Before the Independent Commissioner Hearing Panel

Under	the Resource Management Act 1991 (**RMA**)
In the matter of	an application by **Dunedin City Council** to develop a landfill at Smooth Hill, Dunedin.

Statement of evidence of Allen Ingles

29 April 2022

Applicant's solicitors:
Michael Garbett
Anderson Lloyd
Level 12, Otago House, 477 Moray Place, Dunedin 9016
Private Bag 1959, Dunedin 9054
DX Box YX10107 Dunedin
p + 64 3 477 3973
michael.garbett@al.nz

anderson lloyd.

Qualifications and experience

1 My name is **Allen Moray Ingles**.

2 I am employed by GHD Ltd as a Technical Director for the water sector.

3 I have over 35 years' experience in flood management, land drainage, stormwater and water related engineering in both the public and private sectors in New Zealand and the United Kingdom. I hold a New Zealand Certificate in Engineering (civil), am an Incorporated Engineer with the Institution of Civil Engineers (ICE), United Kingdom and am an Associate Member of the ICE (AMICE).

4 I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2014. This evidence has been prepared in accordance with it and I agree to comply with it. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

Scope of evidence

5 I have been asked to prepare evidence in relation to surface water hydrology, surface water quality and quantity and the impacts the proposed landfill will have on these during construction, operation and following closure. This includes:

(a) Stormwater Management;

(b) Flows to downstream waterways and wetlands; and

(c) Quality impacts on downstream waterways and wetlands.

Executive summary

6 The landfill site has a footprint of 0.186 km^2, occupying less than 1% of the Ōtokia Creek catchment, which is approximately 27 km^2 in area. Assessment of extreme flows indicates that the landfill catchment contributes less than 1% of peak flood flows and 1-2% of low flows in Ōtokia Creek.

7 The landfill design focusses on avoidance of contamination of stormwater by diversion of runoff, minimising exposed areas of landfilling. Any stormwater that comes into contact with waste is treated as leachate and collected and treated as such. This best practice approach along with stormwater controls and monitoring both on and off site will ensure leachate and other contaminant discharges from site is minimised and that effects

immediately downstream are less than minor and are undetectable further downstream in Ōtokia Creek and at Brighton.

8 The construction of the landfill will result in a net loss in stormwater runoff from the site. However, the reduction is less than would be expected to occur due to annual climatic variation and less than would occur as a result of the reafforestation of the area and it is not considered that hydrological changes would lead to loss of wetland extent at the site. The attenuation effect of the wetland systems and the attenuation basin constructed as part of the landfill works will mitigate to a significant extent any impact on low flows or the extent and duration of no flow further downstream from the site.

Site location and description

9 The site is located approximately 28 km south-west of central Dunedin in the hills between State Highway 1 (SH1) and the coast. It is bounded to the north and west by forestry land and to the north-east by pastoral farmland. Within the site, access is via a series of forestry roads and tracks. The site has been logged and re-planted in the past seven years. Areas of remnant native vegetation occur in the gully bottoms.

10 The landfill site is located in a natural "amphitheatre", which is bisected by a larger central ridge and a smaller ridge in the south-western corner – both trending south to north – see Drawing 51-12506381-01-C103 Existing Contours. The site typically has side slopes of 20%. A south to north system of gullies run through the site, which have been observed by many parties visiting the site to be dry most of the year with flowing water only evident after persistent rainfall. The gullies combine into one at the northern edge of the site and join a swamp wetland system with an intermittent stream system to the north of the site that passes under McLaren Gully Rd via a culvert 1 km downstream from the site. Beyond McLaren Gully Rd the stream drains into a wetland area and Ōtokia Creek, approximately 200 m downstream of McLaren Gully Road, from where it flows to the coast near Brighton, approximately 13 km south-east of the landfill site.

11 The lowest elevation within the landfill site is the base of the gully at RL 100 m rising to the ridgeline on Big Stone Road at approximately RL 140 m.

Existing Hydrology and Surface Water

12 The landfill site catchment area, upstream of McLaren Gully Road is approximately 1.5 km^2 and the Designation Area, which is 0.87 km^2, occupies approximately 0.68 km^2 of the catchment and the landfill footprint is 0.186 km^2. This compares to the total catchment area for Ōtokia Creek

of approximately 27 km^2 (i.e. the landfill footprint is less than 1% of the Ōtokia Creek catchment).

13 Gullies within the landfill site are ephemeral with surface flows only occurring following persistent/high rainfall events. Areas of wetland occur within the lower sections of these gullies and at the low point at the northern edge of the landfill site. To the north of the site a series of wetlands connected by intermittent water courses continue for approximately 1.2 km to a culvert beneath McLaren Gully Road with a further wetland area below the road at the confluence with Ōtokia Creek.

14 Recent inspection of Ōtokia Creek identified that while the lower reaches have an open channel, the upper reaches, extending at least 3 km downstream of McLaren Gully Road are predominantly a densely vegetated flowpath with intermittent areas of open channel, with the latter generally limited to area locations where the channel is shaded by taller vegetation.

15 Flood flows for various flood events in Ōtokia Creek, the valley above McLaren Gully Road (including the landfill site) and the upper catchment in the area of the landfill were obtained using the NIWA New Zealand River Flood Statistics flood assessment tool[1]. The assessed flows for various flood /peak events in the landfill footprint, the catchment upstream of McLaren Gully Road and Ōtokia Creek at Brighton are provided in Table 1 below. Increased flows associated with climate change have also been provided. Current predictions indicate this will result in an increase in flood flows of approximately 16% by 2100.

Table 1 Flood Flows

Flood Event	Otokia Creek m^3/s	Valley u/s McLaren Gully Road m^3/s	Landfill Footprint m^3/s
Mean Annual Flood (MAF)	10.7 *(12.4)*	1.0 *(1.16)*	0.33 *(0.38)*
50 year	27.4 *(31.8)*	2.5 *(2.9)*	0.96 *(1.11)*
100 Year	30.9 *(35.8)*	2.8 *(3.2)*	1.08 *(1.25)*

Values are current assessed flows. Italicised values in brackets are assessed flows adjusted for climate change out to the year 2100.

[1] Stream Explorer is an online flood estimation tool utilising the regional flood estimation method for individual waterways

16 Table 1 above indicates that the peak event flows for the landfill catchment are approximately 1.5% of the peak flows in Ōtokia Creek catchment for the same event. However, there is a significant variation in size and time of concentration of these two catchments. With peak flows for the landfill catchment resulting from short duration (10-20 min) high intensity rainfall events while the Ōtokia Creek peak flows will result from longer duration (4-6 hr) events which have lower rainfall intensity. It is extremely unlikely that these two extreme events would coincide and flows from the landfill area will typically contribute less than 1% of flood flows for extreme events in Ōtokia Creek.

17 The Ōtokia Creek catchment (including the landfill site) is hilly and the predominant land use is forestry. A significant percentage of the forest in the area has been harvested and replanted in the past five years.

18 The forestry cover, when present, provides interception of rainfall and stabilises soils reducing catchment runoff and entrainment of sediments in the runoff. During the harvest/replanting cycle of the forestry land use, the removal of the vegetative cover and the associated soil disturbance results in increased runoff volumes and erosion of the surface soils, with associated impacts on water quality in receiving watercourses downstream. While there are some control measures evident, such as sediment control ponds and riparian planting (within the immediate environs of the site), the removal of forestry will still have a significant impact. Overall, there will be a significant variation in runoff volumes, for both peak and low flows, and water quality over the forestry cycle from mature trees through clear felling and then the growth of re-planted trees.

Landfill Design

19 The landfill will be designed to accept municipal solid waste in accordance with acceptance criteria for a Class 1 landfill described in Appendix D of the WasteMINZ (2018) Technical Guidelines for Disposal to Land. Key elements of the design providing protection to surface water quality include:

(a) Construction of a low permeability lining system to contain leachate avoiding seepage into the surrounding environment;

(b) Construction of a leachate collection system above the low permeability lining system;

(c) Stormwater control around the constructed landfill and other areas of the site with appropriate treatment and attenuation of stormwater before it discharges to natural watercourses within the site;

(d) A leachate management system, including leachate storage and tanker loading facilities; and

(e) Additional ancillary services including operation of backup diesel generators to power leachate extraction pumps.

20 The details of these works are described in the Landfill Design Report (GHD, 2020) and the evidence of Richard Coombe. Development of a landfill is essentially a long-term construction project. The landfill will be developed in four stages, with one stage being filled with waste while the next stage is constructed. Each stage will be capped, with a combination of intermediate and final capping on completion of filling. Details of the staging are provided in the evidence of Richard Coombe.

21 The final landfill capping landform is shown on Drawing 51-12506381-01-C202. The lower elevation batter slopes immediately above the 10 m high toe bund will be constructed at 1V:5H. The entire cap will shed water to the perimeter drainage swale that flows to the stormwater attenuation basin to the west of the landfill footprint. The only exceptions are:

(a) The downstream face of the toe bund. Stormwater from this face will shed to the wetland and water course immediately downstream from the bund toe; and

(b) Stormwater discharge from the landfill during the early development of Stage 1. This is described in paragraph 24 of my evidence.

22 Leachate is the liquid produced through waste degradation and rainwater that percolates through the waste to the landfill liner, collecting dissolved and/or suspended matter from the waste as it passes through. Minimisation and management of leachate will be achieved through:

(a) Redirecting upslope surface water from entering the active fill area and leachate collection system;

(b) Minimising the size of the active filling area where waste is exposed and covering areas with intermediate or final cover as soon as is practicable to reduce ingress of stormwater;

(c) Monitoring of stormwater from intermediate or final cover and redirecting runoff to the leachate collection system if it is found to be contaminated; and

(d) Separation of stormwater flow from areas where waste is placed.

23 All stormwater that comes into contact with waste will be treated as leachate and will not be discharged to the stormwater system. Leachate generated within the landfill will flow to the leachate collection system at the base of the landfill from where it will be removed off site for treatment and disposal. Further details of the leachate management are presented in Mr Coombes evidence.

24 Stage 1 of the landfill construction involves excavation to form the base of the landfill. This will be below the level of the perimeter swale drain and attenuation basin preventing gravity discharge of stormwater until waste reaches the level of the swale drain. Until this occurs a separate sedimentation basin to capture and treat runoff from this area will be provided within the landfill footprint. This will discharge via a pipe through the bund to a channel leading to the swamp wetland. As this sediment retention pond is at the base of the landfill it will be at greatest risk of leachate contamination. In order to manage this risk, the pond will have a monitoring station providing full time monitoring of pH, conductivity and ammonia as indicators of leachate presence as described by Anthony Kirk in his evidence. Should set trigger concentrations be exceeded alarms will be activated at site and key site personnel texted allowing closing of a discharge valve preventing any discharge to the downstream system until remedial measures have been completed. Stormwater entering the pond while the valve is closed and remedial works are undertaken would be discharged to the leachate collection system.

25 Trigger levels for the Stage 1 sediment retention pond basin would be set out in the Landfill Management Plan prior to commencement of construction. However, it is expected that some refinement of values would occur during initial operation to avoid excessive false alarms.

Overall Stormwater Management

26 Stormwater management and controls will be required during the construction, operation, closure, and aftercare phases of the landfill to avoid contamination of stormwater though contact with waste, minimise erosion and transport of sediment from earthworks areas and mitigate changes to flow regimes.

27 A site specific stormwater management plan, setting out the controls and procedures, will be developed using relevant guidelines, including Auckland Council GD05 for the sizing of ponds and the Environment Canterbury Erosion and Sediment Control Toolbox. This will form part of the overall Landfill Management Plan.

28 The plan will set out management procedures and controls proposed following best practice with the focus being:

(a) avoidance / minimisation of contamination of stormwater though diversion of flows and controlling the extent of works or landfilling exposed;

(b) treatment of construction stormwater at the site to control sediment discharge off site through sediment fencing, covering and use of sediment ponds;

(c) provision of an attenuation basin to mitigate changes in flow regime; and

(d) monitoring to confirm effectiveness of controls.

29 Stormwater management will be ongoing and evolving through all phases of the landfill with regular revision of measures as stages are developed and completed. This will include the closed landfill which will have an ongoing stormwater management requirement for drainage and maintaining the capping, flow management and water quality monitoring.

30 Stormwater management infrastructure will be designed to accommodate the 1% AEP event including an allowance for climate change.

Monitoring

31 Water quality monitoring has commenced at a number of locations and additional sites will be established and monitoring started to provide baseline data and assess impacts during construction and operation. Monitoring will include water quality and quantity/flow monitoring. Details of monitoring and sampling are set out in proposed consent conditions and the monitoring plan attached to Anthony Kirk's evidence

Monitoring will also include sites at high risk areas within the landfill to provide early detection of leachate leakage to allow remedial action and prevention of site discharges.

Flow to the swamp wetland at the base of the Landfill

32 The evidence of Anthony Kirk indicates that construction of the landfill will result in a reduction in groundwater flow to the swamp wetland in the order of 800 m^3/yr. However, the collection of stormwater runoff in the attenuation basin, which will include some short term retention storage during rainfall events, will allow infiltration to ground, or discharge via a floating decant,

and Anthony Kirk explains why this is expected to largely mitigate this reduction in groundwater flow.

33 The water balance work undertaken by Anthony Kirk indicates that surface runoff to the wetland system would reduce by approximately 20% during construction of the landfill, with this value reducing to 19% following completion of filling due to the change in surface cover. While this is not an insignificant reduction in flow, my review of rainfall data for Dunedin Airport indicates approximately 30% of rainfall events are greater than 15 mm and flows from rainfall in excess of this would pass quickly through the wetland system (approximately 13% of all runoff), providing only a very short term impact on water levels in the downstream wetlands.

34 This potential change in runoff from construction of the landfill has to be set in context of the wider catchment land use changes that are occurring. Changing land use has a significant impact in runoff volumes. In particular studies have shown that forestry can have a significant impact on catchment flows. A 2014 study undertaken in Waikouaiti *(Modelling the hydrological impacts of land use change and integrating cultural perspectives in the Waikouaiti Catchment, Otago, New Zealand: Reeves 2014)* indicates reduction in runoff due to reafforestation reduced Mean Annual Low Flows by up to 52% and peak discharges by 86% primarily due to increased evapotranspiration.

35 Climatic variation will also affect catchment runoff. Review of rainfall records for Dunedin and the Dunedin Airport between 1998 and 2021 indicate annual variation in rainfall of greater than 30%.

36 Inflows from groundwater and surface water are important to the development and maintenance of wetland system. However, geology and landform also play important roles. The reduction in surface runoff associated with construction and operation of the landfill is well within the variation that will occur due to annual climatic variation and will be less than would be expected to occur as a result of reafforestation and therefore is not expected to have an adverse effect on the wetland.

37 The investigation and sampling for Smooth Hill landfill have been undertaken during a period following harvest and replanting, a period when runoff would be least affected by forestry and volumes would be greatest. Annual rainfall (at Dunedin Airport) during this period (2018-2021) has varied from above average (2018-2019) to at or slightly below average following (2020-2021).

Flows in valley floor marsh wetland

38 Downstream of the landfill, between the designation area and McLaren Gully Road, valley floor marsh wetland areas are connected via a channel. The flows in the channel are controlled to a large degree by the swamp wetland within the designation, and the valley floor marsh wetland system outside the designation, which includes the pond located approximately 300 m downstream of the designation. This feature appears to be a remnant farm dam/pond from historical land use. These wetlands provide detention of runoff for small to medium size events releasing it over a prolonged period providing a more stable flow regime in the channels downstream. For larger events, typically 15 mm or greater, depending on the period since the last rainfall event, the retention capacity of the wetlands will start to be exceeded and these larger flows will pass through the system relatively quickly.

39 Visual inspection has shown flows in the connecting channel between the valley floor wetlands are intermittent along its length with extents of no flow sections depending on the time of year or frequency of rainfall events. During winter or wetter periods, flow is expected to be continuous along the length of the channel. However, during summer or prolonged periods without rain, flow is intermittent with little or no flow evident in some sections. This was the situation during a site inspection in February 2022, where there was a small surface flow of 5-10 L/min at approximately 50 m upstream of McLaren Gully Road, and no surface flow evident downstream of the road.

40 Construction and operation of the landfill will result in interception of rainfall and a reduction in surface runoff as noted by Anthony Kirk. A reduction in runoff due to construction and operation of the landfill has the potential to decrease flows in the channel and increase the extent and duration of areas of no flow during periods of low flow. However, the effects of the flow reduction are mitigated to a significant extent by the attenuation effect of the wetland systems and the attenuation basin constructed as part of the landfill works will assist with this – retaining stormwater and releasing surface flows over a longer period.

41 Considering the reduction in runoff predicted due to construction and operation of the landfill against the reduction in runoff from forestry that the landfill will be replacing, I would not expect any significant variation in low flows or the extent of dry channels and that any variation would be within the range currently occurring due to land use and climatic variation.

Flows in Ōtokia Creek

42 Low flows in Ōtokia Creek are fed by groundwater seepage and attenuated runoff in wetlands and ponds within the wider catchment. As with extreme event runoff, the low flow volumes from the landfill area will provide a very minor contribution to Ōtokia Creek low flows. Assessment using the NIWA low flow assessment tool indicates this is in the order 1 - 2%. This is significantly lower than variations that would occur annually as a result of climatic variation and changes that would occur during the forestry cycle and there would be no discernible change in the flow regime.

Surface water quality in the downstream system

43 Potential contaminant sources that could impact surface water quality in wetlands and downstream waterways include:

(a) Leachate and sediment in surface discharges for the landfill;

(b) Leachate in groundwater discharge; and

(c) Traffic related contaminants associated with increased vehicle movements.

44 Design of the landfill has followed a best practice approach with controls to prevent contamination of surface runoff including separation and diversion of clean flows, treating runoff with potential to come into contact with waste as leachate, provision of treatment ponds which also allow testing and isolation of flows prior to discharge. Within Stage 1 of the landfill construction and operation, where there is the greatest risk of a discharge, continuous monitoring with an alarm system will be provided to mitigate the risk of leachate contaminated discharges.

45 Site discharges will pass through sediment retention ponds or the attenuation basin which will provide retention allowing removal of the majority of sediments prior to discharge.

46 Anthony Kirk's evidence has considered the potential for leachate contaminated groundwater to impact surface water quality. His findings showed that even adopting a conservative assessment approach potential adverse impact on water quality will be less than minor. His evidence also notes predicted improvements in water quality in the downstream surface water due to reductions in inorganic nitrogen in the shallow groundwater system following construction of the landfill.

47 Construction and operation of the landfill will result in an increase in traffic movements on McLaren Gully Road and vehicle activity around the site. Runoff from areas of the site where vehicle activity occurs will discharge via

sediment retention ponds. Contaminant concentrations will be relatively low and the ponds will provide effective capture of vehicle related contaminants including metals, hydrocarbons and sediments.

48 Vehicle movements on McLaren Gully Road are understood to be relatively low. Andrew Whaley's evidence indicates approximately 25 truck movements per day, and the proposed development will include sealing of the road. Given the low-level traffic movements and the reduced vehicle wear and sediment loads associated with sealing, any adverse effect on water quality in adjacent waterways will be less than minor and the sealing may result in a net improvement.

49 Based on the above assessments and controls any adverse effect on water quality in wetlands and waterways below the landfill will be less than minor. While the assessment and design of the landfill has not relied on treatment by wetlands downstream or downstream dilution, it is noted that the wetlands will provide further polishing of discharges from the site improving quality as you progress downstream and dilution within wider catchment flows will be significant so that any quality impacts in Ōtokia Creek and at Brighton will be undetectable.

Summary and Conclusions

50 The earthworks associated with the construction operation and closure of the landfill will result in significant disturbance of land and, if not managed, potential for generation of elevated sediment concentrations in runoff from site. The Stormwater Management Procedures (SMPs) and controls that have been included in the preliminary design and Draft Landfill Management Plan will be developed further in the detail design stage and as the final Landfill Management Plan is developed. The SMPs will provide effective management of sediment. In addition, although this has not been relied upon for the assessment, further polishing of discharges will be provided by existing sediment control measures installed during the forest harvesting immediately downstream from the site. As a result, any adverse impact on downstream water quality would be less than minor and undetectable in Ōtokia Creek and at Brighton.

51 Groundwater and surface water discharges at the site are inter-related with groundwater seepage making a small contribution to surface water flows at the downstream end of the site designation. Reduction in discharge volumes of either of these flows has the potential to impact immediate downstream hydrology and wetland systems. However, the stormwater controls provided and infiltration that will occur with the attenuation system and wetland within the site will maintain the existing regime to the extent

that any variation would be less than minor, within the annual variation that occurs and significantly less than variation that occurs due to current land use cycles over time.

52 The inter-relationship of ground and surface water provides potential pathway for contamination of surface water with leachate. I consider that the landfill construction and the leachate management systems will provide an effective means to prevent contamination and that the monitoring proposed will provide an appropriate means of confirming the operation and effectiveness of the system.

Response to any issues in ORC peer review

Protection of wetlands with respect to extent and protection of values

53 As outlined above in my evidence, while a net loss in stormwater is predicted, the influence of the attenuation basin and sediment retention ponds are considered likely to smooth out peak stormwater flows and provide more consistent flow to the catchment. With increasing distance from the landfill designation, the interception of runoff and groundwater recharge from additional catchments is expected to reduce the impact to the hydrological regime.

54 The reduction in stormwater runoff is less than would be expected to occur due to annual climatic variation and less than would occur as a result of the reafforestation of the area. The control measures put in place to prevent/ manage leachate discharges in both surface and groundwater will ensure no adverse impact on the wetlands.

55 The above conclusions coupled with the widespread nature of similar narrow wetland areas in much smaller gully bottom habitats elsewhere in the landfill designation and surrounding hill country leads to the conclusions that:

(a) Much smaller gully bottom areas with correspondingly smaller catchment yields (but that otherwise likely have similar poor draining soils and similar groundwater regimes) support wetland habitat.

(b) The existing hydrological regime (total catchment yield) for the existing swamp wetland (and below areas) is highly variable due to climate and land use factors. The currently observed runoff volumes are not considered critical for the persistence of wetland habitats (in terms of wetland type or extent). This could be different, were the wetlands of an altogether different type (e.g., ephemeral), wherein the extent and nature of wetland habitat is tightly coupled to the hydrological regime, but this is not the case.

(c) Wetland habitats below the landfill contain only widespread, generalist and tolerant indigenous wetland plant species that are adapted to varying runoff and prolonged dry periods based on the evidence of Jaz Morris.

(d) Hence, I consider that the 'swamp wetland' area below the landfill toe within the designation (and in turn the valley floor marsh wetland below it) would continue to receive sufficient water inputs to sustain wetland habitat of the same type and extent.

56 On this basis, it is not considered that hydrological changes would lead to loss of wetland extent within the designation area or downstream. Further, the protection of wetland values would occur via the establishment of a reserve area (per the draft Vegetation Restoration Management Plan, draft VRMP) to set aside, fence, and manage wetland areas below the landfill (within the designation site) for their enhancement. Their restoration would be promoted via other draft RMP measures including removal of existing extensive weeds, and restoration plantings of appropriate local species.

Response to any issues in section 42A report

57 In paragraphs 19 to 29 of his report Mr Cochrane comments on the interception of 20% of the annual runoff and from the information provided he was unable to conclude the magnitude of the effect on water flows and the extent of mitigation that soakage within the attenuation basin will provide and the effect that the low-level attenuation basin outlet will have on the wetland hydrology. He indicates that he is unable to draw a confident conclusion regarding the effect of the reduced runoff on the hydrology of the swamp wetland and valley floor marsh wetland.

58 The water balance carried out indicates that the landfill does intercept 20% of the annual runoff to the downstream wetland. However, as noted in my evidence above, an estimated 13% of annual runoff from larger events runoff will pass quickly through the wetland system providing only a very short-term impact on water levels in the downstream wetlands. It is also noted in my evidence that reafforestation of the area, as would be anticipated for the site if the landfill did not proceed, would result in a significant reduction in surface runoff, with the referenced Waikouaiti study indicating reductions in mean annual low flows by up to 52%. Based on this information and comparing it to the likely alternative and former land use of forestry, which is a permitted land use, there would be little variation in

runoff volumes, and there is likely to be a net increase in flow when compared against an established forestry plantation.

59 As noted in my evidence the hydrological regime is highly variable due to forestry land use with the growth and harvest cycles and climatological variations. As there are no publicly available flow records for streams and waterways in the immediate area available to me at time of writing my evidence, my assessment has relied on a desk top evaluation.

60 However, along with Anthony Kirk, I am proposing the establishment of automated flow recorders at two or possibly three locations downstream of the landfill along with water level monitoring in the swamp wetland within the designation. A weather station has been established at the site for some time (see evidence of Peter Stacey). These flow recorders together with the weather station rainfall data will provide the baseline information required to understand the relationship between rainfall and stream flows and variation that is occurring with the re-establishing forestry within the catchment and longer term the impact of the landfill construction and operation.

61 Three years (36 months) of continuous baseline flow monitoring is proposed to be undertaken prior to landfill construction. Flow monitoring will continue once the landfill is constructed and in operation and will assist in assessing any impact from the landfill on the downstream system and help guide the need for any mitigation (see the evidence of Jaz Morris and Tanya Blakely).

62 The locations of the flow monitoring sites have been provided on GHD Drawing 12506381 -01 C309 appended to Anthony Kirk's evidence.

63 In paragraphs 47-52 of his report, Mr Cochrane comments on the continuous monitoring of the Stage 1 sediment retention pond and the attenuation basin, and the risk of discharge of contaminated surface water to ground. The basis for the inclusion of continuous monitoring of the Stage 1 sediment retention pond and, following completion of Stage 1, the attenuation basin, is to provide early warning of a potential issue with leachate contamination rather than monitoring the quality of the discharge. As noted in paragraph 26 above, some refinement of trigger levels during the early stages of operation will be required to avoid frequent false alarms. However, the levels will be sufficiently low to allow remedial measures to be adopted before there is potential for a significant discharge to the receiving environment.

64 Mr Cochrane notes is paragraph 53 the potential for the discharge to ground and groundwater from the attenuation basin which has been designed to

allow infiltration. As noted above, continuous monitoring and associated trigger levels will be low limiting the potential for any such discharge.

65 Anthony Kirk provides evidence on additional design measures for the attenuation basin providing recharge via a floating decant and a control orifice delivering a surface discharge to the swamp wetland immediately downstream of the attenuation basin. Further details of detention and flows are provided in the evidence of Anthony Kirk. This approach provides:

(a) better control of long-term discharge for wetland recharge;

(b) will be visible to confirm operation/provide surety of the discharge;

(c) avoids the issue of achieving the required flows through the low permeability soils or blinding from retained fine sediments; and

(d) continues to include a valve that could also be closed in the event of trigger levels being exceeded.

Response to matters raised in submissions

Flood Assessment and Impact,

Submissions by A Hutchison, S & B Judd and S Laing

66 Submissions questioned the basis for assessment of flood/extreme event assessment based on a 2020 event.

67 Catchment flows for extreme event flows have been based on the NIWA New Zealand River Flood Statistics Tool. The tool has been developed based on the statistical analysis of datasets 640 sites throughout New Zealand taking into account catchment, topography, climate, soil and rock type, landuse to provide catchment flows for defined watercourses. This tool was updated in 2016.

68 In the absence of a flow record from a site based recorder, which does not exist for Ōtokia Creek this NIWA tool is considered to provide the most accurate assessment of extreme event flows. Assessment utilising calculation methods such as the rational method or Technical Memorandum 61 have not been considered appropriate.

69 As noted in my evidence the areal extent of the works are a very small percentage of the catchment. Any change in flood level or risk in the lower reaches of Ōtokia Creek will not be discernible.

Climate Change

Submissions by S Laing, Ōtokia Creek and Marsh Habitat Trust, Resawesome Ltd, South Coast Neighbourhood Society Inc (SCNS)

70 Calculation for extreme event flows and for sizing of stormwater management infrastructure have included a 16% allowance for climate change. This has been based on assessment of rainfall intensities from HIRDS V4 for current day intensities versus predicted intensities out to 2100 based on RCP 8.5 (Representative Concentration Pathway) which is currently the most extreme climate change path prediction.

Water Quality impacts downstream and at Brighton

Submissions by Brighton Surf Lifesaving Club, R Aburn, Big Stone Forest Ltd, S & A Ramse, A Hutchison, Saddle Hill Community Board, South Coast Neighbourhood Society Inc (SCNS), Scott Weatherell

71 As set out in paragraphs 43 to 49 above, any effect on water quality in the wetlands downstream from the landfill will be less than minor. Quality impacts further decrease as you progress downstream and any effect in the lower reaches of Ōtokia Creek and at Brighton would be undetectable.

72 With respect to landfill Stage 1 discharge. The stormwater in the sediment retention pond will have full time monitoring to detect leachate contamination with alarms and texts to personnel in the event of trigger level exceedance.

Flow assessment and effects on downstream wetlands and ecology

Submissions by Big Stone Forest Ltd, S & A Ramsey, South Coast Neighbourhood Society Inc (SCNS).

73 The submission notes potential adverse impacts on the wetland due to inadequate assessment. Details of the assessment and associated wetlands impacts is covered in paragraphs 34-39 and 48-53 of my evidence above.

Risk of ponding creating new bird habitat

Submissions by Dunedin International Airport Ltd.

74 The submission notes the risk creation of new bird habitat. Referring to my evidence, construction and operation of the landfill will not result in an increase in ponding downstream.

75 The landfill facilities will include sediment retention ponds and an attenuation basin. The sediment retention ponds are designed to drain following rainfall events, however there is a degree of dead storage in the base that will result in prolonged ponding of some water, particularly during winter. The attenuation basin will be designed to detain water following rainfall events allowing slow discharge to the swamp wetland and as such will contain water for the majority of the year. To avoid the SRP/attenuation basin becoming an attraction to birds, remedial measures such as netting of the ponds/basin are proposed to be proactively implemented.

Use of attenuation basin for emergency storage

Submission by Resawesome Ltd

76 The submission notes that use of the attenuation basin for emergency storage of leachate is unacceptable. The attenuation basin will not be used as an emergency leachate storage facility – as noted in Mr Coombes evidence, in the event of an emergency event at the site the primary location for emergency storage of leachate will be the landfill. In the event that stormwater is found to be contaminated with leachate, the attenuation basin will be fitted with a shut off valve which can be closed retaining flows and preventing a discharge to the wetland and downstream system. In the event of leachate contamination having entered and been held in the attenuation basin, removal of contaminated surface soils would be undertaken before the pond was recommissioned and discharges recommenced. Procedures will be set out in the Landfill Management Plan.

Allen Ingles

29 April 2022