during wet weather exceeded MoH guidelines for *E.coli.*

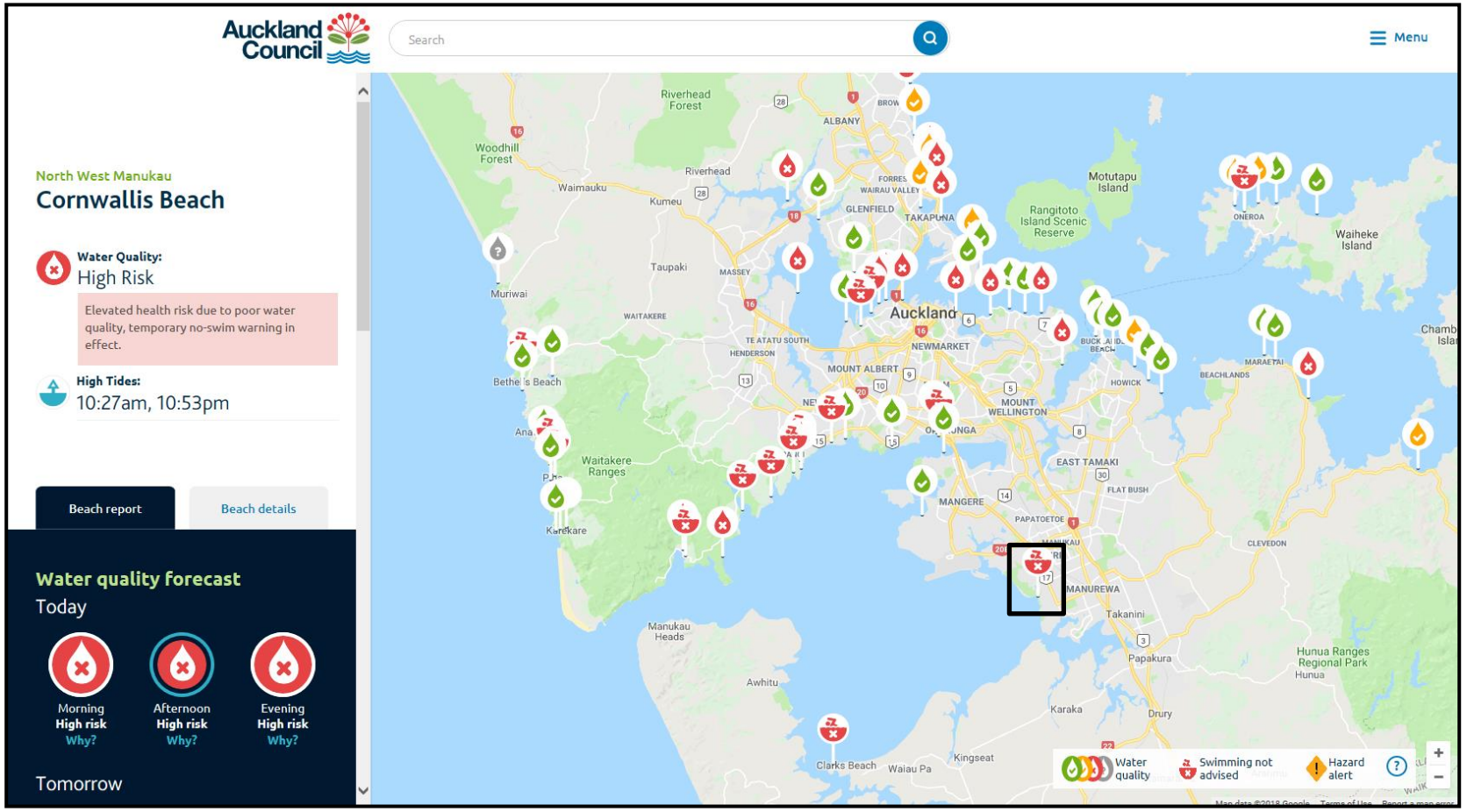
- During dry weather human markers were picked up at the bottom of the stream only. Dog and avian markers were also present
- During wet weather human and dog markers were picked up at 12 of the 15 sites, with no avian markers found

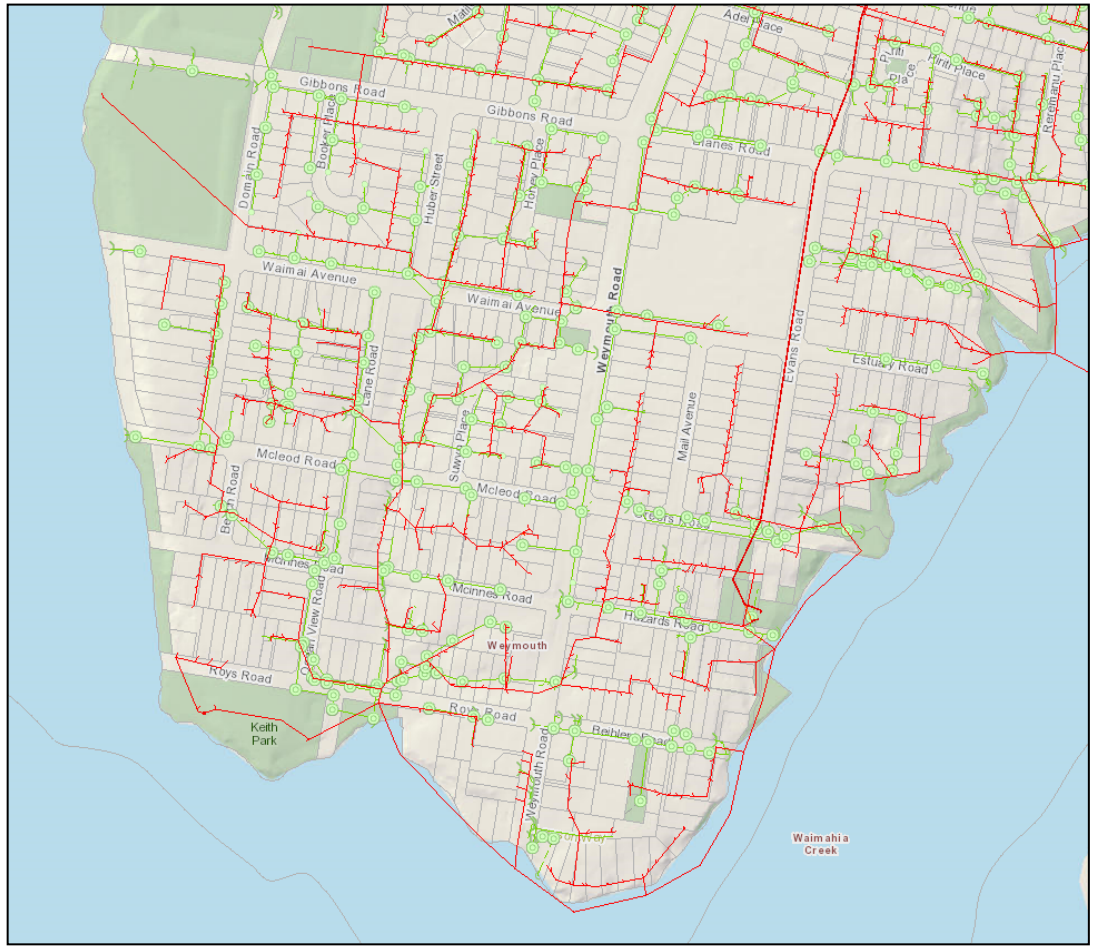
- Wet weather is a larger contributor then dry weather of elevated levels of *E.coli* to the marine environment
- Human and dog faecal contribution are the main concern

Next steps for Laigholm Beach

- Investigate stormwater network during wet weather and dry weather
- Once sampling is complete look at hot spots and investigate further to property boundaries

Case study: Weymouth





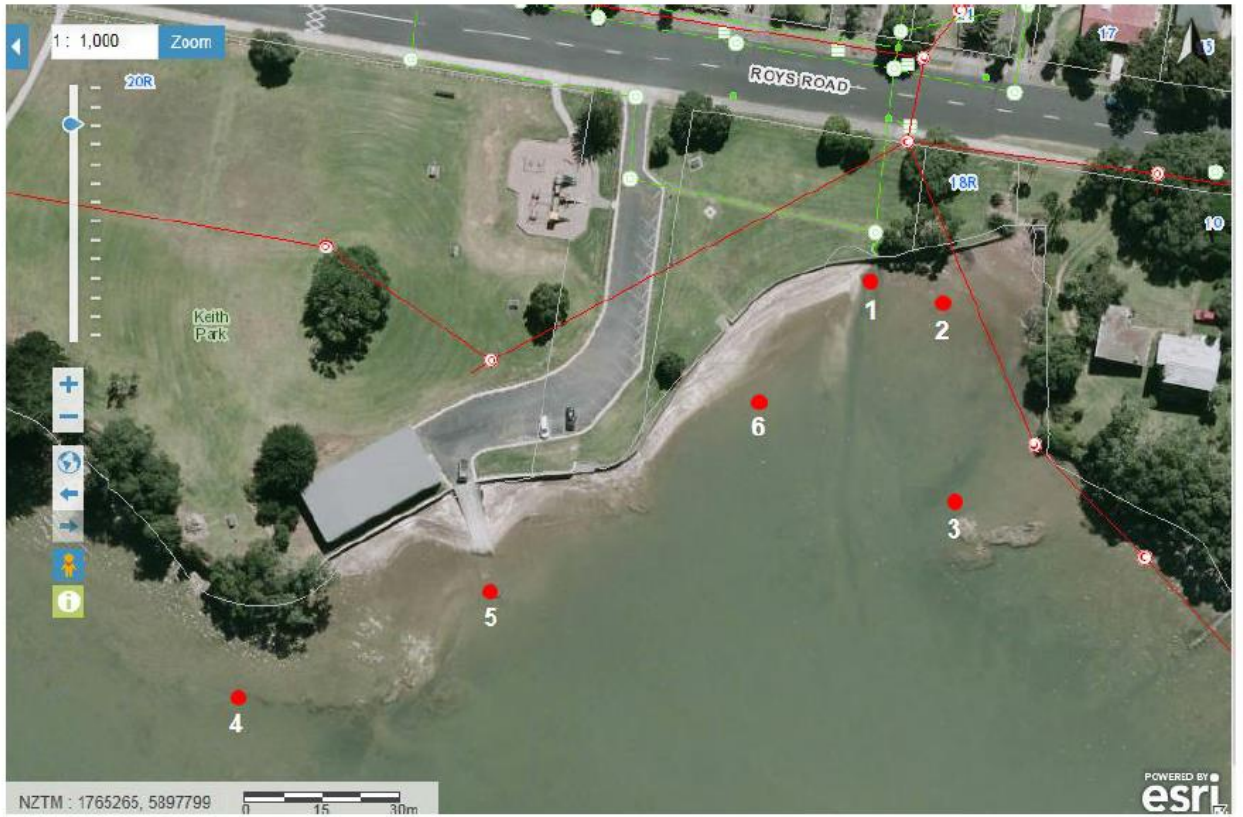


Figure 2-1 Location of 6 sampling sites visited during this investigation in 2014 (red dots). Stormwater lines and manholes are shown by green lines and green and white dots, respectively. Wastewater lines and manholes are shown with red lines and red and white does, respectively.

Results

- Stormwater outfall onto Weymouth Beach was main source of human faecal contamination.
- Birds and dogs contributed to a lesser extent.
- Investigation into wastewater and stormwater infrastructure resulted in 44 issues being identified – all of which were remedied.

- Post remediation monitoring found human faecal contamination removed (almost completely).
- However – was replaced with high avian faecal contamination (in the 10,000’s).

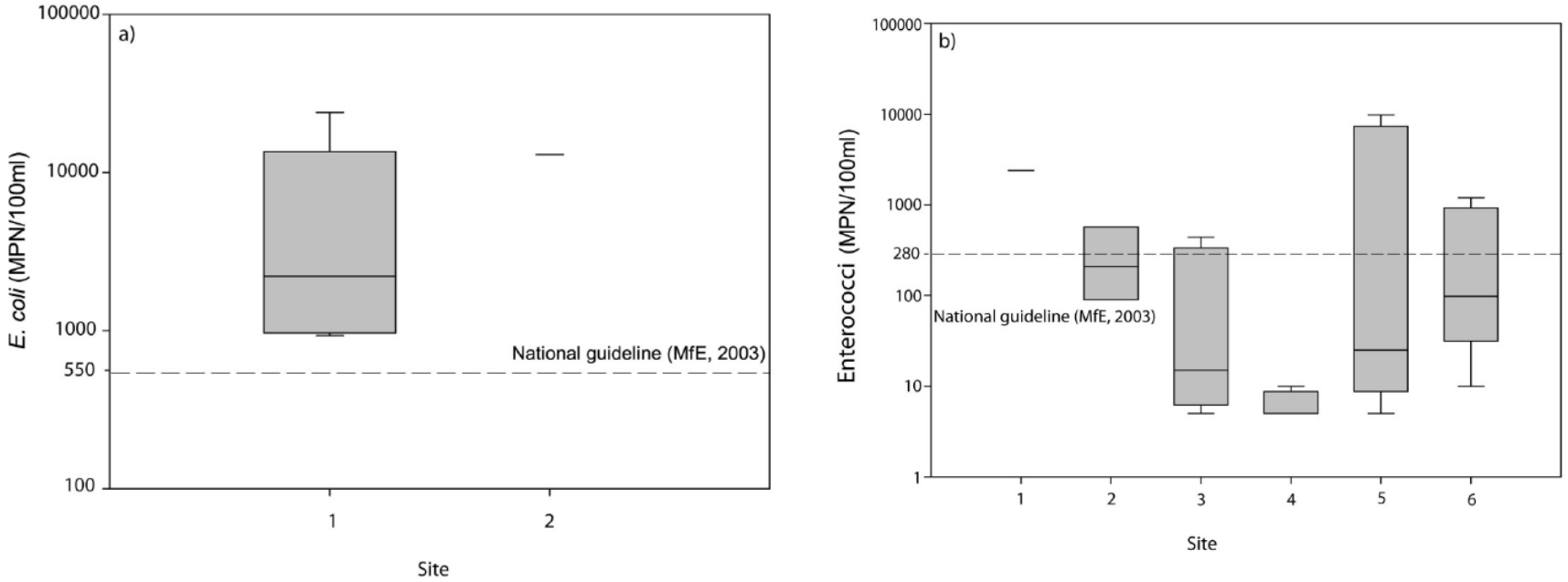


Figure 3-2 Boxplot showing the distribution of **a)** *E. coli* data for each of the freshwater samples and **b)** Enterococci data for each of the saline samples from Apr 2014. Boxes represent the interquartile range, the midline represents the median value and the upper and lower error bars represent the highest and lowest values, respectively. A single freshwater sample was collected at Site 2 **(a)** and a single saline sample w

2015 pre-remediation

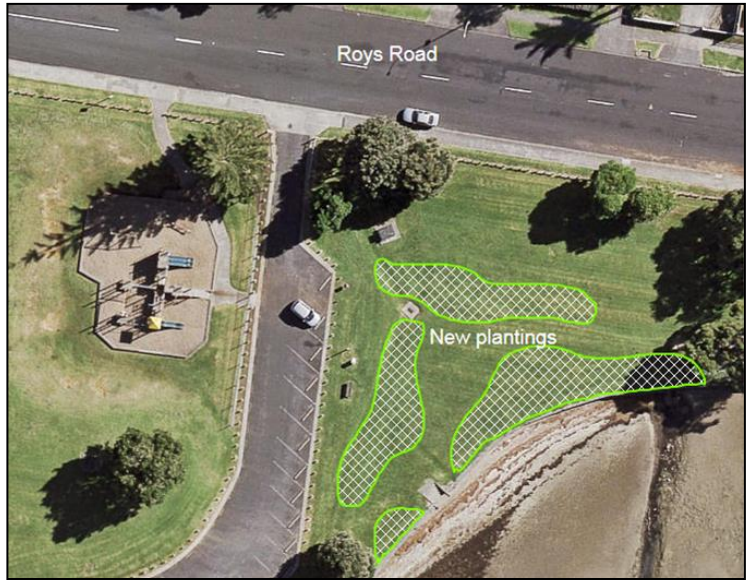
Date	Site	Tide	Salinity (ppt)	Enterococci (MPN/100ml)	*E. coli* (MPN/100ml)	General marker result (GenBac)	Faecal sources
8 Apr	1	High	0	1,800	*2,200*	Very strong positive	Human (BiADO and BacH)
8 Apr	1	Low	0	2,900	*1,000*	Very strong positive	Weak human (BacH)
13 Apr	1	High	0	3,700	*3,100*	Strong positive	Not Detected
13 Apr	2	High	32.4	*570*	3,800	Strong positive	Bird
16 Apr	1	High	26.8	*2,400*	2,600	Very strong positive	Human (BiADO and BacH), bird
16 Apr	1	Low	0.2	2,200	*930*	Strong positive	Not Detected
17 Apr	**1**	**High**	**0**	**24,000**	***24,000***	**Very strong positive**	**Human (BiADO and BacH), dog**
17 Apr	**2**	**High**	**2.4**	**24,000**	***13,000***	**Very strong positive**	**Human (BiADO), dog**
17 Apr	**3**	**High**	**32.5**	***440***	**310**	**Very weak positive**	**Not Detected**
17 Apr	**5**	**High**	**28.1**	***9,800***	**3,000**	**Positive**	**Not Detected**
17 Apr	**6**	**High**	**32.1**	***1,200***	**780**	**Weak positive**	**Not Detected**

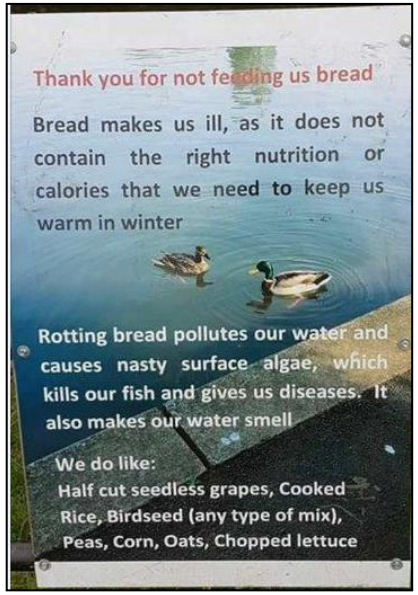
2016/2017 Post-remediation

Date	Site	Enterococci (MPN/100mL)	*E coli* (MPN/100mL)	General marker result	Weather
4/01/2017	6	160	770	Avian	Wet
9/03/2017	6	3600	2400	Avian + Human	Wet
30/11/2016	6	1100	3000	Not identified	Dry
14/12/2016	6	20,000	24,000	Avian	Dry
1/02/2017	6	140	20,000	Avian	Dry
20/12/2016	1	24,000	9800	Avian	Wet
4/01/2017	1	~~230~~	800	Avian	Wet
15/02/2017	1	640	6500	Avian	Wet
9/03/2017	1	5800	3600	Avian + Human	Wet
30/11/2016	1	260	~~1200~~	Not identified	Dry
14/12/2016	1	14,000	24,000	Avian	Dry
18/01/2017	1	2800	11,000	Avian	Dry
25/01/2017	1	1300	~~5800~~	Avian	Dry
1/02/2017	1	2200	24,000	Avian	Dry
8/02/2017	1	1000	8700	Avian	Dry

Mitigation

- Installing signs asking people not to feed the ducks
- Strategic planting to help with filtering runoff and stop ducks from congregating
- Post monitoring will occur after the planting is completed





Case study conclusions

- Microbial Source Tracking remains a highly efficient tool for highlighting areas of faecal contamination when used in conjunction with *E.coli* or enterococci sampling
- Replication of MST analysis at each site is imperative to ensure positive marker identification
- Sampling on both dry and during or immediately after rain events have shown to be important method in understanding what is happening within the catchment
- Stream walks have been beneficial for investigation potential sources of contamination upstream of an outfall
- Up to date GIS layers with all known outfalls identified make identifying illegal and suspicious outfalls easier.

Questions