

Compliance monitoring assessment

Consent No:	WGN940045	[5963] [4956] [20346] [35860]	Date: 09 April 2021
	WGN970233	[2290] [1521]	
	WGN030091	[22421]	
Activity:	Various consents associated with the operation of Southern Landfill and composting operations		

Your compliance rating

WGN940045 [20346] – Discharge to air WGN940045 [5963] – Collect leachate WGN940045 [4956] – Continued operation of landfill, including earthworks WGN970233 [2290] – Discharge of compost to land WGN970233 [1521] – Discharge contaminants to air from compost disposal WGN030091 [22421] – Discharge to land of compost and bulking agents for storage puposes		FULL COMPLIANCE Well done! No further action required
WGN940045 [35860] – discharge to land		MODERATE NON-COMPLIANCE Condition(s) not met/Action required (see comments below)

Overall compliance summary for the Southern Landfill:

GOOD 	Overall good management of site and consents. The consent holder is generally on top of meeting their consent requirements. Whilst there are some minor breaches of consent conditions, these have no ongoing environmental effects.
--	--

Comments

This compliance report covers the period from 1 January 2020 to 31 December 2020 to align with Greater Wellington Regional Council's (GWRC) compliance monitoring programme. This report

assesses consent suites WGN940045 for landfilling, and WGN030091 and WGN970233 for composting activities at Southern Landfill which are under the management of Wellington City Council. Consent WGN080137 managed by Nova Energy is assessed in a separate report.

I was on site at the landfill on 28 October 2020 and 23 March 2021. During these visits, the general landfilling operations appeared to be working well with the active filling area kept to a minimum.

Thank you for submitting the Southern Landfill Compliance Report for GWRC for the year to June 2020. This was received by GWRC on 24 November 2020 and reviewed by contaminated land expert Dave Bull from Hail Environmental on behalf of GWRC.

During the 2020 compliance period some notable events impacted landfill operations. Firstly, the pipeline which sends sludge from the Moa Point Wastewater Treatment Plant to the Sludge Dewatering Plant at Carey's Gully failed in late January 2020 and was only repaired in May 2020. This meant that the sludge was trucked from Moa Point into the Sludge Dewatering Plant.

Secondly, the volume of waste received by the Southern Landfill significantly decreased during the Covid-19 lockdown.

Thank you for continuing to operate at a high standard throughout these disruptions, and continuing to work with GWRC in regards to consent compliance.

Water Quality:

Conditions 25, 26 and 27 of consent [35860] set out the groundwater, surface water and biological monitoring required by the consent holder. Rather than having any limits on the quality of water monitored by the landfill, condition 25 states, "there shall be no significant increase in the following parameters by virtue of the exercise of this permit". Condition 37 of the consent reiterates this level of expected effects, by stating that "if a significant change in the monitoring results, either between upstream and downstream sites, or over time at the downstream sites in condition 26, 27 or 28, the grantee shall instigate investigations into why these changes are occurring and identify and undertake remedial action that may be required".

In previous annual reports AECOM have identified 'significant increases' in contaminants based on the following criteria in order to assess compliance with conditions 25 and 26:

- Values greater than the Practical Quantification Limit (PQL calculated as 10 times the Method Detection Limit (MDL)).
- Single values greater than 10 times the median (calculated from the entire data set beginning in July 2008).
- Single values above ANZG 95% fresh water guidelines.
- Three consecutive increasing measurements (at least one of which is greater than the median).

Since the last compliance report was published, GWRC and the consent holder have agreed that Mann Kendall statistical analysis will be used to identify trends in the concentration of contaminants, and subsequently will form the basis of determining a 'significant increase'.

Groundwater:

Groundwater quality results are required to be taken from bores sited at the toe of Stage 2 landfill, BH2A, BH2B, BH103A, BH103B and upstream bore BH6.

BH6 was brought back online in April 2020 following 17 months of not being able to provide samples due to being covered by a landslide. Therefore, monitoring results from this bore are provided for 17 April 2020 and 21 May 2020. The reinstatement of monitoring from this bore is positive because BH6 is the only point that provides upstream groundwater quality samples. The reinstatement of this monitoring addresses the non-compliance with condition 25 of consent [35860] which was identified in the previous compliance report.

The AECOM Water Quality Monitoring Report appended to the annual report includes the water quality results for all samples taken throughout the year.

The AECOM Water Quality Monitoring Report sets out that based on visual analysis of the time series graphs no significant short-term trends in contaminant concentrations were recorded over the compliance period. Additionally, this report identifies the following potentially increasing long-term trends at each of the relevant monitoring bores:

- BH2A: electrical conductivity and phosphorous.
- BH2B: electrical conductivity and manganese.
- BH3A: pH.
- BH3B: BOD5.

The AECOM report identifies that key contaminants of concern such as ammoniacal nitrogen, BOD5, faecal coliforms, and dissolved manganese are elevated in bore BH103B (and BH103A to a lesser extent) compared to the other bores. The report also details that a statistical review (Mann-Kendall) of the longer term faecal coliform concentrations shows an increasing trend in bore BH103B.

While a statistical review (Mann-Kendall) of the longer term manganese concentrations identified no trend (in bores BH2A and BH2B) and decreasing trends (in bores BH103A and BH103B).

The results, trends, and Mann-Kendall analysis were reviewed by Dr. Dave Bull who concurred that there are no obvious trends at the moment, with the exception of the increased faecal coliforms which is considered **non-compliant**. In regards to faecal coliforms trends Dr. Bull requested an explanation of the investigation and improvements being carried out in response to the increasing trend. The consent holder responded to this on 26 February 2021 setting out the following improvements were being carried out to address the increasing faecal coliform trend:

1. Improvement to existing borehole infrastructure to minimise possible contamination from surface water– completed.
2. Improvements to drainage along tip face closest to bund at the northern most tip face. – new drainage to ensure limited ponding
3. Suggestions to sample approximately 100 meters upstream in addition to current upstream sampling location.
4. Updates to ELS around decontamination requirements when sampling boreholes.

Overall, I consider the ground water quality results are generally stable or declining in respect to the previous compliance period. With the exception of the increasing trend in faecal coliforms at BH103B which is **non-compliant** with condition 25.

During my site visit on 23 March 2021 and during the CLG meeting on 29 March 2021 we discussed that faecal source tracking (FST) of BH103B has been carried out and the results are being interpreted by AECOM. The results of this tracking will be useful to determine whether the source of the faecal coliforms is from the human waste leaching from the landfill or from animal sources in the catchment.

Required actions: Upon receiving the analysis of the FST for BH103B, please share these with GWRC so that we can make a plan for how to address this increasing trend in faecal coliforms resulting in non-compliance.

Surface Water:

Surface water quality is required to be sampled at both an upstream and downstream location monthly for a limited suite of parameters, and six monthly for an extended list of parameters and for macroinvertebrates.

The results of the monitoring for this compliance period generally show higher concentrations of contaminants in the downstream monitoring location indicating the landfill is having an impact on surface water quality in the receiving environment.

The AECOM Water Quality Review sets out that based on visual analysis of the time series graphs the 2020 samples generally show a decreasing trend in recorded concentrations. Particularly when compared to the generally elevated results in key contaminants which were recorded in 2018 and 2019.

However, the report details that a statistical review (Mann-Kendall) of the longer-term faecal coliform concentrations shows an increasing trend in both the upstream and downstream monitoring locations. This increasing trend is considered **non-compliant** with condition 25 of this consent.

As with the faecal coliform trend in BH103B, during my site visit on 23 March 2021 and at the CLG meeting on 29 March 2021 we discussed that FST of the upstream and downstream monitoring locations has been carried out and the results are being interpreted by AECOM. The results of this

tracking will be useful to determine whether the source of the faecal coliforms is from the human waste leaching from the landfill or from animal sources further up the catchment.

Required Actions: Upon receiving the results of the FST for upstream and downstream surface water monitoring points, please share these with GWRC so that we can discuss your plan for how to address this increasing trend.

Dust and Odour

GWRC are not aware of any dust complaints at the landfill, and during my site visits on 28 October 2020 and 23 March 2021, dust did not appear to be an issue.

Six odour complaints were reported to GWRC throughout 2020 in relation to the Southern Landfill. GWRC officers did not detect any offensive or objectionable odours relating to the landfill or compost when investigating odour complaints, therefore there was no breach of the resource consent conditions. Due to the proximity of other odour generating activities to the landfill, it is difficult to determine the source of the odour during GWRC and WCC led investigations.

Gas Collection System

Although Nova Energy own and operate the gas collection and combustion infrastructure at Southern Landfill, WCC is the consent holder for landfilling, and discharges of landfill gas to air, and is therefore responsible for ensuring that landfill gas is collected and disposed of properly.

The gas collection system comprises a series of wells and collection pipes in stage 2 and 3 of the landfill, the gas is piped from the landfill to the gas generator and flare located adjacent to the recycling centre. During my site visit on 23 March 2021 I observed the new 'above ground' main gas collection pipe was operating.

During my site visit on 23 March 2021 and during the CLG on 29 March 2021 it was discussed that the gas generator was not operating due to a damaged component.

Because the generator was not operating the landfill gas was being destroyed by the flare. I note that in the previous compliance report the destruction of gas via the flare was considered a technical non-compliance. However, Nova energy confirmed on 24 March 2021 that the flare now meets the National Environmental Standards for Air Quality 2004, and therefore the gas destruction is **compliant**.

Required Actions: By 23 April 2021, please let GWRC know when the gas generator is expected to be operational.

Capping and Closure

As filling in Stage 3 reaches capacity, WCC have been progressively capping the landfill. Condition 18 of consent [35860] sets out the parameters the final landfill cap must meet. Further parameters that the landfill cap must meet are set out in section 3.2 of the Landfill Management Plan.

The letter received by GWRC on 12 June 2020 following up on the actions from the previous compliance report set out that the capping has been carried out in accordance with the methodology which had been demonstrated to comply with the requirements of condition 18. The Annual Report also states that random sampling of the capping will be carried out to demonstrate compliance.

Required Action: By 23 April 2021 please provide the results of the random sampling carried out on the landfill capping, or confirm when these result will be available.

Litter

When on site on 28 October 2020 I observed the new, larger litter control screens at the northern face of the landfill and around the active tipping face. GWRC received no complaints about litter from the Southern Landfill during this compliance period.

Community Liaison Group Meetings

During the compliance period the Southern Landfill Community Liaison Group (CLG) held a meeting at the Southern Landfill on the 23rd June 2020 and 13 October 2020. The community did not raise any notable concerns directly related to the compliance of Southern Landfill. Although outside of the relevant compliance period a CLG meeting was held on 29 March 2021.

Required Action: Please confirm the date for the next CLG meeting.

Daily Cover

The conditions of consent [35860] were changed on 12 December 2018 to allow WCC to use alternative daily cover (ADC) as a means of daily cover. However, WCC have not continued the use of ADC. Instead traditional soil/clean fill cover is used. During my site visit on 23 March 2021 and during the CLG on 29 March 2021 we discussed the work progressing towards the use of ADC sprayed from a modified truck.

Please notify GWRC prior to recommencing the use of ADC.

Landfill management plan

Condition 19 of the consent [35860] requires WCC to exercise their Landfill Management Plan (LMP), and condition 20 requires the LMP to be reviewed annually. WCC last updated the LMP in August 2019. The most recent changes reflect the new practice of handling asbestos contaminated material by staff, contractors and visitors to limit risk to human health.

While the LMP was not updated in 2020, no explicit changes were required so this is considered compliant.

PFAS (polyfluoroalkyl substances)

PFAS (polyfluoroalkyl substances) and its presence and impacts on landfills is an emerging issue that GWRC wants to be proactive at managing. On 23 March 2021 Robert Hon confirmed to me that he is not aware of the disposal of any PFAS containing waste at the Southern Landfill. Please consult with GWRC prior to considering accepting any waste likely to contain PFAS. We are also aware that there are some PFAS-containing material that would not be known to contain PFAS. Therefore, we are considering the value of speculative testing for PFAS in the receiving environments of landfills throughout the Wellington Region. Please continue to work with us in regards to PFAS.

Leachate Management WGN940045 [5963]

In 2018 a liquid substance began leaching out of a bank at the toe of the landfill close to where stages one and two meet. This liquid has elevated levels of key contaminants and therefore is considered to be at least partially leachate. The 'leak' is captured by a concrete drain and is diverted directly to the sewer system. Sampling of this 'leak' shows that concentrations of key contaminants have decreased between August 2017 and February 2019 with the exception of faecal coliforms.

I have a concern that this 'leak' has only been discovered because it is located in an observable area close to the culvert outlet, and that other similar leaks in less obvious locations may also exist.

Required Actions:

- Continue to monitor the quality of this 'leak' and ensure that it continues to be diverted to the sewer.
- By 23 April 2021, please provide a plan to investigate if any other 'leaks' have formed along the toe of stages one and two of the Southern Landfill following heavy rainfall (7mm in 1 hour, or 20mm in 24 hours), then report the findings of this to GWRC.

Potential concrete recovery trial

On the 3rd March 2020 GWRC received the outline of a proposal to use a piece of unused land at the Southern Landfill for the reprocessing of concrete. During my site visit on 23 March 2021 I was shown the proposed location for this concrete recycling would be adjacent to the Sludge Dewatering Plant.

GWRC are supportive in principle of recycling concrete. The concrete crushing process could be considered a permitted activity so long as it complies with the conditions of Rule R27 'Handling of bulk solid materials' of the PNRP. I suggest that you review this rule and determine if you think the conditions can be met by the proposal. You will also need to consider the management of stormwater from the site and how you will ensure contaminants from the process will not enter nearby waterways.

Conclusion:

Thank you for generally complying with the conditions of your consents. Please follow up on the identified 'required actions' by the 23rd of April.

Please note that the Greater Wellington Regional Council (GWRC) has a responsibility to enforce the Resource Management Act 1991 (RMA). Accordingly, you should take all necessary steps to ensure you comply with your obligations under the RMA, including all conditions of your consent.

Your consent incurs variable compliance monitoring charges at your consent anniversary. These charges are likely to increase to reflect any additional time spent monitoring your consent to due to non-compliance.

GWRC compliance rating system

Assessment made for each individual consent relating to the site/activity.		
	<p>FULL COMPLIANCE – All conditions met - well done! No further action required</p> <ul style="list-style-type: none"> All conditions assessed are met including supplying information and/or records 	<p>Compliance toolbox</p> <p>Compliance report</p> <p>Please explain</p> <p>Advisory notice</p> <p>Abatement notice</p> <p>EDG referral</p> <p>Notes:</p> <ol style="list-style-type: none"> All non-compliance to be entered on Ozone by end of calendar month. Incident logged for works outside scope of consent, or where non-compliance results in significant environmental effects Additional monitoring will be undertaken to ensure compliance is achieved
	<p>LOW RISK NON-COMPLIANCE – Most conditions met. Some action may be required</p> <ul style="list-style-type: none"> Minor breach of effects based conditions or works outside scope of consent with low risk of adverse environmental effects Breach of conditions which is technical in nature (e.g. failure to submit monitoring report or records) 	
	<p>MODERATE NON-COMPLIANCE – Some condition(s) not met. Action required</p> <ul style="list-style-type: none"> Repeated failure to supply monitoring report or records. Breach of conditions where there are some environmental consequences and/or moderate risk of adverse environmental effects 	
	<p>SIGNIFICANT NON-COMPLIANCE – Many condition(s) not met. Immediate action required</p> <ul style="list-style-type: none"> Breach of conditions where there are significant environmental consequences and/or high risk of adverse environmental effects 	

<p>VERY GOOD</p> <p>★★★★</p>	Overall excellent management of site and consents. The consent holder is proactive in meeting their consent requirements. If issues have arisen concerning consent conditions, the consent holder responds with promptness and effectiveness.
<p>GOOD</p> <p>★★★☆☆</p>	Overall good management of site and consents. The consent holder is generally on top of meeting their consent requirements. Whilst there are some minor breaches of consent conditions, these have no ongoing environmental effects.
<p>FAIR</p> <p>★★★☆☆</p>	Overall the management of site and consents is considered to be fair. There are occasional breaches of consent conditions and/or lapses in providing information to GWRC.
<p>POOR</p> <p>★☆☆☆☆</p>	Overall the management of site and consents is considered to be poor. There are consistent and ongoing breaches of consent conditions. The consent holder is not getting on top of their consent requirements.

Consent monitoring charges

Each consent receives a consent monitoring charge from GWRC.

This charge is made up of three parts:

- A *customer service charge* that covers the administrative cost of your consent(s);
- A *compliance monitoring charge* that covers all actual and reasonable time associated with assessing compliance with your consent(s) including the time spent visiting and assessing your site, information and reports you submit, file notes, travel time and reporting to you on compliance with your consent(s); and
- A *State of the Environment (SoE) charge* that covers a proportion of the cost of GWRC monitoring the environment that relates to your activity.

For further information on consent monitoring charges, please see our *Resource Management Charging Policy*.

23 April 2021

Joshua Knowles
Greater Wellington Regional Council
100 Cuba Street
Te Aro
Wellington 6011

Dear Mr. Knowles

Re: Response to Compliance Report for the Southern Landfill 2020

Thank you for your compliance report.

In the report, you have requested responses to the following outstanding matters.

1. When the landfill gas generator at the Southern Landfill is expected to be operational?

We confirm that the gas generator has operational from the 16th April 2021.

2. Please provide results of the random sampling carried out on the landfill capping

We have reviewed our current landfill filling plan. When we decided to cap certain areas of the landfill in 2016, we did so under the assumption that it was likely that an extension to the landfill would form part of our future plans. Recent changes to the Council's position on a landfill extension have altered our thinking. The 'final capped' areas may be reopened for filling to ensure adequate capacity until the expiry of our consent in 2026. On this basis, any random sampling for testing is unnecessary at this point but we will provide proof of compliance for any final cap once the current stage of the Southern Landfill is officially closed.

3. Please provide a plan to investigate if any other leaks have formed on the stage one and two of the Southern Landfill following heavy rainfall (7mm in 1 hr or 20mm in 24hrs), then report findings to GWRC.

I attach a new leachate leak investigation protocol with this letter.

I also attach the latest round of inspections following this new leachate leak investigation protocol.

Please advise if you have any comments on this protocol, if you are in agreement, it will be form part of our Southern Landfill Management Plan and placed on a monitoring schedule.

Yours sincerely



Robert Hon
Waste Operations Engineer – Waste Operations
Ph: 021 227 8148
Email: Robert.hon@wcc.govt.nz

Southern Landfill

Southern Landfill Leachate Leak Inspection Protocol	
Original Author: Robert Hon	Revision Number: 0
Date: 12.04.2021	

Background

Part of management of the Southern Landfill involves periodic inspections of the earth bunds built as part of the support infrastructure of the disposal of waste.

In general, valley filled landfills and generally buttressed with a compacted earth bund to support waste placed behind the bund.

This was constructed for all stages (active and closed) at the Southern Landfill. Over time, leachate may 'break out' leak out of these bunds and enter the environment.

As part of our ongoing responsibility, both to existing consent conditions and to the adjacent environment, we are required to attend to any leachate breaks – ensuring it does not enter the existing environment.

Frequency

As a minimum, these inspections should twice a year.

Once in the middle of winter and another in middle of summer.

Methodology

1. Choose a sunny day; preferably 24 hrs after heavy rains.
2. Walk the toe of the BUND A, BUND B and BUND C – Please refer to figure 1 & 2.
3. Look for any signs of water pooling at the base of the bunds
4. Review and see if you can trace the source of the water pooling – look for constant streams of liquid. You may have to chase this up the bund to find the source of this if it is safe to do so.
5. Mark the location of the pooling on an aerial map of the site. If possible, get a GPS location point.
6. Continue walking the toe of the bund noting any pooling of fluid/possible leaks.
7. Compile information and alert Landfill Operations Manager Waste Operations Engineer and Waste Operations Manager.
8. Contain the liquid either by sending it to sewer or with bunding.
9. Collate information and contact Water Quality Testing contractor and request samples be collected and tested.
10. Tests for the following:

pH

Suspended Solids - Total

Conductivity at 25°C - mS/m unit

Chemical Oxygen Demand

BOD5 - Total

Sample Collection Charge

Nitrate - Nitrogen

Ammonia Nitrogen

Iron - Acid Soluble

Manganese - Acid Soluble

Faecal Coliforms by MF - Environmental Water

11. Review sample results – 3rd party advice may be required
12. If the sample is considered leachate; alert Landfill Operations Manager, Waste Operations Engineer and Waste Operations Manager.
13. One of the above will alert the GWRC
14. File inspection report in accordance with document management procedures.
15. Planning for permanent solution will begin following timeframes as per Landfill Management Plan.

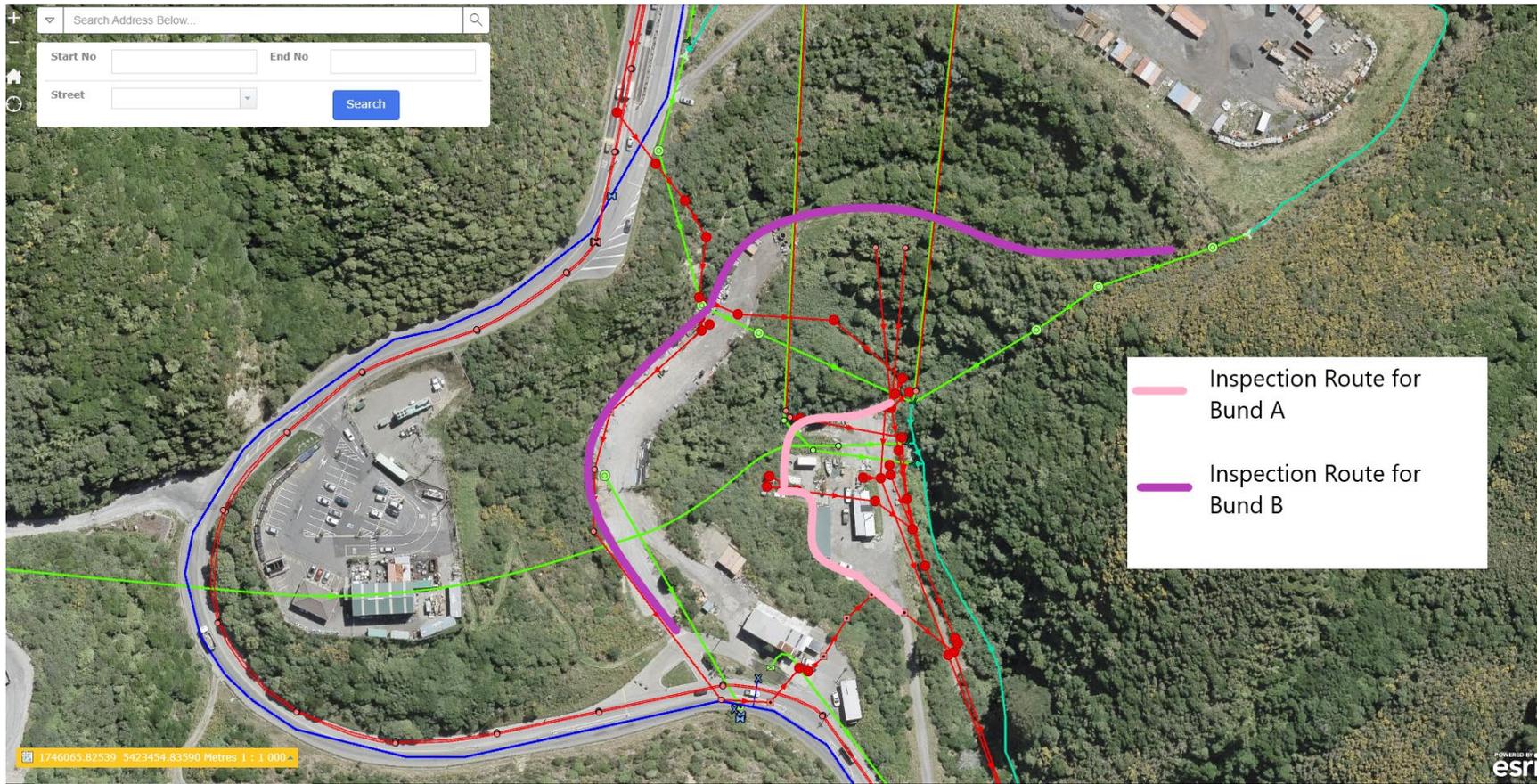


Figure 1: Aerial View of leachate leak inspection route for Bund A and Bund B

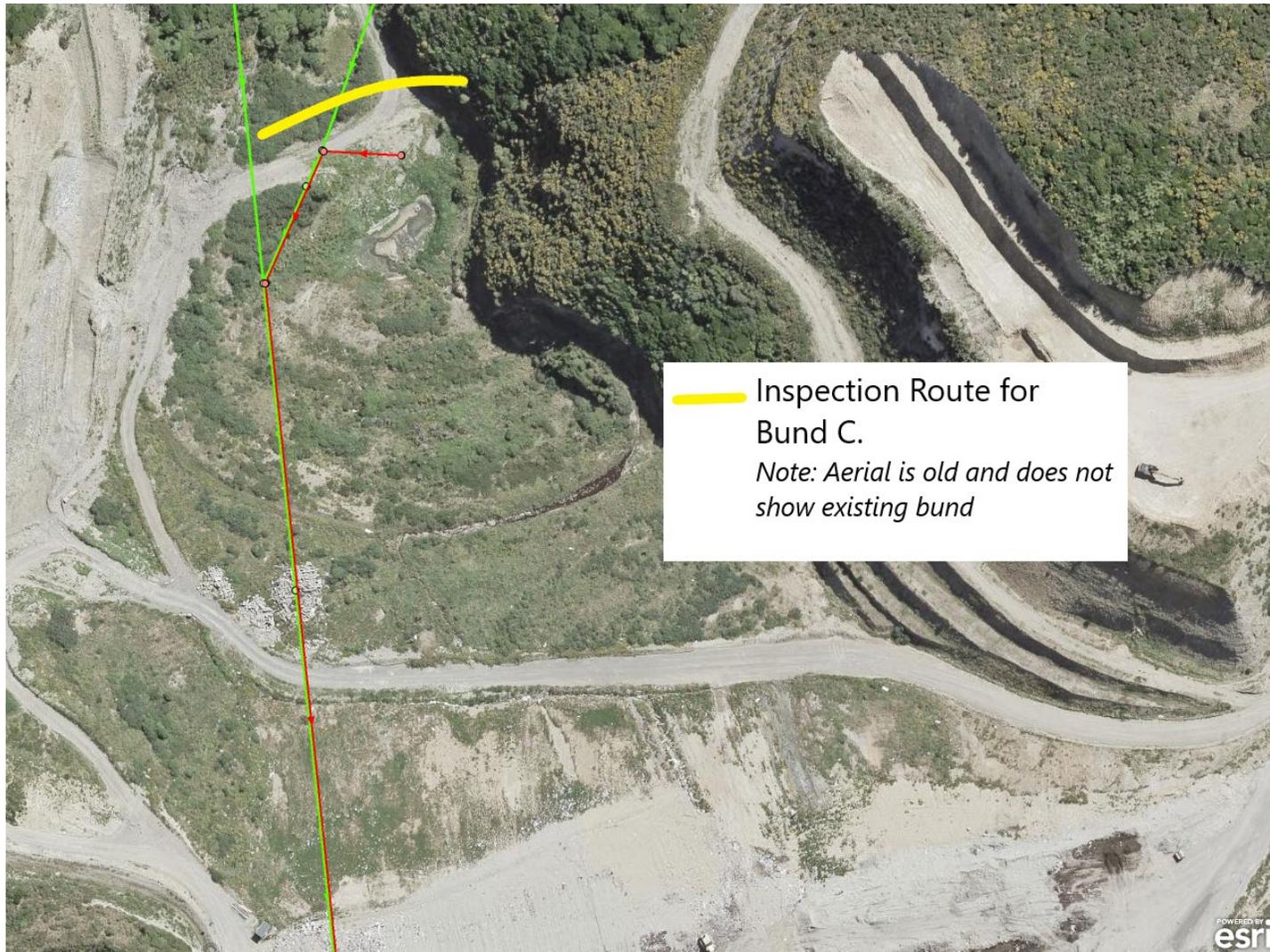


Figure 2: Aerial View of leachate leak inspection route for Bund C

Southern Landfill Inspection Report

Date: 15.04.2021	Location: Leachate Leak BUND A
Time: 10:00 am	Inspection by: Robert Hon
Weather: Overcast	CC: Darren Hoskins

Comments:

Other than the known leak adjacent to the SW tunnel outlet which is currently being sent to sewer, there were no other signs of leaks.

The capture system is in good working order.

Photos:

None

Further Actions:

Programme cleaning out of capture system in the next 3 weeks.

Southern Landfill Inspection Report

Date: 15.04.2021	Location: Leachate Leak BUND B
Time: 10:45 am	Inspection by: Robert Hon
Weather: Overcast	CC: Daren Hoskins

Comments:

Inspected area with lease holder – GP Friel Ltd.
No leachate break detected.

GP Friel Ltd Staff also indicated they have not seen any pooling of water at base of this bund.

Photos:

None

Further Actions:

None

Southern Landfill Inspection Report

Date: 15.04.2021	Location: Leachate Leak BUND B
Time: 11:30 am	Inspection by: Robert Hon
Weather: Overcast	CC: Daren Hoskins

Comments:

Inspected area.
No leachate break detected.
Works to create new drainage channel above bund that drains into existing leachate system ongoing.

Photos:

None

Further Actions:

Instruct Leach & Co. Ltd to prioritise completion of new drainage channel as soon as practical.
Completion expected in the next 2 weeks.

26 May 2021

Background

The Southern Landfill receives approximately 100,000 tonnes of waste per annum including a large proportion of the city's dewatered sewage sludge.

As part of increasing community concerns around the levels of faecal matter in the Owhiro catchment; Waste operations has commissioned Faecal Source Tracking (FST) analysis of surface water samples collected at various points along the Carey's Stream tributary that flows into the wider Owhiro catchment.

These samples were collected by Eurofins Ltd under supervision by an independent consultant, AECOM Ltd on the 18th of February 2021 and sent to the Institute of Environmental Science and Research Ltd (ESR) for analysis.

Two appendices are attached with this document.

Appendix 1 – Aerials showing the locations of the sampling sites.

Appendix 2 – Final report showing the results of the Faecal Source Tracking (FST) Analysis.

Summary

We monitor faecal levels by measuring E. Coli; this is a widely accepted measure for determining faecal contamination.

From the FST analysis, we confirm the source of the faecal of the samples was from birds (avian).

There was no detectable evidence of ruminant faecal source (goats, pigs, deer) and very little evidence of human faecal coliforms.

We will continue to monitor water quality and consider other potential improvements to further minimise any impact from our operations on the Owhiro catchment.

Thank you.

Waste Operations

Wellington City Council.

APPENDIX 1: Aerials showing the locations of sampling sites



PROJECT MANAGEMENT

Approved		Date	14/08/2020
Checked	KS	Date	14/08/2020
Designed	SS	Date	14/08/2020
Drawn	SS	Date	14/08/2020

ISSUE/REVISION

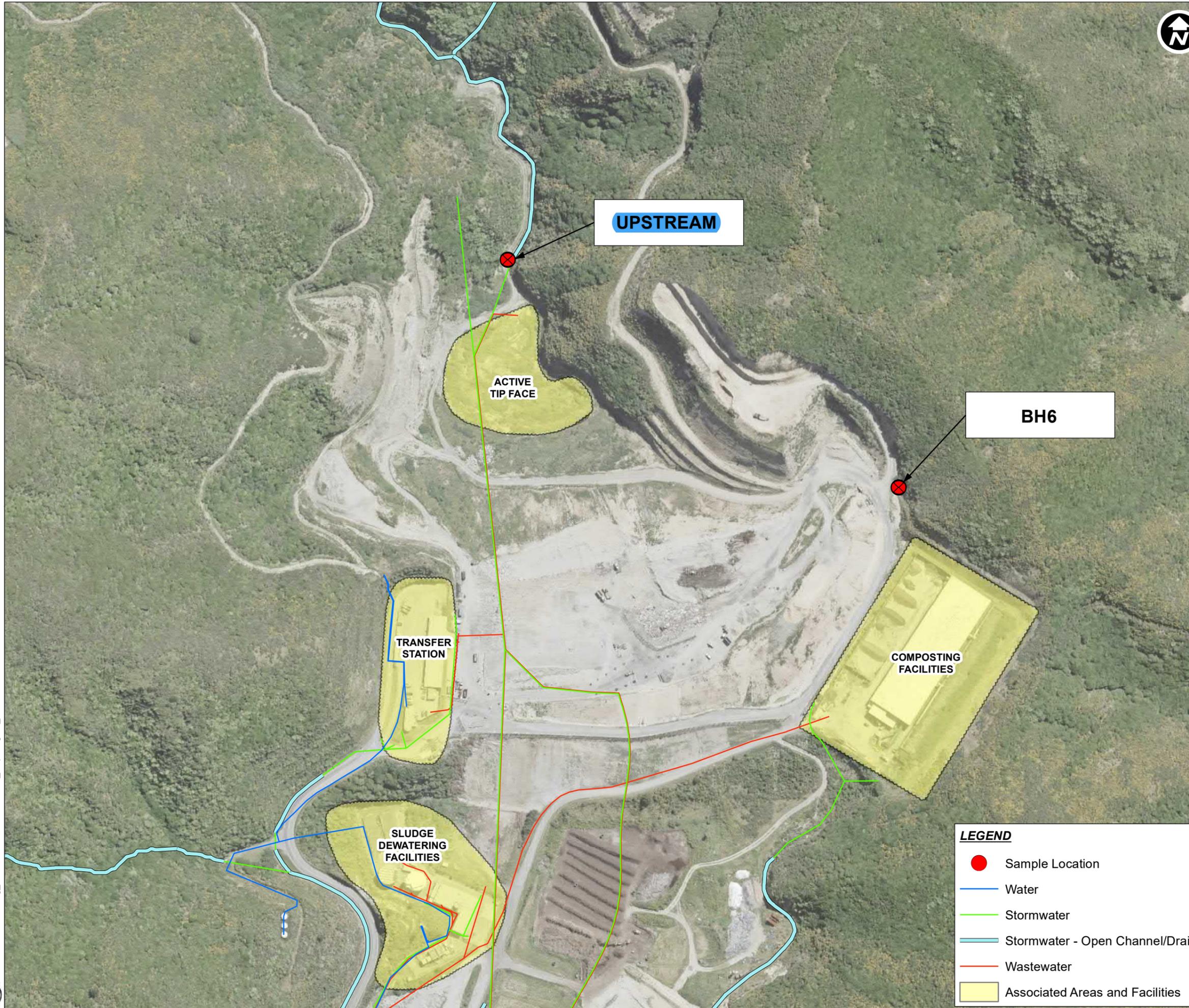
Rev	Date	Description
A	14/08/2020	DRAFT



PROJECT NUMBER
60629483

SHEET TITLE
NORTHERN (UPGRADIENT/UPSTREAM) SAMPLE LOCATION PLAN AND RESULTS

MAP NUMBER
FIGURE 1A



LEGEND

- Sample Location
- Water
- Stormwater
- Stormwater - Open Channel/Drain
- Wastewater
- Associated Areas and Facilities

© Copyright AECOM New Zealand Limited, 2015. This map is confidential and shall only be used for the purposes of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM Quality Assurance system certified to AS/NZS ISO 9001:2008.



WCC_SW022308

WCC_SW022313

LEGEND

- Sample Location
- Water
- Stormwater
- Stormwater - Open Channel/Drain
- Wastewater



PROJECT
WCC SOUTHERN LANDFILL JUNE 2020 INVESTIGATIVE SAMPLING

CLIENT

Absolutely Positively Wellington City Council
Me Heke Ki Pōneke

CONSULTANT
AECOM New Zealand Limited
www.aecom.com

SPATIAL REFERENCE

Scale: 1:1,250 (A3 size)

10 5 0 10 20 30 40
m

Map features depicted in terms of NZTM 2000 projection.

Data Sources:
Cadastral Boundaries – LINZ NZ Cadastral Dataset

PROJECT MANAGEMENT

Approved		Date	3/09/2020
Checked	KS	Date	3/09/2020
Designed	SS	Date	3/09/2020
Drawn	SS	Date	3/09/2020

ISSUE/REVISION

Rev	Date	Description
A	3/09/2020	DRAFT



PROJECT NUMBER
60629483

SHEET TITLE
CENTRAL SAMPLE LOCATION PLAN AND RESULTS

MAP NUMBER
FIGURE 1B

© Copyright AECOM New Zealand Limited, 2015. This map is confidential and shall only be used for the purposes of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM Quality Assurance system certified to AS/NZS ISO 9001:2008.



CLIENT

CONSULTANT
AECOM New Zealand Limited
www.aecom.com

SPATIAL REFERENCE
Scale: 1:600 (A3 size)
10 5 0 10 20 m
Map features depicted in terms of NZTM 2000 projection.

Data Sources:
Cadastral Boundaries – LINZ NZ Cadastral Dataset

PROJECT MANAGEMENT

Approved		Date	14/08/2020
Checked	KS	Date	14/08/2020
Designed	SS	Date	14/08/2020
Drawn	SS	Date	14/08/2020

ISSUE/REVISION

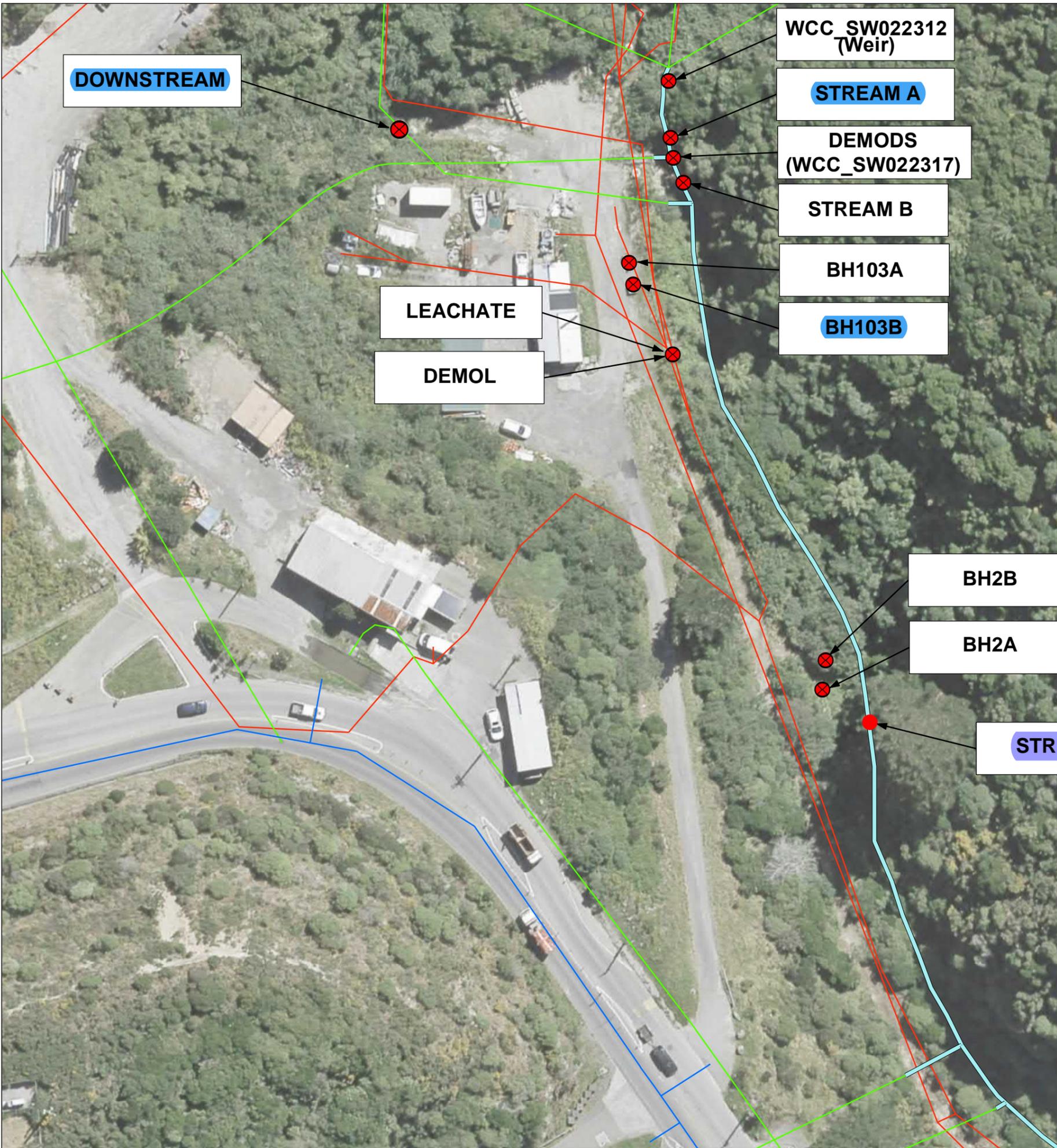
Rev	Date	Description
A	14/08/2020	DRAFT



PROJECT NUMBER
60629483

SHEET TITLE
SOUTHERN (DOWNGRADE/DOWNSTREAM)
SAMPLE LOCATION PLAN AND RESULTS

MAP NUMBER
FIGURE 1C



LEGEND

- Sample Location
- Water
- Stormwater
- Stormwater - Open Channel/Drain
- Wastewater

© Copyright AECOM New Zealand Limited, 2015. This map is confidential and shall only be used for the purposes of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM Quality Assurance system certified to AS/NZS ISO 9001:2008.

APPENDIX 2: Final Report showing the results of the Faecal Source Tracking (FST) Analysis

11 March 2021

To: [REDACTED]

From: ESR Christchurch Science Centre
PO Box 29181
CHRISTCHURCH 8540

Email: faecalsource@esr.cri.nz

REPORT ON FAECAL SOURCE TRACKING ANALYSIS

The following samples were received on 26th February 2021 and were analysed for faecal source PCR markers as requested.

ESR Number	Client Reference	Date Sampled	Site Description	<i>E. coli</i> (MPN/100mL)
CMB210224	None given	18/02/2021 08:50	WCC_SLF_Upstream	70
CMB210225	None given	18/02/2021 10:45	WCC_SLF_Downstream	49
CMB210226	None given	18/02/2021 11:55	WCC_SLF_Stream_A	26
CMB210227	None given	18/02/2021 11:05	WCC_SLF_BH103B	78
CMB210228	None given	18/02/2021 10:15	WCC_SLF_WCCSW022308	78
CMB210229	None given	18/02/2021 11:35	WCC_SLF_Stream_C	130

Notice of Confidential Information:

If you receive this report in error, please notify the sender immediately. The information contained in this report is legally privileged and confidential. Unauthorised use, dissemination, distribution or reproduction of this report is prohibited.

Results of faecal source PCR Marker Analysis:

Please refer to the appendix for guidance on interpretation of these results

ESR Number	Description / Site ID	<i>E. coli</i> (MPN/100mL)	General GenBac / 100 ml	Human BacH / 100 ml	Human BiADO / 100 ml	Ruminant BacR / 100 ml	Avian GFD / 100 ml	Conclusion
CMB210224	WCC_SLF_Upstream	70	5,300	<17	<21	<18	Detected, <LOQ	Faecal source – probable avian
CMB210225	WCC_SLF_Downstream	49	13,000	<17	<21	<18	<14	No species-specific faecal source identified
CMB210226	WCC_SLF_Stream_A	26	1,800	<17	<21	<18	<14	No species-specific faecal source identified
CMB210227	WCC_SLF_BH103B	78	3,200	<17	<21	<18	<14	No species-specific faecal source identified
CMB210228	WCC_SLF_WCCSW022308	78	590	<17	<21	<18	<14	No species-specific faecal source identified
CMB210229	WCC_SLF_Stream_C	130	39,000	<17	<21	<18	11	Faecal source –avian

Abbreviations: NA = sample was not analysed for this marker.
 NC = not calculated
 LOQ = limit of quantitation

Comment:

The level of the GenBac faecal marker in these samples is low, particularly in the upstream, stream A, BH103B and WCCSW022308 samples. This marker is an indicator of the level of all faecal sources present and at these levels it is not unexpected to not detect / identify a species-specific source even if present.

There is no evidence of a ruminant faecal source in any of the samples and very little evidence of a human faecal source.

Notes:

Brief details of the methods of analysis are available on request.

These results relate to samples as received.

This report may not be reproduced except in full.



Paula Scholes
Laboratory Operations Technical Lead



Beth Robson
Principal Technician

APPENDIX: Assay Interpretation Guidance Notes

PCR Marker interpretation notes

- Each marker is strongly associated with, but not exclusive to the source tested for. They each have some degree of non-specificity.
- Each marker is a separate test and the levels of the various markers within the same sample cannot be compared. For example, if sample A has a BacH result of 1,000 and a BacR of 100 it is not valid to say there is more human contamination than ruminant in sample A.
- Levels of the same marker in different samples can be compared. For example;
 - If sample A has a BacH result of 1,000 and sample B has a BacH of 10,000 it is valid to conclude there is more human faecal contamination in sample B than in sample A; or
 - If site H sampled in January has a GFD result of 500 and when sampled in February has a GFD result of 10,000, it is valid to conclude the level of avian faecal contamination in February is greater.
 - To be classified as a significantly greater or lesser result the level of marker should vary by a factor of 10.
- Both Human markers are required to be present for a positive human result.
- Ruminant specific markers are reported using a percentage value based on levels of this marker relative to the general marker in fresh ruminant faeces.
 - Samples reported as 50-100% ruminant are consistent with all of the general faecal marker having come from a ruminant source.
 - The lower levels reported (10-50%) may be a consequence of the presence of other sources of pollution, or in fact ruminant sources may still account for all the pollution, but this may include aged faecal material where relative levels of the ruminant marker decline more rapidly than the general marker.
 - Levels less than 10% ruminant suggest a very minor contribution from ruminant sources.

The detection limits of these methods vary depending on the volume of water filtered for analysis. We recommend a minimum volume of 200 mls and a maximum of 1000 mls, this range gives the following detection limits:

mls sample filtered	General GenBac / 100 mls	Human BacH / 100 mls	Human BiADO / 100 mls	Human HumM3 / 100 mls	Ruminant BacR / 100 mls	Ruminant Sheep / 100 mls	Ruminant Cow / 100 mls
< 400 mls	<110	<83	<110	<8	<91	<100	<11
400-700mls	<42	<33	<43	<3	<36	<41	<5
700-1000mls	<21	<17	<21	<2	<18	<21	<2

mls sample filtered	Dog DogBac / 100 mls	Avian GFD / 100 mls	Avian E2 / 100 mls	Gull- 2
> 400 mls	<79	<72	<99	presence / absence test
400-700mls	<31	<29	<40	
700-1000mls	<16	<14	<20	

FWA interpretation notes

The analysis of FWAs in septic tank and community wastewater consistently identifies levels between 10 and 70 µg/L. In previous analysis of water samples levels of FWA greater than 0.1 µg/L suggest human sewage, with levels greater than 0.2 µg/L strongly indicative of human sewage. Levels greater than 0.1 µg/L correlate well with other indicators of human pollution and indicate a local or recent source of pollution. FWAs degrade under sunlight exposure and will undergo dilution. Levels lower than 0.1 µg/L may be indicative of dilute or distant sources of human pollution.

Reference: Devane M., Saunders D. and Gilpin B. (2006). Faecal sterols and fluorescent whiteners as indicators of the source of faecal contamination. Chemistry in New Zealand 70(3), 74-7.
http://www.nzic.org.nz/CiNZ/articles/Devane_70_3.pdf

Faecal sterol Intepretation Notes:

Faecal sterol ratios must be interpreted with consideration to the levels of sterols, and relative to one another. For example H1 is typically also above 5-6% in ruminant faeces. Human and ruminant sources generally require at least two of three ratios to reach thresholds. Plant sterols and mixed sources also have differing effects on sterol interpretations which must be considered.

Conclusions are the best interpretation of sterols in our opinion. Conclusions in **bold** are highly supported by the sterol data, conclusions in brackets are supported by sterol data with some variation from a pure source, or with a lower degree of certainty.

Ratio Key:

<i>Ratios indicative of faecal pollution (either human or animal)</i>		
F1	coprostanol/cholestanol..	>0.5 indicative of faecal source of sterols
F2	24ethylcoprostanol/ 24-ethylcholestanol.	>0.5 indicative of faecal source of sterols.
<i>Human indicative ratios (values exceeding threshold in red)</i>		
H3	coprostanol/ 24-ethylcoprostanol	Ratio >1 suggests human source
H1	% coprostanol	Ratio >5-6% suggests human source
H2	coprostanol/(coprostanol+cholestanol)	Ratio >0.7 suggests human source
H4	coprostanol/(coprostanol+24-ethylcoprostanol)	Ratio >0.75 suggests human source
<i>Ruminant indicative ratios (values exceeding threshold in blue)</i>		
R3	24-ethylcholesterol/24-ethylcoprostanol	Ratio <1 suggests ruminant source, ratio >4 suggests plant decay
R1	% 24-ethylcoprostanol	Ratio >5-6% suggests ruminant source
R2	coprostanol/(coprostanol+24-ethylcoprostanol)	Ratio <30% suggests ruminant source
<i>Avian indicative ratios (values exceeding threshold in yellow)</i>		
A1	24-ethylcholestanol/(24-ethylcholestanol+24-ethylcoprostanol+24-ethylepicoprostanol)	A1 Ratio >0.4 suggests avian source
A2	cholestanol/(cholestanol+coprostanol+epicoprostanol)	AND A2 Ratio >0.5 suggests avian source

