ENGINEERING AND INFRASTRUCTURE REPORT
TO SUPPORT A RESOURCE CONSENT APPLICATION
FOR A RESIDENTIAL 49 LOT DEVELOPMENT
FOR THE KILNS LTD
AT 34-36 SANDSPIT ROAD, WARKWORTH

Job No: 85070-01

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Engineering *Ingenuity*

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Contents

Executive Summary

This report addresses the civil engineering and infrastructure requirements for the proposed residential development at 34-36 Sandspit Road, Warkworth. The proposed development will involve the subdivision of the subject property into 49 residential lots and the construction of 49 houses on the site. The existing structure will be demolished to enable the construction.

We have determined that the site is suitable for residential development and is not generally subject to natural hazards. Connections to existing roading, stormwater, wastewater, water supply, power and telecommunications infrastructure in the vicinity of the site will be constructed to service the development.

It is concluded that the development can be serviced by the existing and proposed infrastructure detailed within this report.

1 INTRODUCTION

Airey Consultants Ltd has been engaged to carry out an engineering infrastructure assessment for the proposed 49-lot development at 34-36 Sandspit Road, Warkworth.

The purpose of the report is to address relevant engineering issues in relation to a Resource Consent Application and provide an assessment of the serviceability of the proposed development.

In general, these include:

- Flooding considerations & overland flow paths
- Earthworks and erosion and sediment control
- Access and vehicle crossing
- Stormwater disposal
- Wastewater disposal
- Water supply
- Power and Telecommunications

2 SITE DESCRIPTION

2.1 Location

The subject site is located approximately north of the Warkworth CBD, across the Mahurangi River from the town. The northern boundary of the site is bounded by Sandspit Road, and the western and eastern boundaries are bounded by streams (Viponds Creek to the west and an unnamed stream to the east).

The site is shown in Figure 1 below.

Figure 1 - Subject Site (from Auckland Council GeoMaps)

2.2 Titles/Zoning

The subject site has a total area of 2.96ha and is zoned Future Urban under the Auckland Unitary Plan. The subject site consists of two properties:

- 34 Sandspit Road (Lot 1 DP 66360) – 0.1224ha
- 36 Sandspit Road (Pt Lot 51 DP 703, Lot 1 DP 39534) – 2.8365ha

A Private Plan Change (PPC) application has been submitted which will enable the rezoning of the site to Mixed Housing Urban Zone for the development.

The eastern part of the site (along the unnamed stream) is within the Significant Ecological Area (SEA) overlay. An esplanade reserve will be required to be provided along the western, eastern and southern boundaries of the site, as the river/stream widths all exceed 3m at annual fullest flow.

2.3 Topography & Features

The subject site contains a mixed topography and rises from all boundaries from the river/stream level to a central high point located in the western part of the site. Elevations in the site range from approximately RL2.0 to RL26.0. There are some existing archaeological features in the southern part of the site (the kilns) which are addressed in reports prepared by others.

2.4 Proposed Development

The proposal involves constructing 49 new houses on the site, with a mixture of terraces, duplexes and standalone dwellings proposed. A new public road and private accessways will be constructed to facilitate access to the dwellings. New stormwater, wastewater, water supply and utility services will be constructed to serve the development.

3 FLOODING CONSIDERATIONS

3.1 Flood plain and flood prone area

Auckland Council Geomaps indicates that the site is not located within a flood plain, flood sensitive areas or flood prone areas and is not subject to coastal inundation.

The site is subject to flooding in the 1% AEP storm event, however the flood plains are confined to the immediate vicinity of the watercourses bounding the site. All proposed development including bulk earthworks will be located outside the flood plains.

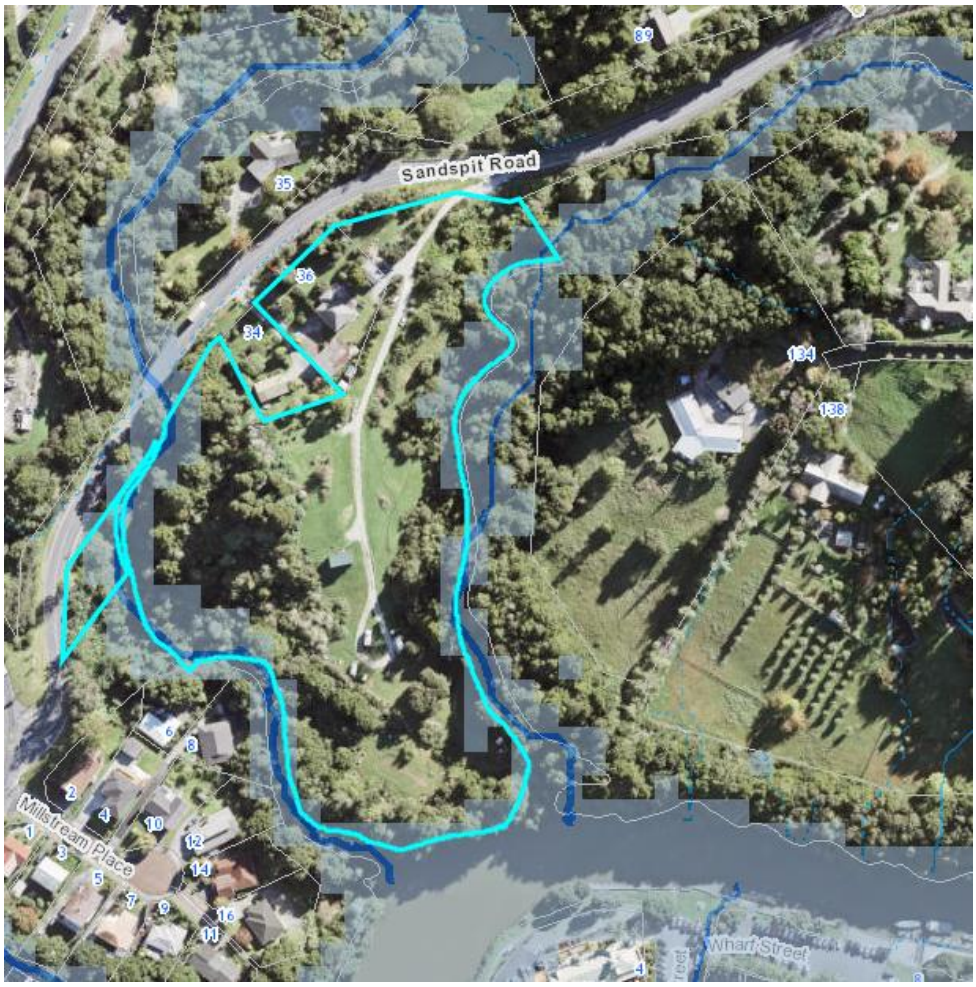


Figure 2 - Flood Plains (from Auckland Council GeoMaps)

The site is also subject to coastal inundation and the southern end of the site is within the coastal inundation 1% AEP plus 1m sea level rise overlay. This area is also within the 1% AEP flood plain and no development or bulk earthworks are proposed in this area.

The proposed shared path bridge (refer to section 5) across Viponds Stream will be located above the 1% AEP flood level and will be able to be designed so as not to cause an impediment to flood flows. As such no increase in flood levels upstream or downstream of the site is anticipated as a result of the proposed development. We note that the proposed development will result in an increase in impervious coverage on the site and therefore runoff will be increased in the 1% AEP storm. We consider that the increase in impervious area is minor compared with the Mahurangi River catchment and therefore we anticipate that any increase in flood levels upstream or downstream of the site will be less than minor and will not result in any increased risk of inundation of buildings. We consider that the flooding and coastal inundation does not pose a risk to potential development or to the future users/residents of the site or surroundings.

We note that the defined Auckland Unitary Plan indicative coastline is locates approximately 1.5km southeast of the site, and therefore we consider that any tidal influence in the Mahurangi River adjacent to the site will be neglible.

Refer to the Stormwater Management Plan prepared by Airey Consultants (accompanying the RC & PPC applications) for more details on the hydraulic analysis undertaken for the Mahurangi River catchment.

4 EARTHWORKS AND EROSION & SEDIMENT CONTROL

4.1 Bulk Earthworks

The site soils generally consist of topsoil overlying a range of soils including colluvium, alluvium, uncontrolled fill, and limestone. The underlying geology is Mahurangi limestone residual soils in the northern and central part of the site, and Pakiri formation (Waitemata Group) residual soils in the southern part of the site. A geotechnical investigation report has been prepared by CMW Geosciences (CMW) and should be referred to along with this report.

Bulk earthworks will be required in order to facilitate road and accessway construction to achieve gradients in accordance with Auckland Council and Auckland Transport requirements. Bulk earthworks will also be required in order to lower the high point of the site in order to facilitate the proposed residential development. This high point has been identified by CMW Geosciences as a limestone formation and so excavation into the limestone will be necessary.

Earthworks will primarily consist of cut operations. The required earthwork quantities are shown below:

Table 1 Earthworks Quantities

	Area (m^2)	Volume (m^3)
Fill	2,927	3,400
Cut	14,773	46,800
Total	17,700	43,300 (excess cut)

The bulk earthworks will generally be undertaken as a cut to waste operation, with a moderate amount of fill anticipated to be able to be placed in the southern and north-western parts of the site. All excavated material disposed of off-site will be disposed of at a clean-fill or at another earthworks site with a resource consent to accept fill material.

4.2 Site Stability and Retaining

Retaining walls to facilitate the development. Two main retaining wall types are proposed:

- Mass block walls – these are proposed at the entrance along the Sandspit Road frontage. Construction of these walls will create flat platforms for Lot 1 and Lots 43 – 49, and will also enable excavation within the Sandspit Road reserve to achieve the required sightlines for the new public road intersection. The maximum height of these walls is approximately 5.4m.
- Timber pole walls – these are proposed around parts of Lots 11 – 12 & 19 – 21. These walls will facilitate flat outdoor living areas for these lots and enable the driveway for Lot 12 to be formed between Lots 11 and 13. Timber pole walls will also be required to facilitate the pathway from the development to Millstream Place (refer to section 5). The maximum height of retaining to form the pathway is approximately 4.0m, while the maximum height of retaining for the lots is approximately 2.6m.

In ground palisade walls are also proposed in order to improve ground stability in some areas of the site. These walls are shown on Airey Consultants' drawings but are based upon advice provided by CMW Geosciences. Reference should be made to the geotechnical investigation report accompanying the application.

4.3 Auckland Unitary Plan Assessment

Section E11. Land disturbance – Regional – Table 11.4.1. Activity Table – all zones and roads of AUP – Land Disturbance Section states the following:

Table E11.4.1 Activity table – all zones and roads

Activity		Activity status				
		Residential zones, business zones, Business – City Centre Zone, Future Urban Zone, rural zones (excluding Rural – Rural Conservation Zone)	Open space zones (excluding Open Space – Conservation Zone)	Rural – Rural Conservation Zone and Open Space –Conservation Zone	Special Purpose – Quarry Zone	All other zones and roads
(A9)	Greater than 2,500m^2 within the Sediment Control Protection Area[1]	RD	RD	RD	Refer to H28 Special Purpose – Quarry Zone	RD

The site is zoned *Future Urban Zone* under the Auckland Unitary Plan and has a total earthworks area within the sediment control protection area of 1,300m^2. It is therefore considered a *Restricted Discretionary* activity. As such the relevant assessment criteria are addressed below. The proposal also involves earthworks exceeding 5m^2 in area and 5m^3 in volume within the significant ecological area, and so is also a *restricted discretionary* activity under E11.4.3 (A28 & A30).

Standard E11.8.2 Assessment criteria states the following:

"The Council will consider the relevant assessment criteria below for restricted discretionary activities:

(1) All restricted discretionary activities:

(a) whether applicable standards are complied with"

We consider all applicable standards have been complied with as that all proposed works comply with GD05.

"(b) the proximity of the earthworks to any water body and the extent to which erosion and sediment controls and the proposed construction methodology will adequately avoid or minimise adverse effects on:

(i) water quality including of the coastal marine area;

(ii) ecological health including of the coastal marine area;

(iii) riparian margins;

(iv) the mauri of water; and

(v) the quality of taiāpure or mahinga mātaitai."

The Mahurangi River is the receiving environment for the site. The Mahurangi River at Warkworth has a contributing catchment of approximately 5,500ha (based on Auckland Council GeoMaps). The proposed earthworks area represents approximately 0.03% of the Mahurangi River catchment. Ultimately the Mahurangi River discharges into the coastal marina area (CMA) approximately 1.5km downstream of the site.

The proposed erosion and sediment controls are designed to prevent sediment laden runoff from being discharged from the site and therefore to minimise effects on the downstream environment. Although the proposed earthworks are within the sediment control protection area, the works are separated from the adjacent watercourses as follows:

- Mahurangi River – 20m separation
- Viponds Creek – 15m separation (other than for the pathway bridge structure)
- Unnamed stream – 5m separation

The existing vegetation between the works and the watercourses will be retained and will act to further protect the receiving environment from the unlikely event of a failure of the sediment control devices (noting that all sediment retention ponds and decanting earth bunds will be provided with spillways designed for the 1% AEP storm in accordance with GD05).

We consider that the adverse effects on the Mahurangi River and CMA as a result of the proposed earthworks will be less than minor.

"(c) the extent to which the earthworks minimises soil compaction, other than where it benefits geotechnical or structural performance"

Soil compaction will be required over most of the site in order to construct the proposed pavements and building platforms. This compaction is required to ensure structural performance of the pavements and to provide safe and stable platforms for building foundations. It should be noted that the majority of the earthworks are cut, so soil compaction of the subgrade will be required. Any fill placed will be compacted in layers as specified by the project geotechnical engineer in order to achieve the required level of compaction and stability.

"(d) the proximity of the earthworks to areas of significant ecological value and the extent the design, location and execution of the works provide for the maintenance and protection of these areas"

The proposed earthworks are in proximity to the significant ecological area (SEA) surrounding the unnamed stream east of the site and encroach into it in places. The extent of the earthworks within the SEA is 500m^2 and the volume is 610m^3. This area of SEA is proposed to be removed, and will be replaced by the portion of the site west of Viponds Creek (approximately 590m^2) which is proposed to be planted with native vegetation and vested to Council as reserve and SEA. This new area of SEA will mitigate the effects of removing the portion of SEA in the east of the site.

"(e) whether monitoring the volume and concentration of sediment that may be discharged by the activity is appropriate within the scale of the proposed land disturbance"

Monitoring by Council is anticipated for this site in addition to that provided by the contractors and Engineers. Monitoring will be undertaken by the bulk earthworks contractor and the controls will be checked before and after periods of heavy rain. Controls will also be checked by the Engineer at least once a fortnight. We do not consider that any specific monitoring programme is warranted for this site other than regular weekly or fortnightly visits by Council's Erosion and Sediment Control Team.

"(f) whether the extent or impacts of adverse effects from the land disturbance can be mitigated by managing the duration, season or staging of such works"

The bulk earthworks will be undertaken in a single stage in a single earthworks season. We estimate that the duration of the bulk earthworks phase will be approximately 20 weeks (5 months). Although earthworks will be undertaken in a single stage, it is unlikely that the entire 1.8ha earthworks area will be exposed at one time, and the site will be progressively stabilised as areas of earthworks are completed.

"(g) the extent to which appropriate methods are used to prevent the spread of total control pest plants or unwanted organisms (as listed under the Biosecurity Act 1993), such as kauri dieback disease."

No pest plants or unwanted organisms have been identified on the site.

(2) Additional assessment criteria for land disturbance within the Significant Ecological Areas Overlay or Water Supply Management Areas Overlay:

(a) whether the land disturbance proposed within a Significant Ecological Areas Overlay or Water Supply Management Areas Overlay are undertaken so they have no adverse effect, or minor adverse effect, on the aquatic and terrestrial ecology and wildlife of the area and in particular, where relevant:

(i) nesting, feeding and breeding of species;

(ii) biological processes;

(iii) connections between ecosystems;

(iv) the diversity of species;

(v) the habitat of threatened or protected species, both terrestrial and aquatic;

(vi) rare habitat, threatened habitat or at risk habitat;

(vii) sand dune ecosystems;

(viii) buffering of indigenous ecosystems; or

(ix) cumulative effects.

The proposed earthworks within the SEA will be able to be undertaken without adverse effect on any of the above. We note that the proposed removal of SEA will be mitigated by an additional area being vested as reserve and provided with a new area of SEA overlay. Reference should be made to the ecological assessment prepared by Bioresearches which forms part of the application.

(b) within the Water Supply Management Areas Overlay, how potential adverse effects on water quality within water supply catchments will be avoided, remedied or mitigated; and

Not applicable.

(c) the extent to which adverse effects on ecological and indigenous biodiversity values have been avoided or minimised.

We consider that the adverse effects on ecological and indigenous biodiversity values have been minimised by the proposed planting in the new SEA area west of the site. Refer to the ecological assessment prepared by Bioresearches for more details.

Section E12. Land disturbance – District – Table 12.4.1. Activity Table – all zones and roads of AUP – Land Disturbance Section states the following:

Table E12.4.1 Activity table – all zones and roads

Activity	Activity status							
	Residential zones	Business zones and City Centre Zone	Future Urban Zone and rural zones (excluding Rural – Rural Conservation Zone)	Open space zones (excluding Open Space – Conservation Zone)	Rural – Rural Conservation and Open Space – Conservation Zone	Special Purpose – Quarry Zone	All other zones and roads	
General earthworks not otherwise listed in this table [1]								

(A6)	Greater than 2500m^2	RD	RD	RD	RD	RD	Refer to H28 Special Purpose – Quarry Zone	RD
(A10)	Greater than 2500m^3	RD	RD	RD	RD	RD	Refer to H28 Special Purpose – Quarry Zone	RD

The site is zoned *Future Urban Zone* under the Auckland Unitary Plan and has a total earthworks area of 17,700m^2 and volume of 43,00m^3. It is therefore considered as *Restricted Discretionary* activity. As such, the relevant assessment criteria are addressed below.

Standard E12.8.2 Assessment Criteria states the following:
"The Council will consider the relevant assessment criteria below for restricted discretionary activities:
(1) all restricted discretionary activities:
(a) whether applicable standards are complied with;"

The erosion and sediment control design has been prepared in accordance with GD05.

"(b) the extent to which the earthworks will generate adverse noise, vibration, odour, dust, lighting and traffic effects on the surrounding environment and the effectiveness of proposed mitigation measures;"

The use of noise generating equipment and vehicle movements to and from the site associated with earthworks activity will be controlled and kept to a minimum level. No operation of noise-generating equipment and vehicles will take place on Sundays or public holidays. Construction works will not generate unreasonable vibration and disturbance beyond the boundaries of the subject site. Dust control in accordance with GD05 will be provided for the duration of the earthworks. Dust control will primarily be provided by watercart. No odours are anticipated to be generated by the earthworks.

We note that the bulk earthworks are primarily a cut operation and therefore material will be removed off-site, most likely by truck and trailer units. A total of over 3,000 truck movements are anticipated in order to remove cut material from the site. We recommend that consent conditions be included requiring a construction management plan (CMP) and construction traffic management plan (CTMP) be prepared by the earthworks/civil works contractor and approved by Council/Auckland Transport prior to the commencement of works. This will ensure that a construction methodology is adopted which minimises the impact of the construction phase of the works.

"(c) whether the earthworks and any associated retaining structures are designed and located to avoid adverse effects on the stability and safety of surrounding land, buildings, and structures;"

The earthworks area will be kept within the site boundary. Temporary excavation slopes will be carefully managed with minimum exposure time, especially excavation near the boundaries. Temporary excavation may be carried out in short sections. Soils between opened sections may be left as support to the excavation slopes. Cut slopes will be positioned with sufficient distance away from property boundaries, other retaining walls, structures, or steep slopes. Working close to excavation slopes will be carried out in accordance with the Worksafe NZ Excavation Safety Guidelines. There will be no land disturbance or any impact on land stability beyond the boundaries of the subject site.

"(d) whether the earthworks and final ground levels will adversely affect overland flow paths or increase potential volume or frequency of flooding within the site or surrounding sites;"

The area of earthworks is clear of the flood plain and overland flow paths present in the vicinity of the site. The proposed bridge over Viponds Creek will be designed to provide no impediment to the 1% AEP flood, and therefore we do not consider that there will be any adverse effects on overland flow paths or flooding that will impact other properties.

"(e) whether a protocol for the accidental discovery of kōiwi, archaeology and artefacts of Māori origin has been provided and the effectiveness of the protocol in managing the impact on Mana Whenua cultural heritage if a discovery is made;"

We consider that the likelihood of accidental discovery is very low. If any kōiwi, archaeology and artefacts of Māori origin are discovered works will be halted and the relevant Mana Whenua authority and Heritage New Zealand will be notified.

"(f) whether the extent or impacts of adverse effects from the land disturbance can be mitigated by managing the duration, season or staging of such works;"

Earthworks will be completed in one earthworks season and we consider that this will minimise the effects associated with the proposed land disturbance as the site will be permanently stabilised as quickly as possible.

"(g) the extent to which the area of the land disturbance is minimised, consistent with the scale of development being undertaken;"

The earthwork area will be kept within the site boundary and has been minimised. The total earthworks area (including the road reserve and the pathway to Millstream Place) equates to approximately 375m^2 for each new residential dwelling, which we consider is appropriate and relatively minimal. Earthworks will be completed in one earthworks season to ensure the duration of land disturbance is minimised and consistent with the scale of the development.

"(h) the extent to which the land disturbance is necessary to provide for the functional or operational requirements of the network utility installation, repair or maintenance;"

Not applicable

"(i) the extent of risks associated with natural hazards and whether the risks can be reduced or not increased;"

With the exception of the proposed pathway, the proposed earthworks are not within any part of the site which is subjected to sea level rise, coastal inundation or flooding. Therefore, we do not consider that there will be any risks associated with natural hazards.

Some of the earthworks to form the proposed pathway will be within the flood plain, these works are relatively limited in scale and will be undertaken during periods of forecast dry weather only in order to minimise the likelihood and risk associated of flooding.

"(j) whether the land disturbance and final ground levels will adversely affect existing utility services;"

The existing network utilities within or near the site include stormwater reticulation, electricity reticulation and telecommunications reticulation. The public infrastructure will be protected during the works to ensure the land disturbance will not adversely affect the existing utilities.

"(k) the extent to which the land disturbance is necessary to accommodate development otherwise provided for by the plan, or to facilitate the appropriate use of land in the open space environment, including development proposed in a relevant operative reserve management plan or parks management plan;"

The land disturbance is necessary to accommodate the proposed development.

"(l) for land disturbance near Transpower New Zealand Limited transmission towers;"

The land disturbance is limited within the subject site. No land disturbance is expected near Transpower New Zealand Limited transmission towers.

"(m) the extent to which earthworks avoid, minimise, or mitigate adverse effects on any archaeological sites that have been identified in the assessment of effects."
The historic kilns and tramway present within the site have been identified as an archaeological heritage feature. Refer should be made to the heritage assessment report accompanying the application for details of how these features will be protected.

4.3.1 Erosion & Sediment Control

Prior to earthworks commencing, the site sediment controls in accordance with the requirements of Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region GD05 (legacy ARC TP90) will be established.

The proposed erosion and sediment control plans and details are included in Appendix A Dwg no. 230 - 241. The erosion and sediment control measures to be used will include the following:

- Stabilised site access
- Sediment retention pond (SRP) (one)
- Decanting earth bunds (DEB) (nine)
- Clean and dirty water diversions (as shown on plans and as required throughout site works)

The site generally falls towards Sandspit Road in the north and the Mahurangi River in the south, and one main sediment control catchments is proposed. Sediment retention ponds (SRP) are recommended by Auckland Council GD05 as the best practice sediment control device for earthworks of this scale and we consider that one SRP for the central part of the site, would be a practical and effective sediment control solution for the site. The sediment retention pond will be located near the Sandspit Road frontage in the western corner of the site and will collect runoff from the central part of the site, including the majority of the proposed road reserve.

A series of decanting earth bunds will supplement the sediment control provided by the sediment retention pond and will generally collect runoff from areas closer to the perimeter of the site.

The sediment retention pond and the decanting earth bunds will all be provided with chemical treatment in accordance with Auckland Council requirements.

There are no upstream catchments that discharge to the site so cleanwater diversion drains are unlikely to be required for the site.

The SPR calculations are attached in Appendix B. The catchments and volumes are shown below.

Table 2 SRPs and DEBs Catchments and Volumes Summary

	SRP1	DEB1	DEB2	DEB3	DEB4	DEB5	DEB6	DEB7	DEB8	DEB9
Contributing Area (m^2)	7,400	1,500	800	800	900	2700	900	2,200	300	300
Volume (m^3)	222	45	24	24	27	81	27	66	9	9

A stabilised construction entrance would also be formed at the commencement of works in order to prevent sediment being tracked onto the road by trucks. The existing driveway may be suitable for this purpose but this would be confirmed at the detailed design stage. Additional erosion and sediment controls will be provided in specific areas as required, such as silt fences around the site.

Top soiling and grassing of the earth-worked area will occur as soon as practical after completion of works to stabilise the site. Road and accessway areas that are to be sealed or concreted will be stabilised with metal.

All proposed sediment controls will be maintained and monitored during the duration of works. Water spray will be used to control dust in periods of dry and/or windy weather. Other controls in accordance with the requirements of GD05 may also be installed during the construction phase as required (to be determined by the Engineer or as requested by Council). All earthworks for the development are proposed to be undertaken during a single earthwork construction season from 1 October to 30 April.

Based on adherence to the erosion and sediment control methodology described above, we consider that the effects of the earthworks will be less than minor.

5 ACCESS

5.1 Existing Access

The two existing properties that comprise the site are accessed from Sandspit Road via separate driveways.

5.2 Proposed Access

Access to the proposed development will be obtained from Sandspit Road, with a new public road and intersection located approximately 40m west of the existing access to 36 Sandspit Road. The public road will be a cul-de-sac with a 16m road reserve and footpaths on each side. A new intersection and right turn bay will be formed on Sandspit Road to facilitate access to the site. Some widening of the southern side of Sandspit Road will be required to form the right turn bay.

Two private accessways (common access lot) will be utilised within the site to provide access to the some of the dwellings.

The public road will be designed in accordance with Auckland Transport requirements and the accessways will be designed in accordance with Auckland Council requirements. A traffic engineering assessment has been undertaken by Team Traffic Engineering & Management Ltd (Team) and should be referred to along with this report. Team have determined that some vegetation clearance and excavation will be required within the Sandspit Road reserve in order to ensure safe sightlines are achieved for the new intersection. A retaining wall will be required on the north-western boundary of the site (in front of the existing dwellings) in order to facilitate the excavation within the road reserve.

Pedestrian access will be provided from the new road, along Accessway 2 to the heritage kilns, which will be retained as a heritage feature accessible by the residents of the development.

A pathway usable by pedestrians and cyclists is proposed to provide safe connectivity with Warkworth town centre. A bridge will be constructed over Viponds Creek in the southern part of the site. The pathway will then run through the reserve located east of 16 Millstream Place and connect to the existing pathway to Millstream Place. Access to Warkworth town centre would be along the footpaths on Millstream Place, Sandspit Road, and Elizabeth Street. This proposed pathway would mean the walking distance from the southern end of the site to the corner of Elizabeth Street and Queen Street is approximately 500m (6 minutes walk). The proposed pathway and bridge will be designed in accordance with Auckland Council and Auckland Transport requirements. The bridge will be provided with freeboard above the 1% AEP flood level and will be able to be constructed without any disturbance of the bed or banks of Viponds Creek. The design of the bridge will be undertaken at the building consent design stage.

6 STORMWATER

6.1 Stormwater Reticulation

The proposed development will be provided with a reticulated stormwater network in accordance with Auckland Council requirements. All runoff from roof areas and paved surface will be collected and directed into a new public stormwater network.

Two new stormwater outlets to Viponds Creek are proposed. Both stormwater outlets will be located above mean high water springs (MHWS) and outside the 1% AEP flood plain. Relatively steep pipe gradients are anticipated and therefore erosion and scour protection will be required. We consider that stilling wells will be an appropriate outlet structure, however the detailed design of the outlets will be undertaken at the engineering approval stage.

6.2 Auckland Unitary Plan (AUP)

AUP stormwater provisions relating to the site include:

- E8 – Stormwater – Discharge and Diversion
    - E8.6 General Standards are addressed as follows:

1) *The design of the proposed stormwater management device(s) must be consistent with any relevant precinct plan that addresses or addressed stormwater matters.*
   The site is not located within any precinct.

2) *The diversion and discharge must not cause or increase scouring or erosion at the point of discharge or downstream.*
   The stormwater outlets will be provided with suitable erosion control measures to ensure that there will be no increase in scouring or erosion at the point of discharge. The detailed design of the stormwater outlets will be undertaken at the Engineering Approval stage.

3) *The diversion and discharge must not result in or increase the following:*
    a. *flooding of other properties in rainfall events up to the 10 per cent annual exceedance probability (AEP); or*
    b. *inundation of buildings on other properties in events up to the 1 per cent annual exceedance probability (AEP).*

   All stormwater runoff from rainfall events up to and including the 10% AEP storm will be captured in the proposed stormwater pipe network and discharged to Viponds Creek through the stormwater outlets described above. The development will not result in flooding of other properties in rainfall events up to and including the 10% AEP storm. Overland flow paths will be provided in order to ensure that no inundation of buildings occurs in events up and including the 1% AEP storm. The overland flow paths will direct runoff onto Sandspit Road and into Viponds Creek. The increase in overland flow as a result of the development will have a minimal impact on the Mahurangi River and there will be no increase in inundation of buildings on other properties in events up to the 1% AEP storm.

4) *The diversion and discharge must not cause or increase nuisance or damage to other properties.*
There are no downstream properties between the site and the receiving environment. The proposed stormwater discharge will not cause or increase nuisance or damage to other properties.

5) *The diversion and discharge of stormwater runoff must not give rise to the following in any surface water or coastal water:*
   a. *the production of conspicuous oil or grease films, scums or foams, or floatable or suspended materials;*
   b. *any conspicuous change in the colour or visual clarity;*
   c. *any emission of objectionable odour;*
   d. *the rendering of fresh water unsuitable for consumption by farm animals; or*
   e. *any significant adverse effects on aquatic life.*

   As discussed in *Stormwater Management – Quality*, stormwater treatment raingardens and proprietary filtration devices will be provided to treat runoff from all paved impervious areas. Provision of these treatment devices will ensure that there is no:
   - conspicuous oil/grease/scum/foams/floatable or suspended material in Viponds Creek or the Mahurangi River
   - conspicuous change in colour or visual clarity of the water in Viponds Creek or the Mahurangi River
   - emissions of objectionable odour
   - adverse effect on aquatic life.

6) *Where the diversion and discharge is to ground soakage, groundwater recharge or peat soil areas any existing requirements for ground soakage, including devices to manage discharges or soakage, must be complied with*
The proposed discharge is not to ground soakage.

6.3 Stormwater Management – Quantity

Stormwater quantity treatment is proposed for all impervious areas. The urban-zoned areas west of the site are within the Stormwater Management Area Control – Flow 1 (SMAF 1). The hydrology mitigation requirements for this control area are set by AUP Rule E10.6.3.1.1 and are reproduced overleaf. As the site discharges to the same catchment as the nearby SMAF 1 area (the Mahurangi River), we propose to adopt SMAF 1 for the new development. Retention and detention tanks will be provided on each lot and the stormwater treatment devices utilised for the roads and accessways will be designed to provide detention in accordance with SMAF 1 requirements. Based on the geotechnical investigation undertaken by CMW, we consider that the site soils are not suitable for infiltration, and therefore we consider that the SMAF 1 retention requirement should only be applied to the residential lots, not the road and accessways. The road and accessways can be provided with detention in accordance with AUP Rule E10.6.3.1.1(2)(c).

Stormwater management area control	Hydrology mitigation requirements
(1) Except as provided for in (2) below the following applies:	
Stormwater management area – Flow 1	(a) provide retention (volume reduction) of at least 5mm runoff depth for the impervious area for which hydrology mitigation is required; and (b) provide detention (temporary storage) and a drain down period of 24 hours for the difference between the pre-development and post-development runoff volumes from the 95th percentile, 24 hour rainfall event minus the 5 mm retention volume or any greater retention volume that is achieved, over the impervious area for which hydrology mitigation is required.
(2) Where: (a) a suitably qualified person has confirmed that soil infiltration rates are less than 2mm/hr or there is no area on the site of sufficient size to accommodate all required infiltration that is free of geotechnical limitations (including slope, setback from infrastructure, building structures or boundaries and water table depth); and (b) rainwater reuse is not available because: (i) the quality of the stormwater runoff is not suitable for on-site reuse (i.e. for non-potable water supply, garden/crop irrigation or toilet flushing); or (ii) there are no activities occurring on the site that can re-use the full 5mm retention volume of water. (c) the retention volume can be taken up by detention as follows: (i) provide detention (temporary storage) and a drain down period of 24 hours for the difference between the pre-development and post-development runoff volumes from the 95th percentile (SMAF 1) / 90th percentile (SMAF 2), 24 hour rainfall event minus any retention volume that is achieved, over the impervious area for which hydrology mitigation is required.	

Figure 3 - AUP Table E10.6.3.1.1 Hydrology mitigation requirements

The stormwater retention/detention strategy is summarised in Table 3 below.

Table 3 – Stormwater Retention/Detention Devices

Area	Device Proposed	Retention/Detention
Public Road	Raingardens	Retention volume taken up by detention
Common Accessways	Underground Tanks	Retention volume taken up by detention
Residential Lots	Underground Tanks	Retention and detention provided

The proposed stormwater retention and detention volumes are summarised in Table 4 below.

Table 4 – Proposed retention/detention volumes

	Proposed for road/accessway	Proposed for residential lot	Required for total site
Detention volume (m^3)	73.5	113.1	186.6
Retention volume (m^3)	0	42.4	42.4
Total (m^3)	**73.5**	**155.5**	**229**

As a consequence of the increase in impervious area on the site, the flow rate and volume of stormwater runoff will increase as a result of the development.

Table 5 - Runoff flow rates and volumes

	10% AEP peak flowrate (m^3/s)	10% AEP 24-hr volume (m^3)	1% AEP peak flowrate (m^3/s)	1% AEP 24-hr volume (m^3)
Pre-development	0.891	4,704	1.526	8,166
Post-development	0.952	5,209	1.580	8,725
Percentage increase	7%	11%	4%	7%

We note that the increase in peak flow rate and volume as a result of the development is relatively minimal and we consider that the adverse effects on the receiving environment will be less than minor. We note that the timing of the peak flow from the development is significantly earlier than the peak flow into the Mahurangi River, and therefore we are confident that there will be no increase in flood levels in the Mahurangi River as a result of the development. Refer to the Stormwater Management Plan accompanying the application for details and analysis of the hydrology of the wider catchment.

6.4 Stormwater Management – Quality

Stormwater quality treatment of road and accessway runoff is proposed in compliance with the objectives of the Mahurangi Action Plan. The raingardens proposed for the public road will provide water quality treatment as well as SMAF detention. The catchpits in the private accessways will be provided with filter inserts which will capture gross pollutants. No water quality treatment is proposed for the residential lots, as we consider that they will not create any high contaminant yielding roofing, spouting, cladding material or architectural features.

Detailed design and specification of treatment devices will be undertaken at the Engineering Approval stage for the public road and the Building Consent stage for the private accessways.

6.5 Stormwater Management – Overland Flow

The development has been designed so that overland flow in large rainfall events (up to and including the 1% AEP storm) is able to be discharged to the receiving environment without inundating buildings or other properties. Overland flow will generally be contained with the road and accessway corridors, however the primary overland flow path flows through Lot 13 towards the watercourse located east of the site. The other two overland flow paths run north along each side of the new road and will discharge onto Sandspit Road.

The overland flow paths are summarised in Table 4 overleaf.

Table 6 – Overland Flow Paths

Overland Flow Path	Catchment Area (m^2)	1% AEP Peak Flow Rate (L/s)	Description
A	5,500	322	Southern part of site – flows along Road 1, Accessway 2 and between the dwelling and the retaining wall on the northern side of Lot 13
B	3,300	193	Northwestern part of site – flows along Access 1, western side of Road 1 and out to Sandspit Road
C	1,700	105	Northeastern part of site – flows along eastern side of Road 1 and out to Sandspit Road

7 WASTEWATER

7.1 Existing Wastewater

The site is not connected to existing public wastewater reticulation. The site is not currently provided with a connection to the public wastewater infrastructure. The nearest downstream public wastewater reticulation is currently located within Millstream Place at approximate level of RL15m and on Sandspit Road (opposite Millstream Place) at approximately RL10m.

7.2 Proposed Wastewater

A new public gravity wastewater reticulation network will be constructed to serve the development. The new network will collect wastewater from all new dwellings and direct it into the existing public wastewater network located within 1A Matakana Road, southwest of the site.

The wastewater network will need to cross over Viponds Creek and it is proposed to utilise the shared path bridge (refer to section 5.2) as a pipe bridge as well. The pipe would be hung from the underside of the bridge, with the shared path bridge deck running above it. Detailed design of the pipe bridge structure will be undertaken at the engineering approval/building consent stage of the project.

Watercare have advised that the existing Warkworth WWTP has no existing capacity to accept any flows from land that is not currently zoned for development, therefore connection to the existing network is refused by Watercare.

The Warkworth Wastewater Scheme is to be constructed by Watercare to serve the greater Warkworth area, including the site. Wastewater collected by this scheme will be treated at a new WWTP to be constructed at Snells Beach. A new wastewater pipeline (the North West pipeline) is proposed cross the Sandspit Road – State Highway 1 intersection and run southeast through Warkworth to a new pump station in Lucy Moore Park. A new rising main will run from this pump station to the new Snells Beach wastewater treatment plant. The locations of these proposed assets are shown in Figure 5.

We consider that the new Warkworth Wastewater Scheme will have capacity to serve the proposed development and note that no new titles are proposed to be created prior to the completion of the wastewater scheme.

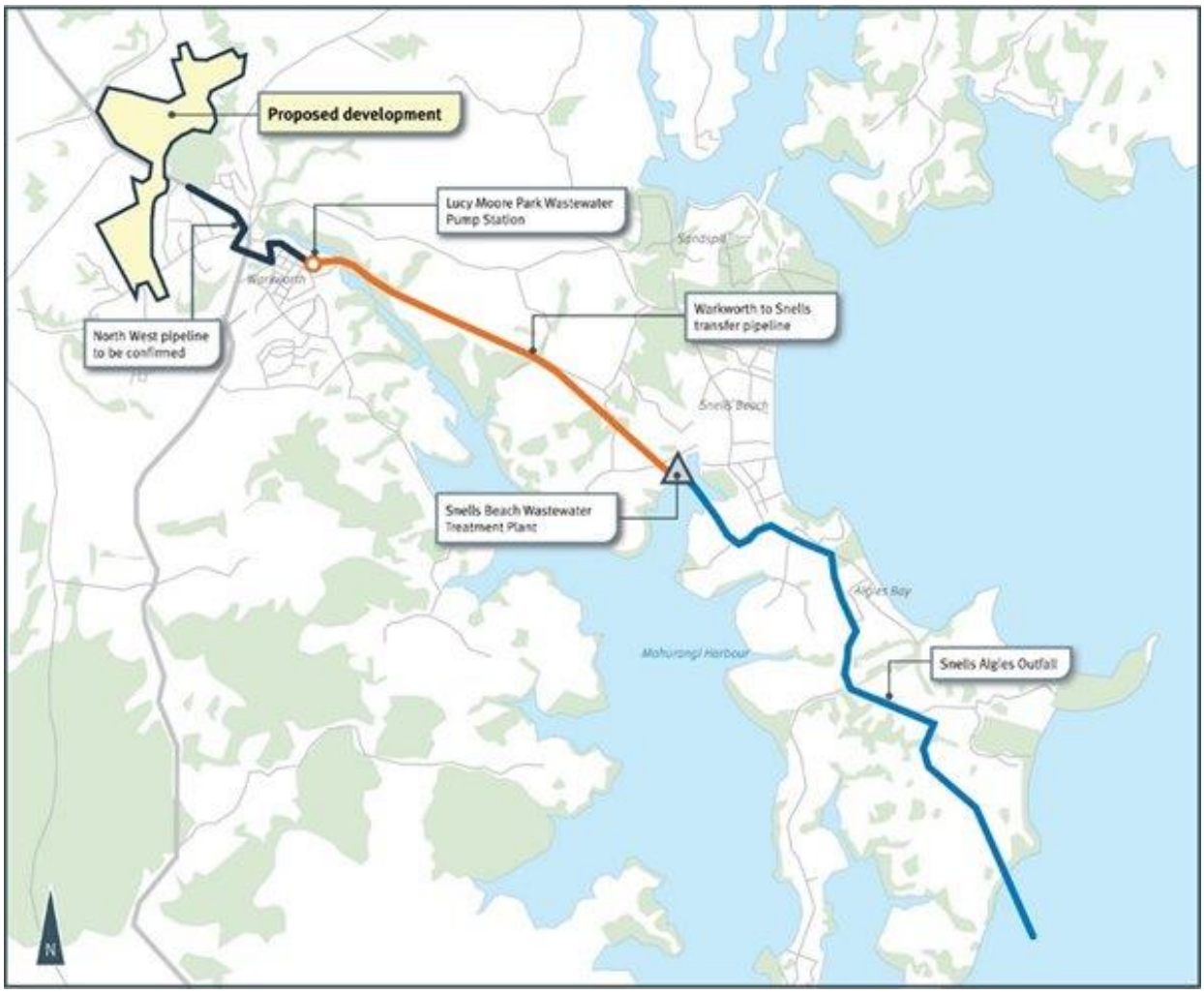


Figure 4 - Proposed Warkworth wastewater scheme (from Watercare website)

8 WATER SUPPLY

8.1 Existing Water Supply

The site is not currently provided with a connection to the public water supply network.

The Warkworth Structure Plan – Water and Wastewater states:
New groundwater abstraction bores at Hudson Road and a new water treatment plant at Sanderson Road are operational. The plant is designed to treat the consented abstraction volume limit, which caters for approximately 16,000 people.

A future water source will need to be found to provide water beyond the current abstraction consent limit. However, Watercare is confident that such a source will be found prior to this population trigger being reached.

8.2 Proposed Water Supply

A new public water supply network will be constructed to service the development. The network will generally consist of a watermain on one side of the road and a rider main on the other side. Individual water connections will be provided to each new lot.

The existing Watercare 100mm diameter water supply reticulation currently extends to a location opposite the intersection of Sandspit Road and Millstream Place. A new 100mm diameter watermain will be extended from Millstream Place along Sandspit Road to serve the development. The new watermain will be extended east of the new road intersection at the site frontage, in order to facilitate future extension to serve the *future urban* zone area east of the site.

A new fire hydrant will be provided within the site in order to provide fire fighting water supply to the development.

Detailed design of the new water supply network will be undertaken at the engineering approval stage of the project. Water supply flow and pressure testing will be undertaken to enable a water network model to be developed to confirm the pipe sizing, and to confirm that the firefighting flow and pressure requirements can be met.

9 UTILITY SERVICES

There are existing Vector overhead power lines along Sandspit Road and we anticipate these would be able to be extended underground to serve the site.

The properties making up the Plan Change area are currently provided with connections to the Chorus telecommunications reticulation and we consider that the Chorus network will be able to be extended to serve the site.

The detailed design of power and telecommunications reticulation will be undertaken by Vector and Chorus following resource consent approval for the development.

10 SUMMARY

This report concludes that the proposed development can be serviced by provision of appropriate infrastructure as described in this report. The engineering and infrastructure as proposed will enable the subject site to be serviced in accordance with Council's and Watercare's requirements. It should be noted that the site will not be able to be connected to the public wastewater network until Watercare's Warkworth Wastewater Scheme has been constructed (estimated to be 2024), however we consider that bulk earthworks and civil construction work could commence prior to this date (subject to the required consents and approvals).

We consider that the effects of the proposed development can be mitigated in accordance with the policies and objectives of the Auckland Unitary Plan.

Appendix A

Design Plans

Appendix B

Erosion & Sediment Control Calculations

CLIENT: The Kilns Ltd
PROJECT: 34 36 Sandspit Road
JOB No.: 85070-01

SHEET No.: 1
CALCS. BY: S.Z
DATE: March 2022

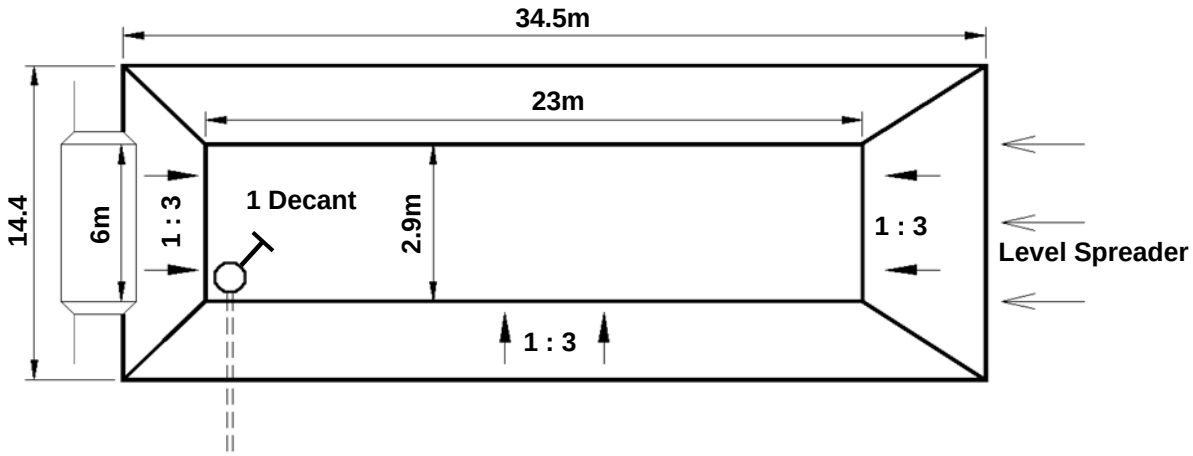
SEDIMENT POND 1 CALCULATIONS

					REFERENCE
					Auckland Council TP-90
Catchment Details					
Catchment Area	A	**0.74**	ha		*0.3ha - 5.0ha*
Sand Soils		**No**			
Catchment Length		**200m +**			
Catchment Slope		**10% +**			
Pond Volume Required	**V**	**222**	**m^3**		*(3% of catchment)*
100 Year Flow Rate					
Coefficient of Runoff	c	**0.60**			
1% AEP Rainfall	i_{100}	**300**	mm/hr		
100 Year Flow Rate	**Q**	**0.37**	**m^3/s**		*Rational Formula*
Pond Design					
Pond Depth	d	**1.20**	m		*1.0m to 2.0m*
Pond Side Slope	1 :	**3**			*1:2 - 1:3*
Inlet Batter Slope	1 :	**3**			*1:3 max.*
Dimension Ratio	1 W :	**3**	L		*1 W : 3 - 5 L*
Storage Level Width	W	10.1	m		
Storage Level Length	L	30.2	m		
Base Width		2.9	m	**OK**	
Base Length		23.0	m		
Dead Storage Volume		67	m^3		*(30% total volume)*
Dead Storage Depth		**0.57**	m		
Live Storage Volume		155.4	m^3		*(70% total volume)*
Live Storage Depth		0.63	m		
Decant Details					
Decant Rate		2.2	l/s		*3.0 l/s/ha*
No. Decants Required		**1**			*4.5 l/s/decant*
Holes Per Decant Required		**99**	**of 200**		
100 Year Spillway Details					
Spillway Width		**6**	**m**		*Max. of 6m or pond base*
Spillway Flow Depth		**0.11**	**m**		*$Q = 1.7\ L\ h^{3/2}$*

SEDIMENT POND 1 CALCULATIONS	REFERENCE

Pond Construction Parameters

Catchment Area	**0.74**	**ha**
Pond Volume	**222**	**m^3**
Pond Base Level	**13.08**	**m RL**
Pond Top Embankment Level	**14.99**	**m RL**
Decant 1 Level	13.65	m RL
Decant 2 Level	N/A	
Decant 3 Level	N/A	
Spillway Level	14.28	m RL
Level Spreader Level	14.78	m RL
Emergency Spillway Level	14.58	m RL
Pond Internal Batter Slope	1 : 3	
Pond Base Dimensions	**2.9m wide x 23m long**	
Pond Embankment Dimensions	**14.4m wide x 34.5m long**	



Holes Per Decant Required: 99 of 200

Appendix C

Stormwater Calculations

AIREY CONSULTANTS LTD.	Consulting Civil and Structural Engineers	Client: Denis Horner		Sheet No: 1
		Job: 34&36 Sandspit Rd Warkworth		Job No: 85070-01
Takapuna Botany Queenstown		Calc's By: SZ Checked: AW	Phone: (09) 4864542	Date: Mar-22

TOTAL SITE SMAF CALULATIONS

Enter Values

Result Cells

AREAS

		PRE-DEVELOPMENT	POST-DEVELOPMENT	
Pervious Area (m²)	=	14324	5849	
Impervious Area (m²)	=	0	8475	(new/redeveloped)
Impervious percentage		0%	59%	>50%, full site area mitigation required
Site Area (m²)		14324	14324	

HYDROLOGIC PARAMETERS

24-hour Rainfall Depth		43	mm
Pervious Area Curve Number (CN)	=	74	
Impervious Area Curve Number (CN)	=	98	
Pervious Area Storage (S)	=	89.24	mm
Impervious Area Storage (S)	=	5.18	mm
Pervious Area Initial Abstraction (Ia)	=	5.00	mm
Impervious Area Initial Abstraction (Ia)	=	0.00	mm

RUNOFF DEPTHS & VOLUMES

Pervious Area Runoff Depth	=	11.35	mm		
Impervious Area Runoff Depth	=	38.37	mm		
Runoff Volume	=	162.55	m^3	66.38	m^3 PERVIOUS
				325.22	m^3 IMPERVIOUS
				391.60	m^3 TOTAL
Hydrology Mitigation Volume	=	**229.0**	m^3		
Minimum Retention Volume	=	42.38	m^3		
Minimum Detention Volume	=	186.67	m^3		

CLIENT:	**Denis Horner**	**SHEET No.:**	**1**
PROJECT:	**34 & 36 Sandspit Road**	**CALCS BY:**	**SZ**
JOB No.:	**85070-01**	**DATE:**	**Mar 22**

TP108 RUNOFF PARAMETERS & TIME OF CONCENTRATION

REFERENCE

ARC TP108

Catchment

Note: Road - Northern Portion

1: Runoff Curve Number (CN) and Initial Abstraction (I_a) - PRE-DEV

Soil Classification	Cover Description	Curve Number	Area (ha)	CN x Area
Waitematas, C	Grass and lightly grazed paddocks	74	0.0668	4.94
		Total	0.0668	4.94

2: Runoff Curve Number (CN) and Initial Abstraction (I_a) - POST-DEV

Soil Classification	Cover Description	Curve Number	Area (ha)	CN x Area
Waitematas, C	Grass and lightly grazed paddocks	98	0.0668	6.55
		74	0.0000	
		Total	0.0668	6.55

	Pre-Dev	Post-Dev		
Total CN x Area	4.94	6.55		
Total Area	0.0668	0.0668	ha	
CN (Weighted)	**74**	**98**		= Total CN x Area / Total Area
I_a (Weighted)	**5.0**	**0.0**	mm	= 5 x Permeable Area / Total Area
Storage **S**	**89.2**	**5.2**	mm	= [(1000/CN)-10].25.4

3: Time of Concentration

Assuming 10min Time of Concentration

	10	10	min
t_c	**0.32**	**0.27**	**hrs**

4: Peak Flow Rate and Volume

24hr Rainfall Depth	P_{24} =	43.0		mm
Index	c* =	0.16	0.81	
Specific Flow Rate	q* =	0.039	0.140	
Peak Flow Rate	q_p =	0.001	0.004	m^3/s
Runoff Depth	Q_{24} =	11	38	mm
Runoff Volume	V_{24} =	8	26	m^3

95th Percentile

= $(P_{24}-2.I_a)/(P_{24}-2.I_a+2.S)$

From Fig. 5.1

= $q^*.A.P_{24}$

= $(P_{24}-I_a)^2/[(P_{24}-I_a)+S)]$

= $1000.Q_{24}.A$

Percentage Difference		357%	
Peak Flow Difference	q =	0.003	m^3/s
Percentage Difference		338%	
Volume Difference	V =	18.1	m^3

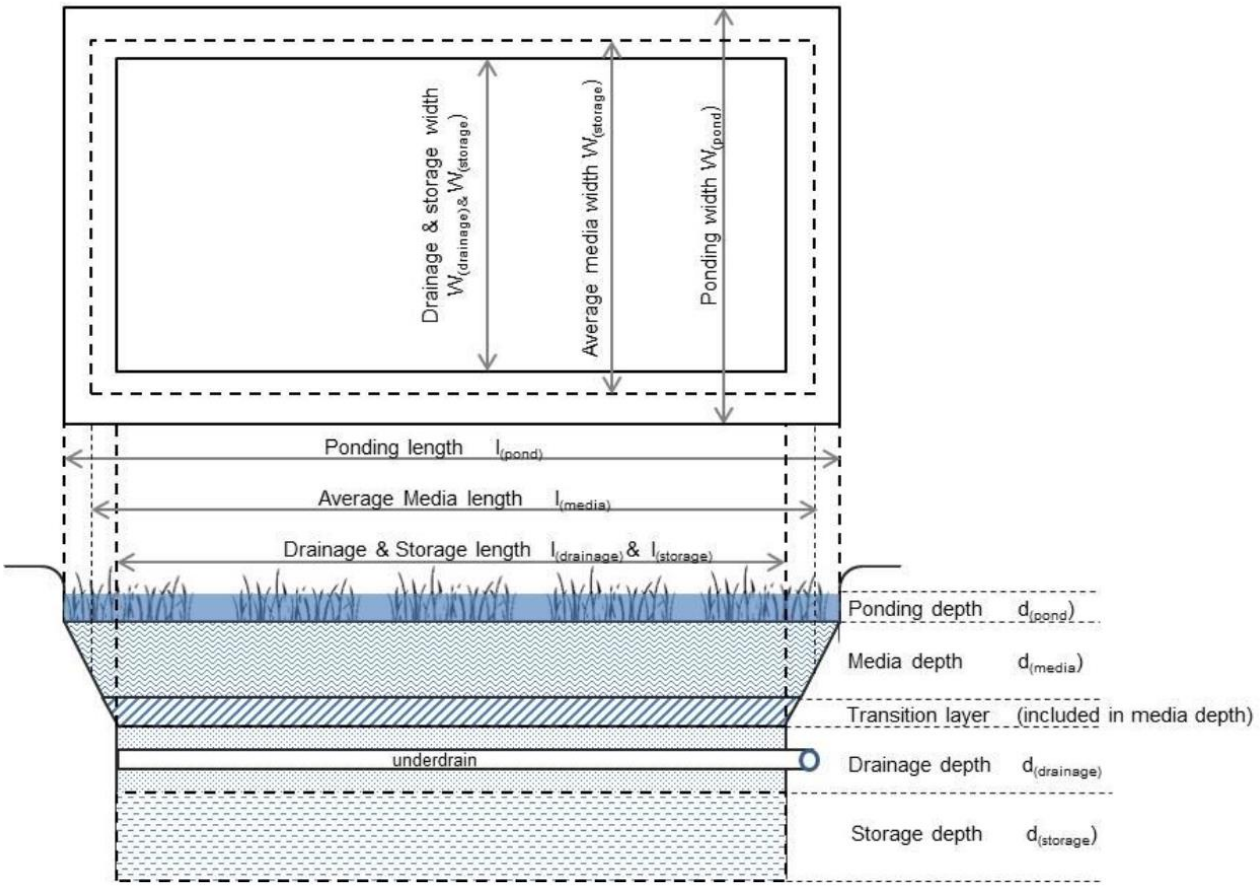
RAINGARDEN CALCULATIONS					REFERENCE
Hydrology Mitigation Requirements					*ARC GD01; Section C3*
Post-Pre Development Runoff Volume		**18.1**	m^3		*From TP108 Calculation*
SMAF-1 Retention Volume					
Impervious Area	$A_{(connect)}$ =	**668**	m^2		*Impervious Area*
Retention Depth		**5.0**	mm		*SMAF-1 Requirement*
Retention Volume	$V_{(ret)}$ =	**3.3**	**m^3**		
SMAF-1 Detention Volume					
Post-Pre Development Runoff Volume		**18.1**	m^3		
Retention Volume		**3.3**	m^3		
Required Detention Volume	$V_{(det)}$ =	**14.7**	**m^3**		
Minimum Infiltration, Ponding and Media Area and Depths					
Minimum Infiltration Area		**23.4**	m^2		*≥3.5% of Catchment Area*
Minimum Ponding Area		**33.4**	m^2		*≥5% of Catchment Area*
					For SMAF1:
Ponding Depth	$d_{(pond)}$ =	**200**	mm		*≥200mm*
Media Depth	$d_{(media)}$ =	**600**	mm		*≥500mm*
Transition Layer		**100**	mm		*100mm*
Drainage Layer	$d_{(drainage)}$ =	**250**	mm		*≥200-300mm*
Storage Layer Depth	$d_{(storage)}$ =	**0**	mm		*≥450mm*
	No retention provided				
Void Space Assumptions					
Ponding Layer		**100%**			
Bioretention Layer		**30%**			
Transition Layer		**30%**			
Draingae Layer		**35%**			
Storage Layer		**35%**			
Detention Volumes					
Ponding Length	$l_{(pond)}$ =	**24.0**	m		
Ponding Width	$w_{(pond)}$ =	**1.50**	m		
Raingarden Footprint		**36.0**	m^2	**CHECK**	*Area of Raingarden*

RAINGARDEN CALCULATIONS				REFERENCE
Ponding Volume	$V_{(pond)}$ =	7.2	m^3	
Media Volume	$V_{(media)}$ =	6.0	m^3	ϕ = 30 % void space
Drainage Volume	$V_{(drainage)}$ =	2.0	m^3	ϕ = 35 % void space
Available Detention Volume	$V_{(detention)}$ =	**15.2**	m^3	

Detention Volumes Check

Parameter	Area (m^2)	Void Space	Avail. Vol (m^3)	Req. Vol (m^3)
Ponding	33.4	100%	7.20	
Media Layer	28.39	30%	6.0	
Drainage Layer	23.4	35%	2.0	
Total Detention			**15.21**	**14.7**

Raingarden Specifications



RAINGARDEN CALCULATIONS				REFERENCE
$l_{(pond)}$ =	24.0	m	Raingarden Length	
$w_{(pond)}$ =	1.5	m	Raingarden Width	
$l_{(drainage/storage)}$ =	0.0	m	Infiltration Length	
$w_{(drainage/storage)}$ =	0.0	m	Infiltration Width	
	0.9	m/m	Side Slopes (only for width)	
$d_{(pond)}$ =	200	mm	Ponding Depth	
$d_{(media)}$ =	700	mm	Media Depth (including Transition Layer)	
$d_{(drainage)}$ =	250	mm	Drainage Layer	
$d_{(storage)}$ =	0	mm	Storage Layer Depth	

CLIENT:	**Denis Horner**	**SHEET No.:**	**1**
PROJECT:	**34 & 36 Sandspit Road**	**CALCS BY:**	**SZ**
JOB No.:	**85070-01**	**DATE:**	**Mar 22**

TP108 RUNOFF PARAMETERS & TIME OF CONCENTRATION

REFERENCE

ARC TP108

Catchment

Note: Road - Southern Portion

1: Runoff Curve Number (CN) and Initial Abstraction (I_a) - PRE-DEV

Soil Classification	Cover Description	Curve Number	Area (ha)	CN x Area
Waitematas, C	Grass and lightly grazed paddocks	74	0.1042	7.71
		Total	0.1042	7.71

2: Runoff Curve Number (CN) and Initial Abstraction (I_a) - POST-DEV

Soil Classification	Cover Description	Curve Number	Area (ha)	CN x Area
Waitematas, C	Grass and lightly grazed paddocks	98	0.1042	10.21
		74	0.0000	
		Total	0.1042	10.21

	Pre-Dev	Post-Dev		
Total CN x Area	7.71	10.21		
Total Area	0.1042	0.1042	ha	
CN (Weighted)	**74**	**98**		$= {}^{\text{Total CN x Area}}/_{\text{Total Area}}$
I_a (Weighted)	**5.0**	**0.0**	mm	$= {}^{\text{5 x Permeable Area}}/_{\text{Total Area}}$
Storage **S**	**89.2**	**5.2**	mm	$= [(1000/CN)-10].25.4$

3: Time of Concentration

Assuming 10min Time of Concentration

	10	10	min
t_c	**0.32**	**0.27**	**hrs**

4: Peak Flow Rate and Volume

24hr Rainfall Depth	**P_{24} =**	**43.0**		**mm**
Index	**c* =**	**0.16**	**0.81**	
Specific Flow Rate	**q* =**	**0.039**	**0.140**	
Peak Flow Rate	**q_p =**	**0.002**	**0.006**	**m^3/s**
Runoff Depth	**Q_{24} =**	**11**	**38**	**mm**
Runoff Volume	**V_{24} =**	**12**	**40**	**m^3**

95th Percentile

$= (P_{24}-2.I_a)/(P_{24}-2.I_a+2.S)$

From Fig. 5.1

$= q^*.A.P_{24}$

$= (P_{24}-I_a)^2/[(P_{24}-I_a)+S)]$

$= 1000.Q_{24}.A$

Percentage Difference	357%	
Peak Flow Difference **q =**	0.005	**m^3/s**
Percentage Difference	338%	
Volume Difference **V =**	**28.2**	**m^3**

RAINGARDEN CALCULATIONS					REFERENCE
Hydrology Mitigation Requirements					*ARC GD01; Section C3*
Post-Pre Development Runoff Volume		**28.2**	m^3		*From TP108 Calculation*
SMAF-1 Retention Volume					
Impervious Area	$A_{(connect)}$ =	**1042**	m^2		*Impervious Area*
Retention Depth		**5.0**	mm		*SMAF-1 Requirement*
Retention Volume	$V_{(ret)}$ =	**5.2**	**m^3**		
SMAF-1 Detention Volume					
Post-Pre Development Runoff Volume		**28.2**	m^3		
Retention Volume		**5.2**	m^3		
Required Detention Volume	$V_{(det)}$ =	**23.0**	**m^3**		
Minimum Infiltration, Ponding and Media Area and Depths					
Minimum Infiltration Area		**36.5**	m^2		*≥3.5% of Catchment Area*
Minimum Ponding Area		**52.1**	m^2		*≥5% of Catchment Area*
					For SMAF1:
Ponding Depth	$d_{(pond)}$ =	**210**	mm		*≥200mm*
Media Depth	$d_{(media)}$ =	**600**	mm		*≥500mm*
Transition Layer		**100**	mm		*100mm*
Drainage Layer	$d_{(drainage)}$ =	**250**	mm		*≥200-300mm*
Storage Layer Depth	$d_{(storage)}$ =	**0**	mm		*≥450mm*
		No retention provided			
Void Space Assumptions					
Ponding Layer		**100%**			
Bioretention Layer		**30%**			
Transition Layer		**30%**			
Draingae Layer		**35%**			
Storage Layer		**35%**			
Detention Volumes					
Ponding Length	$l_{(pond)}$ =	**35.0**	m		
Ponding Width	$w_{(pond)}$ =	**1.50**	m		
Raingarden Footprint		**52.5**	m^2	**CHECK**	*Area of Raingarden*

RAINGARDEN CALCULATIONS

Ponding Volume	$V_{(pond)}$ =	**11.0**	m^3
Media Volume	$V_{(media)}$ =	**9.3**	m^3
Drainage Volume	$V_{(drainage)}$ =	**3.2**	m^3
Available Detention Volume	$V_{(detention)}$ =	**23.5**	m^3

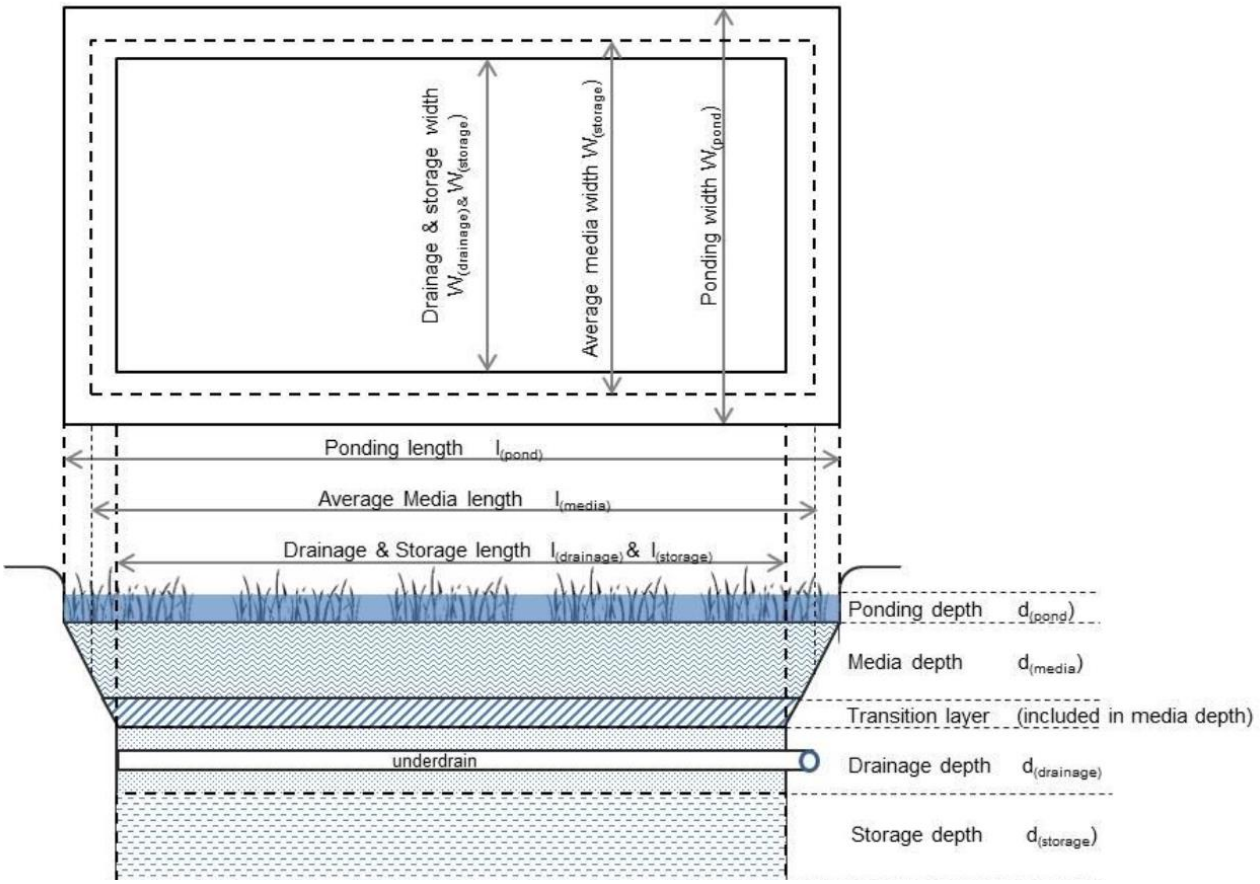
REFERENCE

ϕ = 30 % void space
ϕ = 35 % void space

Detention/Retention Volumes Check

Parameter	Area (m^2)	Void Space	Avail. Vol (m^3)	Req. Vol (m^3)
Ponding	52.1	100%	11.03	
Media Layer	44.29	30%	9.3	
Drainage Layer	36.5	35%	3.2	
Total Detention			**23.52**	**23.0**

Raingarden Specifications



RAINGARDEN CALCULATIONS

REFERENCE

$l_{(pond)}$ =	35.0	m	Raingarden Length
$w_{(pond)}$ =	1.5	m	Raingarden Width
$l_{(drainage/storage)}$ =	0.0	m	Infiltration Length
$w_{(drainage/storage)}$ =	0.0	m	Infiltration Width
	0.9	m/m	Side Slopes (only for width)
$d_{(pond)}$ =	210	mm	Ponding Depth
$d_{(media)}$ =	700	mm	Media Depth (including Transition Layer)
$d_{(drainage)}$ =	250	mm	Drainage Layer
$d_{(storage)}$ =	0	mm	Storage Layer Depth

CLIENT:	**Denis Horner**	**SHEET No.:**	**1**
PROJECT:	**34 & 36 Sandspit Road**	**CALCS BY:**	**SZ**
JOB No.:	**85070-01**	**DATE:**	**Mar 22**

TP108 RUNOFF PARAMETERS & TIME OF CONCENTRATION

REFERENCE

ARC TP108

Catchment

Note: **Access 1 - Northern Portion**

1: Runoff Curve Number (CN) and Initial Abstraction (I_a) - PRE-DEV

Soil Classification	Cover Description	Curve Number	Area (ha)	CN x Area
Waitematas, C	**Grass and lightly grazed paddocks**	**74**	**0.0432**	3.20
		Total	**0.0432**	3.20

2: Runoff Curve Number (CN) and Initial Abstraction (I_a) - POST-DEV

Soil Classification	Cover Description	Curve Number	Area (ha)	CN x Area
Waitematas, C	**Grass and lightly grazed paddocks**	**98**	**0.0432**	4.23
		74	**0.0000**	
		Total	**0.0432**	4.23

	Pre-Dev	Post-Dev		
Total CN x Area	3.20	4.23		
Total Area	0.0432	0.0432	ha	
CN (Weighted)	**74**	**98**		$= {}^{\text{Total CN x Area}}/_{\text{Total Area}}$
I_a (Weighted)	**5.0**	**0.0**	mm	$= {}^{\text{5 x Permeable Area}}/_{\text{Total Area}}$
Storage **S**	**89.2**	**5.2**	mm	$= [(1000/CN)-10].25.4$

3: Time of Concentration

Assuming 10min Time of Concentration

	10	10	min
t_c	**0.32**	**0.27**	**hrs**

4: Peak Flow Rate and Volume

24hr Rainfall Depth	**P_{24} =**	**43.0**		**mm**
Index	**c* =**	**0.16**	**0.81**	
Specific Flow Rate	**q* =**	**0.039**	**0.140**	
Peak Flow Rate	**q_p =**	**0.001**	**0.003**	**m^3/s**
Runoff Depth	**Q_{24} =**	**11**	**38**	**mm**
Runoff Volume	**V_{24} =**	**5**	**17**	**m^3**

95th Percentile

$= (P_{24}-2.I_a)/(P_{24}-2.I_a+2.S)$

From Fig. 5.1

$= q^*.A.P_{24}$

$= (P_{24}-I_a)^2/[(P_{24}-I_a)+S)]$

$= 1000.Q_{24}.A$

Percentage Difference	357%	
Peak Flow Difference **q =**	0.002	**m^3/s**
Percentage Difference	338%	
Volume Difference **V =**	**11.7**	**m^3**

DETENTION TANK CALCULATIONS				REFERENCE
Hydrology Mitigation Requirements				
Post-Pre Development Runoff Volume		11.7	m^3	*From TP108 Calculation*
SMAF-1 Retention Volume				
Impervious Area	$A_{(connect)}$ =	432	m^2	*Impervious Area*
Retention Depth		5.0	mm	*SMAF-1 Requirement*
Retention Volume	$V_{(ret)}$ =	2.2	**m^3**	
SMAF-1 Detention Volume				
Post-Pre Development Runoff Volume		11.7	m^3	
Retention Volume		2.2	m^3	
Required Detention Volume	$V_{(det)}$ =	9.5	**m^3**	

CLIENT:	**Denis Horner**	**SHEET No.:**	**1**
PROJECT:	**34 & 36 Sandspit Road**	**CALCS BY:**	**SZ**
JOB No.:	**85070-01**	**DATE:**	**Mar 22**

TP108 RUNOFF PARAMETERS & TIME OF CONCENTRATION

REFERENCE

ARC TP108

Catchment

Note: **Access 1 - Southern Portion**

1: Runoff Curve Number (CN) and Initial Abstraction (I_a) - PRE-DEV

Soil Classification	Cover Description	Curve Number	Area (ha)	CN x Area
Waitematas, C	**Grass and lightly grazed paddocks**	**74**	**0.0417**	3.09
		Total	**0.0417**	3.09

2: Runoff Curve Number (CN) and Initial Abstraction (I_a) - POST-DEV

Soil Classification	Cover Description	Curve Number	Area (ha)	CN x Area
Waitematas, C	**Grass and lightly grazed paddocks**	**98**	**0.0417**	4.09
		74	**0.0000**	
		Total	**0.0417**	4.09

	Pre-Dev	Post-Dev		
Total CN x Area	3.09	4.09		
Total Area	0.0417	0.0417	ha	
CN (Weighted)	**74**	**98**		$= {}^{\text{Total CN x Area}}/_{\text{Total Area}}$
I_a (Weighted)	**5.0**	**0.0**	mm	$= {}^{\text{5 x Permeable Area}}/_{\text{Total Area}}$
Storage **S**	**89.2**	**5.2**	mm	$= [(1000/CN)-10].25.4$

3: Time of Concentration

Assuming 10min Time of Concentration

	10	10	min
t_c	**0.32**	**0.27**	**hrs**

4: Peak Flow Rate and Volume

24hr Rainfall Depth	**P_{24} =**	**43.0**		**mm**
Index	**c* =**	**0.16**	**0.81**	
Specific Flow Rate	**q* =**	**0.039**	**0.140**	
Peak Flow Rate	**q_p =**	**0.001**	**0.003**	**m^3/s**
Runoff Depth	**Q_{24} =**	**11**	**38**	**mm**
Runoff Volume	**V_{24} =**	**5**	**16**	**m^3**

95th Percentile

$= (P_{24}-2.I_a)/(P_{24}-2.I_a+2.S)$

From Fig. 5.1

$= q^*.A.P_{24}$

$= (P_{24}-I_a)^2/[(P_{24}-I_a)+S)]$

$= 1000.Q_{24}.A$

Percentage Difference	357%	
Peak Flow Difference **q =**	0.002	**m^3/s**
Percentage Difference	338%	
Volume Difference **V =**	**11.3**	**m^3**

DETENTION TANK CALCULATIONS				REFERENCE
Hydrology Mitigation Requirements				*ARC GD01; Section C3*
Post-Pre Development Runoff Volume		**11.3**	m^3	*From TP108 Calculation*
SMAF-1 Retention Volume				
Impervious Area	$A_{(connect)}$ =	**417**	m^2	*Impervious Area*
Retention Depth		**5.0**	mm	*SMAF-1 Requirement*
Retention Volume	$V_{(ret)}$ =	**2.1**	**m^3**	
SMAF-1 Detention Volume				
Post-Pre Development Runoff Volume		**11.3**	m^3	
Retention Volume		**2.1**	m^3	
Required Detention Volume	$V_{(det)}$ =	**9.2**	**m^3**	

CLIENT:	**Denis Horner**	**SHEET No.:**	**1**
PROJECT:	**34 & 36 Sandspit Road**	**CALCS BY:**	**SZ**
JOB No.:	**85070-01**	**DATE:**	**Mar 22**

TP108 RUNOFF PARAMETERS & TIME OF CONCENTRATION

REFERENCE

ARC TP108

Catchment

Note: Access 2

1: Runoff Curve Number (CN) and Initial Abstraction (I_a) - PRE-DEV

Soil Classification	Cover Description	Curve Number	Area (ha)	CN x Area
Waitematas, C	Grass and lightly grazed paddocks	74	0.0773	5.72
		Total	0.0773	5.72

2: Runoff Curve Number (CN) and Initial Abstraction (I_a) - POST-DEV

Soil Classification	Cover Description	Curve Number	Area (ha)	CN x Area
Waitematas, C	Grass and lightly grazed paddocks	98	0.0773	7.58
		74	0.0000	
		Total	0.0773	7.58

	Pre-Dev	Post-Dev		
Total CN x Area	5.72	7.58		
Total Area	0.0773	0.0773	ha	
CN (Weighted)	**74**	**98**		$= {}^{\text{Total CN x Area}}/_{\text{Total Area}}$
I_a (Weighted)	**5.0**	**0.0**	mm	$= {}^{\text{5 x Permeable Area}}/_{\text{Total Area}}$
Storage **S**	**89.2**	**5.2**	mm	$= [(1000/CN)-10].25.4$

3: Time of Concentration

Assuming 10min Time of Concentration

	10	10	min
t_c	**0.32**	**0.27**	**hrs**

4: Peak Flow Rate and Volume

24hr Rainfall Depth	**P_{24} =**	**43.0**		**mm**
Index	**c* =**	**0.16**	**0.81**	
Specific Flow Rate	**q* =**	**0.039**	**0.140**	
Peak Flow Rate	**q_p =**	**0.001**	**0.005**	**m^3/s**
Runoff Depth	**Q_{24} =**	**11**	**38**	**mm**
Runoff Volume	**V_{24} =**	**9**	**30**	**m^3**

95th Percentile

$= (P_{24}-2.I_a)/(P_{24}-2.I_a+2.S)$

From Fig. 5.1

$= q^*.A.P_{24}$

$= (P_{24}-I_a)^2/[(P_{24}-I_a)+S)]$

$= 1000.Q_{24}.A$

Percentage Difference	357%	
Peak Flow Difference **q =**	0.003	**m^3/s**
Percentage Difference	338%	
Volume Difference **V =**	**20.9**	**m^3**

DETENTION TANK CALCULATIONS					REFERENCE
Hydrology Mitigation Requirements					*ARC GD01; Section C3*
Post-Pre Development Runoff Volume		**20.9**	m^3		*From TP108 Calculation*
SMAF-1 Retention Volume					
Impervious Area	$A_{(connect)}$ =	**773**	m^2	CHECK!!	*Impervious Area*
Retention Depth		**5.0**	mm		*SMAF-1 Requirement*
Retention Volume	$V_{(ret)}$ =	**3.9**	**m^3**		
SMAF-1 Detention Volume					
Post-Pre Development Runoff Volume		**20.9**	m^3		
Retention Volume		**3.9**	m^3		
Required Detention Volume	$V_{(det)}$ =	**17.0**	**m^3**		

Appendix D

Watercare Water and Wastewater Planning Forms

Watercare
An Auckland Council Organisation

Development information form – Water network planning summary assessment

Development consideration	Description	Comments
Query status	Resource Consent application	~~*Pre-purchase enquiry / Enquiry to support Plan Change application / Pre-application enquiry /*~~ *Resource Consent application* ~~*/ Engineering Plan approval.*~~
Query submission date		
Address	36 Sandspit Road, Warkworth	*Include suburb*
Attach layout plan	See attached Airey Consultants plans	*Plan must clearly show proposed development site and include:* • *Aerial photograph with elevation contours (Note 1)* • *Road names* • *Boundary of development* • *Preferred point of connection to existing water supply and wastewater asset.*
Current land use	Large lot residential	~~*Residential (single family dwellings) / Residential (multi-unit dwellings) / Residential (multi-storey apartment blocks) / Commercial / Industrial /*~~ *Other (Please specify).*
Proposed land use	Residential	
Unitary plan zoning	Future Urban	*Refer Auckland Unitary Plan*
Total development site area (m^2/ hectares) (i.e. Land area for residential developments)	1.43ha	Note this is the developed area only, not the site area
Total development floor area (m^2) (i.e. Include all levels of multi-storey apartments and commercial developments)	4500m^2 building coverage proposed	
Number of proposed residential dwellings	49 total	*Include type and number of bedrooms for residential dwellings:*

(Typically consent or include ultimate if development is to be staged and consented at a future date)	8 x 2 bedroom 41 x 3 bedroom	*Type:* *Quantity:* *1 bed* *2 bed* *3 bed* *4bed* *5+bed*
Note: (1) Watercare's GIS Viewer for Asset Data Query and Land Development/ Subdivision can be used to display aerial photography and land contour information.		

Information to be completed by Developer/ Engineering Consultant
(This section should not be duplicated if both water and wastewater is applied. Refer to Chapter 5 of the CoP.)

Refer to the Auckland Code of Practice for Land Development and Subdivision chapter 6: Water, when completing this form:

Water supply development assessment		
Design consideration	**Description**	**Comments**
Average and Peak Residential Demand (L/s)	Design Population = 49 dwellings x 3 people = 147 people Average Demand Design Flow = 147 x 220 = 32,340 L/day Peak Demand Design Flow Peak day demand = 32,340 x 2 = 64,680L/day Peak hourly demand = (23760 / 24) x 2.5 = 6,737.5L/day	*Show calculations based on Watercare CoP.*
Average and Peak Non-Residential Demand **(L/s)**	none	*Show calculations based on Watercare CoP.* Section 6.3.5.3 PF (day demand) = 2 PF (hourly demand) = 2.5 Section 6.3.5.3 Hotels – 200L/room/day

Non-Residential Demand typical daily consumption profile / trend	N/A	*E.g. 24 hr operation / 10 hr (9am – 5pm) / Filling on-site storage at certain frequency.*
Fire- fighting classification required by the proposed site	FW2	*Refer to New Zealand Standard SNZ PAS 4509:2008.*
Hydrant flow test results	☐ Yes ☒ No (to be provided at EPA stage)	*Attach hydrant flow test layout plan and results showing test date & time; location of hydrants tested and pressure logged; static pressure; flow; residual pressure.*
Sprinkler system in building?	☐ Yes ☒ No	*Sprinkler design should consider Watercare Level of Service: minimum pressure at 200kPa and minimum flow at 25 l/min. The building owner shall conduct periodic review of sprinkler design.*
Further water supply comments:		

Refer to the Auckland Code of Practice for Land Development and Subdivision chapter 5: Wastewater, when completing this form:

<table>
<tr><th colspan="4">Wastewater development assessment</th></tr>
<tr><th colspan="2">Design consideration</th><th>Description</th><th>Comments</th></tr>
<tr><td rowspan="2">Existing site design flows -

pre-development scenario

(If site is currently undeveloped, write 0.00 L/s in the design flows for this section)</td><td>Residential Design Flows (L/s)</td><td>Self-Cleansing Design Flow

= 0.00 L/s

Peak Design Flow

= 0.00 L/s</td><td rowspan="2">Show calculations based on Watercare CoP.

<u>Ultimate development:</u>

Ultimate development is where further development may / can / will occur upstream / or within the development site currently under consideration.

If relevant Ultimate Peak Design Flow is to be calculated and will include number of potential units/ lot.</td></tr>
<tr><td>Non-Residential Design Flows (L/s)</td><td>Self-Cleansing Design Flow

= 0.00 L/s

Peak Design Flow

= 0.00 L/s</td></tr>
<tr><td>Proposed development site design flows - post-development scenario</td><td>Residential Design Flows (L/s)</td><td>Design Population = 49 dwellings x 3 people = 147 people

Design ADWF (L/s) = (147 x 180) / 86400 = 0.31 L/s

<u>Self-Cleansing Design Flow</u>

= 0.31 x 3.0 = 0.93 L/s

<u>Peak Design Flow</u>

= 0.31 x 6.7 = 2.08 L/s

And if relevant

Ultimate Peak Design Flow

= N/A</td><td>For further guidance on whether this application needs to consider Ultimate development, refer CoP Sections:

• 5.3.2 Structure Plan
• 5.3.3 Future development
• 5.3.4 System Design

Section 5.3.5

Design wastewater flow allowance – 180L/room/day

PF, self-cleansing design flow (normal PDWF) – 3.0

PF, peak design flow (PWWF) – 6.7</td></tr>
</table>

Wastewater development assessment			
Design consideration		**Description**	**Comments**
	Non-Residential Design Flows (L/s)	N/A	
	Non-Residential Discharge profile / trend (i.e. Operations)		*E.g. 24 hr operation / 10 hr (9am – 5pm) / Other (Please specify).*
Change in site flows	**Net difference between post-development and pre-development site design flows (L/s)**	Net Change in Self-Cleansing Design Flow = **0.93 L/s** Net Change in Peak Design Flow = **2.08 L/s**	
New assets required for development		150Ø gravity pipe network and associated manholes	*If applicable please provide supporting calculations and indicative design parameters (i.e. pump station and rising main or storage.*
Existing network infrastructure capacity assessment *A sewer capacity check is to be carried out if the 'Net Change in Peak Design Flow' calculated above shows a net increase of greater than 1.0 L/sec.* <u>Notes:</u> 1. *At Watercare's discretion, a Sewer Capacity Check may be required even if the net increase in site flow is < 1.0 L/sec.* 2. *The Level 1 Sewer Capacity Check as described in the CoP is to be undertaken in the first instance, unless specifically advised*		Type of Sewer Capacity Check undertaken: = (Level 1 ~~/ Level 2 / Level 2~~) *(circle / delete as appropriate)* Did the *Existing WW Capacity Assessment Design Flow* exceed the pipe-full capacity for <u>*any*</u> pipes within the *Existing Network Assessment Extents?* On pipes where asset data (i.e. gradient and diameter) is known:	*See Watercare's GIS Viewer for Asset Data Query and Land Development/Subdivision to assist with obtaining data required for the capacity assessment.* *In addition to the assessment findings summary requested here, other required existing network capacity assessment key steps/ deliverables include<u>:</u>* 1. *<u>Network Assessment Extents</u> to be identified as described in the CoP. A map is to be provided showing the network assessment extent.* 2. *<u>Catchment Boundaries</u> for the assessment is to be determined. Catchment Boundary data (where available) can be viewed*

Wastewater development assessment		
Design consideration	**Description**	**Comments**
by Watercare. The Level 1 Capacity Check is intended to help identify applications that may require more accurate/detailed design calculations and/or identify whether data held on the existing network is sufficient to enable an accurate assessment of capacity.	= NO (Yes / No) On pipes where asset data was assumed: = NO (Yes / No)	*in the Watercare GIS Viewer. Where not available, the developer and their engineers will be required to produce catchment boundaries. A map is to be submitted depicting the catchment extents.* 3. *Existing WW Capacity Assessment Design Flow is to be calculated as described in the CoP. The flows are to be tabulated for each pipe-reach within the Network Assessment Extent. A pipe-reach will typically be regarded as the section of network between points where significant tributaries enter the network.* 4. *Pipe Capacity Vs. Design Flow Check is to be carried out; a table detailing the calculated full pipe capacity compared to the 'Existing WW Capacity Assessment Design Flow' is to be provided. Pipes with missing asset data are to have the missing data assumed as described in the CoP.* 5. *Pipe Full Capacity Exceedance - Pipes where the 'Existing WW Capacity Assessment Design Flow' exceeds the pipe full capacity are to be identified both in the tabular data, and on a map of the Network Assessment Extent. Pipes with assumed data are to be identified separately to those with known data.*

Further wastewater comments:

We note that the development will not be connected to the Watercare wastewater network until the Warkworth Wastewater Scheme is constructed (anticipated to 2024). For this reason no downstream capacity check has been undertaken, as we consider that the downstream infrastructure, including parts of the Warkworth Wastewater Scheme, will have capacity to serve the development. A detailed downstream capacity assessment can be undertaken in conjunction with Watercare prior to the acceptance of the connection to the Watercare network.