



14 June 2021

✦ Florian Risse  
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**Christchurch**

Dear Florian

## **DETERMINATION OF SOIL QUALITY GUIDELINE VALUES FOR SIX STORMWATER FACILITIES**

### **1.0 Introduction**

Pattle Delamore Partners Limited (PDP) has been engaged by Christchurch City Council (CCC) to determine the most appropriate and relevant soil quality guideline values as part of the Environment Canterbury (ECan) resource consent monitoring of six CCC stormwater facilities. The six facilities are located at Denton Park, Beckenham Library, Tumara Park, Hornby Industrial Park, Richmond Housing Complex and Grove Road, as shown in Figure 1 (attached).

The guideline values are to be determined in accordance with the Environmental Monitoring Programme (EMP) for the Comprehensive Stormwater Network Discharge ECan Consent CRC190445 (now replaced by CRC214226), for the protection of human health, groundwater quality and surface water quality. The EMP specifies that the following documents be assessed as to their suitability for soil guideline values:

- ✦ *Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011*. In particular, the recreation standards in *Table B2: Soil Contaminant Standards for health (SCS<sub>(health)</sub>) for inorganic substances*;
- ✦ *Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Revised 2011)*, (Ministry for the Environment, 2011);
- ✦ *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000)<sup>1</sup>; and
- ✦ Trigger values for soil quality contained in other CCC stormwater discharge consent conditions.

In addition to the above referenced guidelines, and for completeness, we have also considered the following guidelines to address heavy metals that are not included in the above guidelines:

- ✦ *Guideline on the Investigation Levels for Soil and Groundwater* (National Environmental Protection Council) (NEPC, 2013).

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<sup>1</sup> Note: the AZECC 2000 guidelines have been superseded by the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018 (ANZG 2018).

PDP has reviewed the above documents and has proposed soil quality guideline values for the six CCC stormwater facilities, which are provided as Table 1 (attached). Section 2.0 describes the rationale used in determining the proposed guideline values, and Table 2 (attached) summarises the key information used in determining the proposed guideline values.

PDP's assessment is limited to proposing the most relevant soil quality guidelines for the protection of human health, surface water and groundwater quality, based on the above listed documents and in accordance with the EMP and CCC Scope of Works. PDP note that Manaaki Whenua (Landcare Research) has prepared draft guidelines for the protection of ecological receptors in soils (Manaaki Whenua, 2019), however these are outside the scope of the current assessment, which is limited to human health, surface and groundwater quality.

## 2.0 Guideline Values

In determining which guidelines are most appropriate for each of the six stormwater facilities, PDP considered the following key factors:

- ∴ **Human contact:** the key considerations are the facility location (e.g., in an open space/recreational area) and the potential for direct human contact. The recommended guideline values are for the protection of human health, and require collecting **surface soil samples**, to be analysed for total contaminant concentrations (mg/kg).
- ∴ **Stormwater discharge location:** the key consideration is the nature of the receiving environment (i.e., discharge to groundwater or surface water following release from the stormwater treatment facility and what the receiving water is used for). Where it has been determined that the human contact guideline values alone are insufficient, a second set of guideline values have been recommended for the protection of groundwater quality in aquifers used for water supply and/or surface water quality, dependent on the nature of the receiving environment. This will require collecting **surface soil samples**, with heavy metals analysed for leachability (mg/L) via the Synthetic Precipitation Leaching Procedure (SPLP), and polycyclic aromatic hydrocarbon compounds (PAH) analysed for total contaminant concentrations (mg/kg).

### 2.1 Denton Park

This facility is located in Denton Park, i.e., a recreational area, and discharges to ground located over an aquifer used for water supply. As such, the guideline values must be appropriate to protect the health of potential recreational users and groundwater quality.

- ∴ **Human contact:** facility is located within a recreational area. Recommended guideline values:
  - Heavy metals total concentrations (mg/kg) for recreational land use.
  - PAH total concentrations (mg/kg) for recreational land use (i.e., for Benzo(a)pyrene eq. (BaPeq<sup>2</sup>)), and where recreational guideline values are not available, residential guideline values are proposed (i.e., for naphthalene and pyrene).
- ∴ **Groundwater:** as indicated on Canterbury Maps, the facility is located over an unconfined or semi-confined aquifer that provides recharge to the Christchurch aquifer system. The facility is located in the community drinking water protection zones for supply bores M35/1866 and M35/3547.

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<sup>2</sup> For benzo(a)pyrene, the equivalent BaP concentration is calculated as the sum of each of the detected concentrations of nine carcinogenic PAHs (benzo(a)anthracene, benzo(b)fluoranthene, benzo(j)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, fluoranthene and indeno(1,2,3-cd)pyrene), multiplied by their respective potency equivalency factors (see table 40 of the *Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health*, MfE 2011).

However, these bores are more than 90 m deep and are therefore at a lesser risk than shallower bores as a result of the operation of the stormwater facility, although other undocumented abstraction bores may be located within the site vicinity. The following guideline values are therefore recommended:

- Heavy metals leachate concentrations (mg/L, analysed via SPLP laboratory method) and compared to the *Drinking-water Standards for New Zealand 2005 (Revised 2018)* maximum acceptable values (MAV) and guideline values (GV) for aesthetic determinands. The MAVs and GVs have been multiplied by a factor of 20x to allow for attenuation of contaminants, in accordance with recent consents granted by ECan.
- Selected PAH total concentrations (mg/kg) compared to the MfE 2011 *Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Revised 2011)*, for the protection of groundwater quality, in accordance with recent consents granted by ECan. However, given the expected depth to groundwater at the facility (more than 8 m)<sup>3</sup>, the MfE Guidelines (Table 4.20) state that “contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site (i.e., 20,000 mg/kg for TPH, 10,000 mg/kg for other contaminants)”. As such, no further guidelines are proposed for benzo(a)pyrene, naphthalene and pyrene.

## 2.2 Beckenham Library

The facility is located adjacent to a green space at Beckenham library, and therefore guideline values must be appropriate to protect the health of potential recreational users. Given the proximity of the facility to the Ōpāwaho/Heathcote River, it should also be considered whether further guideline values are required to protect surface water quality.

- ∴ **Human contact:** facility is located adjacent to the library’s green space. Recommended guideline values for human contact are the same as those recommended for Denton Park (refer to Section 2.1).
- ∴ **Surface water:** facility is a detention device (i.e., not an infiltration device), and the CCC 3-Waters Network Asset Map does not indicate any underdrains. Based on this, it is expected that there is minimal potential for soil quality to affect surface water quality of the adjacent surface waterway through the expected small volume migration of stormwater via ground soakage, and therefore no further soil guideline values are considered necessary.

## 2.3 Tumara Park

The facility is located in Tumara Park (a recreational area), and therefore guideline values must be appropriate to protect the health of potential recreational users. The facility includes both infiltration and detention of stormwater. As indicated on CCC 3-Waters Network Asset Map, the facility is connected to a drain, which ultimately discharges to the Travis Wetland area. As such, it should be considered whether additional guidelines are required with respect to surface water and/or groundwater quality.

- ∴ **Human contact:** facility is located within a recreational area. Recommended guideline values for human contact are the same as those recommended for Denton Park (refer to Section 2.1).
- ∴ **Groundwater:** the facility is located above the Coastal Confined Aquifer, is not within a community drinking water protection zone, and discharges to shallow groundwater. Furthermore,

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<sup>3</sup> Average depth to groundwater approximately 17 m bgl, as per the Canterbury Maps ‘Piezometric Contours’ layer (Piezometric contours Christchurch Aquifer 1 average levels).

the shallow groundwater table is unlikely to be used for abstraction purposes in the area. Based on this, it is considered that further soil guideline values are not required to protect groundwater.

- ∴ **Surface water:** the CCC 3-Waters Network Asset Map does not show any underdrains for this facility, however as noted above, the facility discharges to shallow groundwater. Shallow groundwater would need to travel over 400 m before reaching the northern end of the Travis Wetland Nature Heritage Park, at its nearest point. Attenuation by processes including dilution, dispersion and adsorption would occur over this distance for any potential contaminants released (leached) from the facility's soils, and therefore it is considered that further soil guideline values are not required to protect surface water.

## 2.4 Hornby Industrial Estate

The facility is located within an industrial area, and discharges to ground. Therefore, the guideline values must be appropriate to protect the health of people who may come in direct contact with the soil, as well as groundwater quality.

- ∴ **Human contact:** facility is located within an industrial area. Nonetheless, to be conservative, it is recommended that the same recreational/residential guideline values are used as for Denton Park (refer to Section 2.1).
  - Heavy metals total concentrations (mg/kg) for recreational land use. Note that for this facility, a larger suite of heavy metals is required (arsenic, cadmium, chromium, nickel, in addition to copper, lead and zinc).
  - PAH total concentrations (mg/kg) for recreational land use (i.e., BaPeq), and where recreational guideline values are not available, residential guideline values are proposed (i.e., for naphthalene and pyrene).
- ∴ **Groundwater:** the facility is located over an unconfined or semi-confined aquifer that is used for water supply purposes, however, is not located within a community drinking water protection zone. It is recommended that:
  - For heavy metals, leachability concentrations (mg/L) are compared against 20x MAV and 20x GV, consistent with the recommended guideline values for Denton Park (refer to Section 2.1). Note that for this facility, a larger suite of heavy metals is required (arsenic, cadmium, chromium, nickel, in addition to copper, lead and zinc).
  - For selected PAH compounds (benzo(a)pyrene, naphthalene and pyrene), given the expected depth to groundwater at the facility (more than 8 m)<sup>4</sup>, no further guidelines are proposed for the same reasons outlined in Section 2.1 for Denton Park.
  - For semi-volatile organic Compounds (SVOC), total concentrations (mg/kg) are analysed for the standard suite of SVOC compounds. Should any SVOC compounds be detected above the laboratory limits of detection, other than the three PAH compounds (benzo(a)pyrene, naphthalene, pyrene), a suitably qualified environmental practitioner (SQEP) should be contacted for advice.

## 2.5 Richmond Housing Complex

The facility is located within a green space in the Richmond Housing Complex, and the guideline values must be appropriate to protect the health of potential recreational users. The facility includes a swale and

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<sup>4</sup> Average depth to groundwater approximately 18 m bgl, as per the Canterbury Maps 'Piezometric Contours' layer (Piezometric contours Christchurch Aquifer 1 average levels).

first flush basin, and as such it should be considered whether additional guidelines are required with respect to groundwater quality.

- ✦ **Human contact:** facility is located within a green space in a housing complex. Recommended guideline values for human contact are the same as those recommended for Denton Park (refer to Section 2.1).
- ✦ **Groundwater:** the facility is located above the Coastal Confined Aquifer, is not within a Community Drinking Water Protection Zone, and discharges to shallow groundwater. Furthermore, the shallow groundwater table is unlikely to be used for abstraction purposes in the area. Based on this, it is considered that further soil guideline values are not required to protect groundwater.
- ✦ **Surface water:** Shallow groundwater underneath the facility would need to travel over 200 m before reaching the Ōtākaro/Avon River. Attenuation by processes including dilution, dispersion and adsorption would occur over this distance for any potential contaminants released (leached) from the facility's soils, and therefore it is considered that further soil guideline values are not required to protect surface water.

## 2.6 Grove Road

The facility is a raingarden located within a commercial area, and discharges to Addington Brook via an underdrain that is connected to the CCC reticulated stormwater network. As such, the guideline values must be appropriate to protect the health of people who may come into direct contact with the soil, as well as surface water quality.

- ✦ **Human contact:** facility is located within a commercial area. Nonetheless, to be conservative, it is recommended that the same recreational/residential guideline values are used as for Denton Park (refer to Section 2.1).
- ✦ **Surface water:** the CCC 3-Waters Network Asset Map indicates that the raingarden includes an underdrain, which connects to the CCC reticulated stormwater network and discharges to Addington Brook. Therefore, soil leachability (SPLP) testing could be considered with results compared to the ANZG 2018 guidelines (which supersede the ANZECC 2000 guidelines), and potentially allowing for reasonable mixing.

Water quality of the Addington Brook is monitored at ECan monitoring site SQ34493 ("Addington Drain d/s Riccarton Ave"), with heavy metals results available from November 2010 to September 2019. The results indicate that the water quality in Addington Brook already exceeds the ANZG 2018 guideline values (Table 3 of the EMP) for dissolved copper and dissolved zinc. Based on this, it is considered that further guideline values, relating to soil leachability, are not required at this stage. If CCC wishes to include a further set of guideline values, it could consider the ANZG 2018 guideline values for heavy metals (specified in Table 3 of the EMP) for comparison against soil leachability tests, however this would likely result in non-compliance given that the guidelines value concentrations are so low.

## 3.0 Applicability of Recommended Guidelines

It is important to recognise that these guidelines have been determined as a desktop exercise, without the opportunity to compare them with test results from all the stormwater basins. Until such testing comparisons have been undertaken, they should be viewed as interim guidelines. If the guideline values are exceeded, then a site-specific evaluation of actual potential adverse effects should be undertaken to determine the appropriateness of the guideline or whether subsequent amendment is required.

## 4.0 References

ANZECC (Australian and New Zealand Environment and Conservation Council, ANZECC, and Agriculture and Resource Management Council of Australia and New Zealand, ARMCANZ) (2000). *Australian and New Zealand guidelines for fresh and marine water quality. Volume 1: The guidelines*. ANZECC & ARMCANZ, Artarmon, New South Wales.

ANZG 2018. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Governments and Australian state and territory governments, Canberra, ACT, Australia.

Christchurch City Council, (n.d.). *3-Waters Network Asset Map*. Retrieved 3 June 2021, from <https://ccc.govt.nz/services/water-and-drainage/three-waters-advanced-asset-network-map>.

Christchurch City Council, 2020. *Environmental Monitoring Programme for the Comprehensive Stormwater Network Discharge Consent Version 7*. Christchurch: Christchurch City Council.

Environment Canterbury, (n.d.). *Canterbury Maps*. Retrieved 3 June 2021, from <https://canterburymaps.govt.nz/>.

Manaaki Whenua (Landcare Research), 2019. *UPDATED User Guide: Background soil concentrations and Soil Guideline Values for the Protection of Ecological Receptors (Eco-SGVs) – Consultation Draft*.

Ministry for the Environment, 2011. *Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health*. Wellington: Ministry for the Environment.

Ministry for the Environment, 2011. *Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Revised 2011), Module 4, Tier 1 Soil Acceptance Criteria*. Wellington: Ministry for the Environment.

Ministry of Health, 2018. *Drinking-water Standards for New Zealand 2005 (revised 2018)*. Wellington: Ministry of Health

National Environment Protection Council (NEPC), 2013. *Guideline on Investigation Levels for Soil and Groundwater, Assessment of Site Contamination Amendment Measure 2013*.

## 5.0 Limitations

This letter has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Christchurch City Council and others (not directly contracted by PDP for the work), including Environment Canterbury. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the letter. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This letter has been prepared by PDP on the specific instructions of Christchurch City Council for the limited purposes described in the letter. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

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Yours faithfully

**PATTLE DELAMORE PARTNERS LIMITED**

Prepared by



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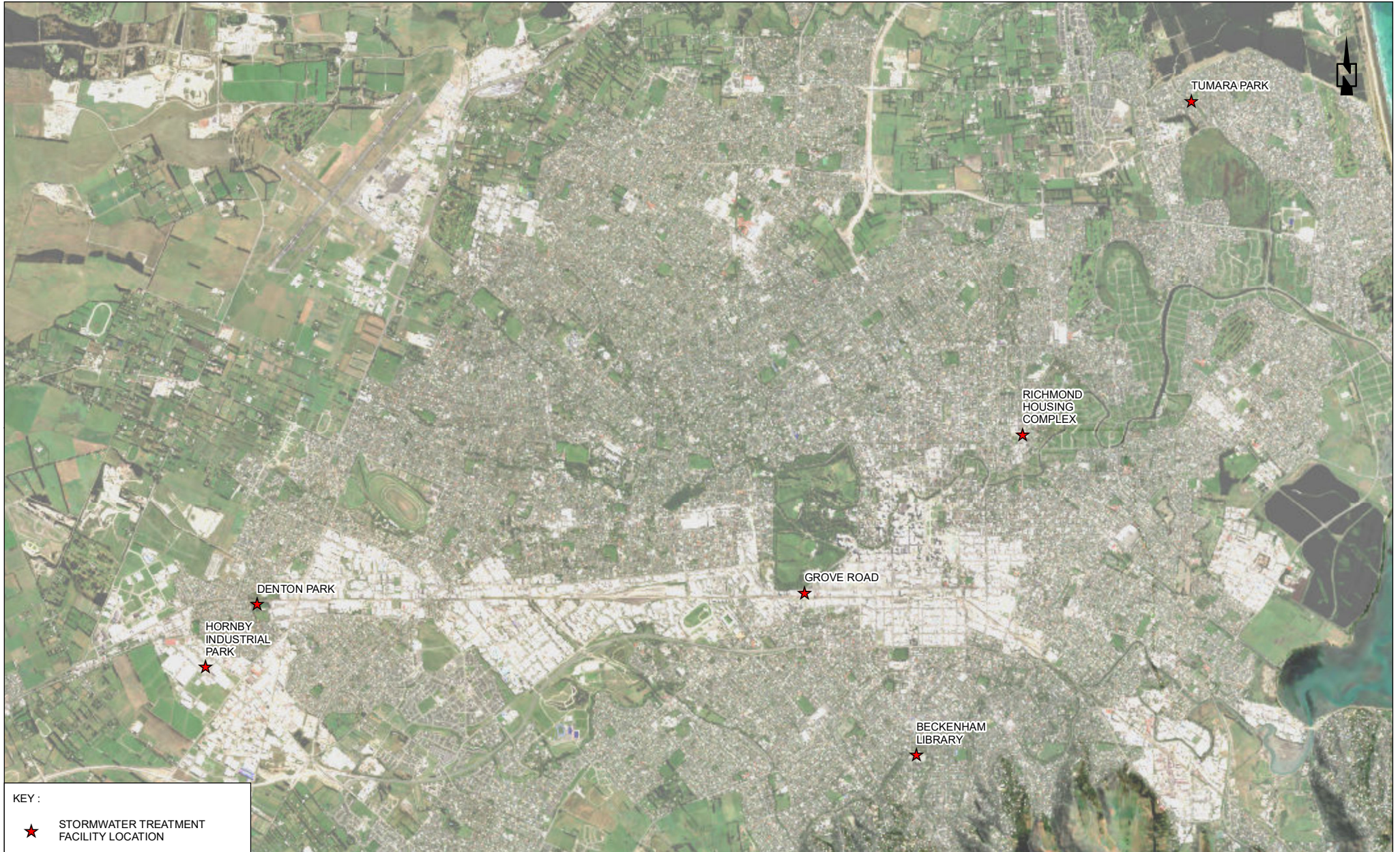
Technical Director - Contaminated Land

Approved by



**Peter Callander**

Director



KEY :  
★ STORMWATER TREATMENT FACILITY LOCATION

SOURCE:  
1. AERIAL IMAGERY (FLOWN 2018-2019) SOURCED FROM THE LINZ DATA SERVICE <https://data.linz.govt.nz/layer/105041-christchurch-0075m-urban-aerial-photos-2018-2019/> AND LICENCED BY ENVIRONMENT CANTERBURY FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENCE.  
2. STORMWATER TREATMETN FACILITY LOCATIONS PROVIDED BY CHRISTCHURCH CITY COUNCIL AND USED WITH PERMISSION.

SCALE : 1:75,000 (A4)  
0 250 500 1,000 1,500  
METRES

FIGURE 1 : LOCATION MAP



Table 1 : Stormwater Soil Quality Monitoring - Site Specific Guideline Criteria

Location	Type of Treatment System	Contaminant	Tested Contaminant Parameters Trigger Value	
			Contact Guideline (mg/kg)	Groundwater Guideline (mg/L)
Denton Park	Soakage Basin	Total Recoverable Copper (Cu)	>10,000 <sup>1</sup>	40 mg/L <sup>5</sup>
		Total Recoverable Zinc (Zn)	30,000 <sup>2</sup>	30 mg/L <sup>6</sup>
		Total Recoverable Lead (Pb)	880 <sup>1</sup>	0.2 mg/L <sup>5</sup>
		Benzo(a)pyrene	40 <sup>1,3</sup>	NA <sup>7,8</sup>
		Naphthalene	63 <sup>4</sup>	NA <sup>8</sup>
		Non-carc. (Pyrene)	1,600 <sup>4</sup>	NA <sup>8</sup>
Beckenham Library	Detention Swale	Total Recoverable Copper (Cu)	>10,000 <sup>1</sup>	
		Total Recoverable Zinc (Zn)	30,000 <sup>2</sup>	
		Total Recoverable Lead (Pb)	880 <sup>1</sup>	-
		Benzo(a)pyrene	40 <sup>1,3</sup>	
		Naphthalene	63 <sup>4</sup>	
		Non-carc. (Pyrene)	1,600 <sup>4</sup>	
Tumara Park	Infiltration and Detention	Total Recoverable Copper (Cu)	>10,000 <sup>1</sup>	
		Total Recoverable Zinc (Zn)	30,000 <sup>2</sup>	
		Total Recoverable Lead (Pb)	880 <sup>1</sup>	-
		Benzo(a)pyrene	40 <sup>1,3</sup>	
		Naphthalene	63 <sup>4</sup>	
		Non-carc. (Pyrene)	1,600 <sup>4</sup>	
Hornby Industrial Estate	Infiltration Basin	Total Recoverable Arsenic (As)	80 <sup>1</sup>	0.2 mg/L <sup>5</sup>
		Total Recoverable Cadmium (Cd)	400 <sup>1</sup>	0.08 mg/L <sup>5</sup>
		Total Recoverable Chromium (Cr)	2,700 <sup>1,9</sup>	1 mg/L <sup>5</sup>
		Total Recoverable Copper (Cu)	>10,000 <sup>1</sup>	40 mg/L <sup>5</sup>
		Total Recoverable Lead (Pb)	880 <sup>1</sup>	0.2 mg/L <sup>5</sup>
		Total Recoverable Nickel (Ni)	1,200 <sup>2</sup>	1.6 mg/L <sup>5</sup>
		Total Recoverable Zinc (Zn)	30,000 <sup>2</sup>	30 mg/L <sup>6</sup>
		Benzo(a)pyrene	40 <sup>1,3</sup>	NA <sup>7,8</sup>
		Naphthalene	63 <sup>4</sup>	NA <sup>8</sup>
		Non-carc. (Pyrene)	1,600 <sup>4</sup>	NA <sup>8</sup>
		Semi-Volatile Organic Compounds (SVOC) excl. PAH	Contact SQEP if detected	Contact SQEP if detected
Richmond Housing Complex	Swale & First-flush Basin	Total Recoverable Copper (Cu)	>10,000 <sup>1</sup>	
		Total Recoverable Zinc (Zn)	30,000 <sup>2</sup>	
		Total Recoverable Lead (Pb)	880 <sup>1</sup>	-
		Benzo(a)pyrene	40 <sup>1,3</sup>	
		Naphthalene	63 <sup>4</sup>	
		Non-carc. (Pyrene)	1,600 <sup>4</sup>	
Grove Road	Rain Garden	Total Recoverable Copper (Cu)	>10,000 <sup>1</sup>	
		Total Recoverable Zinc (Zn)	30,000 <sup>2</sup>	
		Total Recoverable Lead (Pb)	880 <sup>1</sup>	-
		Benzo(a)pyrene	40 <sup>1,3</sup>	
		Naphthalene	63 <sup>4</sup>	
		Non-carc. (Pyrene)	1,600 <sup>4</sup>	

NOTES:

1. Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health (MfE, 2011) - Recreation Land Use.
2. Guideline on Investigation Levels for Soil and Groundwater (Assessment of Site Contamination Amendment Measure 2013) (NEPC, 2013) - Recreational Land Use.
3. Benzo(a)pyrene equivalent concentration.
4. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Revised 2011), Module 4, Tier 1 Soil Acceptance Criteria (MfE, 2011). Tier 1 Soil acceptance criteria Residential use, All Pathways, sandy silt, surface (<1 m).
5. 20 x MAV (Maximum Acceptable Value) for determinand of health significance in Drinking-water Standards for New Zealand 2005 (Revised 2018) (Ministry of Health, 2018).
6. 20 x GV (Guideline Value) for aesthetic determinand in Drinking-water Standards for New Zealand 2005 (Revised 2018) (Ministry of Health, 2018).
7. For Benzo(a)pyrene concentration only (not equivalent concentration).
8. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Revised 2011), Module 4, Tier 1 Soil Acceptance Criteria (MfE, 2011). Tier 1 Soil acceptance criteria for protection of groundwater quality, surface (< 1m), GW 8 m, sandy silt. NA (units - mg/kg) indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.
9. Chromium (VI) used as a conservative approach - compare to total chromium laboratory result.

Table 2 : Supporting Information

Location	Type of Treatment System	Land Use	Year Constructed	Receptors <sup>1</sup>			Most Sensitive Receptor <sup>1</sup>
				Groundwater Sensitivity <sup>1,2,3</sup>	Surfacewater Sensitivity <sup>1,3</sup>	Human Contact Sensitivity	
Denton Park	Soakage Basin	Facility located within a recreational area (park). Residential catchment	1997	Sensitive: - Facility located over a Unconfined/Semi-Confined Aquifer. - Located within Community Drinking Water Protection Zones for M35/1866 and M35/3547, however these bores are both more than 90 m deep.	N/A (facility discharges to ground)	Recreational contact - facility located within a park.	Groundwater (unconfined/semi-confined aquifer)  Human health
Beckenham Library	Detention Swale	Facility located adjacent to library green space. Car park catchment.	2005	Low sensitivity: - Stormwater is conveyed to surface water. - Facility is located over the Coastal Confined Aquifer. - Facility located within 6 Community Drinking Water Protection Zones, however these bores are more than 28 m deep.	Low sensitivity: - While facility discharges to Ōpāwaho/Heathcote River, it is listed as a detention device. CCC 3-Waters Network Asset Map does not indicate any underdrains.	Recreational contact - facility located adjacent to a library green space.	Human health
Tumara Park	Infiltration and Detention	Facility located within a recreational area (park). Large Scale Residential catchment.	2003	Low sensitivity: - Facility located over Coastal Confined Aquifer. - Not within a Community Drinking Water Protection Zone.	Low sensitivity: - While the facility includes infiltration, the CCC 3 Waters Network Asset Map does not indicate any underdrains. - Travis Wetland is more than 400 m away.	Recreational contact - facility located within a park.	Human health
Hornby Industrial Estate	Infiltration Basin	Industrial	1995	Sensitive - Facility located over Unconfined/Semi-Confined Aquifer - Not located within a within a Community Drinking Water Protection Zone	N/A (facility discharges to ground)	Human contact - facility located within industrial zone, adjacent to road.	Groundwater (unconfined/semi-confined aquifer)  Human health
Richmond Housing Complex	Swale & First-flush Basin	High-density Housing	2007	Low sensitivity: - Facility located over Coastal Confined Aquifer. - Not within a Community Drinking Water Protection Zone.	Low sensitivity - While the facility discharges to the Ōtākaro/Avon River, the first flush is treated by a first flush basin. CCC 3 Waters map do not indicate any underdrains. - Ōtākaro/Avon River is more than 200 m away.	Recreational contact - facility located within a green space adjacent to a housing complex.	Human health
Grove Road	Rain Garden	Commercial zone. Commercial/road catchment	2015	Low sensitivity - Treated stormwater is conveyed to surface water (via subsoil drains in raingarden). - Facility located over Coastal Confined Aquifer - Not within a Community Drinking Water Protection Zones.	Potentially Sensitive - Raingarden underdrains discharge to Addington Brook (via reticulated network). 190-200 m downstream, Addington Brook is listed as Mudfish spawning habitat. - Monitoring data for Addington Brook <sup>4</sup> indicates that instream concentrations of dissolved zinc and copper exceed ANZG (2018) guideline values.	Human contact - facility located within commercial area, adjacent to road.	Human health

NOTES:

1. Potential receptors, in relation to soil contaminants, considered as part of the assessment are: human health, surface water and groundwater. Considers sensitivity with respect to human health, and the potential for contaminants to leach from soil and affect groundwater or surface water, depending on stormwater treatment facility design and location.
2. Based on ECan GIS database layers (e.g. stormwater system underlain by 'Semi-confined or Unconfined Aquifer', and/or within a Community Drinking Water Protection Zone). Accessed 3/06/2021 from <https://canterburymaps.govt.nz/>.
3. Based on reticulated stormwater network information from the CCC 3-Waters Network Asset Map. Accessed on 3/06/2021 from <https://ccc.govt.nz/services/water-and-drainage/three-waters-advanced-asset-network-map>.
4. Water quality monitoring data for ECan monitoring site SQ34493 (Addington Drain d/s Riccarton Ave), for the period 21 November 2010 to 5 September 2019. Retrieved 9/06/2021 from <https://www.ecan.govt.nz/data/water-quality-data/>.
5. Table to be read in conjunction with PDP letter dated 14 June 2021, Determination of Soil Quality Guideline Values for Six Stormwater Facilities.