New Zealand Transport Agency
Erosion and Sediment Control Standard Road Test
Christchurch Southern Motorway
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1.0 Project Location

The existing Christchurch Southern Motorway (CSM) is located to the south-west of Christchurch city centre. The existing motorway is about 3 km in length and is orientated in an east-west direction.

The eastern end of the motorway is located about 3 km south west of the city centre at the intersection with Barrington Street. The western end currently terminates at Curletts Road. New Zealand Transport Agency (NZTA) proposes to duplicate this section.

2.0 Project Scope

The proposed Greenfield section will extend the CSM west from Curletts Road, south of Wigram Aerodrome and Hornby until it connects into Halswell Junction Road at its junction with Springs Road. The Greenfield section will be about 5 km in length. Halswell Junction Road will be upgraded between its intersections with Springs Road and Main South Road/State Highway 1 (SH1) to provide an arterial link between the greenfield section and Main South Road/SH1. This section is approximately 2.5km in length. Total project length is approximately 10.5 km.

There are also a number of local roads in the vicinity of the project’s greenfield section, some of which will be closed or re-aligned to suit the motorway alignment. These include Wigram Road, Dunbars Road, Awatea Road, Carrs Road, Wilmers Road, Springs Road and Halswell Junction Road.

3.0 Project Delivery Method

The project is being delivered using a ‘Design and Construct’ delivery method.

4.0 Site Constraints

An extensive range of options for the project were considered by NZTA, both in terms of alternative alignments and alternative designs along the preferred alignment.

In 1994 a feasibility study to consider the alternative options to improve the southern transportation corridor into Christchurch was undertaken for NZTA by Gabites Porter Consultants. This compared the existing Main South Road/SH1 route, the route of the existing motorway designation, and a third option between the eastern side of Wigram Road and the existing motorway designation. This latter option was supported by traffic modelling undertaken at that time. In 1995 Royds Consulting undertook an environmental impact assessment of these options for NZTA. This indicated that there was no best route on the basis of environmental factors.
The presence of former landfills provides challenges for the contractor. Where there is landfill material along the route it is necessary to remove the waste material or undertake some form of ground improvement, as the landfills are typically characterised by non-engineered, or compressible fill that may be loosely-placed, voided and/or undergoing decomposition. Engineering mitigation is required to provide satisfactory long-term performance of the new road.

Groundwater is a significant resource for the Canterbury region and must be protected. The presence of groundwater within 1m of the surface provides challenges in relation to both Erosion and Sediment Control and also permanent stormwater drainage.

5.0 Natural Site Features

5.1 Roading

The existing road network in the vicinity of the project comprises a number of arterial routes from the centre of Christchurch to the south and west, and a number of local subarterial routes that serve the western and southern suburbs of the city. The main arterial route is State Highway 73 (SH73), which runs along Brougham Street before joining the existing motorway. This in turn connects with Curletts Road before joining with Blenheim Road/SH73A and then Main South Road/SH1.

5.2 Geology

The Waimakariri River plains are underlain by sediments up to 1.5 km thick. Alluvial sediments of between 15 m and 20 m thick have been deposited since the last deposits of glacial outwash material (about 70,000 years ago). In the project area these recent sediments comprise mainly the Yaldhurst Member of the Springston Formation, which includes:

- Flood channel infill materials generally comprising gravels and sands
- Overbank alluvial silt deposited during flooding
- Peat deposits formed in well established swamps

Estuarine deposits underlie parts of Spreydon and sands containing shells were encountered in boreholes at Barrington Street at the eastern end of the motorway route, and are inferred to be part of the Christchurch Formation. The recent alluvial and estuarine sediments are underlain by glacial gravels of the Riccarton formation, which are up to 20 m thick.

5.3 Freshwater Ecology

Curletts Road Stream runs parallel to the north side of the existing motorway and is piped across the motorway. It receives stormwater from a large industrial and commercial area
with little or no existing stormwater treatment. The invertebrate community is predominately made up of worms reflecting the ‘poor’ quality status as determined by the macroinvertebrate community index (MCI). Shortfin eels and upland bullies have been recorded downstream of the motorway but only shortfin eels upstream.

Haytons Stream is a modified system with the section upstream of Wigram Road sized to accommodate large runoff from the catchment. Downstream of Wigram Road to Wigram Retention Basin the stream is more naturalised with extensive riparian planting. The invertebrate community is dominated by taxa tolerant of degraded conditions. The nonmigratory native upland bully is the only fish species found in the stream with distribution limited to downstream of Wigram Road.

Halswell Junction Detention Basin was constructed in 1992 by Christchurch City Council (CCC) to receive stormwater from the surrounding industrial and business area. There are no surface water connections to any natural waterbodies.

There are a number of dry remnant channels within the project area as follows:

Upper Jacksons Creek, flow varies greatly on a daily and weekly basis due to the Lane Walker Rudkin cooling water discharge. The invertebrate fauna in the lower areas are typical of an urban system. Fish are absent due to a 2km piped section prior to discharge into the Heathcote River.

Dry Stream is downstream of the small pond at Musgroves. It feeds into the Heathcote River.

Upper Heathcote River, stormwater currently discharges into the Heathcote River from new subdivisions but there is no permanent flow until approximately 1.9km downstream.

Knights Stream in the vicinity of the CSM the stream is permanently dry. Periodic flow does not occur until approximately 2.3km downstream of Halswell Junction Road.

5.4 Terrestrial Ecology

The vegetation of the CSM corridor is composed almost entirely of exotic species. Apart from the productive and amenity species there are also many pest plants including environmental weeds such as sward grasses and shrubs capable of displacing small remnant areas of native dry grasslands if left unmanaged.

Some localised “primary habitats” of remnant indigenous plant communities survive. Of the remaining localised primary habitats of remnant indigenous plant communities that have been identified along the CSM corridor, only three are identified as significant. These are summarised as follows:
- An approximately 2ha area of native grasslands at the intersection of Halswell Junction, Springs, and Wilmers Roads ("the Wilmers Road grasslands"). Although the Wilmers Road grasslands are now degraded and semi-natural, this area still contains populations of various species of indigenous plants of significance, including some that are regionally rare, such as Geranium solanderi and Muehlenbeckia spp., in a range of locations throughout the grasslands area. In terrestrial ecological terms the Wilmers Road grasslands is considered the most valuable site along the CSM corridor, and is identified in the City Plan as “Ecological Heritage Site 15.06 - Danthonia grassland”;

- The Upper Heathcote River, where crossed by the CSM corridor, contains populations of various species of indigenous plants of significance, including the regionally rare marsh species Rorippa palustris. The Upper Heathcote River is identified in the City Plan as “Ecological Heritage Site 15.21 - Riparian willow woodland (with native trees, shrubs, ferns and sedges)”; and

- Planted riparian vegetation along Haytons Drain, where crossed by the CSM corridor, is considered significant due to its rarity in the district.

### 5.5 Avian Ecology

There are two main sets of wildlife (bird) values of potential conservation interest: those associated with a range of wetlands (mainly ponds) in the area, and those associated with the farmed grasslands.

The latter are considered insignificant in national, regional or even a local context, as grassland species are considered widespread in New Zealand, occur in very large numbers.

Regarding the wetlands (mainly ponds) of the area, a former pond at Musgrove Bros has been infilled. (This has been undertaken by way of resource consents granted by Environment Canterbury (ECan) (CRC040606.2) and CCC (RC971527) and held by GG & RJ Vickers (Musgrove Bros Ltd) for reclamation on the pond area.) In addition, Owaka Pond is currently being infilled by landfill. Consequently there are now no wetland avian values at Musgroves and those at the Owaka pond are extremely poor and are even of low local value due to the high rate of habitat deterioration.

The Upper Heathcote River supports little or no wetland avian habitat, except maybe on temporary bases after heavy rainfall.

Haytons Drain flows permanently and has riparian fencing for vegetation management and has value as a wildlife (avian) habitat.
5.6 Ground Conditions

In the duplication section of the motorway, silt and sand alluvium up to 22m thick and an intermediate gravel layer of up to 6 m thick overlie the Riccarton Gravel formation. The intermediate gravel layer is not present near Curletts Road. Ground water levels are between 1m and 3m depth below ground level.

In the greenfield section of the motorway, a surficial layer of fine alluvium of up to 6m thick was encountered which predominantly comprises silt, but with some thin layers of sand. This is underlain by gravel, with thin layers of silt and sand. Groundwater is indicated to be 3m to 5m below the ground surface. The greenfield section will cross over or nearby a number of known former landfill areas.

The near surface groundwater regime in the area of the southern motorway is indicated to comprise perched water and unconfined aquifers while the aquifer in the Riccarton gravels is artesian at Barrington Street end and sub-artesian elsewhere.

5.7 Groundwater

The ‘Geology of the Christchurch Urban Area’ (Brown and Weeber, 1992) describes the near surface geology of the area as ‘alluvial gravel, sand and silt of historic river flood channels’. Drillers’ logs from bores in this general area indicate that it is predominantly underlain by irregular layers and lenses of permeable gravel and sandy gravels with less frequent occurrences of lower permeability clayey silts.

According to the Proposed Natural Resources Regional Plan (PNRRP) (Environment Canterbury (ECan), July 2007 – Variation 6), the area of Christchurch covered by the motorway designation is generally characterised by the absence of an adequate surface confining layer and the absence of upwards groundwater pressure, i.e. underlain by an unconfined aquifer. Furthermore, ECan define the area as being located within the land surface recharge area for the Christchurch Groundwater System. Information obtained from the North Canterbury Catchment Board and Regional Water Board (NCCB, December 1986) indicates that the currently used productive aquifers in the Sockburn and Halswell areas extend to respective depths of 82 and 107 m below ground level. A schematic geological cross-section through the area is presented in Figure 2 of the PDP Report (Appendix 1 Volume 2).

Furthermore, the NCCB document details that in the Sockburn area the depth of most bores abstracting from the shallowest permeable aquifer are between 16-40 m below ground level, with the water table ranging between 2 m and 9 m below ground level. In the Halswell area, the depth of most bores abstracting from the shallowest permeable aquifer are between 10-24 m below ground level, with the water table ranging between ground level and 3 m below ground level.
Groundwater beneath the area is expected to flow in a general easterly to south-easterly direction (NCCB 1986) as indicated by the piezometric contours (Figure 3 (PDP report), although the drainage influences of both the Heathcote and Halswell Rivers may also influence this direction. Furthermore, some locally varying flow directions could result from the presence of more permeable coarse sand and gravel channels within the near surface strata and because of localised influences from the backfill material and its level of compaction.

ECan records show a number of groundwater abstraction bores in the area of the motorway designation. The location of these bores is presented in Appendix D of the PDP report. These bores are reportedly used for domestic, commercial, industrial, irrigation, stockwater, and water quality monitoring purposes. There are no CCC public water supply bores listed within 500 m down-hydraulic gradient of the former landfill boundaries (Landfills B, D, E1-E3 and 97).

At the eastern end of the route the PNRRP planning maps identify the presence of the Coastal Confined Gravel Aquifer System and from Wigram Road onwards semi-confined or unconfined aquifer.

The water table within the general area of the motorway designation is expected to range between 2 m and 9 m below ground level in the Sockburn area and between ground level and 3 m below ground level in the Halswell area.

5.8 Landfill sites

The corridor of the CSM crosses or passes close to a number of historical landfill sites. A series of investigations since 2002 have been carried to characterise the landfills and in August 2007 further investigations were completed. The sites are:

Site A: located off Wigram Road
Site B: located off mid-Wigram Road, Musgroves Limited
Site C: located off Wigram Road/Dunbars Road
Site D: located off Carrs Road and McTigues Road
Site E located off Owaka Road and is made up of three sites:
Site E1: Fumitaka Kaneko
Site E2: Owaka Road Investments Limited
Site E3: Bak Cheong Lee
Site F: located at the intersection of Halswell Junction Road and Springs Road
Site 97: located between Springs and Wilmers Roads, City Care Limited

Investigations concluded that Landfills A and C, did not reveal any signs of landfill material and so were not considered any further.
Investigations concluded that Landfill F is not located directly beneath the CSM designation but it is proposed that the site will be used as a stormwater detention basin for stormwater generated from the impervious road surface.

Groundwater was encountered in ten of the 35 test pits excavated along the motorway designation as part of the 2007 investigations.

Test pits were dug to determine whether there is a possible presence of hazardous substances, including pesticides. The 69 test pits excavated along the motorway corridor in addition to the 14 test pits excavated in the vicinity of Lee’s Basin did not reveal any obvious signs of any drums (plastic/metal). Pesticide compounds would typically be contained in such drums.

The test pits typically revealed the presence of construction/demolition waste in a soil matrix (Landfills B, E3, 97 and F), predominantly domestic/industrial in a soil matrix (Landfill E1 and E2) and domestic/industrial waste with minimal soil matrix in Landfill D.

5.9 Groundwater Quality

The groundwater data has been obtained from a number of sources including the Ecan GIS groundwater quality database. This data (at least 25 years worth) has been used to describe the groundwater quality in the vicinity of Landfill 97 which shows (as detailed in the report) no significant landfill leachate issues associated with this landfill.

Additional groundwater data has been obtained from groundwater monitoring/sampling undertaken as part of ECan resource consent requirements. This includes three consents (CRC040606.2, CRC972433 and CRC970337.1), which relate to Landfills B, D and E respectively, as described in the PDP (2008) report. Independent interpretation of data relating to CRC972433 by URS indicates that groundwater in the immediate vicinity of Landfill D (down-gradient of Landfills E1 and E2) does show the effects of landfill leachate however deeper potable supplies located in the vicinity of Landfill D show no adverse effect from landfill leachate.

In addition, groundwater sampling has been undertaken by PDP at four available abstraction bores located down-gradient and one bore located up-gradient of Landfills D and E1-E3. The results of the PDP sampling indicated no significant degradation in groundwater quality compared within groundwater sampled from the up-gradient bore to these landfills.

In all cases the groundwater data that was reviewed was considered to be relevant with respect to those issues likely to be associated with landfill leachate migration into the underlying groundwater.
Groundwater gradients and/or depths have been based on numerous PDP groundwater investigations undertaken in the local vicinity and on supporting information provided by ECAn, a PhD thesis undertaken by V Smith on Landfill D1 and URS in relation to Ecan resource consent CRC972433. This data is considered to provide an appropriate assessment of the likely variances in these groundwater parameters.

It is considered that the information presented in Section 8 of the PDP (2008) report provides an appropriate assessment of the existing groundwater conditions in the vicinity of the landfills along the motorway corridor and in particular in the vicinity of the 'worst' landfill (D) and to a lesser extent Landfills E1 and E2.

With respect to a qualitative assessment of surface waterways, there is a separation distance of over 250m between landfills D, E1, E2 and E3 (some of which contain putrescible matter) and the nearest surface waterway, which is not located in the expected downgradient direction. The nearest downgradient surface waterway is at least 500m in the south-easterly (down-gradient) direction. Natural processes including adsorption, biological degradation, chemical reactions and dispersion will reduce any contaminant loading in the groundwater environment and the separation distances between these landfills and the surface waterways is expected to mitigate any adverse environmental impacts during or post motorway construction (refer to section 7.3.1 for more discussion).

Although Landfill B is located close to a tributary of the Heathcote River, the benign material encountered within Landfill B motorway corridor test pits indicates that there is not expected to be any adverse environmental impacts during or post motorway construction. Furthermore, dilution with other flow in the surface waterway provides additional protection against adverse effects.

The current landscape of Christchurch results from the geomorphology of its alluvial and volcanic landforms, the subsequent soil and vegetation patterns that appeared on these landforms and the relatively recent effects of urbanisation; all of which are affected by a prevailing westerly temperate climate. Christchurch contains a range of ecosystems that are a direct reflection of its component landscapes - the coast, wet plains, dry plains, Port Hills and the urban landscape.

5.10 Landscape and Visual Character

The proposed CSM project is located within the southern extent of Christchurch’s wet plains and dry plains, which are overlaid in part by urban development.

The existing CSM and its proposed extension westwards traverse a landscape that is representative of the southern extent of the city, its peri-urban margin and of the southern headwaters of the Heathcote River.

The landscape the proposal traverses may be summarised into the following three sections:
• Duplication section - is a predominantly urban residential landscape, bisected by existing arterial roads and motorway.

• Greenfield section - is largely rural, with the only existing residential area being at Westlake and the Aidanfield subdivision. Some significant areas are in the process of being planned or developed for residential use (ie, the Wigram block and the Awatea block) and commercial use (ie, the Wigram block and the Awatea block).

• Halswell Junction Road Upgrade - consists of an industrial and commercial landscape.

The landscape traversed by the proposal is not identified in any relevant district or regional plan as an outstanding landscape.

6.0 Environmental Factors

<table>
<thead>
<tr>
<th>Terrain</th>
<th>The terrain can be characterised as:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duplication section - is a predominantly urban residential landscape, bisected by existing arterial roads and motorway.</td>
<td></td>
</tr>
<tr>
<td>Greenfield section - is largely rural, with the only existing residential area being at Westlake and the Aidanfield subdivision. Some significant areas are in the process of being planned or developed for residential use (ie, the Wigram block and the Awatea block) and commercial use (ie, the Wigram block and the Awatea block).</td>
<td></td>
</tr>
<tr>
<td>Halswell Junction Road Upgrade - consists of an industrial and commercial landscape.</td>
<td></td>
</tr>
</tbody>
</table>

| Site Area | Approximately 50ha (based on preliminary Erosion and Sediment Control schedule) |

| Size of earthworks | Approximately 50ha (based on preliminary Erosion and Sediment Control schedule) |

| Volume of material moved | 500,000m$^3$ of imported fill together with approximately 130,000m$^3$ of cut to fill. |

| Topography | The CSM topography can be described as flat. There are steeper areas associated with the batters of the existing CSM. |

| Catchments | The catchments contributing to the sediment control devices vary between 0.5ha – 1.5ha, across the project. |

| Drainage Features | The CSM project discharges to the Heathcote and Halswell River Catchments. |

| Geotechnical limitations/ opportunities | The main limitation is the presence of the former landfill sites. The site soils limit the types of stormwater devices that could be installed. |

| Soils | The geology of the area is indicated in the Institute of Geological and |
Nuclear Sciences urban map series Map 1 “Christchurch” at 1:25,000 scale (IGNS, 1992). The Waimakariri River plains are underlain by sediments up to 1.5 km thick.

Alluvial sediments of between 15 m and 20 m thick have been deposited since the last deposits of glacial outwash material (about 70,000 years ago). In the project area these recent sediments comprise mainly the Yaldhurst Member of the Springston Formation, which includes:

- Flood channel infill materials generally comprising gravels and sands
- Overbank alluvial silt deposited during flooding
- Peat deposits formed in well established swamps

Estuarine deposits underlie parts of Spreydon and sands containing shells were encountered in boreholes at Barrington Street at the eastern end of the motorway route, and are inferred to be part of the Christchurch Formation.

The recent alluvial and estuarine sediments are underlain by glacial gravels of the Riccarton formation, which are up to 20 m thick.

<table>
<thead>
<tr>
<th>Erosion Potential</th>
<th>The sites gradients (essentially flat) significantly reduce the erosion potential of the project.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Flooding History</td>
<td>The CSM site is not located within the floodplain, although areas within the lower catchment are subject to flooding.</td>
</tr>
<tr>
<td>Design Storm Event</td>
<td>Erosion and Sediment Controls were designed in accordance with Environment Canterbury’s (ECan) “Erosion and Sediment Control Guidelines” (Report No. R06/23 – dated February 2007). The guideline utilises the 10hour 20% AEP rain event.</td>
</tr>
<tr>
<td>VKT at time of completion.</td>
<td>The CSM is still being constructed.</td>
</tr>
<tr>
<td>Catchment classification.</td>
<td>The project catchment is classified as Urban – Peri-Urban</td>
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</table>

<table>
<thead>
<tr>
<th>Sensitivity of receiving environment</th>
<th>Attribute</th>
<th>Sensitivity</th>
<th>Score</th>
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<tbody>
<tr>
<td>Type Sensitivity</td>
<td>Moderate</td>
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<tr>
<td>Ecological Value</td>
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</tr>
<tr>
<td>Human Use Value</td>
<td>Moderate</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Overall Sensitivity Rating</td>
<td></td>
<td>35</td>
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</table>
7.0 Designed Solutions

This section of the ‘road test’ compares the designed Erosion and Sediment Control solutions compared to that required through NZTA’s Draft Erosion and Sediment Control Standard (NZTA draft standard).

7.1 Design Philosophy

Existing Design

The Canterbury Regional Policy Statement contains the following objectives and policies in relation to earthworks and impacts on water quality.

Chapter 9 – Water Quality

Objective 2
Enable present and future generations to gain cultural, social, recreational, economic, health and other benefits from the water quality in Canterbury’s water bodies and coastal waters, while:

(a) safeguarding the existing value of water bodies for efficiently providing sources of drinking water for people;
(b) safeguarding the life-supporting capacity of the water, including its associated: aquatic ecosystems, significant habitats of indigenous fauna and areas of significant indigenous vegetation;
(c) safeguarding their existing value for providing mahinga kai for Tangata Whenua;
(d) protecting wahi tapu and other wahi taonga of value to Tangata Whenua;
(e) preserving the natural character of lakes and rivers and protecting them from inappropriate use and development;
(f) protecting outstanding natural features and landscapes from inappropriate use and development;
(g) protecting significant habitat of trout and salmon; and
(h) maintaining, and where appropriate, enhancing amenity values.

Policy 9
To manage point and non-point source discharge and set water quality conditions and standards and terms in plans, and conditions on resource consents, that achieve (a) to (h) of Objective 3. Adverse effects of discharges on existing water quality should be avoided, remedied or mitigated and, where appropriate, degraded water quality should be enhanced.

Policy 11
Promote land use practices which maintain and where appropriate enhance water quality.

The Canterbury Proposed Natural Resources Regional Plan contains the following objectives and policies in relation to earthworks and impacts on water quality.
Chapter 8 – Soil Conservation

Policy SCN5: Earthworks and vegetation clearance activities

(1) Wherever any earthworks or vegetation clearance activity is carried out that increases the risk of soil erosion, the use of best management practices for reducing the amount of erosion likely to occur as a result of that activity should be adopted.

(2) Earthworks and vegetation clearance activities that have the potential, regardless of the method adopted, to result in significant induced soil erosion, or to lead to significant off-site effects, should not be undertaken unless effective measures are in place to:

(a) minimise the risk of induced erosion occurring;
(b) contain the movement of sediment transported in runoff generated from the activity site;
(c) undertake land rehabilitation necessary to stabilise the site, and to restore an intact vegetation cover wherever practicable; and
(d) avoid any significant adverse effects of erosion or sediment deposition on:
   (i) water bodies, including their aquatic habitat and beds, associated wetlands and their flood carrying capacity;
   (ii) areas important for the protection of indigenous biodiversity, including indigenous flora, and the habitats of indigenous fauna;
   (iii) sites of significance to Ngāi Tahu, including wāhi tapu;
   (iv) sources of mahinga kai;
   (v) outstanding natural features and landscapes or amenity values for the area; and
   (vi) property or built assets including network utilities.

Draft NZTA Standard

The above requirements would have still been applicable had the NZTA draft standard been in place. In addition NZTA’s Environmental Plan contains the following objectives that would need to be applied.

- Ensure construction and maintenance activities avoid, remedy or mitigate effects of soil erosion, sediment run-off and sediment deposition.
- Identify areas susceptible to erosion and sediment deposition and implement erosion and sediment control measures appropriate to each situation with particular emphasis on high-risk areas.
- Use bio-engineering and low-impact design practices where practicable.

It is not considered however that these objectives would have altered the design of Erosion and Sediment Control devices.

7.2 Criteria

Existing Design

Decanting Earth Bunds are sized on a 10 hour 20% AEP rain event. In this regard the CSM project adopted 1.5ha = 75m³ of storage. Maximum allowable catchment 1.5ha (flat gravels). Decanting Earth Bunds are the main sediment control device being utilised in the CSM project.

Diversion Channels are sized on a 10 min 5% AEP rain event. In this regard 0.5m bunds were required for the CSM project.

Silt fences maximum catchment is determined by soil and slope length draining to the silt fence. On the CSM the maximum allowable slope length is 100m. Silt fences were used in isolated areas and adjacent to culvert duplications.

Copies of the Erosion and Sediment Control Plans are contained at Appendix 1)

Draft NZTA Standard

The NZTA draft standard sizes sediment control devices based on a hydrological design approach taking into account the following parameters:

- Soil,
- Slope,
- Rainfall,
- Ground cover, and
- Risk associated with the design.

This approach is similar to that contained within ECAN's guideline.

For the CSM project the following parameters would have been used:

Runoff – 0.15 (Flat gravel – flat silty loam).
Rainfall – 20 year storm
Risk – 95% design risk – High Potential (disturbance greater than 6 months)

Storage volumes for decanting earth bunds would equate to 1.5ha = 51m³. This is a decrease in storage volumes by approximately 32%. It is noted that the NZTA draft standard has a maximum allowable catchment of 0.3ha. In this regard either 102 additional Decanting Earth Bunds (refer Appendix 2) would be required for the same area of earthworks or Sediment Retention Ponds would have need to considered as the main method of sediment control.
The diversion bunds would be a similar size utilising the NZTA draft standard approach.

The design approach using the NZTA draft standard would require approval from NZTA to increase the contributing catchment to the Decanting Earth Bunds.

7.3 References

Existing Design

Erosion and Sediment Control devices were designed in accordance ECan’s “Erosion and Sediment Control Guidelines” (Report No. R06/23 – dated February 2007) and the suite of consents and associated conditions.

Draft NZTA Standard

The reference documents utilised to design Erosion and Sediment Controls would still include ECan’s “Erosion and Sediment Control Guidelines” (Report No. R06/23 – dated February 2007) and the suite of consents and conditions. The NZTA draft standard also requires consideration of NZTA Environmental Plan and Australia New Zealand Environmental and Conservation Council Guidelines for Fresh and Marine Water Quality.

It is noted that when reviewing project requirements the ‘more’ stringent criteria for design takes precedence. In this regard the ECan’s guideline provides more stringent requirements in terms of storage for Decanting Earth Bunds. Whereas the NZTA draft standard and Guidelines for Fresh and Marine Water Quality provides greater guidance for addressing receiving environment risk and water quality monitoring.

8.0 Project Requirements

8.1 Local Consent Requirements

Existing Design

Discharge consents are required from ECan for earthwork operations. The consents consider discharges to air, land and water. Further consents are also required for works adjacent to riparian margins and in, on or under the bed of watercourses.

The following consents contained references to Erosion and Sediment Control.

CRC082970 - Discharge Permit for the temporary discharge of water and water containing contaminants onto and into land and into water.

CRC082964 - To discharge contaminants into air from excavating landfill material.
CRC082969 - Discharge permit to discharge stormwater onto and into land from Temporary Construction Management Areas.

CRC082943 - To use land to excavate and remove landfill materials from landfills.

CRC082945 - To use land to deposit screened landfill material.

CRC082946 - To excavate land over an unconfined or semi-confined aquifer.

CRC082948 - To disturb land and deposit soil within the riparian margins of the Heathcote River.

CRC082950 - To clear vegetation within the riparian margins of the Heathcote River.

CRC082953 - To erect and use a bridge structure and stormwater outfalls.

CRC082961 - To permanently divert Haytons Drain and Curletts Drains.

CRC082957 - To temporarily divert surface water.

Draft NZTA Standard

The NZTA draft standard would not have altered the consenting requirements for the project as this is determined by ECan’s (and others) statutory planning documents.

Conditions of consent may have been altered, but as the contract is a Design and Construct it is the successful project team’s obligation to design Erosion and Sediment Control devices in accordance with these conditions and references to guidance documents or standards.

8.2 Phasing

Existing Design

The CSM is being undertaken (and managed) in three Zones. The Figure below details the sectioning of the project into the three Zones (A, B, C) and outlines the key features and the overall sequence of events for the construction of each Zone.

The Zones are progressed concurrently and are managed by construction management teams dedicated to each Zone. All three Zones require preliminary works to be completed before major construction activities can begin.

Zone A requires early works to relocate services and complete the drainage upgrade works before the main widening and pavement work can begin. Work will generally be
progressed from west to east in the Zone with the first stage concentrating on the widening of the eastbound lane.

Zone B is greenfields motorway construction with early works required to begin landfill monitoring, establish sediment controls and complete drainage works at the east end. Pavement construction is mostly at grade after coming off the embankment fill at the east end and will progress in a westerly direction. Structures will be completed generally in sequence with the pavement construction. The landfills will be dealt with later in the Zone programme when sufficient baseline monitoring data has been collected, in accordance with the Landfill Management Plan.

Zone C is on the critical path and early works involve service relocation and building demolition at the east end to allow ground improvements and embankment preloading to be completed prior to bridge construction. The major structures will be started after the necessary settlement periods and are regarded as significant activities in this Zone. Embankment and pavement construction will be progressed from east to west and embankment bulk fill works will begin soon after the stone column ground improvements are completed.

Draft NZTA Standard

The requirement for phasing/ staging is at the discretion of the consenting authorities, in this case ECan.

The NZTA draft standard promotes phasing and staging as a means of reducing the impact of sediment on the receiving environment, however does not contain specific directives on this matter.

8.3 Winter Construction

Existing Design

The suite of consents does not place a restriction on winter works. It is acknowledged however that construction is dependent on periods of nil to low rainfall. In this regard
construction activities, specifically bulk earthworks are programmed in periods of low rainfall which are typically the summer months.

**Draft NZTA Standard**

Restricting work in winter is at the discretion of the consenting authorities, in this case ECan. The NZTA draft standard would not have significantly altered this requirement.

### 8.4 Temporary Measures Converted to Stormwater Practices

**Existing Design**

The CSM utilised permanent stormwater ponds where they were available as sediment control practices. The devices were constructed as permanent measures and temporarily used as sediment control practices.

**Draft NZTA Standard**

The NZTA draft standard would not have significantly altered this approach to construction.

### 8.5 Dewatering, Sediment Removal and Disposal

**Existing Design**

Intermittent pumping from a sump pit at the bottom of the excavation/piling is being undertaken. Pumped water is discharged to sediment control measures detailed in the Erosion, Sediment and Dust Control Plan, primarily Decanting Earth Bunds.

Where practicable water within the Decanting Earth Bunds is being collected and reused (water trucks) for dust control and to promote grass growth.

**Draft NZTA Standard**

The NZTA draft standard would not have significantly altered this approach to construction, however it does provide additional guidance on this matter when compared to ECan’s “Erosion and Sediment Control Guidelines” (Report No. R06/23 – dated February 2007).

### 8.6 Decommissioning

**Existing Design**

The Erosion, Sediment and Dust Control Plan details the decommissioning of Erosion and Sediment Control devices. It is anticipated that the site will be stabilised prior to the removal of the Erosion and Sediment Control measures.

**Draft NZTA Standard**

The NZTA draft standard also contains specific guidance on the decommissioning of Erosion and Sediment Control devices. This guidance is similar to that contained in ECan’s guideline and in this regard the NZTA draft standard would not have altered the manner in which decommissioning was undertaken.

### 9.0 Erosion and Sediment Control Practices

#### 9.1 Erosion Control

**Existing Design**

Erosion control being used on the CSM includes cleanwater diversions, sediment laden diversions and progressive stabilisation (including the use of rock fill).

The erosion control practices are required to comply with ECan’s guideline. The specific measures were assessed and approved by ECan prior to implementation.

**Draft NZTA Standard**

The NZTA draft standard contains specific guidance on erosion control practices. These practices are similar to that contained in ECan’s guideline. The NZTA draft standard would not have significantly altered this approach to erosion control on the CSM project.

#### 9.2 Sediment Control

**Existing Design**

Sediment control on the CSM was predominantly Decanting Earth Bunds. The Decanting Earth Bunds were sized on $75\text{m}^3$ of storage per $1.5\text{ha}$ of contributing catchment.

The sediment control practices are required to comply with ECan’s guideline. The specific measures were assessed and approved by ECan prior to implementation.

The design to date requires the implementation of 40 Decanting Earth Bunds ranging in storage size from $25\text{m}^3$ to $75\text{m}^3$ (Appendix A).

Decanting Earth Bunds require the installation of an upstand decant to operate as a controlled outlet.
Draft NZTA Standard

The NZTA draft standard would have altered the approach to the type of sediment control. The design of Decanting Earth Bunds in the NZTA draft standard have a maximum contributing catchment is 0.3ha whereas the EC guideline allows a maximum contributing catchment of 1.5ha (flat gravel).

In this regard the NZTA draft standard would require an additional 102 Decanting Earth Bunds or the consideration of using Sediment Retention Ponds. The NZTA draft standard does allow alternatives to be considered however this would be at the discretion of the NZTA project manager.

The other significant difference is the outlet arrangement. The NZTA draft standard requires the use of a floating T-Bar. The use of T-Bar decants would add a small additional cost to the construction of the device.

If however approval from NZTA was gained to allow a greater contributing catchment (>0.3ha) the additional cost associated with the outlet would be offset by the reduced numbers of Decanting Earth Bunds.

9.3 Non-Sediment Contaminants

Existing Design

The Contractors Environmental Management Plan (CEMP) outlined procedures for dealing with non-sediment contaminants. The CEMP dealt with the following matters:

Contents
1. Introduction
   1.1. Purpose
   1.2. Scope and Application
2. Designations and Resource Consents
   2.1. CEMP Table
3. Other Legal Requirements
   3.1. Health Safety and Employment Act
   3.2. Hazardous Substances and New Organisms Act and Hazardous Substances regulations 2001
   3.3. Transit New Zealand Act
   3.4. Land Transport Management Act
   3.5. Historic Places Act
   3.6. Resource Management Act
4. Risk and Opportunity
5. Contractual Requirements
   5.1. Principles Requirements
5.2. Subcontracted Activities

6. Fulton Hogan Commitment
   6.1. Policy
   6.2. Environmental Objectives

7. Construction Methodology Overview

8. Environment Background
   8.1. General Location and Context
   8.2. Existing Road Network
   8.3. Geology
   8.4. Fresh Water Ecology
   8.5. Terrestrial Ecology
   8.6. Ground Conditions
   8.7. Groundwater
   8.8. Landfills

9. Personnel
   9.1. Structure
   9.2. Roles and Responsibilities

10. Mitigation of Environmental Effects
    10.1. Environmental Management Approach and Methods
           10.1.1. Stormwater Management (including erosion and sediment control, and dust management)
           10.1.2. Managing Noise and Vibration
           10.1.3. Landfill Management

11. Environmental Monitoring and Auditing
    11.1. Monitoring and Measurement
    11.2. Plan Certification Process
    11.3. Systems Audits and Reviews
    11.4. Environmental Management Records
    11.5. Reporting
    11.6. Non Conformance, Corrective and Preventative Action
    11.7. Training and Awareness
    11.8. Communications
    11.9. Complaints
    11.10. Emergency Response Plan

Appendix 1  Environmental Management Control Group
Appendix 2  Project Procedures, Methods & Other Controls
Appendix 3  Resource Consents
Appendix 4  Dewatering Management Plan
Appendix 5  Erosion, Sediment & Dust Control Plan
Appendix 6  Construction Noise Management Plan
Appendix 7  Landfill Management Plan
Appendix 8  Vibration Management Plan
Appendix 9  Settlement Monitoring Plan
The NZTA draft standard (Section 10) lists a variety of non-sediment contaminants associated with construction projects.

<table>
<thead>
<tr>
<th>Work activity/product</th>
<th>Stormwater contaminants</th>
<th>Contaminant indicator</th>
<th>Associated non-visible potential contaminants</th>
</tr>
</thead>
</table>
| Adhesives             | • Adhesives, glues, resins, epoxy, PVC cement  
                        • Caulks, sealers, putty, sealing agents  
                        • Coal tars (naphtha, pitch) | Oily sheen or other discolouration from some product | Phenolics, formaldehyde, asbestos, benzene, phenols, and naphthalene |
| Asphalt paving        | Hot and cold mix asphalt | Oil sheen             | • Oil, petroleum distillates  
                        • Polycyclic Aromatic Hydrocarbons (PAHs) |
| Cleaners              | Cleaners, ammonia, lye, caustic sodas, bleaching agents and chromate salts | Discolouration acidity/alkalinity | |
| Concrete              | Cement                  | Discolouration         | Alkalinity (high pH) |
| Sanitary waste        | • Portable toilets  
                        • Disturbance of sewer lines | Visible sanitary waste | Bacteria, BOD, pathogens |
| Vehicle and equipment use | • Equipment operation  
                        • Equipment maintenance  
                        • Equipment washing  
                        • Equipment fueling | Oil sheen, sediment | Total petroleum hydrocarbons, coolants, benzene and derivatives |
| Treated wood          | • Copper  
                        • Chromium  
                        • Arsenic | Greenish tinge to water | Arsenic |
| Nutrients             | • Nitrogen  
                        • Phosphorus  
                        • Magnesium  
                        • Sulphur | Little discolouration | • Nitrogen  
                        • Phosphorus  
                        • Magnesium  
                        • Sulphur |

It then further assists in potential mitigation of these contaminants (refer following table).
It is considered that the NZTA draft standard would not have significantly altered the approach taken in handling or mitigation of non-sediment contaminants. In this regard the CEMP would have met the NZTA draft standard requirements.

10.0 Cost

10.1 Resource Consents

The consents were notified by ECan and CCC. The costs associated with preparing the Assessment of Environmental Effects, preparation of evidence and attending the hearing (and associated hearing costs) are unknown.

It is not anticipated that any additional costs would be incurred with the inclusion of the NZTA standard.

SouthernSkies Environmental Limited
10.2 Design, Construction and Monitoring

Existing Design

The contract is Design and Construct. Information provided by NZTA indicate that the cost associated with the design, construction and monitoring of Erosion and Sediment Control is in the order of $850,000 and hydrosedding $50,000. The cost of Erosion and Sediment Control compared to the total Design and Construction ($105 million) cost is 0.8%.

Council monitoring costs are anticipated at $1000 per month of construction.

Draft NZTA Standard

It is not anticipated that any additional costs for design would be incurred with the inclusion of the NZTA draft standard.

There could possibly be an increase in cost associated with the construction of the sediment control practices implemented onsite given the maximum allowable catchment to a Decanting Earth Bund of 0.3ha (NZTA draft standard) vs 1.5ha (ECan Standard).

The increase in cost would be associated with the additional Decanting Earth Bunds required to treat the same area of earthworks and the outlet arrangement (upstand to floating T-Bar). The plans prepared to date, provide treatment for approximately 43ha through 40 Decanting Earth Bunds. Using the NZTA Standard the equivalent area of earthworks utilising the NZTA standard would require 142 Decanting Earth Bunds. It is acknowledged that the standard does allow alternatives to be considered however this would be at the discretion of NZTA project manager.

The increase in cost could possibly be offset by the reduced volume requirement of the NZTA draft standard. However it is noted that where more stringent requirements are contained within local guidelines then they will override the NZTA draft standard.

As the costs for design, construction and monitoring are only a single line item in the contract it is difficult to break these down further to ascertain the actual costs of any single component. It is not anticipated that the NZTA draft standard would significantly increase any of these costs.

Additional water quality monitoring is anticipated through the NZTA draft standard however work that Southern Skies is undertaking on other projects demonstrates that the costs are in the order of $1000 per storm event exceeding 25mm over 24 hours. Additional costs are incurred on projects where automated monitoring systems are required and laboratory analysis of water samples.
It is generally accepted that Environmental Management is in the order of 1 – 3% of total project costs.

10.3 Time

Existing Design

The resource consent applications were completed on 30 May 2008 with the hearing undertaken in September/ October 2008. A decision was released on 23 February 2009, a total time period of 8.5 months.

Draft NZTA Standard

The preparation of the resource consent applications and processing timeframe would not have changed with the NZTA draft standard assuming that the consenting authority technical experts had a working knowledge of the NZTA draft standard. It is considered that as the NZTA draft standard is rolled out through New Zealand it will become more widely used and technically understood.

10.4 Final Design

Existing Design

A Design and Construct contract allows the project team to progressively undertake the design based on the contract programme. The CSM project is still being constructed and therefore design modifications occur in parallel.

The design of the Erosion and Sediment Control Plans were undertaken based on conceptual earthwork plans and consent conditions and sufficient plans to allow the bulk works to commence were completed prior to construction commencing.

The Erosion and Sediment Control Plans took 4 months from award of contract to prepare.

Draft NZTA Standard

The design of the Erosion and Sediment Control Plans using the NZTA draft standard would not have taken any longer to prepare given that sizing of sediment control practices within the ECan guideline is similar to that of the NZTA draft standard.

SouthernSkies had no previous experience with the ECan guideline when designing the Erosion and Sediment Control Plans and therefore regardless of the guideline being used time is required to understand the guideline/ standard.
10.5 Construction

Existing Design

Construction of the CSM is currently being undertaken. The Erosion and Sediment Controls were integrated into the construction of the CSM alignment and therefore the individual time taken to construct practices is unknown.

Decanting Earth Bunds can generally be completed within 1 day of commencement of works and are integrated into the perimeter cleanwater/ sediment laden diversions.

Draft NZTA Standard

The time taken to construct the Erosion and Sediment Controls using the NZTA draft standard would not have changed, other than if the sediment control devices were changed from Decanting Earth Bunds to Sediment Retention Ponds.

10.6 Monitoring

Existing Design

Monitoring of the Erosion and Sediment Controls are undertaken by the CSM project team on a weekly basis, and before and after rainfall. Inspections sheets are completed and any remedial works undertaken

Allowance has been made within the contract for ECAn monitoring, however this is generally on an ad-hoc basis.

Draft NZTA Standard

The frequency of monitoring by the CSM project team would not be altered by the adoption of the NZTA draft standard. Water quality monitoring as required by the NZTA draft standard would be additional to what is being undertaken by the CSM project team. In this regard staff with sufficient training and expertise in water quality monitoring would be required. On many projects throughout New Zealand these services are contracted into the project team. The associated costs are in the order of $1000 per storm event exceeding 25mm in 24 hours. Automated sampling can increase these costs in terms of sampler hire fees and laboratory analysis of water samples.

11.0 General Comments

The NZTA draft standard considers a risk based approach to erosion and sediment control practices taking into account:

- Soil,
- Slope,
- Rainfall,
- Ground cover, and
- Risk associated with the design.

It is considered that this approach will generally exceed local guideline requirements and is a more scientific approach to sizing of practices taking into account site specific parameters. The ECAn guideline takes a similar approach as it considers rainfall and runoff to determine device sizing.

In some instances on the CSM project the ECAn guideline is less stringent than the NZTA draft standard, particularly regarding the contributing catchments to Decanting Earth Bunds (1.5ha vs 0.3ha) and the outlet arrangements (upstand decant vs T-Bar decant). There is a significant difference in storage volumes per hectare (75m$^3$ vs 51m$^3$).

The NZTA draft standard provide clear information in relation to design, construction and decommissioning of devices similar to that contained within the ECAn guideline. The addition of the Contractors Field guide will assist contractors to understand the key parameters of the devices. This is considered integral to ensure they are constructed, operated and maintained in accordance with Best Practice and will perform as designed.

The increase in water quality monitoring required by the NZTA draft standard will generally increase monitoring costs associated with construction projects. The results however will assist in refinement of controls and the NZTA draft standard itself.

A key issue associated with any Erosion and Sediment Control plan development and approval by consenting authorities is education and experience. In many cases the council staff reviewing plans do not have adequate technical knowledge of the guidelines/standards and this leads to delays in approvals. Education on the NZTA draft standard is considered a key matter that NZTA will need to address to ensure that delays are not experienced.
# Appendix 2 – Decanting Earth Bunds

<table>
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<th>Decanting Earth Bund</th>
<th>Contributing Catchment (ha)</th>
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<th>NZTA</th>
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