TRANSFIELD SERVICES

ALPURT Sectors A2 and B1 Stormwater Management system Review

Transit New Zealand

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1.0 INTRODUCTION

Transfield Services (NZ) Limited has been commissioned by Transit New Zealand to provide information regarding design, construction, catchments and resource consents regarding the stormwater treatment system for sectors A2 and B1 of the ALPURT project.

This report forms part of the Final Stormwater Management Standard and Valuation Review undertaken by Transit New Zealand.

It should be noted that due to the length of time that has passed since its commissioning in 1999 many construction and design details have been unable to be located despite an intensive search of the archive files located at Transit New Zealand and the PSMC005 maintenance contract. The Serco archives that formed part of the Sailnet contract located at Transfield Services Professional Solutions were also searched; however many of the documents required to complete this review were unable to be located. As a consequence this report contains all available information. Any gaps in information have been identified in the relevant sections of this report.

2.0 ENVIRONMENTAL FACTORS

2.1 Description of Catchments

2.1.1 Terrain

The terrain of the of the A2 and B1 sections of the ALPURT project is characterised by rolling hill country in both peri-urban and rural environments.

The area has an abundance of small perennial streams that run parallel to, and in several places run underneath the now existing motorway. The notable streams are identified as:

- Weiti Stream (B1);
- Johns Creek (A2);
- Top Road (A2); and
- Okura River (A2).

Estuarine environments are located at the start of the A2 sector (Awanohi Road) of the motorway and also at the conclusion of the B1 sector (prior to Grand Drive) of the motorway. These are identified as being:

- Orewa Estuary; and
- Okura Estuary (part of the Okura Marine Reserve).

2.1.2 Area

The A2 and B1 sectors of the ALPURT project are comprised of many catchment areas, for the purposes of this report they are listed in the table which details the different treatment devices.

2.1.3 Topography

The topography of the catchment can be characterised as rolling hill country. The motorway is bordered by, in some cases, quite steep hills and valleys to either side. This topography is consistent along the length of both the A2 and B1 sectors.

2.1.4 Drainage Features

The A2 and B1 sectors primarily utilise constructed swales which are located along the side of the motorway as the key drainage mechanism for ALPURT. The swales are extensive and run the length of ALPURT. The ALPURT stormwater treatment system utilises, as much as possible, the existing natural contours of the land and associated streams to provide effective and efficient drainage.

With regards to sector A2, the swales divert the stormwater flows to the various detention ponds where the treated water is then discharged to the various streams and creeks within the catchment.

Sector B1 also utilises the swales for drainage however, the swales in B1 function as treatment devices for contaminated surface water. The only points at which this differs in the B1 sector is at the treatment device No.1 and 2 here the swale diverts.

Treatment device No.1 consists of 2 sand filters. The stormwater is treated by the sand filters then, as in sector A2, the treated water is discharged into an adjacent stream.

2.1.5 Geotechnical Information

Geotechnical reports were unable to be located for the purposes of this report after an extensive search of the Transit New Zealand and Serco archives.

2.1.6 Soils

Information on the soils was not able to be obtained for the purposes of this report. However, the soil in the area generally consists of the Waitemata group of clays.

2.1.7 Erosion Potential

The potential for erosion within the stormwater system is limited. Erosion could potentially occur on the banks, front or back slopes and bottom of the swales if the swales are not properly maintained or if damaged occurs due to vehicles driving through or into the swales.

With regards to the wetlands, wet ponds, and dry ponds potential erosion could occur around the various discharge pipes, inlet pipes, overflow weirs and culverts that transport treated and un-treated water. The erosion of the ponds themselves should not be an issue due to the extensive planting schemes around the pond edges which provides protection against erosion of the banks of the various ponds.

With regard to the sand filters, erosion can potentially occur around the inlet and outlet pipes.

2.1.8 Flooding

A post –construction review of the ALPURT Sector A stormwater treatment devices undertaken by Transit New Zealand identified that there were no expressed concerns identified in relation to their design, or capacity to handle stormwater run-off.

2.1.9 Design Storm Event

The stormwater treatment devices for sector A2 and B1 are designed to effectively cope with a 1% AEP storm event as stipulated by the Auckland Regional Council in the terms of resource consent.

2.1.10 Vehicle Kilometres Travelled at Time of Opening

Traffic information for the B1 sector (SH1A) was not able to be obtained prior to 2002, possibly due to the traffic information loops not being installed. Data from 2002 shows that the daily vehicle flow count is on average, 12,800 vehicles per day. The length of this sector of motorway is 5.6 km giving a total of 71,680 vehicle kilometres travelled for the B1 sector.

For the purposes of consistency 2002 traffic levels for the A2 sector will also be used. The data shows that 35,000 travel through the A2 sector. The sector is 8.1 km long giving a total of 283,000 vehicle kilometres travelled.

2.1.11 Discharge Points

In terms of discharging treated water from the treatment devices a generic approach has been adopted in both the A2 and B1 sectors. The approach has been to discharge the treated water directly into the abundant streams and creeks that exist within the landscape.

Discharges from the wetlands and ponds for sector A2 occur predominantly through weir structures. Only treatment devices 9, 14 and 16 are discharged through manhole outlet structures.

Stormwater from sector B1 is discharged into the streams directly from the drainage swales as these act as the treatment devices. The exception is treatment device No.1 which discharges water via sand filters.

2.1.12 Catchment Classification

The catchments for ALPURT are a mix of peri-urban and rural as shown on the table overleaf.

Treatment Device No.	Terrain	Area (ha)	Topography	Drainage Features	Geotechnical Limitations	Soils
1 (B1)	Hilly/Peri-urban/ Close proximity to estuary	N/A	Low Gradient Hill Country, Estuary	Swales/Sand filters	N/A	Clay/Silt/Sand
2 (B1)	Hilly/Peri-urban/Stream	N/A	Low Gradient Hill Country	Swales/pond	N/A	Clay/Silt/Sand
3 (A2)	Hilly/Peri-urban/Stream	0.557	Low – moderate Gradient Hill Country	Swales/pond	N/A	Clay/Silt/Sand
4 (A2)	Hilly/Peri-urban/Stream	1.460	Low – moderate Gradient Hill Country	Swales/pond	N/A	Clay/Silt/Sand
5 (A2)	Hilly/Peri-urban/Stream	5.261	Low Gradient Hill Country	Swales/pond	N/A	Clay/Silt/Sand
6 (A2)	Hilly/Peri-urban/Stream	1.334	Low Gradient Hill Country	Swales/pond	N/A	Clay/Silt/Sand
7 (A2)	Hilly/Rural/Stream	1.270	Low – moderate Gradient Hill Country	Swales/pond	N/A	Clay/Silt/Sand
8 (A2)	Hilly/Rural/Stream	3.845	Low – moderate Gradient Hill Country	Swales/pond	N/A	Clay/Silt/Sand
9 (A2)	Hilly/Rural/Stream	2.117	Low – moderate Gradient Hill Country	Swales/pond	N/A	Clay/Silt/Sand
10 (A2)	Hilly/Rural/Stream	0.720	Low – moderate Gradient Hill Country	Swales/pond	N/A	Clay/Silt/Sand
11 (A2)	Hilly/Rural/Stream	2.960	Low – moderate Gradient Hill Country	Swales/pond	N/A	Clay/Silt/Sand
12 (A2)	Hilly/Rural/Stream	1.482	Low – moderate Gradient Hill Country	Swales/pond	N/A	Clay/Silt/Sand
13 (A2)	Hilly/Rural/Stream	4.276	Low – moderate Gradient Hill Country	Swales/pond	N/A	Clay/Silt/Sand
14 (A2)	Hilly/Rural/Stream	3.098	Low – moderate Gradient Hill Country	Swales/pond	N/A	Clay/Silt/Sand
15 (A2)	Hilly/Peri-urban /Stream	1.477	Low – moderate Gradient Hill Country	Swales/pond	N/A	Clay/Silt/Sand
16 (A2)	Hilly/Peri-urban /Stream	0.838	Low – moderate Gradient Hill Country	Swales/pond	N/A	Clay/Silt/Sand
17 (A2)	Hilly/Peri-urban /Stream	1.101	Low – moderate Gradient Hill Country	Swales/pond	N/A	Clay/Silt/Sand
18 (A2)	Hilly/Peri-urban /Stream	1.716	Low – moderate Gradient Hill Country	Swales/pond	N/A	Clay/Silt/Sand
19 (A2)	Hilly/Peri-urban /Stream	0.883	Low – moderate Gradient Hill Country	Swales/pond	N/A	Clay/Silt/Sand

Treatment Device No.	Erosion Potential	Flooding	Design Storm Event	Vehicle KM Travelled at Time of Opening	Discharge Points	Catchment Classification
1 (B1)	Low Risk	No concerns over capacity	10% AEP	71,680	Swale/Filters/ Stream/Estuary	Peri-urban
2 (B1)	Low Risk	No concerns over capacity	1% AEP	71,680	Swale/Pond/Stream	Peri-urban
3 (A2)	Low Risk	No concerns over capacity	1% AEP	283,000	Swale/Pond/Stream	Peri-urban
4 (A2)	Low Risk	No concerns over capacity	1% AEP	283,000	Swale/Pond/Stream	Peri-urban
5 (A2)	Low Risk	No concerns over capacity	1% AEP	283,000	Swale/Pond/Stream	Peri-urban
6 (A2)	Low Risk	No concerns over capacity	1% AEP	283,000	Swale/Pond/Stream	Peri-urban
7 (A2)	Low Risk	No concerns over capacity	1% AEP	283,000	Swale/Pond/Stream	Rural
8 (A2)	Low Risk	No concerns over capacity	1% AEP	283,000	Swale/Pond/Stream	Rural
9 (A2)	Low Risk	No concerns over capacity	1% AEP	283,000	Swale/Pond/Stream	Rural
10 (A2)	Low Risk	No concerns over capacity	1% AEP	283,000	Swale/Pond/Stream	Rural
11 (A2)	Low Risk	No concerns over capacity	1% AEP	283,000	Swale/Pond/Stream	Rural
12 (A2)	Low Risk	No concerns over capacity	1% AEP	283,000	Swale/Pond/Stream	Rural
13 (A2)	Low Risk	No concerns over capacity	1% AEP	283,000	Swale/Pond/Stream	Rural
14 (A2)	Low Risk	No concerns over capacity	1% AEP	283,000	Swale/Pond/Stream	Rural
15 (A2)	Low Risk	No concerns over capacity	1% AEP	283,000	Swale/Pond/Stream	Peri-urban
16 (A2)	Low Risk	No concerns over capacity	1% AEP	283,000	Swale/Pond/Stream	Peri-urban
17 (A2)	Low Risk	No concerns over capacity	1% AEP	283,000	Swale/Pond/Stream	Peri-urban
18 (A2)	Low Risk	No concerns over capacity	1% AEP	283,000	Swale/Pond/Stream	Peri-urban
19 (A2)	Low Risk	No concerns over capacity	1% AEP	283,000	Swale/Pond/Stream	Peri-urban

2.2 Sensitivity of Receiving Environment

This section is referred to the Transit New Zealand document, 2007: “Identifying Sensitive Receiving Environments at Risk from Road Runoff, Land Transport Research Report 315”.

2.2.1 Schematic of SRE Rating Framework

The proposed method is based on a hierarchical system whereby the receiving environment (RE) is sequentially classified according to three attributes:

- Physical ‘type sensitivity’ (depositional vs. dispersive);
- Ecological values; and
- Human use values (including cultural values).

Within each of the above attributes, the receiving environments are classified as being of 'high' (H), 'medium' (M), or 'low' (L) sensitivity and assigned a numerical number accordingly.

The overall sensitivity rating for each receiving environment is calculated by adding the scores for the type sensitivity, ecological value and human use value. The sensitivity rating is grouped under three broad categories, based on the total score, with high ratings indicative of high sensitivity, as follows:

- High sensitivity (high potential risk from road runoff): Total score >40
- Medium sensitivity (moderate potential risk from runoff): Total score 20-40
- Low sensitivity (low potential risk from road runoff): Total score <20

2.2.2 Sensitivity of Receiving Environment - Analysis

Type of Receiving Environment

The small streams which constitute the receiving environments along ALPURT are deemed to have 'high' sensitivity due to the low gradient and low velocities of these streams. The low gradients and velocities of the streams make them strongly susceptible to the deposition and accumulation of sediments. Treatment devices No.1, 18 and 19 ultimately discharge into nearby estuarine environments which also are identified as highly sensitive receiving environments.

Ecological Values

The ecological values of the majority of the streams and creeks within the catchment have relatively 'low' ecological values. However, there are a few exceptions within the ALPURT catchment.

Treatment devices No. 18 and 19 ultimately discharge into the Okura River which forms part of the Long Bay - Okura Marine Reserve. The Long Bay - Okura Marine Reserve is a habitat for several species of benthic fauna and functions as a spawning ground for many species of marine life such as sharks, Snapper, Kingfish and Kahawai. Based on these compelling factors Long Bay -Okura Marine Reserve is highly sensitive in ecological terms.

Treatment device No.1 discharges into adjacent Orewa Estuary. The estuary also has forms a habitat and spawning ground for various coastal species, however these species are not threatened or endangered and the estuary holds no formal conservation status and as such it is identified as having 'medium' ecological values.

Treatment Devices No. 5 and 6 discharge into the Weiti Stream and devices 13 and 14 discharge into the stream at Top Road. Both streams have hold species such as the Banded Kokopu and as such can be deemed to have 'medium' ecological values.

Human Use Values

The small size of the streams and creeks within the catchment means that the human use values are mostly identified as being 'low'. There are however two exceptions to this, these being the Okura River (TD No.18 and 19 discharging into the Long Bay - Okura Marine Reserve and the Orewa Estuary (TD No.1).

The Long Bay - Okura Marine Reserve has a 'high' human use value due to the many recreational activities that take place within the marine reserve, and adjacent Long Bay Regional Park. These include swimming, paddling, kayaking, sailing and recreational walks.

The Orewa Estuary has a 'medium' human use value. The estuary is used for activities such as fishing, kayaking and occasionally swimming although due its size and practicality (of use) the extent of its recreational use is not as high as that of the Long Bay - Okura Marine Reserve.

Below is a table providing a summary of the Overall Sensitivity Rating.

Treatment Device No.	Sensitivity	Ecological Value	Human Use Value	Overall Sensitivity Rating
1 (B1)	30 (H)	20 (H)	5 (M)	55 (H)
2 (B1)	30 (H)	5 (L)	2 (L)	37 (M)
3 (A2)	30 (H)	10 (M)	2 (L)	42 (H)
4 (A2)	30 (H)	5 (L)	2 (L)	37 (M)
5 (A2)	30 (H)	10 (M)	2 (L)	42 (H)
6 (A2)	30 (H)	10 (M)	2 (L)	42 (H)
7 (A2)	30 (H)	5 (L)	2 (L)	37 (M)
8 (A2)	30 (H)	5 (L)	2 (L)	37 (M)
9 (A2)	30 (H)	5 (L)	2 (L)	37 (M)
10 (A2)	30 (H)	5 (L)	2 (L)	37 (M)
11 (A2)	30 (H)	5 (L)	2 (L)	37 (M)
12 (A2)	30 (H)	10 (M)	2 (L)	42 (H)
13 (A2)	30 (H)	10 (M)	2 (L)	42 (H)
14 (A2)	30 (H)	5 (L)	2 (L)	37 (M)
15 (A2)	30 (H)	5 (L)	2 (L)	37 (M)
16 (A2)	30 (H)	5 (L)	2 (L)	37 (M)
17 (A2)	30 (H)	5 (L)	2 (L)	37 (M)
18 (A2)	30 (H)	20 (H)	10 (H)	60 (H)
19 (A2)	30 (H)	20 (H)	10 (H)	60 (H)

3.0 DESIGNED SOLUTIONS

This section provides a brief description of:

- The design philosophy;
- The stormwater management devices, design methodology, positioning and construction; and
- Cost and time.

3.1 Design Philosophy

The stormwater treatment devices for sector A and B1 have been designed and constructed to treat the stormwater run-off before it enters natural waterways. The level of treatment required is set by the conditions of the resource consents granted for the work under the Resource Management Act (1991).

The run-off from roads contains particulates, aromatic hydrocarbons, heavy metals and nutrients that potentially are toxic to the environment. A combination of swales, dry ponds, artificial wetlands, wetponds or filters has been used to ensure adequate treatment of stormwater before it enters natural waterways. Filters and dry ponds have been used where space precludes the use of artificial wetlands.

The intent of these treatment measures is to remove at least 75% of the particulate and toxic substance from the run-off. The swales and ponds are constructed so that water flows primarily over the sediment and through the vegetation. An alternative is vegetated submerged beds in which water flow is engineered for contact with the plant roots. The ponds provide flood mitigation and abatement to ensure the post development flows from the road do not exceed the pre-development flows.

All treatment devices adjacent to the road have been provided with vehicle access from the road to facilitate maintenance. Others are accessible from local roads.

3.2 Objectives

Assumptions

The objectives for developing the stormwater design in the A2 and B1 sectors were:

- To meet the stipulated requirements of the Auckland Regional Council (ARC)stormwater treatment guidelines;
- To provide a comprehensive approach to water resources mitigation during the design process, including provision for stormwater run-off and protection of wetlands and waterways;
- To effectively treat stormwater run-off before it enters the surrounding natural waterways; and
- To provide suitable flows and gradients within the stormwater system to allow for continued or enhanced fish passage.

Options Analysis

Any documents or reports that relate to other potential stormwater options that were explored were unable to be located for this report.

3.3 Criteria

Water Quality

The effect of stormwater ponds and swales on the groundwater is considered to be less than minor, primarily due to the low permeability of the Waitemata group clays on which the stormwater system has been constructed.

The stormwater ponds and swales will assist in retaining pollutants and suspended solids generated from the motorway. The intent of these treatment measures is to remove at least 75% of the particulate and toxic substances from the run-off before the water is discharged.

A recent review of the stormwater system by Transit NZ identified that there had been no recent testing of the stormwater quality at the discharge points. It is however, identified in the same report, that a test was undertaken shortly after construction showed very high quality water was being discharged and that no reasons for any change to this situation were identified.

Water Quantity

The construction of the A2 and B1 sectors of the motorway involved the construction of large impervious areas. The stormwater treatment system was designed to reduce the impact of increased surface water flows on the surrounding receiving environments that would result from the newly constructed impervious surface areas. This has been achieved by utilising the drainage swales to and ponds to dissipate and absorb the energy of the stormwater flows before the water is treated and discharged.

Stream Channel Erosion Criteria

Information pertaining to the stream channel erosion criteria was unable to be located for the purposes of this report.

4.0 STORMWATER MANAGEMENT DEVICES METHODS

4.1 Erosion and Sediment Control

Erosion mitigation measures that have been implemented for the A2 and B1 sectors consist of the following:

- Stabilisation by way of extensive plantings of vegetation around the edges of the wet ponds and wetlands to reduce the potential for erosion and scour around the periphery of the ponds/wetlands;
- Gabion baskets placed within some streams and at various discharge points that act as velocity dissipaters and prevent stream channel erosion;
- Low gradient swales, culverts and discharge pipes designed to reduce velocities of stormwater and subsequently reduce the potential for scour and erosion; and
- Installation of culvert head walls to prevent scour around the culvert.

Sediment mitigation measures that have been implemented for the A2 and B1 sectors consist of the following:

- Treatment swales;
- Wet ponds;
- Wetlands;
- Dry ponds; and
- Sand filters.

4.2 Operational Stormwater Management (Permanent)

i. Collection

The stormwater is collected through the drainage swales that run parallel to the motorway and diverted to the various treatment devices. The motorway is constructed in way that ensures water flows are directed to the swales.

ii. Conveyance

The stormwater is primarily conveyed to the treatment devices through the use of drainage swales and drainage culverts.

The stormwater at treatment device No.1 (B1) is firstly conveyed to a storage pond where it is then conveyed through piping to the sand filters.

Treated stormwater is conveyed from the treatment devices to the stream discharge points though a mix of pipes and swales.

iii. Attenuation

The attenuation rates for the stormwater ponds were unable to be located for the purposes of this report. The attenuation rates for the ponds and wetlands are calculated in accordance with the Auckland Regional Council Technical Publication No.10.

iv. Treatment

There was a multi-functional approach taken in terms of treating the stormwater. The initial treatment of the stormwater is undertaken by an extensive system of swales. The water is then treated through the process of attenuation which is undertaken by the various wet ponds and wetlands that have been constructed. Twin sand filters offer treatment at treatment device No.1 (B1) after pre-treatment by the drainage swales.

The wet ponds treat the water by slowing the water flow down and allowing the coarser sediments to settle as the water is slowly discharged. Plants within the pond provide a secondary treatment by way of aerobic decomposition and the adsorption of contaminants. These processes assist in removing nutrients and sediments.

The wetlands provide a similar treatment but remove a significant amount of contaminants by adhesion to vegetation and aerobic decomposition. The vegetation within the wetland significantly reduces the velocities and turbulence of water flows that enables this process to occur.

The sand filters are effective at removing sediments and contaminants from the stormwater through settling and filtration. The contaminants are removed by attaching themselves to sediments within the filter.

4.3 Maintenance of Treatment Devices

This section identifies the maintenance requirements of the treatment devices located in sectors A2 and B1. The maintenance of these devices ensures that they continue to provide effective treatment of the stormwater.

The maintenance audit checklists for the A2 and B1 sectors are attached in the appendices.

4.3.1 Dry, Wet Ponds and Wetlands

Sediments

Of all the treatment devices ponds are most effective at removing sediments from run-off. They remove sediment by detaining the water long enough for the sediment to settle out. As a result, ponds need periodic maintenance to remove sediments deposited on the bottom. The rate of sedimentation should be measured and compared with data from previous inspection reports to assist in scheduling periodic sediment removal. In a stabilized watershed, the rates of accretion should be consistent. If there is an increase in the rate of sedimentation, then areas contributing stormwater to the facility should be inspected for erosion problems or sediment sources and corrective steps taken.

Accumulated sediments should be removed on a periodic basis before they reduce the detention time. Coarser sediments can be expected to be found close to the pond inlet, with finer sediments deposited closer to the pond outfall. In terms of volume, the coarser sediments occupy a greater volume and removal of these sediments may need to be undertaken more frequently than the removal of finer sediments.

Removing the sediment from the wet ponds involves draining the water down to the lowest possible elevation. If possible, a small pool of water is left to provide a habitat for any resident fish populations. Removing sediment from the dry ponds is done when they are dry and cracked and thereby separated from the vegetation. In both cases, this is achieved by sitting an excavator on top of the pond embankment and excavating the wet material using a swamp bucket. Alternatively, the sediment is removed using a sucker truck similar to those used to clean catchpits.

Toxic Materials and Heavy Metals

Dry and wet ponds are very effective at removing toxic materials and heavy metals when they are attached to sediments, but only wet ponds remove soluble toxics and metals. Pollutant removal effectiveness increases with residence time. Ponds are especially effective at reducing the release of toxic substances that are inadvertently spilled during an accident and function as a holding area until the cleanup is accomplished provided the outlet is blocked off.

To ensure that toxics, especially heavy metals, remain sequestered in the sediment at the bottom of the ponds, it is essential that the bottom environment remains aerobic and that the pH remain neutral. Failure to do this will lead to a release of the pollutants from the sediments and the reintroduction of these contaminants into the run-off.

Nutrients

Nutrients, such as nitrogen and phosphorus, in stormwater come in either particulate or soluble forms. The particulate form of phosphorus is effectively removed through adsorption and sedimentation. The soluble form is not removed by sedimentation but through the processes that occur during the nitrogen cycle.

Ponds only remain effective at removing particulate nutrients if the bottom sediments and water remain aerobic with a pH near 7. To ensure that nutrients remain sequestered in the pond it is important that the [pond bottom remains aerobic. If the pond becomes anaerobic or pH rises or falls, phosphorus that has been previously captured can then be converted to a soluble form and re-enter the run-off.

Oils and Greases

Ponds allow the reduction in oils, greases and other hydrocarbons to occur through vaporization. The effectiveness of this process depends on air and water temperatures, winds, and surface turbulence. Any spills must be cleaned up, contaminated areas removed, and the device appropriately reinstated.

Trash and Debris

The inlet and outlet of the ponds becomes, on occasions, clogged by debris. This must be removed to ensure that all components are operating as required. The removal of trash and debris also prevents possible damage to vegetated areas and eliminate potential mosquito breeding habitats.

Mechanical Components

Valves, gates, locks and access grills should remain functional at all times. All mechanical components should be operated during the annual maintenance inspection to ensure continued performance.

Structural Repairs

Periodic maintenance of structural components are undertaken to ensure their continued operation. This includes inspecting overflow weirs, inlet and outlet pipes and joints for possible leakage or seepage. Areas should also be checked for corrosion; valves should be manipulated and lubricated when needed, and all moving parts inspected for wear and tear. Leakage around the barrel and riser assembly should be checked as it can cause piping of water that adversely affects the structural strength of the facility.

Dam, Embankment and Slope Repairs

Damage to dams and embankments from settlement, scouring, cracking, sloughing, seepage and rutting must be repaired quickly to maintain the integrity and safety of the facility.

Erosion Repair

Where factors have created conditions where erosion will potentially occur corrective steps are taken to prevent the loss of soil and any subsequent risk to the performance of the facility. This is usually remediated using erosion control blankets, or rip-rap.

Control of Weeds

Undesirable aquatic plants invade littoral zones. These smother other plants and adversely affect the operation of the pond. These undesirable plants must be removed through mechanical or chemical means. If chemicals are used, the chemical should be used as directed and left over chemicals disposed of properly. The chemicals that are used for the control of weeds are low in toxicity and residue.

Grass Maintenance

Grass areas require limited periodic fertilizing, de-thatching, and soil conditioning in order to maintain healthy growth. Where grass cover is damaged by sediment accumulation, stormwater flow, or other causes it will be necessary to re-seed and re-establish the grass. Any grass cutting that is created because of 'mowing' within 10m of a watercourse or within the 20% AEP flood plain is collected immediately to ensure that organic material is not washed into the watercourse.

Vegetation Maintenance

Planting within the stormwater treatment devices is maintained and replaced as necessary. Such maintenance ensures the proper functioning of the device. This maintenance also occurs after sediment is removed from the dead storage zone.

4.3.2 Sand Filters

Sediments

Filters are very effective at removing sediments from stormwater through settling and filtration. Coarser sediments are generally removed in the sedimentation chamber and finer sediment in the sand filter. Generally, the sediment will only penetrate a small distance into a filter made of fine sands. However, the coarser the sand, the further the sediment will penetrate and the more filter media that will need to be removed or replaced. The sand can be scraped off when it becomes contaminated and new sand added to restore the depth to 300mm to restore desired infiltration rates.

If standing water is present after rain, partial clogging has occurred and the sediment must be removed once the filter has dried out. If the filter is totally clogged, it will have to be drained and allowed to dry out before removing the sediment. If sediment removal is attempted while water is standing in the filter tank, the finer sediments will become suspended and will remain in the tank.

Toxic Materials and Metals

Toxic materials and metals are removed in filters when they attach to sediments or when they pass through organic materials. This occurs in most sand filters where the surface of the filter becomes highly organic due to the trapping of fine sediments, oils and greases. The organic material enhances the ability of the sand filter material to remove toxics and metals. The addition of up to 20% potash can enhance the ability of filters in removing toxic materials.

Nutrients

Filtration systems only remove particulate nutrients and remove phosphorus from stormwater. However, they are limited in their ability to remove nitrogen.

Oils and Greases

Sand filters are very effective at removing oils and greases. The sedimentation chamber is important in removing hydrocarbons due to the fact that oil adheres to solids. The filter chamber removes oils and greases, which penetrate 25mm to 75mm into the filter media (depending on the gradation of the filter

media) before being bound up in the sand. Clogging can occur from excess oils and greases entering the facility. Clogging can also occur from algae growth when water is allowed to stand too long in the filter tank. Clogging will cause failure of the sand filter and create a long-term problem.

Structural

Periodic maintenance is done of structural components to ensure their continued operation. This includes inspecting any joints for possible leakage or damage and cleaning pipelines, and replacement. Other maintenance concerns such as spalling of concrete, cracks in concrete or damage to grates are addressed when they are discovered.

4.3.3 Swales

Sediment

Sediment accumulation in swales is a long-term process. Sediment is trapped around the roots of grass and is slowly be buried by the grass. Where sediment build-up occurs this is removed during the summer by scraping once the sediment is dry.

Trash and Debris

Following each storm event the swales are briefly inspected with the trash and debris that is caught in the swales removed. This is critical in maintaining the effectiveness of the swales as treatment and conveyance devices.

Vegetation

Mowing is needed up to three times a year but no mowing is done in the winter. The grass is kept at least 100mm high. Mowing the grass too short will damage the grass, increase run-off flow velocities, increase erosion and decrease pollutant removal effectiveness. If the grass grows too tall, it is prone to lying down in a storm event instead of filtering run-off, thus decreasing treatment effectiveness. Any grass cutting created because of ‘mowing’ must be collected immediately to ensure the organic material is not washed into the treatment pond.

The invasion of undesired vegetation can occur. In some situations it is necessary to remove weeds by chemical means and either resow the grass or replace it with grasses and sedges. In autumn it is sometimes necessary to apply fertiliser to promote a dense growth of vegetation.

5.0 Cost

The majority of information regarding the stormwater implementation costs of the A2 and B1 sectors has been unable to be located within the Transit NZ and Serco archives for the purposes of this report**.**

The project cost estimates for the A2 sector have been located; however the document does not explicitly state the professional services costs with regards to the stormwater system. The relevant projected costs that are illustrated in the report are the costs of the geotechnical report and the cost of the drainage system.

The estimated annual cost for the maintenance program has also been located.

Professional Services

The cost of the geotechnical investigation was estimated at $171,000.

Drainage

The total costs for the drainage system was estimated at $1,810,000. The breakdown of the estimated total cost is as follows:

- Pavement drain - $58,000
- Subsoil drain - $252,000
- Stormwater drain and culverts - $1,500,000

Maintenance

The estimated annual cost of maintaining the stormwater system is approximately $12,000. The activities primarily associated with maintaining the stormwater treatment devices include:

- Spraying of undesirable vegetation within swales and ponds;
- Cutting of grass within the swales;
- Removal of trash and debris;
- Removal of oils and greases; and
- Removal of sediment from ponds.

6.0 Time

Details regarding the length of time taken to design and implement the stormwater system were unable to be located within the Transit NZ or Serco archives for the purposes of this report as were details on the life expectancy of the stormwater management system. However, details on the time taken to acquire the resource consent from the submission date to the consent approval date were able to be located.

The resource consent application was received by the ARC on the 28th of August 1996. The applicants were formally notified of consent approval on the 24th of March 1997.

7.0 References

ALPURT – Project Management Plan June 1996

Independent Review of ALPURT Resource Consent Processes, October 1997, Hill Young Cooper Ltd

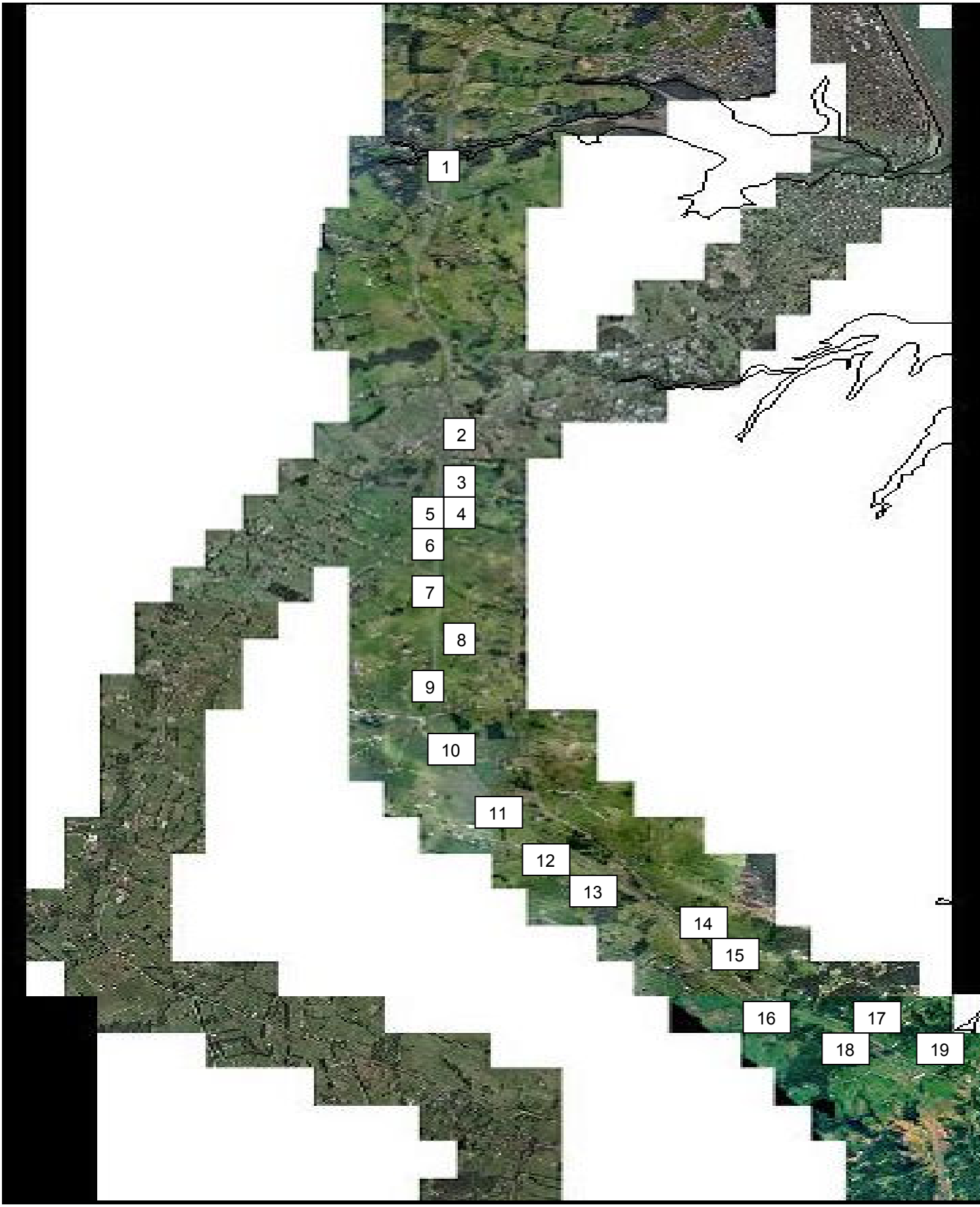
ALPURT – State Highway 1: Albany to Puhoi Realignment, Efficiency of Stormwater Ponds September 2000

ALPURT – State Highway 1: Albany to Puhoi Realignment, Sectors A and B1 Stormwater Treatment Devices, Maintenance and operation Guidelines, July 2001, Serco

ALPURT – Sector A: SH1, Post-Construction Review of Environmental Treatments, 26-27 April 2006, Transit New Zealand

Appendix A: Location of ALPURT Sector A2 and B1 Stormwater Treatment Devices

Treatment Devices Location					
Device No	**Route Position**	**Structure type**	**Outlet Type**	**Pond Volume m^3 (Live)**	**Pond Volume m^3 (Dead)**
1	00/ 2.96 West	Sand filter (x2)	N/A	N/A	N/A
2	00/ 0.60 East	Wetland	Manhole	N/A	N/A
3	00/ 0.08 East	Wet pond	Weir	125	60
4	296/ 0.28 East	Wetland	Weir	525	85
5	296/ 0.36 West	Wetland	Weir	1290	830
6	296/ 0.46 West	Wetland	Weir	395	270
7	296/ 0.96 West	Wetland	Weir	305	160
8	296/ 1.66 East	Wetland	Weir	710	210
9	296/ 2.82 West	Wet pond	Manhole	240	N/A
10	296/ 3.36 West	Wetland	Weir	185	130
11	296/ 4.00 West	Dry pond	Weir	1290	N/A
12	296/ 4.48 West	Wetland	Weir	550	170
13	296/ 4.85 East	Wetland	Weir	1895	250
14	296/ 6.68 East	Wetland	Manhole	885	785
15	296/ 6.88 East	Dry pond	Weir	415	N/A
16	296/ 7.04 West	Wetland	Manhole	200	125
17	296/ 7.70 East	Wetland	Weir	980	290
18	296/ 7.75 West	Wetland	Weir	420	285
19	296/ 7.88 East	Wet pond	Weir	365	250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Appendix B: Maintenance Auditing Checklists for Sand filters, Swales and ponds

Sand Filter Audit Checklist

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ALPURT SAND FILTER AUDIT FORM

Auditor:_____

Date:_____

DESCRIPTION	FREQUENCY	ACCEPTALBE	UN ACCEPTABLE	COMMENTS
Inlets				
Debris and litter removal required	S			
Sediment accumulation	B			
Evidence of erosion	S			
Sediment Trap				
Signs of petroleum contamination	B,A			
Sediment level	B			
Sediment trap requires cleaning (within 300mm of storage level)	B			
Floating or floatable debris removal required	B			
Filter sock requires cleaning	B			
Filter Sock damaged	B,L			
Riser and pipes				
• Cracks or displacement	A			
• Minor spalling >25mm	A			
• Major spalling (rebar exposed)	A			
• Joint failure	A			
• Water tightness of riser	A			
• Inlet pipe clear	A			
• Outlet pipe clear	A			
Grill				
• Damage	A			
• Corrosion	A			
• Secure	A			

S = Standard Maintenance Items; B = Bi Annual Maintenance Items; A = Annual Maintenance Items; L = Long Term Maintenance (5 year revolving schedule)

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ALPURT SAND FILTER AUDIT FORM

DESCRIPTION **Sandfilter**	FREQUENCY	ACCEPTALBE	UNACCEPTABLE	COMMENTS
Visible pollution	B,A			
Sediment or trash accumulation	S			
Sand filter dewaters within 48hours	B			
Water ponding 72hrs after storm	A			
Evidence of short circuiting	B,A			
Sand requires aerating	A			
Top 50 to 75 of sand filter requires replacement	A			
Sand filter requires replacement				
Filter Fabric				
• Clogging	A			
• Damage	A			
• Requires replacement	A.L			
Riser and barrels				
• Cracks or displacement	A			
• Minor spalling <25mm	A			
• Major spalling (rebar exposed)	A			
• Joint failure	A			
• Water tightness of riser	A			
Grill				
• Damage	A			
• Corrosion	A			
• Secure	A			

S = Standard Maintenance Items; B = Bi Annual Maintenance Items; A = Annual Maintenance Items; L = Long Term Maintenance (5 year revolving schedule)

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ALPURT SAND FILTER AUDIT FORM

DESCRIPTION	FREQUENCY	ACCEPTALBE	UNACCEPTABLE	COMMENTS
Outlet Pipe				
• Cracks or displacement	L			
• Pipe clear	L			
• Joint failure	L			
• Requires cleaning	B			
Outfall				
Outfall pipe clear	B,A			
Concrete or rip rap failure	A			
Maintenance access condition	B			
Comments				

S = Standard Maintenance Items; B = Bi Annual Maintenance Items; A = Annual Maintenance Items; L = Long Term Maintenance (5 year revolving schedule)

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Swale Audit Checklist

TRANSFIELD SERVICES
PSMC005

ALPURT SWALE AUDIT FORM

Auditor:_____

Date:_____

DESCRIPTION	FREQUENCY	ACCEPTABLE	UNACCEPTABLE	COMMENTS
Debris				
Swales clean of debris	S			
Contributing catchment clean of debris	S			
Vegetation				
Mowed when needed	S			
Minimum mowing depth not exceeded	S			
Dead or dying grass evident	B			
Swale requires dethatching	S			
Invasive or undesirable vegetation growth	S			
Evidence of erosion	S			
Animal burrows	S			
Fertilised as required	A			
Other				
Dewatering				
Swale dewaters between storms	A			
Standing water or wet spots after dry weather	A			
Other				
Sediment				
Sediment build up evident	A			
Visible pollution	B			
Swale needs scraping	L			
Other				

S = Standard Maintenance Items; B = Bi Annual Maintenance Items; A = Annual Maintenance Items; L = Long Term Maintenance (5 year revolving schedule)

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ALPURT SWALE AUDIT FORM

DESCRIPTION	FREQUENCY	ACCEPTABLE	UNACCEPTABLE	COMMENTS
Rock Check Dam				
Evidence of short circuiting	A			
Erosion	S,A			
Damage	A			
Outlets and Culverts				
Erosion evident	S,A			
Good condition	S,A			
Other				
Comment				

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Pond Audit Checklist

TRANSFIELD SERVICES
PSMC005

ALPURT STORMWATER POND AUDIT FORM

Auditor: _____

Date: _____

DESCRIPTION	FREQUENCY	0.25LI	1.67LI	4.88LI	6.65LI	8.06LI	9.25LI	9.45LI	11.3LI	11.08LI	0.95RI	3.2RD	4.47RD	7.04RD	7.73RD	8.65RD	9.85RD	10.2RD
Embankment and Vegetation cover																		
Vegetation and ground cover	B,A																	
Embankment erosion	S																	
Animal burrows	S																	
Litter and debris	S																	
Weeds	A																	
Cracking, bulging or slips																		
• Upstream face	A																	
• Downstream face	A																	
• At or beyond toe downstream	A																	
• At or beyond toe upstream	A																	
• Emergency spillway	A																	
Pond toe	A																	
Seeps or leaks on downstream face	A																	
Slope protection or rip rap failures	A																	
Emergency spillway clear of obstructions	A																	
Other																		
Wet Pond																		
Vegetation healthy and growing	A																	
Invasive vegetation growth	B,A																	
Vegetation harvesting required	A																	
Floating or floatable debris removal required	A																	
Visible pollution (slick) or eutrophication	A																	
Shoreline problems	S																	
Other																		

S = Standard Maintenance Items; B = Bi Annual Maintenance Items; A = Annual Maintenance Items; L = Long Term Maintenance (5 year revolving schedule)

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ALPURT STORMWATER POND AUDIT FORM

DESCRIPTION Sediment	FREQUENCY	0.25LI	1.67LI	4.88LI	6.65LI	8.06LI	9.25LI	9.45LI	11.3LI	11.08LI	0.95RI	3.2RD	4.47RD	7.04RD	7.73RD	8.65RD	9.85RD	10.2RD
Fore Bay or entrance depth	A																	
Pond depth	A																	
Excessive sedimentation evident	A																	
Outlet																		
Outlet type																		
• Reinforced concrete manhole riser	A																	
• Timber weir	A																	
Outlet weir																		
• Debris removal required	M																	
• Corrosion control	A																	
• Timber damage	A																	
• Excessive sediment accumulation	A																	
Outlet Riser and barrels																		
• Cracks or displacement	A																	
• Minor spalling <25mm	A																	
• Major spalling (rebar exposed)	A																	
• Joint failure	A																	
• Water tightness or riser	A																	
• Pond drain valve	A																	
• Pond drain valve operational	A																	
• Pond drain valve chained and locked	A																	
• Outfall pipe clear	A																	
• Head and end walls	A																	
• Outfall clear	A																	

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ALPURT STORMWATER POND AUDIT FORM

DESCRIPTION	FREQUENCY	0.25LI	1.67LI	4.88LI	6.65LI	8.06LI	9.25LI	9.45LI	11.3LI	11.08LI	0.95RD	3.2RD	4.47RD	7.04RD	7.73RD	8.65RD	9.85RD	10.2RD
Spillway																		
Type																		
• Reinforced concrete	A																	
• Rip rap	A																	
• Other	A																	
Spillway clear	A																	
Concrete rip rap failure	A																	
Slope erosion	S																	
Other																		
Other																		
Grass mowing required on unplanted areas	B																	
Maintenance access condition	A																	
Other																		
Overall condition (A=acceptable/U=unacceptable)																		

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ALPURT STORMWATER POND AUDIT FORM

Comments	
0.25LI	0.95RD
1.67LI	3.2RD
4.88LI	4.47RD
6.65LI	7.04RD
8.06LI	7.73RD
9.25LI	8.65RD
9.45LI	9.85RD
11.3LI	10.2RD
11.08LI	

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