SARB Investments

Thousand Acre Road, Awamoa

3 Waters Infrastructure Design Report

November 2019

Fluent SOLUTIONS

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Issue Date	Revision No.	Author	Checked	Approved
11/11/2019	0	RNH/FLG	MKS	MKS
20/11/2019	1	FLG	MKS	MKS

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Job No.: 000577
Date: 20 November 2019
Reference: RP 19-11-11 RNH 000577 (Rev 1)

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Thousand Acre Road, Awamoa
3 Waters Infrastructure Design Report

1.0 Introduction

Fluent Solutions has been engaged by SARB Investments Ltd to provide a design for meeting the requirements for water, wastewater and stormwater for the proposed new rural lifestyle subdivision at Thousand Acre Road, Awamoa.

This report summarises the proposed design for the purposes of gaining consent for the development.

2.0 Background

2.1 Site

The site is a 24.8Ha block of land that lies adjacent to the coast approximately 6 kilometres (km) south west of Oamaru and 4km north of Kakanui. The land is currently zoned as rural general and is considered pastoral land.

Figure 2.1: Site Location

The site is triangular in shape and is bounded by the Beach Road to the east, Thousand Acre Road to the west and private rural land to the north.

Under lying soils are understood to be clay with silty loam topsoil on the surface.

2.2 Proposed Development

It is proposed that the 24.8Ha Lot be subdivided into 25 rural lifestyle lots ranging in size from 4,096m^2 to 7,566m^2 with access roads and the remainder of the site to be retained in its rural nature.

For the purpose of this design report, we have assumed that sites 1-5 may be occupied by a 200m^2, four bedroom dwelling and that each lot will be used for rural lifestyle activities.

2.3 Existing nearby WDC Water Services

2.3.1 Potable Water

There are two water supply networks near the property.

Adjacent the site (within the road corridor of Thousand Acre Road), there is a DN150 watermain that conveys water from South Hill Oamaru to Kakanui.

There is also a small diameter pipeline that feeds five Restricted connections on Gardiners Road and Thousand Acre Road. This is supplied from the rural scheme connected to the Hamnak Pipeline.

2.3.2 Foul Sewer

There is a DN90 PE foul sewer adjacent the site that is owned and operated by the WDC. This rising main conveys pumped treated sewage from the Kakanui Wastewater Treatment Plant to Oamaru for further treatment.

The foul sewer operates at full capacity and is considered to be unavailable for usage.

The nearest foul sewer reticulation is located approximately 3.5km to the south in the town of Kakanui.

2.3.3 Stormwater

There are two 300mm dia. culverts under Thousand Acre Road and a table drain that are currently all conveyed through the site, entering a naturally occurring spring and forming a second water body. The water then drains through a 250mm dia. culvert under Beach Road.

There are reportedly two other culverts to the south that are in poor condition and do not currently convey any water under Beach Road. It is recommended that the two culverts be reinstated by WDC.

3.0 Potable Water Supply

3.1 Introduction

It is proposed that the potable water supply for the subdivision is supplied by means of a restricted supply via the WDC DN150 watermain in Thousand Acre Road.

3.2 Design Flows

Domestic water demand for each lot is calculated to be as follows:

Average water demand = 2.5 px per Lot x 250L/p/day (NZS 4404:2010)
= 625L/day

Peak water demand = 1 restricted unit (1818L/day)

Domestic water demand for the development is calculated to be as follows:

Average water demand =25 Lots x 2.5 px per Lot x 250L/p/day (NZS 4404:2010)
+10% loss allowance
= 15.6m^3/day +1.56m^3/day
= 15.8m^3/day

Peak water demand = 25 lots x 1 restricted unit (1.818m^3/day) + 10% loss allowance
= 45.45m^3/day + 4.55m^3/day
= 50m^3 /day

3.3 Proposed Design

3.3.1 General

The proposed water supply system comprises:

- Reticulated network design for restricted supply
- On site storage to meet domestic water demands
- Fire storage located on each property to meet SNZ PAS 4509:2008

3.3.2 Reticulation

It is proposed that a DN63PE offtake from the WDC DN150 PVCo watermain on Thousand Acre Road will be installed to supply the subdivision. Water will be reticulated to the 25 Lots via a network of small diameter PE (PN12.5) pipework as indicated in Figure 3.1 below.

Each Lot will be supplied with a shutoff valve, a filter and an in-line Maric restrictor at the boundary. The restrictor is to be sized to allow a flowrate of the total daily volume over 24 hours.

A DN15 PE pipeline between the restrictor to the proposed storage will then be installed at the time of house construction.

Please note that pipe sizing is based on each Lot receiving 2 restricted units.

Alternatively, the WDC DN63 pipe that feeds five restricted properties to the north of the site, could be utilised as a feed, however, modelling may be required to assess the pressure and flow in this pipeline.

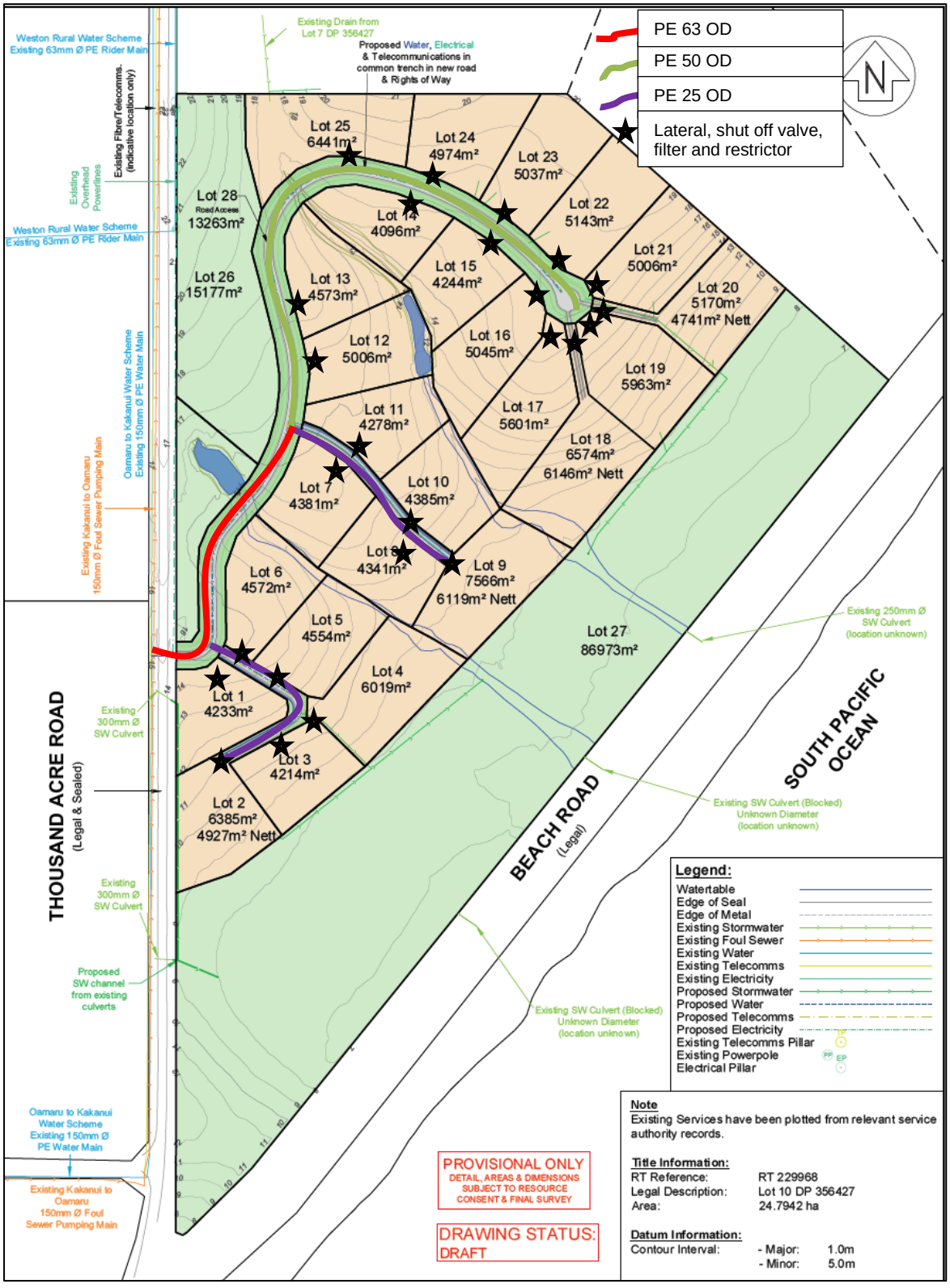

Figure 3.1 Potable Water Layout

3.3.3 Storage

3.3.3.1 Domestic Volumes

Each Lot is to have adequate storage to meet the WDC Water Supply Bylaw (2014) Section 9.5.5 that outlines each connection is to provide storage of a volume greater than three times the daily restricted flow (i.e.: 3 days of storage).

Based on 1 restricted unit per Lot, the minimum domestic storage requirements is therefore:

$= 3 \times 1.818m^3$
$= 5.45m^3$ (5,450 L)

3.3.3.2 Fire Fighting Volumes

For a residential dwelling, SNZ PAS 4509:2008 outlines that there must be a minimum storage of $45m^3$ of water set aside for the use of firefighting and that the firefighting water cannot be used for any other use.

3.3.3.3 Proposed Tank and Layout

Based on domestic demand ($5.45m^3$) and fire fighting requirements ($45m^3$) each Lot is to have a minimum of $50.45m^3$ (50,450L) storage. To achieve this, each Lot should have 2 x 30,000L storage.

Key design features are as follows:

- For simplicity, tanks to operates in series.
- The first tank is to have a high level inlet with a DN15 Rojo Partfill Jobe valve mounted above the water level to provide a suitable airgap between the inlet pipe and valve shut off of at least 100mm. A minimum DN50 overflow pipe is to be located 50mm above the Top Water Level (TWL) and 40mm below the inlet pipe level.
- The pipes are to be interconnected with a DN 100m pipe with rubber bellow to allow for tank movement.
- Reserve storage (33% required under WDC Water Bylaw) of restricted flow storage (and fire fighting storage) by the provision of a normal off-take valve at ¾ of the distance from the bottom and a reserve storage release valve as shown in the drawings.
- An approved suction100mm firefighting coupling to be fitted on one of the tanks to provide water to a fire appliance in an emergency.
- The tanks are to be installed in accordance with the manufacturer's recommendations.
- A hardstand and access for the firefighting appliance is to be provided within 5m of the tanks in accordance with the SNZ PAS 4509:2008.

- A suitable domestic pump to provide a typical domestic house pressure of 300kPA and required domestic flowrates is a SCALA 2 Variable Speed Pump supplied by Hall Machinery Ltd.

The proposed storage tank layout is shown on the attached layout drawing in Appendix A.

4.0 Wastewater

4.1 Introduction

It is proposed that all Lots of the new subdivision will be serviced by a suitable onsite wastewater system in accordance with the Otago Regional Council, Regional Plan Water and the Australian / New Zealand Onsite Domestic Management Standard - AS/NZ 1547:2012.

Two main options were investigated:

1. A centralised, community wastewater treatment plant for the subdivision, including reticulated gravity drainage from each dwelling to the common wastewater treatment plant and large dispersal field located in the eastern Rural Lot.
2. Individual Lot on-site wastewater systems.

A brief assessment of costs highlighted that a gravity reticulation and communal treatment plant was not a cost effective option and therefore individual Lot on-site wastewater systems are proposed.

Design parameters and options for the on-site wastewater systems are discussed in the following sections. The design of each system is required to be in accordance with AS/NZS 1547:2012).

It is proposed that a design guide will be developed by Fluent Solutions and provided to Lot owners (upon land purchase) to ensure the on-site wastewater system meets any regulatory requirements and is appropriate for the site conditions including a resource consent to discharge human waste to land if required.

4.2 Design Flows

The estimated design flow is calculated by the number of persons living in the dwelling multiplied by the water usage per person. AS/NZS 1547:2012 outlines that the number of persons is directly related to the number of bedrooms in the dwelling and the water usage is taken from table H3 of the standard - Typical Domestic Wastewater Design Flow Allowances, Domestic Wastewater from Household, New Zealand.

To develop the design flow for the proposed subdivision, it is assumed that each dwelling contains 4 bedrooms. The calculation of design flow is presented in Table 4.1 below.

Table 4.1: Design Flow

Parameter	Value
Number of Bedrooms	4
Population Equivalent	6 - 7 persons
Water Usage/Person	200L/d
Estimated Peak Design Flow	**1,400L/day/lot**

4.3 Wastewater Treatment

4.3.1 Primary Treatment

Primary treatment is to be provided in a 4,000L (minimum) septic tank. This provides 24 hour settling volume, 24hrs emergency storage as well as storage for the buildup of sludge and scum.

The accumulated sludge and scum will need to be pumped out every 3-5 years to ensure sufficient treatment time is maintained.

4.3.2 Secondary Treatment

Secondary treatment (biological treatment stage) is to be provided in order to give a higher degree for treatment to minimise the impact on the receiving environment and to minimise any impact to the waterbodies on the proposed development.

Depending on the wastewater treatment system selected, reduction of nitrogen of 70g/m^3 to ≤35g/m^3 is possible.

4.3.3 Dispersal Area

Dispersal areas are required for the discharge of wastewater. The design of these is dependent on the design peak flow of each dwelling, soil type and dispersal field design.

AS/NZS 1547:2012 provides for three dispersal field designs as follows:

1. *Subsurface pressure compensating dripline irrigation* - a dispersal field of 15mm dia. pipes buried approximately 150mm below the ground surface that discharge wastewater through a series of holes in the pipe at a predetermined rate. Treatment of wastewater is undertaken in the soil column surrounding the dripline;
2. *Wisconsin mound* - a large above ground sand mound that rejuvenates the wastewater in the sand before discharge to land under the mound;
3. *Evapotranspiration seepage trenches* - a subsurface trench that rejuvenates the wastewater in a sand layer with uptake of wastewater through above ground evaporation via wind and sun and soakage to the surrounding soils;

For each discharge method listed above, a design loading rate (volume of wastewater that can be discharged to an area of land on a vertical scale in mm) is established.

To establish the dispersal field area required, it is assumed:

- Design flows are as outlined in Table 4.1 above. The dispersal field area for each dwelling will be confirmed once a design for the dwelling is confirmed and;
- The soil composition is of impermeable clay, Category 6 as defined by AS/NZS 1547:2012[1].

Table 4.2: Dispersal Land Area

Dispersal Method	Design Loading Rate	Dispersal Area Required
Subsurface Dripline Irrigation	2mm/d	700m^2
Wisconsin Mound	5mm/d	280m^2
Evapotranspiration-Seepage Trench	5mm/d	280m^2

From Table 4.2 above, based on the design flow of 1,400L/d the largest dispersal area that may be required is 700m^2. Due to the large section sizes, dispersal fields in this size range will be achievable with areas set aside for reserve area if further development of the Lots is required at a later date. (Note: A larger dwelling and therefore a larger design flow will require a larger dispersal field area and vice versa).

4.4 Resource Consent Requirements

The Otago Regional Council (ORC), Otago Regional Plan: Water (ORPW), rule 12.A.1.4: Discharge of Human Sewage, outlines permitted activities to discharge wastewater to land with certain conditions. If a discharge does not meet these conditions, the activity is then a discretionary activity and is required to have a resource consent.

Other relevant clauses of the RPW Rule 12.A.1.4 are as follows:

a. A resource consent is required for any system that discharges more the 2,000L per day.

b. The discharge does not exceed 2000 litres per day (calculated as a weekly average); and

c. The discharge does not occur within the A zone of any Groundwater Protection Zone, as identified on the C-series maps, nor in the area of the Lake Hayes catchment, as identified on Map B6; and

d. The system's disposal field is sited more than 50 metres from any surface water body or mean high water springs; and

e. The system's disposal field is sited more than 50 metres from any bore which: (i) Existed before the commencement of the discharge activity; and (ii) Is used to supply water for domestic needs or drinking water for livestock; and

- [1] A review of Soil Map on-line (Landcare Research) shows the soil type to vary between silty loam over clay and clay.

f. There is no direct discharge of human sewage, or effluent derived from it, to water in any drain or water race, or to groundwater; and

g. Effluent from the system does not run off to any other person's property; and

h. The discharge does not cause flooding of any other person's property, erosion, land instability, sedimentation or property damage.

Of the 25 Lots, Lots 4 through 18 border or are intersected by one or in some cases, two of the water bodies on the site.

For these lots, if the dispersal area cannot be made available with separation of equal to or greater than 50m from these water bodies, the activity is then considered as a discretionary activity and a resource consent from the ORC will be required. Once the land use consent has been granted, Fluent Solutions will seek approval from the ORC for a consent under rule 12A.1.4 for each of these properties before title is issued.

5.0 Stormwater

5.1 Introduction

The site slopes from Thousand Acre Road towards Beach Road (abandoned due to erosion) and then discharges to the east coast. Drainage from site generally flows to either of the two water bodies on site. The water bodies then drain to a WDC owned 250mm culvert under the remains of Beach Road. Apparently, there are two additional culverts located under Beach Road, but these are reportedly blocked.

The following sections summarise the stormwater assessment and proposed management strategy.

5.2 Hydrological Assessment

A hydrological assessment has been completed to determine the impact of the development on the stormwater flows.

The Rational method (suitable for site <50Ha) was used to assess the impact of the development on stormwater runoff flows.

The Rational method uses the following formula to calculate flows:

$$Q_p = 1/360 \times C \times I \times A$$

Where;

- Q_p = peak discharge (m^3/s),
- C = coefficient of runoff,

- I = average rainfall intensity (mm/hour),
- A = catchment area (hectares).

The following runoff coefficients and catchment areas were used:

Table 5.1: Runoff Coefficient for Different Site Areas

Area Description	Runoff Coefficient	Area (Ha)
Pre-development Grass	0.3	24.79
Post-development Grass	0.3	23.72
Post-development Road	0.85	0.52
Post-development Roof	0.9	0.50
Post-development Paths	0.8	0.05

For the rainfall intensity (I), data from NIWA HIRDS Totara Station was used with RCP8.5.

Recommended design storms for rural residential sites under NZS 4404:2010 are as follows:

- Primary System 10 year ARI storm
- Secondary System 100 year ARI storm

Pre and post development runoff for the 10 year and 100 year storm events at various durations is presented in Table 5.2 below:

Table 5.2: Runoff Coefficient for Different Site Areas

Storm Event	Duration (min)	Pre-development Peak Flowrate	Post-development Peak Flowrate	Difference
		L/s	L/s	L/s
10 year ARI	10	950	1,030	80
	15	810	880	70
	20	670	720	50
	30	550	600	50
	60	400	440	40
100 year ARI	10	1,720	1,860	140
	15	1,460	1,580	120
	20	1,200	1,300	100
	30	990	1,070	80
	60	720	780	60

Based on these calculations the critical storm in terms of flowrate is a 10 minute duration storm.

The post-development peak run off flowrates are 8% higher than pre-development. This is considered a minor increase and flow attenuation is not considered necessary as there are no affected downstream properties.

5.3 Stormwater Management

It is proposed that the stormwater runoff from the new roads is conveyed via swales to the existing water bodies. As described above, this water body will continue to pass under Beach Road through culverts and to the coast. These swales will also convey water that currently passes under Thousand Acre Road via two 300mm culverts.

Any water collected from the new roofs can be discharged to ground and runoff from the Lots will be directed safely to the swales as shown in Figure 5.1.

An assessment[2] of the operational 250mm culvert under Beach Road, indicates a maximum capacity of around 80L/sec. This is considered inadequate to convey the existing 10 year ARI storm pre-development peak flows and is likely resulting in the water backing up and causing ponding on Lot 27. In large storms flooding over Beach Road (RL 7m) is expected.

While flooding caused from the unmaintained culverts is not likely to result in flooding of properties in the new development (minimum RL of the boundary of the habitable properties 8.5m - 1.5m above Beach Rd) it is recommended that WDC be asked to clean out the existing culverts to provide better drainage from the site.

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[2] Using Colebrook-White equation

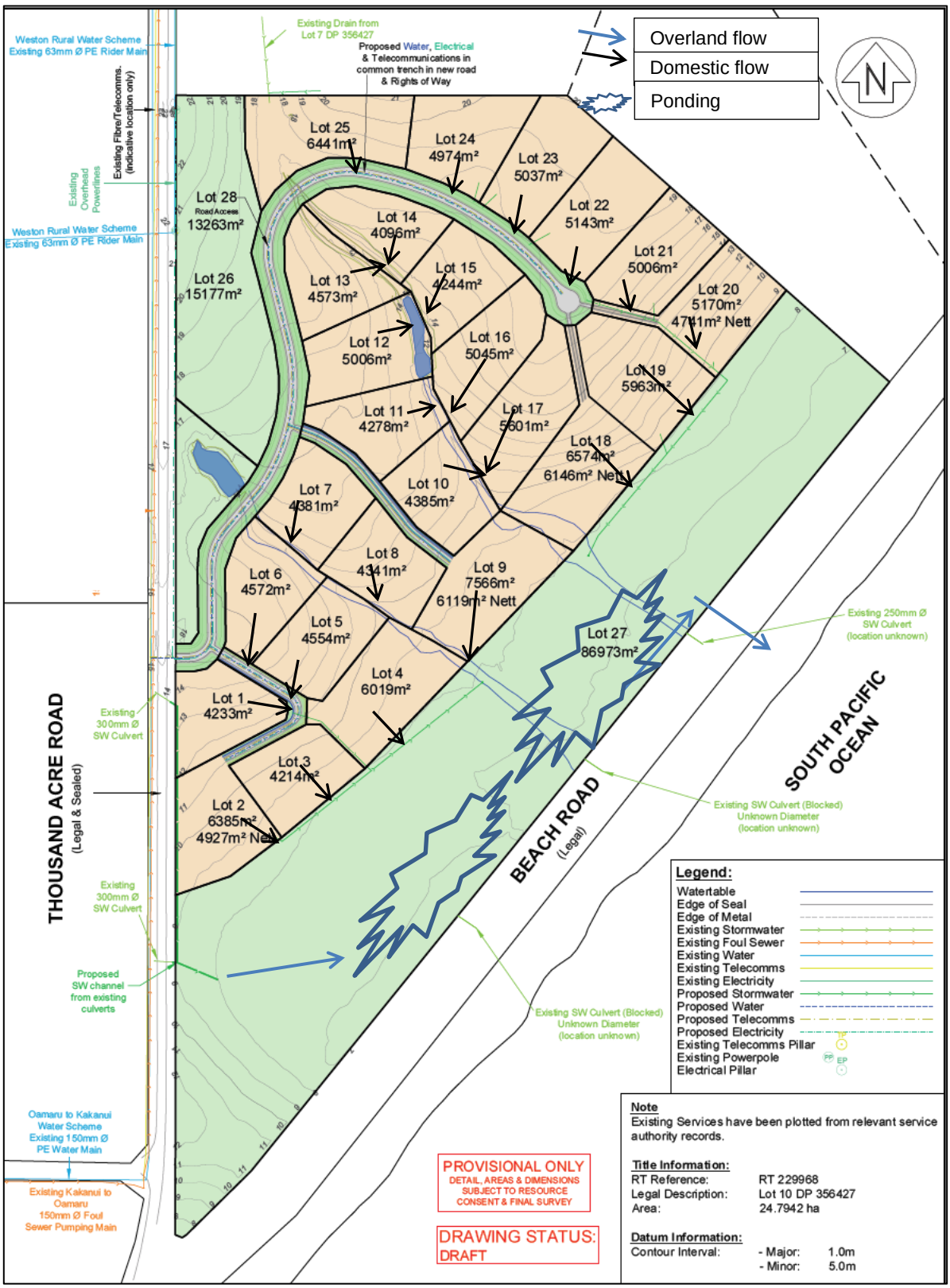

Figure 5.1: Stormwater Management Layout

APPENDIX A

Potable Water Supply Drawings