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Civil.
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4.1 Overview

4.1.1 Purpose

The Civil section of the Design Standard Guidelines provides a reference document to support consistency across design and engineering objectives. The document provides guidance on the minimum performance standards for civil design, and ultimately aims to maximise the ability of the built environment to support the University’s long term objectives.

This section of the Design Standard Guidelines is intended to be read and applied in conjunction with Section 01 – General and any project specific brief and agreements.
4.2 Design Concepts

4.2.1 General
The following general design parameters should be considered during the civil design of works undertaken at the University.

Key requirements have been included wherever possible, however it is the responsibility of the civil consultant to identify any areas of ambiguity or omission and ensure that the overall design meets the overall performance intentions identified in this guideline.

The civil consultant shall coordinate with all other consultants engaged on the project to ensure requirements for aspects such as structure and architectural design are met within the civil scope of works. Where these consultants are not engaged on a project, the civil consultant shall flag any areas of concern or issues with compliance in these areas to the University of Canterbury Project Manager for discussion.

4.2.2 Design Options
The Consultant shall investigate design options such as ring mains, reservoir storage and pumping systems and provide recommendations of the most effective and efficient solution with respect to the University’s present and future supply demands.

4.2.3 Due Diligence Activities Options
The civil consultant shall obtain all necessary data such as mains water pressures/flows etc. to assist system design and for the submission of design for approvals.

The consultant shall also provide full computer-designed hydraulic calculations to the satisfaction of the Regulatory Authorities and the University to support the selected design option.

4.2.4 Stormwater Design

4.2.4.1 Minimum Design Criteria
The stormwater system shall be designed for a minimum of the 100 years return rainfall intensity.

4.2.4.2 Stormwater Discharge
All stormwater discharges at the Ilam campus currently end up in two waterways; the Avon, and the Okeover.

All new works shall be the subject of a detailed assessment to ensure that these do not cause further degradation to the current fragile state of these waterways.

Additionally, every opportunity should be taken to improve the existing discharge conditions into these environments where practical.

4.2.4.3 Treatment
Large scale use of zinc or copper solutions on facades or roofs have been proven to transfer these heavy metals into the waterways.

These solutions should be avoided where ever possible, and if not they need to be treated at source before entering the site infrastructure to waterways.
4.3 Civil Works Elements

4.3.1 Sewer Drainage
Generally heavy duty sewer class uPVC pipe and fittings are acceptable for all in-ground and suspended sewer drainage installation.

Sewer drainage receiving hot discharge and/or solvents shall be brass pipe and fittings or other approved material.

Inspection openings under concrete paving shall be extended to the finished level to provide access to the entire drainage installation.

Inspection chambers shall be provided at main junctions, changes in gradient and direction and at intervals not exceeding 60 metres.

Covers and frames to be "Gatic" cast iron type. Internally placed chambers shall be fitted with edge strips to accommodate floor finishes.

Step irons shall be provided in chambers exceeding 1.2 metres in depth.

Internal chamber drops shall be in cast iron pipe and fittings.

At least one overflow relief gully shall be provided for each building.

Test sumps to neutraliser pits and mixing tanks shall be easily accessible.

Placement of neutraliser tanks shall take into account the requirement for vehicular access where pumping out procedures are necessary. Associated dosing tanks shall be located where access can be gained independently of any laboratory or office areas. An adjacent cold water point shall also be provided for washing down purposes.

4.3.2 Stormwater Drainage
Underground stormwater drainage shall be rubber ring reinforced concrete class "X" pipe for sizes 300mm and greater in diameter. Pipes subjected to greater loadings or reduced cover shall be class "Y" or "Z" depending upon circumstances.

Underground stormwater drainage shall be sewer class uPVC pipes and fittings for sizes up to 300mm in diameter (minimum size of 100mm in diameter to be used).

Provide pits at changes in direction, grade, junctions and at spacing’s no more than 60 metres for pipes 225mm diameter or greater.

Provide inspection openings at changes in direction, grade and junctions for pipes 150mm diameter or greater. Extend selected inspection openings to finished level when pipes are located under concrete paving.

Provide grated pits at the base of all downpipes.

Pit covers, grates and frames to be "Gatic" cast iron type. The duty shall be dependent upon location.

Pits are to be either precast or in situ concrete. In situ concrete pits to have a minimum wall thickness of 150mm and placed using inner and outer forms. PVC or poly heavy duty pits may be used for PVC drains up to 150mm diameter.

Provide step irons in pits exceeding 1.2 metres in depth.

Consideration shall be made in the design to exclude garden mulch entering the drainage system causing blockages and reducing efficiency.

4.3.3 Service Culverts
Culverts shall be constructed of reinforced concrete cast in-situ or pre-cast and shall be provided with removable reinforced concrete lids fitted with substantial lifting eyes along the entire length.

The culverts shall be formed up internally and externally prior to casting.

Piping supports and fittings shall be galvanised. Pipe supports shall be installed in slots casing the culvert walls rather than by the use of masonry anchors. All supports should be 65mm clear of the floor of the culvert so as not to impede the flow of possible seepage water.

Lids on culverts should be sealed at sides and ends with an approved mastic compound. Notwithstanding, all culverts shall be laid to a grade and be provided with sumps and outlets for drainage.

Piping supports should not impede the free flow of seepage water along the floor of the culvert. All piping fittings including valves, expansion bellows and flanges shall be accessible from pits brought up to ground level.

Service culverts shall be provided with natural ventilation where there is a potential for culvert temperatures to exceed 50°C.

4.3.4 Landscaping Drainage
Provide sub-soil drainage to below ground building structures, back of kerbs and landscape areas where excessive ground water may be a problem.

Pipework for straight lengths shall be slotted rigid uPVC pipes and fittings and elsewhere shall be slotted flexible corrugated type pipe and purpose fittings. Pipe sizes shall be 100mm minimum diameter.

Pipework shall be surrounded in 150mm clean, washed, evenly graded, granular bedding material. The granular material and pipework shall be overwrapped with a geotextile layer to prevent fines entering the drainage system.

4.3.5 Standard Specification
Detailed guidance for the construction of other civil works elements at the University of Canterbury is to be as per the details in Appendix A - Civil Works Standard Specification.

The specification covers the following:
- Concrete kerb and channels
- commercial crossing
- concrete nib kerbs
- concrete paving in non-trafficked areas
- concrete paving in trafficked areas
- asphaltic concrete footpaths
- trafficked asphaltic concrete
- timber edging
- cobble paving with concrete edge restraint (epoxy)
- cobble paving with concrete edge restraint (butted)
- concrete pavers in non-trafficked areas
- concrete pavers in trafficked areas
- trenching/backfilling pipework
- works around protected trees
- saw-cutting existing reinforced concrete
- pavement crack filling
- erosion and sediment control
4.3 Civil Works Elements

4.3.5.1 CCC Construction Standard Specifications

The Civil Works Standard Specification references in detail the Christchurch City Council Construction Standard Specifications. It is the University’s expectation that designers and contractors working on civil works designs at the University are familiar with these documents.

4.3.5.2 Common Requirements for Construction

The following minimum requirements are generally applied in the Civil Works Standard Specification.

- Testing of all subgrade ground conditions to ensure a California Bearing Ratio (CBR) of greater than 7.
- On site measurements to confirm a minimum dry density of 98%, or 2200 kg/m^3 of all compacted fill.
- Evidence that the concrete used has a slump of 80mm and a 28 day compressive strength of 20 Mpa.
- The contractor is to provide documentation that the above three requirements have been met (as a minimum).

Designers and contractors should check to ensure that higher or additional requirements are not prescribed elsewhere in this design guideline or the appended specification.
CIVIL WORKS STANDARD SPECIFICATION

REINSTATEMENT WORKS
FOR
UNIVERSITY OF CANTERBURY

14 March 2016 | Issue A
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CIVIL WORKS STANDARD SPECIFICATION ISSUE A
C.1 CONCRETE KERBS AND CHANNELS

C.1.1 DELIVERABLES

The Contractor shall allow to produce and supply the University of Canterbury with the following documentation.

- Test results that indicate that the exposed subgrade has a California Bearing Ratio (C.B.R.) value greater than 7.
- NDM test results indicating that the density of the foundation material has a minimum dry density of 98%, or 2200 kg/m³.
- Evidence that the concrete used has a slump of 80mm and a 28 day compressive strength of 20MPa.
- Tickets with the recorded amounts of material imported/removed from the site.
- Proof of the verticality of the kerbs does not exceed ±5mm

C.1.2 FOUNDATION

The 250mm AP40 foundation shall consist of crushed rock free from all non-mineral matter and should comply with T.N.Z. M/4 1995. Although alternative aggregates will be acceptable, provided the Contractor can produce satisfactory evidence as to their suitability.

Compaction shall be in layers not exceeding 150mm of loose depth. On site measurements must be conducted to determine in-situ density and moisture content of the compacted material. Density testing (NDM) on each layer of placed material must be conducted at a spacing of about 2m intervals as appropriate. All fill material shall be compacted to a minimum of 98% maximum dry density as determined by NZS 4402:1986, Test 4.2.2, or 2200 kg/m³.

This is provided that the subgrade ground conditions are met. The Contractor is to proof roll the subgrade and then test the subgrade using the Scalar Penetrometer test, or similar approved alternative, to verify that the subgrade meets the required minimum CBR value of 7.

All testing required to assess compaction and uniformity is to be at the cost of the Contractor. A minimum of 24 hours notice shall be given to the Engineer of when density tests are to be performed. The Contractor is to allow for the costs of the tests for each stage of the construction and provide a copy of the results to the Engineer prior to sealing.

C.1.3 CONSTRUCTION

Concrete kerbs generally shall be in accordance with Christchurch City Council Construction Standard Specification.

Cut down kerbs must be formed in wet concrete when the kerbs are being laid. Saw cutting to form cut down kerbs will not be accepted.

Concrete shall have a minimum 28-day compressive strength of 20 MPa unless otherwise specified and shall have a slump of 80mm. Kerbs shall be cast or placed in one operation on a solid foundation.

Before the concrete has finally set, the kerb shall be steel floated to give a true smooth surface to a Class U3 finish complying with NZS 3114 “Specification for concrete surface finishes” for all exposed front face, top and 100mm of back of kerbs.

The finish on any hand formed kerbs and channels shall match that of the machine laid kerbs and channels.

The verticality of the kerb shall be within ±5mm of vertical over the typical total height of the kerb (270mm).

Form shrinkage control joints using either a grooving trowel or sawcut at 5m centres, and:
- Full thickness sawcut construction joints are to be made at the edge of the concrete surround at sump locations within the kerb and channel.
- Full thickness sawcut construction joints are to be made at tangent points within the kerb and channel.

This practice shall prevent extensive cracking and damage at local weak points in the kerb, channel and around any sumps.
TYPICAL KERB AND FLAT CHANNEL (K&C)
1:10

TYPICAL KERB ONLY
1:10
C.2 COMMERCIAL CROSSING

C.2.1 DELIVERABLES

The Contractor shall allow to produce and supply the University of Canterbury with the following documentation.

- Test results that indicate that the exposed subgrade has a California Bearing Ratio (C.B.R.) value greater than 7.
- NDM test results indicating that the density of the foundation material has a minimum dry density of 98%, or 2200 kg/m$^3$.
- Clegg Hammer test results that indicate that the Impact Value is less than 25
- Evidence that the concrete used has a slump of 80mm and a 28 day compressive strength of 20MPa.
- Tickets with the recorded amounts of material imported/removed from the site.
- Proof of the verticality of the kerbs does not exceed ±5mm

C.2.2 FOUNDATION

The 250mm AP40 foundation shall consist of crushed rock free from all non-mineral matter and should comply with T.N.Z. M/4 1995. Although alternative aggregates will be acceptable, provided the Contractor can produce satisfactory evidence as to their suitability.

Compaction shall be in layers not exceeding 150mm of loose depth. On site measurements must be conducted to determine insitu density and moisture content of the compacted material. Density testing (NDM) on each layer of placed material must be conducted at a spacing of about 2m intervals or a 2m x 2m grid as appropriate. All fill material shall be compacted to a minimum of 98% maximum dry density as determined by NZS 4402:1986, Test 4.2.2, or 2200 kg/m3.

This is provided that the subgrade ground conditions are met. The Contractor is to proof roll the subgrade and then test the subgrade using the Scalar Penetrometer test, or similar approved alternative, to verify that the subgrade meets the required minimum CBR value of 7.

All testing required to assess compaction and uniformity is to be at the cost of the Contractor. A minimum of 24 hours notice shall be given to the Engineer of when density tests are to be performed. The Contractor is to allow for the costs of the tests for each stage of the construction and provide a copy of the results to the Engineer prior to sealing.

C.2.3 CONSTRUCTION

The new kerb crossings and vehicle entrance details are to comply with the requirements of the Christchurch City Council Construction Standard Specification, 2013, Part 6: Roads, SD 607 - SD 612 for commercial crossings, as shown on the drawings. Any services, paths or landscaping damaged as a result of the works is to be reinstated at no cost to the Contract.

Remove the existing redundant access crossing and replace the cut down kerb with a new kerb and channel to match the existing adjacent kerb and channel.

Saw cutting back an existing kerb and channel to form a crossing, or to reinstate a crossing is not approved.

Cut back kerb and channel to form crossings will not be accepted.

Density testing of the construction of the footpath and crossing must be completed prior to sealing. Clegg Hammer tests must be used. At no point on the surface shall the Clegg Impact Value (CIV) be less than 25 for footpaths and residential crossings, and 35 for commercial vehicle crossings.
Concrete shall have a minimum 28-day compressive strength of 20 MPa unless otherwise specified and shall have a slump of 80mm. Kerbs shall be cast or placed in one operation on a solid foundation.

Before the concrete has finally set, the kerb shall be steel floated to give a true smooth surface to a Class U3 finish complying with NZS 3114 “Specification for concrete surface finishes” for all exposed front face, top and 100mm of back of kerbs.

The finish on any hand formed kerbs and channels shall match that of the machine laid kerbs and channels.

Form shrinkage control joints using either a grooving trowel or sawcut at 5m centres, and:

- Full thickness sawcut construction joints are to be made at tangent points within the kerb and channel

This practice shall prevent extensive cracking and damage at local weak points in the kerb, channel and around any sumps.

The Contractor is to arrange the vehicle crossing application with the Council.

The verticality of the kerb shall be within ±5mm of vertical over the typical total height of the kerb (270mm).
TYPICAL HEAVY DUTY COMMERCIAL CROSSING
1:10
C.3 CONCRETE NIB KERBS

C.3.1 DELIVERABLES

The Contractor shall allow to produce and supply the University of Canterbury with the following documentation.

- Test results that indicate that the exposed subgrade has a California Bearing Ratio (C.B.R.) value greater than 7.
- NDM test results indicating that the density of the foundation material has a minimum dry density of 98%, or 2200 kg/m$^3$.
- Evidence that the concrete used has a slump of 80mm and a 28 day compressive strength of 20MPa.
- Tickets with the recorded amounts of material imported/removed from the site.
- Proof of the verticality of the kerbs does not exceed ±5mm.

C.3.2 FOUNDATION

The 250mm AP40 foundation shall consist of crushed rock free from all non-mineral matter and should comply with T.N.Z. M/4 1995. Although alternative aggregates will be acceptable, provided the Contractor can produce satisfactory evidence as to their suitability.

Compaction shall be in layers not exceeding 150mm of loose depth. On site measurements must be conducted to determine insitu density and moisture content of the compacted material. Density testing (NDM) on each layer of placed material must be conducted at a spacing of about 2m intervals or a 2m x 2m grid as appropriate. All fill material shall be compacted to a minimum of 98% maximum dry density as determined by NZS 4402:1986, Test 4.2.2, or 2200 kg/m3.

This is provided that the subgrade ground conditions are met. The Contractor is to proof roll the subgrade and then test the subgrade using the Scalar Penetrometer test, or similar approved alternative, to verify that the subgrade meets the required minimum CBR value of 7.

All testing required to assess compaction and uniformity is to be at the cost of the Contractor. A minimum of 24 hours notice shall be given to the Engineer of when density tests are to be performed. The Contractor is to allow for the costs of the tests for each stage of the construction and provide a copy of the results to the Engineer prior to sealing.

C.3.3 FORMWORK

Any formwork shall comply with the provisions of NZS 3109 "Specification for Concrete Construction" with the following amendments.

The overall finished level of the formwork shall be within ±5mm of the design levels.

The line and level of the formwork shall be straight between tangent points with the maximum deviation from a 3m straight-edge laid along the face or top of 5mm with a cumulative total of all visible gaps of not more than 10mm. Curves shall be swept and formed without kinks, flats or angles in a smooth arc.

C.3.4 CONSTRUCTION

Construct kerb and channel and nib kerbs as indicated on the standard drawing. Concrete kerbs generally shall be in accordance with Christchurch City Council Construction Standard Specification.

Cut down kerbs must be formed in wet concrete when the kerbs are being laid. Saw cutting to form cut down kerbs will not be accepted.

Concrete shall have a minimum 28-day compressive strength of 20 MPa unless otherwise specified and shall have a slump of 80mm. Kerbs shall be cast or placed in one operation on a solid foundation.
Before the concrete has finally set, the kerb shall be steel floated to give a true smooth surface to a Class U3 finish complying with NZS 3114 “Specification for concrete surface finishes” for all exposed front face, top and 100mm of back of kerbs.

The finish on any hand formed kerbs and channels shall match that of the machine laid kerbs and channels.

The verticality of the kerb shall be within ±5mm of vertical over the typical total height of the kerb (270mm).

Form shrinkage control joints using either a grooving trowel or sawcut at 5m centres, and:

- Full thickness sawcut construction joints are to be made at tangent points within the kerb

This practice shall prevent extensive cracking and damage at local weak points in the kerb, channel and around any sumps.
25mm bullnose.

200

25mm bullnose.

250

150

250

250

200x250 concrete edge restraint

- 2-H12 with R6@600crs
- 75 bottom cover
- 50 top cover.

REINFORCED CONCRETE NIB/EDGE RESTRAINT

1:10
C.4 CONCRETE PAVING IN NON-TRAFFICKED AREAS

C.4.1 DELIVERABLES

The Contractor shall allow to produce and supply the University of Canterbury with the following documentation.

- Test results that indicate that the exposed subgrade has a California Bearing Ratio (C.B.R.) value greater than 7.
- NDM test results indicating that the density of the foundation material has a minimum dry density of 98%, or 2200 kg/m³.
- Evidence that the concrete used has a slump of 80mm and a 28 day compressive strength of 20MPa.
- Tickets with the recorded amounts of material imported/removed from the site.
- Proof of the verticality of the kerbs does not exceed ±5mm

C.4.2 SUBBASE

The sub-base material to be imported shall be free from all non-mineral matter. Ninety percent of the material used shall have C.B.R. in excess of 25.

Subbase material 100mm immediately below the basecourse shall have sufficient permeability to ensure that there is no adverse build-up of pore pressure when subject to traffic loads. The sand equivalent shall be greater than 40.

Generally the relevant clauses of T.N.Z. M/3 notes shall be considered as to the required grading and compactibility. The final finished thickness of the subbase shall be a minimum of 250mm provided that the subgrade material has a C.B.R. value greater than 7. If the Contractor has any doubt that the exposed sub-grade does not have a C.B.R. of 7, the Contractor is to test the sub-grade and provide copies of the test results to the Engineer for assessment. The Engineer will then provide an amended detail.

C.4.3 METALCOURSE CONSTRUCTION

Generally both the subbase and basecourse shall be constructed in accordance with the relevant clause of T.N.Z. B/2, and the Christchurch City Council Construction Standard Specifications for construction and testing. All testing required to assess compaction and uniformity is to be at the cost of the Contractor. The Contractor is to allow for the costs of the tests for each stage of the construction and provide a copy of the results to the Engineer prior to sealing.

The siteworks subcontractor is to inspect the backfill of any trenches, backfill around structures etc and view any relevant test information prior to commencing on site. The siteworks subcontractor is then to confirm in writing that the finish meets their requirements for the metalcourse construction.

The finished hardfill surface is to be constructed with the tolerances from +0mm to -15mm with no abrupt changes. Any weak ground shall be dug out and replaced with a crushed metal.

Where the footpaths are constructed over existing concrete the hardfill is to be a minimum of 75mm and maximum of 200mm of AP40 M/4. Where the depth is greater than 200mm AP65 is to be used. Any weak ground shall be dug out and replaced with a crushed metal.

Compaction shall be in layers not exceeding 150mm of loose depth. On site measurements must be conducted to determine insitu density and moisture content of the compacted material. Density testing (NDM) on each layer of placed material must be conducted at a spacing of about 2m intervals or a 2m x 2m grid as appropriate. All fill material shall be compacted to a minimum of 98% maximum dry density as determined by NZS 4402:1986, Test 4.2.2, or 2200 kg/m³.

All testing required to assess compaction and uniformity is to be at the cost of the Contractor. A minimum of 24 hours notice shall be given to the Engineer of when density tests are to be performed. The
Contractor is to allow for the costs of the tests for each stage of the construction and provide a copy of the results to the Engineer prior to sealing.

C.4.4 FORMWORK

Formwork shall comply with the provisions of NZS 3109 "Specification for Concrete Construction" with the following amendments.

The overall finished level of the formwork shall be within ±10mm of the design levels provided for footpaths.

The line and level of the formwork shall be straight between tangent points with the maximum deviation from a 3m straight-edge laid along the face or top of 5mm with a cumulative total of all visible gaps of not more than 10mm. Curves shall be swept and formed without kinks, flats or angles in a smooth arc.

C.4.5 CONCRETE CONSTRUCTION

Non-trafficked areas are to be 100mm thick and reinforced with 665 mesh with 30mm top cover, stopping each side of construction joints or formed joints.

Joints are to be formed at right angles with a 10mm radius edge, to the kerb in accordance with the Landscape Architects layout and documentation.

All concrete work shall comply with the provisions of NZS 3109 "Specification for Concrete Construction"

Concrete production shall be in accordance with the requirements of 3104 "Concrete Production - High Grade and Special Grade". All concrete must be special grade. No additives are to be included in the mix design without the written approval of the Engineer.

The concrete shall have a minimum 28-day compressive strength of 20MPa and shall have a slump of 80mm.

Non-trafficked paving shall be cast in one operation on the solid compacted AP65 hardfill foundation.

C.4.6 LIGHT BROOM FINISH

Broom at across the slope of the concrete surfaces and at right angles to the kerb for footpaths. For all footpaths, provide a 50mm smooth margin on the sides and at the construction joints or formed joints with a 10mm radius edge.

Any exposed edges of the concrete footpaths, paving, insitu ramps etc are to have a Class F5 finish complying with NZS 3114 “Specification for concrete surface finishes” for all exposed.

C.4.7 EXPOSED AGGREGATE FINISH

C.4.7.1 Finish

The exposed aggregate mixture and finish is to match the existing surrounding surface finishes.

Any exposed edges of the concrete footpaths, paving, insitu ramps etc are to have a Class F5 finish complying with NZS 3114 “Specification for concrete surface finishes” for all exposed.
20MPa concrete 100mm thick slab with 665 mesh - 30 top cover.  

Note: Concrete colour and finish to match extg adjacent.

PEDESTRIAN SLAB EDGE THICKENING  
1:10
C.5 CONCRETE PAVING IN TRAFFICKED AREAS

C.5.1 DELIVERABLES

The Contractor shall allow to produce and supply the University of Canterbury with the following documentation.

- Test results that indicate that the exposed subgrade has a California Bearing Ratio (C.B.R.) value greater than 7.
- NDM test results indicating that the density of the foundation material has a minimum dry density of 98%, or 2200 kg/m$^3$.
- Evidence that the concrete used has a slump of 80mm and a 28 day compressive strength of 20MPa.
- Tickets with the recorded amounts of material imported/removed from the site.

C.5.2 SUBBASE

The sub-base material to be imported shall be free from all non-mineral matter. Ninety percent of the material used shall have C.B.R. in excess of 25.

Subbase material 100mm immediately below the basecourse shall have sufficient permeability to ensure that there is no adverse build-up of pore pressure when subject to traffic loads. The sand equivalent shall be greater than 40.

Generally the relevant clauses of T.N.Z. M/3 notes shall be considered as to the required grading and compactibility. The final finished thickness of the subbase shall be a minimum of 250mm provided that the subgrade material has a C.B.R. value greater than 7. If the Contractor has any doubt that the exposed sub-grade does not have a C.B.R. of 7, the Contractor is to test the sub-grade and provide copies of the test results to the Engineer for assessment. The Engineer will then provide an amended detail.

C.5.3 METALCOURSE CONSTRUCTION

Generally both the subbase and basecourse shall be constructed in accordance with the relevant clause of T.N.Z. B/2, and the Christchurch City Council Construction Standard Specifications for construction and testing. All testing required to assess compaction and uniformity is to be at the cost of the Contractor. The Contractor is to allow for the costs of the tests for each stage of the construction and provide a copy of the results to the Engineer prior to sealing.

The siteworks subcontractor is to inspect the backfill of any trenches, backfill around structures etc and view any relevant test information prior to commencing on site. The siteworks subcontractor is then to confirm in writing that the finish meets their requirements for the metalcourse construction.

The finished hardfill surface is to be constructed with the tolerances from +0mm to -15mm with no abrupt changes. Any weak ground shall be dug out and replaced with a crushed metal.

Where the footpaths are constructed over existing concrete the hardfill is to be a minimum of 75mm and maximum of 200mm of AP40 M/4. Where the depth is greater than 200mm AP65 is to be used. Any weak ground shall be dug out and replaced with a crushed metal.

Compaction shall be in layers not exceeding 150mm of loose depth. On site measurements must be conducted to determine insitu density and moisture content of the compacted material. Density testing (NDM) on each layer of placed material must be conducted at a spacing of about 2m intervals or a 2m x 2m grid as appropriate. All fill material shall be compacted to a minimum of 98% maximum dry density as determined by NZS 4402:1986, Test 4.2.2, or 2200 kg/m$^3$.

All testing required to assess compaction and uniformity is to be at the cost of the Contractor. A minimum of 24 hours notice shall be given to the Engineer of when density tests are to be performed. The
Contractor is to allow for the costs of the tests for each stage of the construction and provide a copy of the results to the Engineer prior to sealing.

C.5.4 FORMWORK

Formwork shall comply with the provisions of NZS 3109 "Specification for Concrete Construction" with the following amendments.

The overall finished level of the formwork shall be within ±10mm of the design levels provided for footpaths.

The line and level of the formwork shall be straight between tangent points with the maximum deviation from a 3m straight-edge laid along the face or top of 5mm with a cumulative total of all visible gaps of not more than 10mm. Curves shall be swept and formed without kinks, flats or angles in a smooth arc.

C.5.5 CONCRETE CONSTRUCTION

Trafficked areas are to be 150mm thick and reinforced with 663 mesh with 30mm top cover, stopping each side of construction joints or formed joints.

Joints are to be formed at right angles with a 10mm radius edge, to the kerb in accordance with the Landscape Architects layout and documentation.

All concrete work shall comply with the provisions of NZS 3109 "Specification for Concrete Construction"

Concrete production shall be in accordance with the requirements of 3104 "Concrete Production - High Grade and Special Grade". All concrete must be special grade. No additives are to be included in the mix design without the written approval of the Engineer.

Concrete shall have a minimum 28-day compressive strength of 30 MPa and shall have a slump of 80mm.

Trafficked concrete paving areas shall be cast or placed in one operation on the solid compacted AP65 hardfill foundation.

C.5.6 LIGHT BROOM FINISH

Broom at across the slope of the concrete surfaces and at right angles to the kerb for footpaths. For all footpaths, provide a 50mm smooth margin on the sides and at the construction joints or formed joints with a 10mm radius edge.

Any exposed edges of the concrete footpaths, paving, insitu ramps etc are to have a Class F5 finish complying with NZS 3114 “Specification for concrete surface finishes” for all exposed.

C.5.7 EXPOSED AGGREGATE FINISH

C.5.7.1 Finish

The exposed aggregate mixture and finish is to match the existing surrounding surface finishes.

Any exposed edges of the concrete footpaths, paving, insitu ramps etc are to have a Class F5 finish complying with NZS 3114 “Specification for concrete surface finishes” for all exposed.
30MPa concrete 150mm thick slab with SE72 mesh and 30 top cover.

Note: Concrete colour and finish to match external adjacent.

TRAFFICABLE SLAB EDGE THICKENING
1:10
C.6 ASPHALTIC CONCRETE FOOTPATHS

C.6.1 DELIVERABLES

The Contractor shall allow to produce and supply the University of Canterbury with the following documentation.

- Test results that indicate that the exposed subgrade has a California Bearing Ratio (C.B.R.) value greater than 7.
- NDM test results indicating that the density of the foundation material has a minimum dry density of 98%, or 2200 kg/m$^3$.
- Clegg Hammer test results that indicate that the Impact Value is less than 25.
- Tickets with the recorded amounts of material imported/removed from the site.
- Written confirmation that the asphaltic concrete is laid within the noted tolerance and does not hold/pond water.

C.6.2 SUBBASE AGGREGATE

The sub-base material to be imported shall be free from all non-mineral matter. Ninety percent of the material used shall have C.B.R. in excess of 25.

Subbase material 100mm immediately below the basecourse shall have sufficient permeability to ensure that there is no adverse build-up of pore pressure when subject to traffic loads. The sand equivalent shall be greater than 40.

Generally the relevant clauses of T.N.Z. M/3 notes shall be considered as to the required grading and compactibility. The final finished thickness of the subbase shall be a minimum of 150mm provided that the subgrade material has a C.B.R. value greater than 7. If the Contractor has any doubt that the exposed sub-grade does not have a C.B.R. of 7, the Contractor is to test the sub-grade and provide copies of the test results to the Engineer for assessment. The Engineer will then provide an amended detail.

C.6.3 BASECOURSE AGGREGATE

The basecourse shall consist of crushed rock free from all non-mineral matter and should comply with T.N.Z. M/4 1995. Although alternative aggregates will be acceptable, provided the Contractor can produce satisfactory evidence as to their suitability. The final finished thickness of the basecourse shall be 75mm.

C.6.4 METALCOURSE CONSTRUCTION

Generally both the subbase and basecourse shall be constructed in accordance with the relevant clause of T.N.Z. B/2, and the Christchurch City Council Construction Standard Specifications for construction and testing. All testing required to assess compaction and uniformity is to be at the cost of the Contractor. The Contractor is to allow for the costs of the tests for each stage of the construction and provide a copy of the results to the Engineer prior to sealing.

The siteworks subcontractor is to inspect the backfill of any trenches, backfill around structures etc and view any relevant test information prior to commencing on site. The siteworks subcontractor is then to confirm in writing that the finish meets their requirements for the metalcourse construction.

The finished hardfill surface is to be constructed with the tolerances from +0mm to -15mm with no abrupt changes. Any weak ground shall be dug out and replaced with a crushed metal.

Where the asphalt has been scrapped back and overlays the existing pavement, the minimum basecourse depth detailed in this specification must be provided. This may necessitate scraping back the existing pavement to achieve the correct top of subbase levels. Where the new finished levels are lower than the existing, the whole of the existing pavement is to be removed and replaced as per this specification.
Compaction shall be in layers not exceeding 150mm of loose depth. On site measurements must be conducted to determine insitu density and moisture content of the compacted material. Density testing (NDM) on each layer of placed material must be conducted at a spacing of about 2m intervals or a 2m x 2m grid as appropriate. All fill material shall be compacted to a minimum of 98% maximum dry density as determined by NZS 4402:1986, Test 4.2.2, or 2200 kg/m³.

C.6.5 GENERAL

This seal is to be a thin surface mix over the areas designated on the drawings and shall be constructed to the following specification. The sealing subcontractor is to inspect the finished metalcourse surface and view any relevant test information prior to commencing on site. The sealing subcontractor is then to confirm in writing that the surface finish meets their requirements for sealing.

The minimum width for all footpaths at the University of Canterbury is 1.5m, with a maximum width of 3.0m.

The asphaltic concrete shall comply with T.N.Z. M/10 “Specification for Asphaltic Concrete”. The mix shall comply with Table 1 - Crushed Aggregate asphaltic concrete mixes.

The minimum compacted thickness shall be 20mm of Mix No.10.

All asphaltic concrete shall be uniform in density and texture and shall have air voids not less than 2.5% and not more than 8.0% on joins or 6.0% on any mat.

The construction shall comply with T.N.Z. P/9 “Specification for Construction of Asphaltic Concrete Paving’. Particular care must be taken through the entry into buildings, around drainage structures, chambers, channels etc. to ensure a flush finish will be maintained throughout the life of the pavement to ensure vehicles do not bounce over the transitions.

All joints against existing asphalt shall be bandaged and sealed on the completion of the works.

Lay a full prime coat to the prepared basecourse surface before laying the asphaltic concrete.

C.6.6 ASPHALTIC CONCRETE TOLERANCES

The finished surface shall be 5mm above channel fenders or concrete kerbs and shall not hold water in any location. There shall be no point where the general surface varies more than a maximum deviation from a 3m straight-edge of 5mm with a cumulative total of all visible gaps of not more than 10mm. This includes any service boxes and joins.

C.6.7 PREPARATION

All seeds, leaves and debris must be removed from the surface. The Contractor will be liable for all remedial works required as a result of damage to the asphalt caused by seeds germinating under the asphalt.

The surface shall be swept clean with a power brush then sprayed with and approved “total kill” weed killer in accordance with the manufacturer’s instructions.

The Contractor shall ensure that all sumps, manhole covers, toby boxes or any other carriageway fittings are properly protected from sealing operations. The Contractor shall be responsible for the prompt cleaning and freeing of any such equipment which may be fouled during the work. Ensure that no damage is done to adjacent properties.
NOTE: Footpath widths to be between 1.5m (minimum) and 3m (maximum).

FOOTPATH PAVEMENT SECTION
1:10
C.7 TRAFFICKED ASPHALTIC CONCRETE

C.7.1 DELIVERABLES

The Contractor shall allow to produce and supply the University of Canterbury with the following documentation.

- Test results that indicate that the exposed subgrade has a California Bearing Ratio (C.B.R.) value greater than 7.
- NDM test results indicating that the density of the foundation material has a minimum dry density of 98%, or 2200 kg/m³.
- Tickets with the recorded amounts of material imported/removed from the site.
- Written confirmation that the asphaltic concrete is laid within the noted tolerance and does not hold/pond water.

C.7.2 SUBBASE AGGREGATE

The sub-base material to be imported shall be free from all non-mineral matter. Ninety percent of the material used shall have C.B.R. in excess of 25.

Subbase material 100mm immediately below the basecourse shall have sufficient permeability to ensure that there is no adverse build-up of pore pressure when subject to traffic loads. The sand equivalent shall be greater than 40.

Generally the relevant clauses of T.N.Z. M/3 notes shall be considered as to the required grading and compactibility. The final finished thickness of the subbase shall be a minimum of 250mm provided that the subgrade material has a C.B.R. value greater than 7. If the Contractor has any doubt that the exposed sub-grade does not have a C.B.R. of 7, the Contractor is to test the sub-grade and provide copies of the test results to the Engineer for assessment. The Engineer will then provide an amended detail.

C.7.3 BASECOURSE AGGREGATE

The basecourse shall consist of crushed rock free from all non-mineral matter and should comply with T.N.Z. M/4 1995. Although alternative aggregates will be acceptable, provided the Contractor can produce satisfactory evidence as to their suitability. The final finished thickness of the basecourse shall be 100mm.

C.7.4 METALCOURSE CONSTRUCTION

Generally both the subbase and basecourse shall be constructed in accordance with the relevant clause of T.N.Z. B/2, and the Christchurch City Council Construction Standard Specifications for construction and testing. All testing required to assess compaction and uniformity is to be at the cost of the Contractor. The Contractor is to allow for the costs of the tests for each stage of the construction and provide a copy of the results to the Engineer prior to sealing.

The siteworks subcontractor is to inspect the backfill of any trenches, backfill around structures etc and view any relevant test information prior to commencing on site. The siteworks subcontractor is then to confirm in writing that the finish meets their requirements for the metalcourse construction.

Only Benkleman beam tests will be acceptable for tests on the completed pavement prior to sealing. Test results shall have:

- Carparks - 95%ile reading of 2.00mm and a maximum of 2.50mm.
- Roads – 95%ile reading of 1.2mm and a maximum of 1.50mm

For each set of 20 results, one reading higher than the 95%ile limit is permissible. For less than 20 readings, all readings shall comply. No readings shall exceed the specified limits.
The testing is to be performed at no greater than 5m intervals on alternating wheels. Adjacent test runs are to be completed at no greater than 5m centre to centre spacing to effectively test a maximum of 5m x 5m staggered grid.

Where the asphalt has been scrapped back and overlays the existing pavement, the minimum basecourse depth detailed in this specification must be provided. This may necessitate scraping back the existing pavement to achieve the correct top of subbase levels. Where the new finished levels are lower than the existing, the whole of the existing pavement is to be removed and replaced as per this specification.

C.7.5 GENERAL

This seal is to be a thin surface mix over the areas designated on the drawings and shall be constructed to the following specification. The sealing subcontractor is to inspect the finished metalcourse surface and view any relevant test information prior to commencing on site. The sealing subcontractor is then to confirm in writing that the surface finish meets their requirements for sealing.

The asphaltic concrete shall comply with T.N.Z. M/10 “Specification for Asphaltic Concrete”. The mix shall comply with Table 1 - Crushed Aggregate asphaltic concrete mixes.

The minimum compacted thickness shall be 30mm of Mix No.10 for carpark applications.

All asphaltic concrete shall be uniform in density and texture and shall have air voids not less than 2.5% and not more than 8.0% on joins or 6.0% on any mat.

The construction shall comply with T.N.Z. P/9 “Specification for Construction of Asphaltic Concrete Paving’. Particular care must be taken through the entry into buildings, around drainage structures, chambers, channels etc. to ensure a flush finish will be maintained throughout the life of the pavement to ensure vehicles do not bounce over the transitions.

All joints against existing asphalt shall be bandaged and sealed on the completion of the works.

Lay a full prime coat to the prepared basecourse surface before laying the asphaltic concrete.

C.7.6 ASPHALTIC CONCRETE TOLERANCES

The finished surface shall be 5mm above channel fenders or concrete kerbs and shall not hold water in any location. There shall be no point where the general surface varies more than a maximum deviation from a 3m straight-edge of 5mm with a cumulative total of all visible gaps of not more than 10mm. This includes any service boxes and joins.

C.7.7 PREPARATION

All seeds, leaves and debris must be removed from the surface. The Contractor will be liable for all remedial works required as a result of damage to the asphalt caused by seeds germinating under the asphalt.

The surface shall be swept clean with a power brush then sprayed with and approved “total kill” weed killer in accordance with the manufacturer’s instructions.

The Contractor shall ensure that all sumps, manhole covers, toby boxes or any other carriageway fittings are properly protected from sealing operations. The Contractor shall be responsible for the prompt cleaning and freeing of any such equipment which may be fouled during the work. Ensure that no damage is done to adjacent properties.
C.8 TIMBER EDGING

Provide and fix timber edging to alignment and levels shown on the drawings to all free edges of road and parking area construction. Timber edging and pegs shall be *Pinus radiata*, treated to NZS 3602, H4 (for ground contact).

The following minimum timber sizes are to be used:

- Footpaths adjacent to grass berm  
  75 x 25 edging  
  75 x 25 x 600 pegs

- Footpaths adjacent to landscaping.  
  150 x 25 edging  
  50 x 50 x 600 pegs

- Driveways, parking areas, roads etc.  
  150 x 40 edging  
  50 x 50 x 600 pegs

Pegs shall be provided at a maximum of 1.0m centres along the straight portions and at a maximum of 600mm centres around curves. These are minimum requirements and site conditions may necessitate reduced spacing.

Joints butted together on the timber edging must have a fully fixed backing timber. Pegs must be provided at the back of all butt joints to support the joint. Pegs must be provided at the junctions of all changes in angle in the edging.
Note: This detail applies to driveways, parking areas, roads etc.

Note: This detail applies to footpaths adjacent to landscaping.

TIMBER EDGE DETAIL (TE)
1:10
20mm asphalt.

150x25 H4 treated timber edge batten.

50x50x600mm min. length H4 treated pegs at 1m crs max.

Note: This detail applies to footpaths adjacent to grass berms.

**TIMBER EDGE DETAIL (TE)**

1:10
C.9 COBBLE PAVING WITH CONCRETE EDGE RESTRAINT (EPOXY)

C.9.1 DELIVERABLES

The Contractor shall allow to produce and supply the University of Canterbury with the following documentation.

- Test results that indicate that the exposed subgrade has a California Bearing Ratio (C.B.R.) value greater than 7.
- NDM test results indicating that the density of the foundation material has a minimum dry density of 98%, or 2200 kg/m³.
- Evidence that the concrete used has a slump of 80mm and a 28 day compressive strength of 20MPa.
- Tickets with the recorded amounts of material imported/removed from the site.

C.9.2 SUBBASE AGGREGATE

The sub-base material to be imported shall be free from all non-mineral matter. Ninety percent of the material used shall have C.B.R. in excess of 25.

Subbase material 100mm immediately below the basecourse shall have sufficient permeability to ensure that there is no adverse build-up of pore pressure when subject to traffic loads. The sand equivalent shall be greater than 40.

Generally the relevant clauses of T.N.Z. M/3 notes shall be considered as to the required grading and compactibility. The final finished thickness of the subbase shall be a minimum of 300mm provided that the subgrade material has a C.B.R. value greater than 7. If the Contractor has any doubt that the exposed sub-grade does not have a C.B.R. of 7, the Contractor is to test the sub-grade and provide copies of the test results to the Engineer for assessment. The Engineer will then provide an amended detail.

C.9.3 BASECOURSE AGGREGATE

The basecourse shall consist of crushed rock free from all non-mineral matter and should comply with T.N.Z. M/4 1995. Although alternative aggregates will be acceptable, provided the Contractor can produce satisfactory evidence as to their suitability. The final finished thickness of the basecourse shall be 100mm.

C.9.4 METALCOURSE CONSTRUCTION

Generally both the subbase and basecourse shall be constructed in accordance with the relevant clause of T.N.Z. B/2, and the Christchurch City Council Construction Standard Specifications for construction and testing. All testing required to assess compaction and uniformity is to be at the cost of the Contractor. The Contractor is to allow for the costs of the tests for each stage of the construction and provide a copy of the results to the Engineer prior to sealing.

The siteworks subcontractor is to inspect the backfill of any trenches, backfill around structures etc and view any relevant test information prior to commencing on site. The siteworks subcontractor is then to confirm in writing that the finish meets their requirements for the metalcourse construction.

The finished hardfill surface is to be constructed with the tolerances from +0mm to -15mm with no abrupt changes. Any weak ground shall be dug out and replaced with a crushed metal.

Where the pavers have been removed and overlays the existing pavement, the minimum basecourse depth detailed in this specification must be provided. This may necessitate scraping back the existing pavement to achieve the correct top of subbase levels. Where the new finished levels are lower than the existing, the whole of the existing pavement is to be removed and replaced as per this specification.

Compaction shall be in layers not exceeding 150mm of loose depth. On site measurements must be conducted to determine insitu density and moisture content of the compacted material. Density testing
(NDM) on each layer of placed material must be conducted at a spacing of about 2m intervals or a 2m x 2m grid as appropriate. All fill material shall be compacted to a minimum of 98% maximum dry density as determined by NZS 4402:1986, Test 4.2.2, or 2200 kg/m³.

C.9.5 REINFORCED CONCRETE NIB

Refer to C.3 Concrete Nib Kerbs for construction of the concrete restraint.

C.9.6 PAVING

Provide and lay cobble paving to match the surrounding size, colour, type and pattern. Paving shall be laid on 20mm sand blinding over the compacted basecourse. Butt edges together and on completion sweep over sand to fill cavities. The perimeter two rows of cobble pavers shall be laid and epoxied to a reinforced concrete nib.
Cobbles laid on 20mm sand blinding.

Note: Cobble size, colour and style to match extg adjacent.

Epoxy mortar edge cobbles to concrete edge restraint.

Reinforced concrete edge restraint.

**REINFORCED CONCRETE NIB**

1:10
C.10 COBBLE PAVING WITH CONCRETE EDGE RESTRAINT (BUTTED)

C.10.1 DELIVERABLES

The Contractor shall allow to produce and supply the University of Canterbury with the following documentation.

- Test results that indicate that the exposed subgrade has a California Bearing Ratio (C.B.R.) value greater than 7.
- NDM test results indicating that the density of the foundation material has a minimum dry density of 98%, or 2200 kg/m$^3$.
- Tickets with the recorded amounts of material imported/removed from the site.

C.10.2 SUBBASE AGGREGATE

The sub-base material to be imported shall be free from all non-mineral matter. Ninety percent of the material used shall have C.B.R. in excess of 25.

Subbase material 100mm immediately below the basecourse shall have sufficient permeability to ensure that there is no adverse build-up of pore pressure when subject to traffic loads. The sand equivalent shall be greater than 40.

Generally the relevant clauses of T.N.Z. M/3 notes shall be considered as to the required grading and compactibility. The final finished thickness of the subbase shall be a minimum of 150mm provided that the subgrade material has a C.B.R. value greater than 7. If the Contractor has any doubt that the exposed sub-grade does not have a C.B.R. of 7, the Contractor is to test the sub-grade and provide copies of the test results to the Engineer for assessment. The Engineer will then provide an amended detail.

C.10.3 BASECOURSE AGGREGATE

The basecourse shall consist of crushed rock free from all non-mineral matter and should comply with T.N.Z. M/4 1995. Although alternative aggregates will be acceptable, provided the Contractor can produce satisfactory evidence as to their suitability. The final finished thickness of the basecourse shall be 75mm.

C.10.4 METALCOURSE CONSTRUCTION

Generally both the subbase and basecourse shall be constructed in accordance with the relevant clause of T.N.Z. B/2, and the Christchurch City Council Construction Standard Specifications for construction and testing. All testing required to assess compaction and uniformity is to be at the cost of the Contractor. The Contractor is to allow for the costs of the tests for each stage of the construction and provide a copy of the results to the Engineer prior to sealing.

The siteworks subcontractor is to inspect the backfill of any trenches, backfill around structures etc and view any relevant test information prior to commencing on site. The siteworks subcontractor is then to confirm in writing that the finish meets their requirements for the metalcourse construction.

The finished hardfill surface is to be constructed with the tolerances from +0mm to -15mm with no abrupt changes. Any weak ground shall be dug out and replaced with a crushed metal.

Where the pavers have been removed and overlays the existing pavement, the minimum basecourse depth detailed in this specification must be provided. This may necessitate scraping back the existing pavement to achieve the correct top of subbase levels. Where the new finished levels are lower than the existing, the whole of the existing pavement is to be removed and replaced as per this specification.

Compaction shall be in layers not exceeding 150mm of loose depth. On site measurements must be conducted to determine in situ density and moisture content of the compacted material. Density testing (NDM) on each layer of placed material must be conducted at a spacing of about 2m intervals or a 2m x 2m grid as appropriate. All fill material shall be compacted to a minimum of 98% maximum dry density as determined by NZS 4402:1986, Test 4.2.2, or 2200 kg/m$^3$.  

CIVIL WORKS STANDARD SPECIFICATION ISSUE A 19
C.10.5 PAVING

Provide and lay cobble paving to match the surrounding size, colour, type and pattern. Paving shall be laid on 20mm sand blinding over the compacted basecourse. Butt edges together and on completion sweep over sand to fill cavities. The perimeter two rows of cobble pavers shall butt against the relevant kerb/nib kerb detail.
Cobbles laid on 20mm sand blinding.

Note: Cobble size, colour and style to match extg adjacent.

Reinforced concrete nib.

REINFORCED CONCRETE NIB
1:10
C.11  CONCRETE PAVERS IN NON-TRAFFICKED AREAS

C.11.1  DELIVERABLES

The Contractor shall allow to produce and supply the University of Canterbury with the following documentation.

- Test results that indicate that the exposed subgrade has a California Bearing Ratio (C.B.R.) value greater than 7.
- NDM test results indicating that the density of the foundation material has a minimum dry density of 98%, or 2200 kg/m$^3$.
- Evidence that the concrete used has a slump of 80mm and a 28 day compressive strength of 20MPa.
- Tickets with the recorded amounts of material imported/removed from the site.
- Proof of the verticality of the kerbs does not exceed ±5mm

C.11.2  SUBBASE

The sub-base material to be imported shall be free from all non-mineral matter. Ninety percent of the material used shall have C.B.R. in excess of 25.

Subbase material 100mm immediately below the basecourse shall have sufficient permeability to ensure that there is no adverse build-up of pore pressure when subject to traffic loads. The sand equivalent shall be greater than 40.

Generally the relevant clauses of T.N.Z. M/3 notes shall be considered as to the required grading and compactibility. The final finished thickness of the subbase shall be a minimum of 250mm provided that the subgrade material has a C.B.R. value greater than 7. If the Contractor has any doubt that the exposed sub-grade does not have a C.B.R. of 7, the Contractor is to test the sub-grade and provide copies of the test results to the Engineer for assessment. The Engineer will then provide an amended detail.

C.11.3  METALCOURSE CONSTRUCTION

Generally both the subbase and basecourse shall be constructed in accordance with the relevant clause of T.N.Z. B/2, and the Christchurch City Council Construction Standard Specifications for construction and testing. All testing required to assess compaction and uniformity is to be at the cost of the Contractor. The Contractor is to allow for the costs of the tests for each stage of the construction and provide a copy of the results to the Engineer prior to sealing.

The siteworks subcontractor is to inspect the backfill of any trenches, backfill around structures etc and view any relevant test information prior to commencing on site. The siteworks subcontractor is then to confirm in writing that the finish meets their requirements for the metalcourse construction.

The finished hardfill surface is to be constructed with the tolerances from +0mm to -15mm with no abrupt changes. Any weak ground shall be dug out and replaced with a crushed metal.

Where the footpaths are constructed over existing concrete the hardfill is to be a minimum of 75mm and maximum of 200mm of AP40 M/4. Where the depth is greater than 200mm AP65 is to be used. Any weak ground shall be dug out and replaced with a crushed metal.

Compaction shall be in layers not exceeding 150mm of loose depth. On site measurements must be conducted to determine insitu density and moisture content of the compacted material. Density testing (NDM) on each layer of placed material must be conducted at a spacing of about 2m intervals or a 2m x 2m grid as appropriate. All fill material shall be compacted to a minimum of 98% maximum dry density as determined by NZS 4402:1986, Test 4.2.2, or 2200 kg/m$^3$.

All testing required to assess compaction and uniformity is to be at the cost of the Contractor. A minimum of 24 hours notice shall be given to the Engineer of when density tests are to be performed. The
Contractor is to allow for the costs of the tests for each stage of the construction and provide a copy of the results to the Engineer prior to sealing.

C.11.4 FORMWORK

Formwork shall comply with the provisions of NZS 3109 "Specification for Concrete Construction" with the following amendments.

The overall finished level of the formwork shall be within ±10mm of the design levels provided for footpaths.

The line and level of the formwork shall be straight between tangent points with the maximum deviation from a 3m straight-edge laid along the face or top of 5mm with a cumulative total of all visible gaps of not more than 10mm. Curves shall be swept and formed without kinks, flats or angles in a smooth arc.

C.11.5 CONCRETE CONSTRUCTION

Non-trafficked areas are to be 100mm thick and reinforced with 665 mesh with 30mm top cover, stopping each side of construction joints or formed joints.

Joints are to be formed at right angles with a 10mm radius edge, to the kerb in accordance with the Landscape Architects layout and documentation.

All concrete work shall comply with the provisions of NZS 3109 "Specification for Concrete Construction"

Concrete production shall be in accordance with the requirements of 3104 "Concrete Production - High Grade and Special Grade". All concrete must be special grade. No additives are to be included in the mix design without the written approval of the Engineer.

The concrete shall have a minimum 28-day compressive strength of 20MPa and shall have a slump of 80mm.

Non-trafficked paving shall be cast in one operation on the solid compacted AP65 hardfill foundation.

C.11.6 PAVING

Provide and lay pavers to match the surrounding size, colour, type and pattern. Paving shall be laid on 20mm fine bedding concrete with 10 – 12mm joints. The bedding concrete shall vary to tie into the surrounding levels.
Pavers to be laid in fine bedding concrete. Bedding concrete shall vary in thickness to tie into extg levels.

Pedestrian concrete slab.

Note: Paver size, colour and style to match extg adjacent.

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**PEDESTRIAN PAVERS**

1:10
C.12 CONCRETE PAVERS IN TRAFFICKED AREAS

C.12.1 DELIVERABLES

The Contractor shall allow to produce and supply the University of Canterbury with the following documentation.

- Test results that indicate that the exposed subgrade has a California Bearing Ratio (C.B.R.) value greater than 7.
- NDM test results indicating that the density of the foundation material has a minimum dry density of 98%, or 2200 kg/m³.
- Evidence that the concrete used has a slump of 80mm and a 28 day compressive strength of 30MPa.
- Tickets with the recorded amounts of material imported/removed from the site.
- Proof of the verticality of the kerbs does not exceed ±5mm

C.12.2 SUBBASE

The sub-base material to be imported shall be free from all non-mineral matter. Ninety percent of the material used shall have C.B.R. in excess of 25.

Subbase material 100mm immediately below the basecourse shall have sufficient permeability to ensure that there is no adverse build-up of pore pressure when subject to traffic loads. The sand equivalent shall be greater than 40.

Generally the relevant clauses of T.N.Z. M/3 notes shall be considered as to the required grading and compactibility. The final finished thickness of the subbase shall be a minimum of 250mm provided that the subgrade material has a C.B.R. value greater than 7. If the Contractor has any doubt that the exposed sub-grade does not have a C.B.R. of 7, the Contractor is to test the sub-grade and provide copies of the test results to the Engineer for assessment. The Engineer will then provide an amended detail.

C.12.3 METALCOURSE CONSTRUCTION

Generally both the subbase and basecourse shall be constructed in accordance with the relevant clause of T.N.Z. B/2, and the Christchurch City Council Construction Standard Specifications for construction and testing. All testing required to assess compaction and uniformity is to be at the cost of the Contractor. The Contractor is to allow for the costs of the tests for each stage of the construction and provide a copy of the results to the Engineer prior to sealing.

The siteworks subcontractor is to inspect the backfill of any trenches, backfill around structures etc and view any relevant test information prior to commencing on site. The siteworks subcontractor is then to confirm in writing that the finish meets their requirements for the metalcourse construction.

The finished hardfill surface is to be constructed with the tolerances from +0mm to -15mm with no abrupt changes. Any weak ground shall be dug out and replaced with a crushed metal.

Where the footpaths are constructed over existing concrete the hardfill is to be a minimum of 75mm and maximum of 200mm of AP40 M/4. Where the depth is greater than 200mm AP65 is to be used. Any weak ground shall be dug out and replaced with a crushed metal.

Compaction shall be in layers not exceeding 150mm of loose depth. On site measurements must be conducted to determine in situ density and moisture content of the compacted material. Density testing (NDM) on each layer of placed material must be conducted at a spacing of about 2m intervals or a 2m x 2m grid as appropriate. All fill material shall be compacted to a minimum of 98% maximum dry density as determined by NZS 4402:1986, Test 4.2.2, or 2200 kg/m³.

All testing required to assess compaction and uniformity is to be at the cost of the Contractor. A minimum of 24 hours notice shall be given to the Engineer of when density tests are to be performed.
Contractor is to allow for the costs of the tests for each stage of the construction and provide a copy of the results to the Engineer prior to sealing.

**C.12.4 FORMWORK**

Formwork shall comply with the provisions of NZS 3109 "Specification for Concrete Construction" with the following amendments.

The overall finished level of the formwork shall be within ±10mm of the design levels provided for footpaths.

The line and level of the formwork shall be straight between tangent points with the maximum deviation from a 3m straight-edge laid along the face or top of 5mm with a cumulative total of all visible gaps of not more than 10mm. Curves shall be swept and formed without kinks, flats or angles in a smooth arc.

**C.12.5 CONCRETE CONSTRUCTION**

Trafficked areas are to be 150mm thick and reinforced with 663 mesh with 30mm top cover, stopping each side of construction joints or formed joints.

Joints are to be formed at right angles with a 10mm radius edge, to the kerb in accordance with the Landscape Architects layout and documentation.

All concrete work shall comply with the provisions of NZS 3109 "Specification for Concrete Construction"

Concrete production shall be in accordance with the requirements of 3104 "Concrete Production - High Grade and Special Grade". All concrete must be special grade. No additives are to be included in the mix design without the written approval of the Engineer.

Concrete shall have a minimum 28-day compressive strength of 30 MPa and shall have a slump of 80mm.

Trafficked concrete paving areas shall be cast or placed in one operation on the solid compacted AP65 hardfill foundation.

**C.12.6 PAVING**

Provide and lay pavers to match the surrounding size, colour, type and pattern. Paving shall be laid on 20mm fine bedding concrete with 10 – 12mm joints. The bedding concrete shall vary to tie into the surrounding levels.
Pavers to be laid in fine bedding concrete. Bedding concrete shall vary in thickness to tie into extg levels.

Trafficable concrete slab.

Note: Paver size, colour and style to match extg adjacent.

TRAFFICABLE PAVERS
1:10
C.13 TRENCHING/BACKFILLING PIPEWORK

C.13.1 DELIVERABLES

The Contractor shall allow to produce and supply the University of Canterbury with the following documentation.

- Test results that indicate that the exposed subgrade has a California Bearing Ratio (C.B.R.) value greater than 7.
- Test results (NDM, Clegg Hammer) that indicate that any backfill material reclaimed from the excavation has been compacted to 85% of the maximum dry density.
- Test results (NDM, Clegg Hammer) that indicate that the imported backfill under carparks, roads or buildings has been compacted to 98% of the maximum dry density.
- Tickets with the recorded amounts of material imported/removed from the site.
- Provide evidence that the pipework has the appropriate minimum cover, or adequate concrete cover.

C.13.2 EXCAVATION

Trenches shall be excavated in accordance with the typical cross sections shown on the standard detail drawings.

Shoring shall be provided as necessary, to ensure the security of the work and safety of workmen, and to comply with the Health and Safety in Employment Act and its related Regulations and Codes of Practice.

If, for any reason, the sides of a trench collapse, the Contractor shall at his own expense carry out all necessary remedial work.

Any additional works or support required to overcome the problems with ground conditions, at depth, is to be included in the Tender price.

Trench excavation shall be carried out expeditiously, and subject to all specific requirements of the Contract.

Where trenches are located in paved areas, the pavement shall be sawcut parallel to the proposed pipeline or as directed and damage to the adjacent surface shall be minimised. Where trenches are excavated in cultivated ground, topsoil shall be stripped from the area of the excavations and stockpiled for use in reinstating surfaces.

Excavated material shall be stacked well clear of the edge of the excavation and the size of the stockpile shall be limited to avoid any danger to the stability of the trench or adjacent services and facilities. Any surplus material shall be disposed of off-site.

The Contractor shall not open the trench more than fifty metres ahead of the pipelayers and where soft ground is encountered not further than approved by the Engineer.

If the Contractor by his own negligence over-excavates any area, then it may be necessary to carry out remedial filling, with an approved material to achieve the original in-situ density, at no additional cost to the Principal.

Depths excavated shall be to provide a minimum cover for PVC pipes

- 750mm in roads and streets
- 600mm in other areas subjected to traffic
- In all other instances and all other types of pipes at least 500mm cover unless shown otherwise.

Trenches shall be excavated to minimum widths of:

- 330mm for 100mmØ pipes
500mm for 150mmØ pipes
540mm for 175mmØ pipes
600mm for 225mmØ pipes
760mm for 300mmØ pipes
940mm for 375mmØ pipes
1040mm for 450mmØ pipes
1330mm for 525mmØ pipes
1420mm for 600mmØ pipes

Unsuitable excavated material shall be loaded out and removed immediately from the Site.

C.13.3 WATER IN TRENCHES

Should water be present in a trench, the level shall be kept below the level of the bedding until each joint has been made and backfilled.

The Contractor shall provide adequate plant as required to remove and dispose of water without interfering with pipelaying work. Any Consents, fees or structures required to filter the water pumped from the base of the excavation are to be included in the Contract price. The system must comply with the requirements of the local authority. The final discharge from the site shall not exceed 50ppm of suspended solids. An application for dewatering discharge must be made to the local authority prior to commencement of work.

The Contractor shall take precautions to prevent flotation of pipes in locations where open trench excavations may become flooded. The precautions may include partial backfilling of the trench leaving pipe joints exposed while waiting testing of the joints.

The Contractor shall not permit any flooding of property, footpaths, or roadways to result from pumping operations. All water shall be disposed of at the nearest adequate and approved drain point. Pumping of sand and silt from excavations shall be avoided by providing a suitable trap to prevent such material being uplifted by pumping equipment. Any material inadvertently deposited in adjacent services or surface areas shall be removed immediately.

C.13.4 UNSUITABLE FOUNDATION

Where the material in the trench bottom is not suitable for a pipe foundation, the Contractor shall upon receipt of an order from the Engineer over-excavate the trench as necessary and backfill with an approved compacted granular bedding material.

If the natural bottom of the trench becomes weakened or disturbed by the Contractor’s own operations, then he shall undertake all necessary remedial action to strengthen the foundation with approved compacted granular backfill at his own cost.

C.13.5 MAINTENANCE OF TRENCHES

Where trenches are excavated under this Contract for pipes or services to be supplied and laid by others, the open trenches shall be maintained as part of this Contract.

C.13.6 BEDDING

Bedding shall not commence until the base of the trench has been inspected and approved by the Engineer.

Bedding material shall be a well graded AP20 aggregate with the following grading:

<table>
<thead>
<tr>
<th>Size (mm)</th>
<th>19.0</th>
<th>2.36</th>
<th>0.60</th>
<th>0.30</th>
<th>0.15</th>
<th>0.075</th>
</tr>
</thead>
</table>
The Contractor can propose an alternative grading for the approval of the Engineer.

Bedding shall be spread evenly on the trench invert and well compacted. The bedding shall be shaped to receive the pipe, which shall bear firmly on the bedding along the full length of the pipe barrel with at least 180 degrees of the pipe circumference embedded in the bedding. Socket holes shall be provided beneath each pipe joint to permit jointing of the pipe and allow the barrel to rest firmly on the bedding.

The bedding thickness shall be minimum 100mm but ensuring that it is deep enough that the pipe sockets or flanges do not touch the trench floor. Bedding shall continue to 150mm cover over the pipe.

Where unreinforced concrete bedding is required the details must comply with the pipe manufacturer’s recommendation. A construction joint shall be provided at each pipe joint using a soft board spacer or any other method approved by the Engineer.

C.13.7 BACKFILLING MATERIAL

In areas under buildings, car parks, roads, areas subject to heavy loading and around drainage structures the backfill material shall be imported granular hardfill that is well graded with a maximum aggregate size of 65mm. The material shall comply with TNZ M/3.

In areas in landscaping, footpaths, gardens or non-trafficked areas, the backfill material is to be ordinary backfill reclaimed from the excavation. It is the Contractor’s responsibility to separate the salvageable material from the excavation.

Backfilling and surface reinstatement of the trenches shall commence as soon as possible after laying, inspection and testing (if applicable), of each section of pipeline. Where applicable each trench shall be backfilled with material similar to that excavated from the trench and/or selected or supplied to comply with the requirements for backfill as shown on the Drawings and in this Specification.

The Contractor shall replace the materials in the same order which they were excavated where ordinary backfill is used.

Any reinstatement of the roads is to be to the satisfaction of the Engineer and the Council. The surface is to match the existing.

The base course in areas under carparks, roads, areas subject to heavy loading, the top 100mm of the trench reinstatement, is to be TNZ M/4/AP40. The subbase is to be a minimum depth of 500mm of AP65 to TNZ M/3.

C.13.8 BACKFILLING

Minimum cover of PVC pipes shall be 750mm in roads and streets, 600mm in other areas subjected to traffic, with at least 500mm cover in all other instances unless shown otherwise.

Backfill shall be carefully placed in 150mm thick layers and compacted by hand around and over the pipe to a depth of 300mm. The remaining depth of backfill up to ground level shall be carefully placed in layers not thicker than 200mm and compacted by hand operated mechanical equipment.

Backfill material reclaimed from the excavation shall be compacted to ensure that the in-situ strength is at least equal to that of the adjacent earth. Backfill shall be compacted to 85% of the maximum dry density.

Imported backfill under carparks, roads or buildings shall be compacted to 98% of the maximum dry density. The Contractor is to provide test results to the Engineer to confirm compliance of this requirement using comparative testing equipment such as a Clegg Hammer NDM or a shear vane. Organic or deleterious material shall be excluded.

Backfilling around pipes shall be carried out in a manner, which will not cause displacement of or excessive stresses in the buried structure. In general the backfill level on one side of the structure shall be within 300 mm of the level of the other side.
C.13.9 MINIMUM COVER PIPE PROTECTION

Where the cover over the installed pipework is less than detailed above in clause C.13.8 Backfilling or the pipe manufacturers minimal required dimension, the pipe is to be protected by a concrete cover.

Pipe protection under trafficable areas shall be 150mm thick concrete with centrally placed 665 reinforcing mesh constructed over minimum 100mm AP20 surrounding the pipe. Pipe protection in non-trafficable areas shall be 100mm non-reinforced concrete over a minimum 50mm AP20. Concrete shall be 20 MPa with 100mm slump.
### ROAD SURFACES

<table>
<thead>
<tr>
<th>ZONE</th>
<th>MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base course</td>
<td>AP40</td>
</tr>
<tr>
<td>Sub-base</td>
<td>AP65</td>
</tr>
<tr>
<td>Trench fill</td>
<td>AP65</td>
</tr>
<tr>
<td>Bedding</td>
<td>AP20</td>
</tr>
<tr>
<td></td>
<td>Bedding may be omitted if trench base is granular sand or gravel of similar grading.</td>
</tr>
<tr>
<td>Over-excavation</td>
<td></td>
</tr>
</tbody>
</table>

### STANDARD TRENCH DETAIL

1:10

**NOTES:**

1. Specify special bedding to suit the conditions if the trench floor has:
   - irregular outcrops of rock or
   - been disturbed by uncontrolled ground water.
   - constructed on hillside.

2. Compact and evenly grade finish trench floor.

3. Sides of excavation to be kept vertical to at least 150 above the pipe.

**TRENCH CLEARANCE**

<table>
<thead>
<tr>
<th>NOMINAL DIAMETER</th>
<th>MINIMUM CLEARANCE</th>
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<tbody>
<tr>
<td>100</td>
<td>100</td>
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<tr>
<td>150 - 300</td>
<td>150</td>
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<tr>
<td>300 - 450</td>
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<td>450 - 900</td>
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<tr>
<td>900 - 1500</td>
<td>350</td>
</tr>
</tbody>
</table>

*Trench width to enable pipe to be safely laid and compacted around the side support zone.


<table>
<thead>
<tr>
<th>ZONE</th>
<th>MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topsoil or pavement</td>
<td>Original or imported material to match existing.</td>
</tr>
<tr>
<td>Trench fill</td>
<td>Original excavated inorganic fill material with 75 maximum stone size.</td>
</tr>
<tr>
<td>Bedding</td>
<td>AP20</td>
</tr>
<tr>
<td></td>
<td>Bedding may be omitted if trench base is granular sand or gravel of similar grading.</td>
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<td></td>
</tr>
</tbody>
</table>

**STANDARD TRENCH DETAIL**

1:10

- Includes locations where occasional vehicle loading occurs, e.g. reserves and footpaths.

**NOTES:**

1. Specify special bedding to suit the conditions if the trench floor has:
   - irregular outcrops of rock or
   - been disturbed by uncontrolled ground water.
   - constructed on hillside.

2. Compact and evenly grade finish trench floor.

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<td>900 – 1500</td>
<td>350</td>
</tr>
</tbody>
</table>

- Trench width to enable pipe to be safely laid and compacted around the side support zone.
C.14 WORKS AROUND PROTECTED TREES

All works within the protected tree area is to be conducted by hand or by means of hydro excavation to ensure that no damage is inflicted on the roots of the protected trees.
Polyethylene pipe sleeving shall be wrapped around the joints and taped at both ends close to the existing protected trees to prevent root intrusion in the future.
C.15  SAWCUTTING EXISTING REINFORCED CONCRETE

Any existing steel reinforcing that is cut during remedial works shall be protected against rust. To protect the exposed reinforcing, an epoxy is to be used on the exposed steel, ensuring that it is adequately covered to prevent moisture from coming into contact with the steel.
C.16 PAVEMENT CRACKFILLING

C.16.1 DELIVERABLES

The Contractor shall allow to produce and supply the University of Canterbury with the following documentation.

- Laboratory test results that prove that the crack sealant conforms to the CCC Construction Standard Specification, Part 6, Clause 20.0 Pavement Crackfilling.

C.16.2 MATERIALS

The crack sealant shall have a minimum softening point of 70°C. The needle penetration at 25°C shall be less than 150mm, the torsional recovery at thirty minutes shall be a minimum of 85% and the ball resilience shall be greater than 50%.

C.16.3 PREPARATION OF SURFACE

The cracks shall be pressure cleaned and dried and any loose material removed. An approved crack primer shall be applied if required.

C.16.4 APPLICATION OF CRACK SEALANT

The edges of all patches and cracks less than 5mm wide shall be treated as follows. The Engineer shall be notified of cracks over 5mm.

The crack sealant shall be applied hot and inserted directly into the crack with the surplus screeded off to give a minimum ‘bandage’ width of 50mm, a minimum thickness of 2mm followed by surfacing with coarse sand.

Bandages over 75mm shall be treated to ensure they achieve an equivalent skid resistance to the adjacent pavement.

C.16.5 MAINTENANCE

The Contractor shall remove excess sand the day following the application of the crack sealant.

Any crack sealant not adhering to the existing surface shall be replaced during the defects liability period.

C.16.6 TESTING

The Contractor shall supply recently achieved softening point, needle penetration, torsional recovery and ball resistance test results. All tests shall be carried out by an approved laboratory and shall be furnished at least one week prior to commencing the crackfilling work.

One 2-litre sample of crack sealant shall be taken for testing by the Contractor twice during the contract to ensure that the sealant conforms to this specification. Laboratory results shall be forwarded to the Engineer as soon as they become available.
C.17 EROSION AND SEDIMENT CONTROL

C.17.1 DELIVERABLES

The Contractor shall allow to produce and supply the University of Canterbury with the following documentation.

- An Erosion and Sediment Control Plan

C.17.2 GENERAL

The Contractor shall take all the steps necessary to control the erosion and sediment runoff from the site for the duration of the construction works. No runoff water containing sediment or silt is allowed to flow across any boundary or into existing drains or streams.

These steps shall include staging of works to minimise the time and total area that the site is disturbed, time limits and methods of stabilisation. It shall also include details of perimeter controls and any sediment retaining structures, means of protection of waterways, prevention of vehicles spreading sediment outside the site, and the programme to maintain these measures.

The minimum perimeter controls that are acceptable are as follows:

- Silt fence around downstream end(s) of site
- Prevention of vehicles transporting sediment off site
- Protection of all inlets and sumps with an appropriate filter system.
- De-watering pumps discharging through silt fence or other filter media

Where not specified, works shall comply with the relevant clauses of the Christchurch City Council Construction Standard Specifications, all local Regional Council guidelines and the methods detailed in the Auckland Regional Council Technical Publication TP90.

If the Contractor proposes to use alternative measures to those detailed in this Specification, the Contractor shall submit to the Engineer full details, including sketches, of their proposed method for erosion and sediment control within the scope of the works. The proposed method must be designed by a suitably qualified person, and certified as suitable for this site. This must be completed before commencement of the site works or drainage works.

The Erosion and Sediment Control Plan (E&SCP) shall be submitted for approval a minimum of ten working days prior to starting work. If the plan is insufficient or incorrect, it will be returned to the Contractor for amendment and re-submission. No work may commence on site prior to the Contractor’s receipt of the approved plan.

The minimum requirements of the plan must be implemented throughout the duration of the works. Where it becomes necessary to implement measures extra to the minimum required by the approved plan, particularly in case of emergency, these shall be implemented immediately and the Engineer advised.

Where it becomes necessary to amend the plan, amendments shall be submitted to the Engineer for approval within 24 hours, or earlier if the amendments are necessary to prevent sediment discharging to a waterway or stormwater system. No additional payment shall be made to the Contractor for changes required to the E&SCP.

If at any stage the Engineer is not satisfied with the implementation of Erosion and Sediment Control measures, or believes that the standard of the outcomes is compromised, the Contractor shall be advised and shall be required to implement improvements.

Where the requirements of this section are not met, the Engineer may

- Direct the Contractor to suspend work until the improvements are implemented.
• Take whatever steps necessary to ensure satisfactory Erosion and Sediment Controls are provided, at no cost to the Principal.

All uncontrolled discharges shall be removed, repaired and reinstated at no charge to the Principal and in accordance with all affected parties’ requirements.

C.17.3 SEDIMENT CONTROL

Sediment control at the lower end of the carriageway and site, within the site boundary, may be achieved by constructing one (or a combination) of the following methods:

C.17.3.1 Sediment Control in sheet flows

• Site exit points – A number of methods such as shakers, exit ramps and rock aprons exist to help prevent vehicles transferring sediment outside the project boundary.

• Sediment fences – Temporary barriers of woven geotextile fabric are capable of capturing medium to coarse sediment while also slowing the flow.

• Exposed aggregate surfaces – It is important to prepare exposed aggregate surfaces without allowing cement residue to flow into stormwater drains or waterways. Where practical, wash cement residue onto pervious surfaces or fully contain it within temporary sediment dams created
from tightly stacked sandbags. When suitably dry, shovel cement residue into a waste disposal bin. Cement residue or wastewater runoff should never be washed into the roadside gutter.

C.17.3.2 Sediment control in concentrated flows

- Dewatering – Maintaining sediment-laden water onsite for as long as possible and minimising volumes of water to be dewatered will help reduce the concentration of sediment in the discharged water.

- Stormwater inlet protection – Covering stormwater inlets with Bidim A29 geotextile fabric and coarse aggregate. Silt and sediment can be eliminated from entering stormwater openings by installing a temporary catchpit filter. The diagram below shows the suggested minimum requirements for inlet protection.
C.17.4 EROSION CONTROL

Erosion control at the lower end of the carriageway and site, within the site boundary, may be achieved by constructing one (or a combination) of the following methods:

C.17.4.1 Surface protection from wind

- Watering for dust control – Any disturbed soil particles will be sprayed with water to reduce their susceptibility to wind and dust erosion.
- Surface cover – Covering with vegetation, mulch or geotextile will help prevent wind and dust erosion.

C.17.4.2 Surface protection from raindrop impact and sheet flows

- Grassing – Grassing is to be used on all long term cut/fill slopes, embankments and stockpiles to prevent raindrop impact and reduce runoff flows.
- Surface mulching – Where grassing is not possible a surface mulch such as hay, straw or wood chip is to be used.
- Batter blankets – Placing a proprietary Bidim SC04 Filter Roll or similar approved alternative pegged along the ground contours will help protect from erosive forces.
- Surface roughing – Earthmovers equipped with ripper tyres create a rough surface to slow runoff speeds and promote infiltration.
- Soil binders and chemical treatment – Binders and chemicals can be used to create a cohesive surface onto of the soil, apply as per manufacturer’s directions.

C.17.5 DUST NUISANCE

The Contractor shall take all reasonable precautions to mitigate the dust nuisance to the site, adjacent property and the public. Dust nuisance is deemed to be any visible air borne dust particles that are transported across the site boundaries or work area. Control of the dust is to include all of the Contract works, material stockpiled on site, and during operations e.g. excavations. Control of the dust must be maintained for the duration of the Contract.

Reasonable precautions must include the following minimum requirements:

- Provision to dampen any excavated surface.
- Provision to dampen any loaded vehicle to minimise material blowing off vehicles during transit.

No sediment, dust or waste material may be deposited on footpaths, roads or any public property from works on this site. Preventative measures must be taken to ensure loads on vehicles are secure, dust is suppressed and sediment from vehicle tyres is removed.

Accumulated dust and debris is to be removed from site to minimise the potential for dust nuisance.

C.17.6 CONSTRUCTION NOISE

The contractor shall limit construction noise to that typical of an earthworks operation. Mitigation shall be in the form of a maximum decibel level as dictated by the work hours defined in the contract.

It is not expected that any night time works will take place. In the event that night or emergency works are required the Contractor must seek approval from the University before proceeding.

The Contractor is to maintain good relations with the local community to allow for consultation and co-operation regarding the commencement of works in order to help reduce adverse reactions to noise.

All construction noise shall comply with the requirements of NZS 6803 “Acoustics – Construction Noise”.
C.17.7 CHEMICAL SPILLS/CONTAMINATION

The contractor is to take measures to ensure machinery, storage tanks and other equipment containing chemicals such as diesel and oil not contaminate the surrounding environment. Such measures as recommended by the Environmental Protection Agency include:

- Dry break couplings to minimise drips
- Over-fill prevention devices
- Catch trays under connection points
- Spill kits available and instruction on how to use
- Padlocks on valves
- Staff training to include spill response

In addition, static storage tanks and parking sites for the mobile tanks will have:

- Bunded perimeter to contain any spills
- Regular inspection of each site and records of inspections

All chemical use is to comply with the Hazardous Substances and New Organisms Act 1996.

C.17.8 INSPECTION AND MAINTENANCE

Regular inspection and maintenance must be carried out to ensure these temporary sediment/silt traps are not completely clogged by sediment or silt. Sediment and silt collected at the traps must be regularly removed to ensure no spillover.

Particular care must be taken to ensure that the discharges into the pump chambers are maintained to ensure they do not receive contaminated water.

Arrangements must be made for inspections and maintenance of the sediment/silt traps over weekends, during public holidays, over any extended periods when no work is being carried out, and when heavy rain occurs outside normal working hours.
## Compliance Checklist

<table>
<thead>
<tr>
<th>Project Name:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submitting Consultant:</td>
<td>Design Stage:</td>
</tr>
</tbody>
</table>

### Section 20 – Structure

#### Compliance Checklist

<table>
<thead>
<tr>
<th></th>
<th>Section 01 – General</th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>#</td>
<td>All Clauses</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

#### 4.1 Overview

| 4.1.1 Purpose | ☐ | ☐ | ☐ |

#### 4.2 Design Concepts

| 4.2.1 General | ☐ | ☐ | ☐ |
| 4.2.2 Design Options | ☐ | ☐ | ☐ |
| 4.2.3 Due Diligence Activities Options | ☐ | ☐ | ☐ |
| 4.2.4.1 Minimum Design Criteria | ☐ | ☐ | ☐ |

#### 4.3 Civil Works Elements

| 4.3.1 Sewer Drainage | ☐ | ☐ | ☐ |
| 4.3.2 Stormwater Drainage | ☐ | ☐ | ☐ |
| 4.3.3 Service Culverts | ☐ | ☐ | ☐ |
| 4.3.4 Landscaping Drainage | ☐ | ☐ | ☐ |
| 4.3.5 Standard Specification | ☐ | ☐ | ☐ |

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Date: ☐ Acceptable
University Reviewer: ☐ Acceptable subject to comments
Signed: ☐ Resubmission required