

CIVIL SPECIFICATION

FOR

LTA KARAVI BRIDGE STATION (To be used as and where applicable)

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100.0 GENERAL

100.1 SCOPE

These specifications cover civil aspects of the project only and are to be read at all times in conjunction with the other contract documents. These include the general and special conditions of contract, the preliminary and general clauses, the architectural and services specifications and the drawings.

100.2 RELATED DOCUMENTS

100.2.1 Codes, Specifications and Regulations

Documents which relate to all sections of this specification are:

Territorial Authority Bylaws
Health and Safety in Employment Act
Health Act 1956
NZ Building Code
NZ Department of Labour Publications:
Safety in Construction No. 5 - Excavation
Safety in Construction No. 17 - Code of Practise for Roll Over
Protective Structures for Earth Moving Machines
Safety in Construction No. 25 - Roadworks Safety Guide
NZS 4404 Code of Practice for Urban Land Subdivision
NZS 6801 Methods of Measuring Noise
NZS 6803 Measurement and Assessment of Noise from Construction
BS 5228 Part 1 Code of Practice for Basic Information and Procedures for Noise Control

Documents listed above and cited in this Section are deemed to form part of this specification. However, this specification takes precedence in the event of it being of a higher standard than the cited documents. The latest edition of any such document (including amendments in force at the date of tender) applies to this Section.

100.2.2 Existing Information

A Surveyors site survey drawing will be made available.

100.3 SUBMISSIONS AND RECORDS

The Contractor shall obtain all Building Permits that may be necessary for temporary construction works.

100.4 DISCREPANCY

Any discrepancies between any of the documentation is to be brought to the Engineers' attention immediately. In general the more onerous condition will have been deemed to apply and to have been priced for.

100.5 APPROVAL OF VARIATIONS

Before starting any work which may involve variation the Contractor must obtain the approval from the Engineer.

100.6 NUISANCE

The work shall be carried out in such a manner as to cause the least inconvenience to neighbours and the public as is reasonably possible.

100.7 **WORKMANSHIP**

All work shall be executed to the entire satisfaction of the Engineer.

100.8 **COMPLETION**

100.8.1 On completion clean all site and adjacent public roads, footpaths, kerbs and channels and drainage sumps.

100.8.2 Remove from site all materials not used. This shall include excavated material.

200 EARTHWORKS

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200.0 **EARTHWORKS**

200.1 **SCOPE**

This section covers materials to be supplied and work to be done in stripping of vegetation and topsoil, the breaking out of existing structures and the excavation and filling for foundations and roads to bring formations to the profiles as detailed on the contract drawings.

The Contractor may reuse bulk excavated material to raise the general level of the site for building platform levels or general landscaping fill. The Engineer will decide which material can be reused. Rejected material shall be removed from the site. Material that is approved for reuse shall be carefully spread and compacted in accordance with this Specification.

The Contractor may elect to stockpile excavated material as an interim measure. All stockpiles should be protected from water damage. Material stockpiled may be rejected for reuse if in the opinion of the Engineer that the material has degraded in the stockpile.

Work included in this section of the specification includes:

- 1 Stripping of the topsoil and any surface deleterious matter. This shall include the demolition of existing structures and breaking out of hard paving where required.
- 2 Excavation for roads, carparks and building platforms.
- 3 Formation of roading and carpark subgrades and building platforms.
- 4 Spreading and compaction of selected excavated material.
- 5 Disposal of excavated material not suitable as fill.
- 6 Keeping excavations free of water.

200.2 **RELATED DOCUMENTS**

Documents which relate to this section are:

Auckland Regional Council Publication:

Erosion and Sediment Control Guidelines for Earthwork

NZS 4402 Methods of testing soils for Civil Engineering Purposes

NZS 4431 Code of Practice for Earthfill for Residential Development

Documents listed above and cited in this Section are deemed to form part of this specification. However, this specification takes precedence in the event of it being of a higher standard than the cited documents. The latest edition of any such document (including amendments in force at the date of tender) applies to this Section.

200.3 **SUBMISSIONS AND RECORDS**

200.3.1 At completion of the Works, the Contractor shall provide a Registered Surveyors Certificate that the finished levels and positions are within the specified tolerances of the levels and positions shown on the Contract Drawings.

200.3.2 The Contractor shall obtain all necessary permits for Silt Retention and Erosion Control.

200.3.3 The Contractor shall produce a design certificate which certifies that the reinforced soil walls have been designed by a Registered Engineer in accordance with the design parameters specified.

The wall designer shall produce a site specific specification and any further drawings necessary for the construction of the reinforced soil retaining walls. These documents shall be deemed to be part of the Contract. Calculations shall also be provided to the Engineer.

200.3.4 Records Of Measurement

Where provisional quantities are specified or where there have been variations to the contract levels or dimensions, the Contractor shall measure and record the following information:

- depths of excavation related to the datum;
- final plan dimensions of excavations related to the design grid system;
- quantities of excavation in rock;
- quantities of fill and/or topsoil, imports being recorded separately.

200.3.5 Provide an as built plan, showing contours at 250mm intervals and spot levels on a 10m grid.

200.4 TESTING

200.4.1 Soil tests shall comply with NZS 4402.

200.4.2 All soil tests shall be carried out by a PWD registered testing laboratory, or alternative Laboratory approved by the Engineer.

200.4.3 Fill material and fill compaction shall be tested in accordance with NZS 4431 as directed by the Engineer.

200.4.4 Visual inspection of the quality of earthfills shall be made by the Engineer in accordance with NZS 4431 Section 9.

200.5 MATERIALS

200.5.1 Excavated Fill Material

- (i) Material to be used as fill shall be free from topsoil, vegetation, clay or deleterious matter, with a maximum silt content of 10%. Silt shall be deemed material passing a 75 micrometre sieve. Fragments of fill material shall have a maximum dimension of 150mm or less.
- (ii) Material shall be approved for use by the Engineer. The material shall be tested as directed by the Engineer.

200.5.2 Imported Granular Fill Material

General

Imported fill material shall consist of clean sound particles of crushed stone, a mixture of crushed stone, a mixture of crushed stone and sand, or any other granular material approved of by the Engineer.

Samples and test data shall be supplied and approved by the Engineer before material is delivered on site.

The aggregate shall be free from vegetable and other deleterious matter. The presence of clay either free or in the form of a coating on the stone shall render aggregate non-acceptable.

Gradation

The aggregate shall be graded from coarse to fine and shall have no dimension greater than 150mm, and comply with the following grading:

The aggregate shall be graded from coarse to fine and when tested on laboratory screens shall comply with the following grading:

Passing	100.0mm square screen opening	100 percent
Passing	65.0mm square screen opening	70 - 85 percent
Passing	40.0mm square screen opening	45 - 70 percent
Passing	20.0mm square screen opening	30 - 50 percent
Passing	10.0mm square screen opening	23 - 40 percent
Passing	5.0mm square screen opening	17 - 30 percent
Passing	2.4mm square screen opening	10 - 20 percent
Passing	420.0 micrometres	6 - 12 percent
Passing	75.0 micrometres	0 - 5 percent

200.5.3 Imported Granular Fill Behind Retaining Walls

Material to be a GAP 50/20, GAP 20/7 or AP50 material, as indicated on the drawings, and approved by the Engineer for use.

200.5.4 Reinforced Soil Walls

General

The reinforced soil walls shall be designed and certified by a Registered Engineer to the following parameters:

- (i) Seismic Loading
 - 2000 year return period earthquake, 'Ultimate Limit State'.
 - Walls not to collapse, maximum wall displacement 900mm. Seismic coefficient $C = 0.70g$.
 - 250 year return period earthquake, 'Serviceability Limit State'.
 - Walls to suffer no damage or displacement. Seismic coefficient $C = 0.43g$.
- (ii) Vehicular Loading

Design for 4kN/m² surcharge load or a 180kN point load positioned 1m away from the wall face.

- (iii) Bearing pressures beneath wall
Ultimate : 1600 kPa maximum
Allowable : 530 kPa maximum
- (iv) The walls shall comprise a soil block reinforced with galvanised steel strips and with precast concrete facing units. Alternative systems which satisfy the design loadings may be approved by the Engineer.
- (v) All components of the reinforced soil wall shall have a minimum design life of 150 years.

Soil

Reinforcing strips to be backfilled with selected fill which satisfies the following criteria:

- (i) Soil density γ 18kN/m³ minimum, 20kN/m³ maximum.
- (ii) Soil effective angle of internal friction $\phi = 36^\circ$ minimum.
- (iii) Clean granular fill, free of organic material, with cohesion C = 0.

- (iv) Grading

<u>Particle Size</u>	<u>Percent Passing</u>
250mm	100
75 μ m	0 - 15 max

- (v) Electro-chemical requirements
The electro-chemical resistivity requirements for Select Fill shall be deemed to be satisfied if the material lies between the following limits:
 - (a) The pH of the material as measured by NZS 4402:1986 Test 3.3 lies between 5 and 10.
 - (b) The electrical resistivity as determined by the test described in Appendix C attached to this specification is greater than 5000 ohm.cm.

The electrical resistivity is to be determined by the test method described in AS 1289 D4.1 (1980) on a sample compacted in the test mould to 95% of its maximum dry density as determined by AS 1289 E1.1 (1977) (Standard Compaction). The measured resistivity should be corrected back to a standard temperature of 20°C using the following relationship:

$$\rho_{20} = \frac{\rho T(20 + T)}{40}$$

where ρ_{20} = Resistivity corrected to 20°C
 ρT = Measured Resistivity at Temperature T°C

- (vi) Fill to comply with all requirements of the certified design and specification.

Reinforcing Strips

Galvanised medium tensile ribbed strips that comply with all requirements of the certified design and specification shall be used.

Precast Concrete Facing Units

Units to be constructed with 30MPa minimum strength concrete that complies with this specification. The units shall form a continuous and even surface and comply with all requirements of the certified design and specification.

200.6 WORKMANSHIP

200.6.1 Excavation

Excavation and filling shall be carried out in accordance with NZS 4431.

Excavations Generally

Excavate and trim to levels required for building foundations and roading sub grades.

Unless shown otherwise foundations shall be excavated to solid bearing to a minimum of 300mm below original ground levels and a minimum of 450mm below finished adjacent external ground levels. In filled areas the foundation excavations shall be as approved by the Engineer.

The works shall be maintained free of water. All surfaces of excavations and fill shall be formed to provide adequate drainage falls where possible. The Contractor shall provide temporary drains, sumps and pumps as necessary.

Where excavations are below the water table, the Contractor's proposed method of dewatering shall be submitted to the Engineer and shall not be used until approved.

Excavate generally as required or as shown on the drawings including adherence to the tolerances given in this specification.

Redundant Services - seal off and remove all or any redundant services which may become uncovered during the carrying out of excavations, all in accordance with the requirements of the ruling Authority and/or Authorities having jurisdiction over them.

200.6.2 Setting Out

Before using the survey marks provided, the Contractor shall satisfy himself that they are the marks shown on the drawings, that they have not been disturbed and that their levels, if shown on the drawings, agree with the levels of one or more existing features on the site.

The Contractor shall set out the works in accordance with the documents and in conjunction with a Registered Surveyor.

200.6.3 Existing Services

If services or obstructions not shown on the drawings are discovered prior to or during the work under the Contract, notify the Engineer immediately.

Do not excavate by machine within 1m of existing underground services without prior approval.

The Contractor must confirm with the Engineer that approval from all relevant authorities has been obtained before commencement of Works.

200.6.4 Inspection

All foundation excavations and roading subgrade formations shall be approved by the

Engineer as work proceeds and no backfilling, site concrete or foundation concrete shall be placed until approval has been given by the Engineer.

200.6.5 Break Out of Obstructions

Break out and remove old foundations, drains, manholes and septic tanks, seal up connections and remove contaminated soil. Backfill with selected excavated material well rammed in layers to approval.

200.6.6 Silt Retention And Erosion Control

The Contractor shall indemnify the Principal and the Engineer against any proceedings which may be brought for breach of a permit in respect of silt discharge resulting from his operations. He shall not commence earthworks until he is satisfied that all conditions and requirements of the permit can be met and suitable silt traps, cut off drains etc. have been constructed to the approval of the Regional Council. The Contractor shall maintain the approved control measures until the end of the maintenance period.

a) General

Before any earthworks begin the Contractor shall take all necessary precautions to protect public and private property from possible damage by stormwater runoff from the Contract area and catchment below the Contract area. The Contractor shall continue to provide and maintain adequate stormwater control facilities as the work proceeds and until the end of the maintenance period.

The Engineer may order the Contractor to cease all other operations until he is satisfied that the stormwater control systems are adequate.

b) Surface Profile

During the progress of the work, the surface profile shall be maintained in such shape and condition that there is adequate drainage at all times.

In particular, the formation surface within 3 metres of all fill batters shall be kept graded away from the top of the batter and surface water shall be led to suitable discharge positions by means of vee drains and prevented from spilling over the batter and causing erosion.

c) Contour Drains

The Contractor shall be deemed to have allowed in his tender for the digging and maintaining of adequate lengths of temporary and permanent open intercepting and contour drains.

Contour drains leading to discharge points on virgin ground shall be put in at intervals depending on the general slope of the ground after earthworks operations have ceased for the day. Contour drains should have gradients of 1% and be spaced at 30 metre intervals.

Intercepting drains shall be dug at the toe of batters and uphill of private boundaries and include the connection to approved outlets.

Where these drains are required to be dug through soft material, the Engineer may direct that they be concrete lined, and the Contractor shall be paid extra for this concreting work.

d) Silt Traps

The Contractor shall provide silt traps on all temporary or permanent open channels to be used for carrying stormwater. The type and size of silt traps may vary according to location but shall generally consist of a stilling pond and mesh fence.

Where, in the opinion of the Engineer, permanent silt traps are required, payment shall be made for their provision and maintenance at the schedule rate. No extra payment shall be made for temporary silt traps.

The Contractor shall maintain all silt traps and remove all trapped debris as required to locations where it will not be washed down into open or piped drains. He shall restore pond areas after all risk of soil contamination has been removed.

Silt traps shall have a surface area of at least 2% of the catchment served and have adequate depth to hold silt from that catchment. They shall be maintained until a good cover of grass has been produced over the catchment.

Where silt traps and other drainage work are of a nature likely to be a danger to the public, the Contractor shall take adequate protective measures by fencing off the dangerous areas and putting up clear and strong notice boards indicating the danger and warning people to keep off.

If the measures taken fail to prevent damage to private and public properties and utilities, the Contractor shall, at his own expense, clean up and repair all damage including the clearing and repair of existing piped drains that may have become blocked or damaged.

200.6.7 Preparation Of Formation Levels

All formations to excavations shall be trimmed, levelled, cleared of loose material and compacted in accordance with this specification, prior to placement of reinforcement cages or roading sub base material.

200.6.8 Protection of Building Formation Levels

To avoid damage to excavation formations, excavation surface shall be left at least 150mm above formation level until immediately before being offered for inspection. Seepage and water shall be kept off the works as specified.

A 50mm thick layer of blinding concrete shall be placed on every foundation formation that is to be left exposed for more than 8 hours.

Construction plant and other vehicular traffic shall not be operated on the formation, except for that required for preparation of the formation, unless adequate protection is provided.

The Contractor's proposals for preparing the formation and in particular how he intends to traffic it shall be agreed with the Engineer prior to it happening.

The Contractor shall sequence the risk in such a way as to minimise the exposure of open trenches to the elements.

If any areas of formation are damaged by the weather or any other cause the Engineer shall be immediately notified.

200.6.9 Disposal Of Soil

Except where otherwise directed by the Engineer, remove all excavated material not approved as fill material from site.

200.6.10 **Excess Excavation**

Excess excavation not authorised by the Engineer and consequent additional backfilling, compacting or testing, shall not justify contract variation or extension of time.

Where excavation exceeds the required depth, fill back to correct depth with material as follows:

Roads and carparking areas - imported fill

Below slabs on ground - imported fill

Below footings, beams and other structural elements - 10MPa concrete.

200.6.11 **Excavation In Rock**

Rock shall mean material which is too hard to be excavated by a Kato HD880 hydraulic excavator or its equivalent having a proven rating of 110 kW. The machine shall have a 300mm bucket width, be in good order and under the control of a competent operator. No material shall be accepted as rock unless the Contractor clearly demonstrates that the rock cannot be excavated by such a machine or its equivalent and such demonstration may be required by the Engineer at any stage of the excavation work.

The classification of the material being excavated shall be agreed with the Engineer at the time of excavation. It shall be the responsibility of the Contractor to seek such agreement and to demonstrate that the material shall be classified as 'rippable' or 'non-rippable' rock.

The Engineer reserves the absolute right to determine what is rock and such determination shall be final and binding on the Contractor who must obtain a determination prior to commencing work.

All other material shall be classified as other than rock.

200.6.12 **Use Of Explosives**

The method of rock excavation shall be subject to approval.

Pursuant to 'Blasting' - Special Conditions of Contract, do not use explosives in excavation unless permission in writing is first obtained from the Engineer. Approval must then be obtained from all authorities having jurisdiction.

It is unlikely permission would be granted by the Local Authority.

200.6.13 **Rate For Rock**

All excavation is deemed to be in 'other than rock' unless otherwise determined by the Engineer.

The Contractor is to specifically note a rate for rock excavation, which would be an 'extra over' the excavation in 'other than rock'.

Where rock is encountered the Contractor shall be paid an extra amount for the actual quantity of rock necessarily and reasonably excavated, as determined by the Engineer.

200.6.14 **Dewatering**

Maintain excavations, levelled and filled areas free of water by temporary catch drains,

sumps, pumping, bailing or whatever means are suitable and effective.

Immediately before placing concrete or masonry on ground remove all free water and foreign matter.

Prevent any water flow over freshly laid work.

200.6.15 Shoring

Provide all shoring, planking and strutting necessary to retain the sides of excavations to ensure safe working. Provide safety covers over holes.

No instruction shall relieve the Contractor of sole responsibility for the sufficient support of excavation sites.

Guard against the formation of voids outside sheeting or sheet piling if used, and should any voids form, fill and compact them in a manner approved by the Engineer.

Remove shoring and timbering progressively as the work proceeds unless otherwise instructed.

200.6.16 Bad Ground

Should unsuitable material be encountered at the prescribed depths of excavation, or soft, wet and unstable areas develop during excavation, obtain instructions from the Engineer before carrying out additional excavations. Backfill and compact to the correct levels as directed by the Engineer.

If the Contractor has not caused or contributed to the above conditions and if their occurrence could not have been reasonably anticipated at the date of the Contractor's tender, the additional work shall constitute a variation to the work under the Contract.

200.6.17 Benching

Slopes steeper than 1 in 10 against which filling is carried out shall be benched as the fill is brought up. The maximum vertical spacing between shall be 1.0m. The fall inwards across benches shall be 1 in 20 and longitudinally between 1 in 20 and 1 in 100 with adequate drainage outlets extended clear of the toe of the filling to prevent scouring.

200.6.18 Batters - Temporary Protection

Protect batters with change of level between crest and toe greater than 1.5 metres from weather erosion with a waterproof covering either hessian and tar, or heavy duty black polythene sheet. Seal at joints and securely fix down at crest and toe. Maintain coverings in good condition until ground is secured by permanent construction.

200.6.19 Filling

All fill material is to be imported onto the site unless it can be provided from spoil recovered from the site excavations. Reuse of excavated material is subject to the Engineer's approval. No fill shall be placed in water.

If at any time the Engineer considers that the moisture content lies outside the above limits or finds after testing that this is so, he shall order compaction to cease until the material has been dried out or wetted up as the case may be.

Where drying out of fill material is necessary, it shall be carried out by discing or other suitable means to the full depth of the wet layers, and allowing this full depth to dry uniformly until the moisture content is within the above limits. Discing shall only be carried out when the weather permits recompaction and shaping before rain.

Where wetting up is required, this shall be carried out with Plant which will ensure a uniform and controlled distribution of water, and in such a way that areas of dry material alternated with areas of saturated soil or pools of water are avoided. After wetting, the soil shall be disced and bladed to ensure a uniform distribution of moisture throughout the layer.

When the soil has regained a moisture content within the specified limits after the wetting or drying process, it shall be recompacted with the specified number of passes, and reshaped.

200.6.20 Compaction

- (i) Compaction shall be carried out as soon as practicable after deposition of the fill materials. Fill shall be spread and compacted in uniform layers of thickness appropriate to the compaction equipment being used as specified in Table 1.
- (ii) During compaction maintain moisture content of fill in the range OMC $\pm 2\%$ by drying or the addition of moisture as appropriate. Water spraying equipment used for this purpose shall be capable of distributing uniformly in controlled quantities over uniform widths. Mix mechanically to ensure uniform distribution of moisture before commencing rolling.

Table 1

Type of Plant	Category	Maximum Depth of Compacted Layer	Minimum Number of Passes
Smooth Wheeled Roller			
Mass per metre Width of roll : kg	2000 - 5000 Over 5000	125 150	10 8
Vibratory Roller			
Mass per metre width of roll : kg	300 - 600 600 - 1100 100 - 1800 Over 1800	75 125 150 150	16 12 8 4
Vibrating Plate Compactor			
Mass per metre ² of base plate : kg	1000 - 1200 1200 - 1400 Over 1400	75 75 125	10 6 6
Vibro-Tamper			
Mass : kg	50 - 75 Over 75	100 150	3 3
Power Rammer			
Mass : kg	100 - 500 Over 500	150 275	6 12

200.6.21 **Density Of Compaction**

- (i) Compact to the following minimum ratios of in-situ compacted dry density to New Zealand standard compaction (NZS 4402 test 5.1.1), expressed as a percentage.

ITEM	LOCATION		
	Under Structures	Under Pavements & Slabs on Ground	Landscape Areas
Excavation Subgrade	100%	98%	85%
Fill: 250mm or more below finished surface	98%	95%	85%
Fill: Top 250mm	100%	98% (Min CBR 15)	85%
Basecourse			

& Subbase 95% 95% --

Note: Under buildings includes within a 'Line of Influence' measured at 35° from the horizontal.

- (ii) In-situ compacted dry density to be measured as defined in NZS 4402.
- (iii) The Engineer may give approval for the density of compaction to be measured as a ratio of in-situ compacted dry density to the solid density of the aggregate. Unless specified otherwise by the Engineer, a minimum ratio of 85% should be achieved. The saturated surface dry specific density shall be used to determine the solid density.
- (iv) For cohesive material, the Engineer may approve that the following two tests both be used to measure the density of compaction:
 - Maximum Air Voids: The maximum air voids shall not exceed 12% for any single test and the average of any 5 consecutive test shall not exceed 10%.
 - Minimum Shear Strength: The minimum shear strength shall not have any corrected value of less than 120kPa for any single test nor less than 150kPa for any 5 consecutive tests.

200.6.22 Testing Of Compaction

- (i) Soil Classification tests: one set of tests for each distinguishable soil type used as determined by the Engineer.
- (ii) In-situ Density and Water Content tests
 - : one set of tests for every 200m² plan area of subgrade and for each 500mm height of fill, on an approved grid.*
 - : three sets of tests for every 200m² plan area on the final layer of fill.*
 - : at 10m centres along trenches on the subgrade and each 500mm height of fill.*
- (iii) The Engineer may instruct the Contractor to proof roll the whole or part of the compacted material with a roller with a minimum rating of 5 tonne per metre width static.
- (iv) Should testing disclose a lack of uniformity yielding and/or any areas compacted below standard the Contractor shall replace, further compact or otherwise strengthen the sub-standard areas in accordance with the Engineer's directions. Further testing will be undertaken to verify compliance with the Specification.
- (v) The cost of all testing shall be borne by the Contractor.
- (vi) Test results shall be submitted to the Engineer within 24 hours. All test results shall be signed and dated by a representative of the testing agency.

200.6.23 Tolerances

Bulk Excavation

- Extent of excavation measured on plan, Variation from true size +100mm, -0mm
- Depth of excavation. Variation from true level -50mm, +0mm

Detail Excavation (pit and trench)

- Measured on plan. Variation from true size. +50mm, -0mm
- Depth of excavation. Variation from true level. -50mm, +0mm
- Deviation in plan. ± 50 mm

Bulk Filling

- Extent of filling measured on plan, Variation from true size. +50mm, -0mm
- Depth of filling, site. Variation from true level. -50mm, +0mm
- Depth of filling, building platform. Variation from true level. +0mm, -25mm

Detail Filling (pit and trench)

- Measured on plan. Variation from true size. +25mm, -0mm
- Depth of filling. Variation from true level. +10mm, -0mm
- Deviation in plan. ± 50 mm

200.6.24 **Reinforced Soil Walls**

Reinforced soil walls to be built by persons familiar and competent in their construction. Construction to be to the satisfaction of the certified designer.

200.7 **COMPLETION**

200.7.1 Remove from site all materials not used. This shall include all excavated material.

200.7.2 Clean all streets and reinstate to original condition.

310.0 GRANULAR SUB BASE AND BASECOURSE

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310.5.3 GAP40 Basecourse Aggregate

310.6 Workmanship

310.6.4 Tolerance

310.6.5 Subgrade Preparation

310.6.6 Subbase Construction

310.6.7 Basecourse Construction

310.6.8 Density Of Compaction

310.6.9 Testing Of Compaction

310.0 GRANULAR SUB BASE AND BASECOURSE

310.1 SCOPE

Work Included In This Section Of The Specification

- 1 Preparation of subgrade to receive subbase/basecourse material.
- 2 Supply, placement and compaction of subbase material and basecourse material.
- 3 Preparation and protection of finished surface to be paved.

310.2 RELATED DOCUMENTS

Documents which relate to this section are:

NZS 4402 Methods of testing soils for Civil Engineering Purposes
Transit New Zealand (TNZ) Specifications
 B/2 Construction of Unbound Granular Pavement Courses
 F/1 Earthworks Construction
 M/4 Crushed Basecourse Aggregate
 M/5 *Approved Regional Basecourses (Wellington 1)*
 T/1 Benkelman Beam Deflection Measurements

Documents listed above and cited in this Section are deemed to form part of this specification. However, this specification takes precedence in the event of it being of a higher standard than the cited documents. The latest edition of any such document (including amendments in force at the date of tender) applies to this Section.

310.3 SUBMISSIONS AND RECORDS

Method Statement

- 310.3.1 The method by which the Contractor proposes to supply, place and compact the subbase and basecourse material shall be submitted to the Engineer and shall not be used until approved.
- 310.3.2 The Contractor shall provide a record of test results to confirm that compaction complies with the Specification and supply material quality test results to confirm suitability.

310.4 TESTING

- 310.4.1 Soil tests shall comply with NZS 4402.
- 310.4.2 All soil tests shall be carried out by a PWD registered testing laboratory or otherwise Approved.
- 310.4.3 Fill material and fill compaction shall be tested in accordance with NZS 4431 as directed by the Engineer.
- 310.4.4 Proof rolling with a vibratory roller or a loaded rubber tyre to test the quality of the subgrade, subbase and basecourse shall be made as requested by the Engineer.

310.5 **MATERIALS**

310.5.1 **Subbase Aggregate**

(a) General

The sub-base course aggregate shall consist of clean sound particles of crushed stone, a mixture of crushed stone, a mixture of crushed stone and sand, or other granular material approved by the Engineer.

Source of material, gradings and test data shall be supplied to and approved by the Engineer before material is delivered on site.

Any added fines shall be non-plastic. The aggregate shall be free from vegetable and other deleterious matter. The presence of clay either free or in the form of a coating on the stone shall render aggregate non-acceptable.

(b) Quality Control

Size of Samples

Tests to check compliance with Specification requirements will be carried out on representative samples of the aggregate selected from a bin, a stockpile, or truck load or in place. The size of a representative sample shall be such that it shall have a mass of approximately 25kg.

Hardness

When tested in a Los Angeles Abrasion Machine in accordance with the methods laid down in ASTM Designation C.131 - 55 the percentage of water of all constituent aggregate shall not exceed 40.

The aggregate shall have a crushing resistance of at least 130 kN.

(c) Soundness

The aggregate shall be sound and durable. Aggregates which break down under the action of weathering will not be accepted.

(d) Liquid Limit and Plasticity Index Requirements

The portion of the aggregate passing the 420 micrometre sieve shall be either non plastic or shall have a liquid limit not greater than 25 and a plasticity index not greater than 5.

Liquid limit will be determined in accordance with ASTM Standard B.423, and plasticity index will be determined in accordance with ASTM Standard D.424, each modified as to sample preparation and testing in accordance with the following requirements:

- The sample shall not be oven dried or subjected to any artificial drying before processing for testing.

- The sample shall be dried to approximately the liquid limit with care being taken

to prevent caking or lumping during the drying process. The liquid limit test shall be performed from wet of the liquid limit to dry of the liquid limit, using the mechanical method. No dry soil shall ever be added to the sample during the performance of either the liquid limit or the plastic limit test.

(e) Gradation

The sub-base aggregate shall be graded from coarse to fine and when tested on laboratory screens or in place shall comply with the following grading:

Passing	65.0mm square screen opening	100 percent
Passing	40.0mm square screen opening	55 - 80 percent
Passing	20.0mm square screen opening	35 - 60 percent
Passing	10.0mm square screen opening	20 - 40 percent
Passing	5.0mm square screen opening	10 - 25 percent
Passing	2.4mm square screen opening	3 - 15 percent
Passing	75 micrometres	0 - 5 percent

Alternative gradings may be submitted to the Engineer for approval.

Sand equivalent not less than 30.

Any deficiency in grading shall be made good at the Contractor's expense. The grading of the sub-base aggregate in particular is considered critical in order to obtain the required qualities of a dense sub-base and no departure from the limits of the specified grading will be tolerated.

310.5.2 TNZ M/4 AP40 Basecourse Aggregate

Basecourse material to comply with TNZ Specification M/4.

The Engineer may approve for *TNZ M/5 (Wellington 1)* Basecourse Aggregate to be used as a substitute for TNZ M/4 AP40 Basecourse Aggregate.

310.5.3 GAP40 Basecourse Aggregate

(a) General

The basecourse aggregate shall consist of clean sound particles of crushed stone, a mixture of crushed stone, a mixture of crushed stone and sand, or other granular material approved by the Engineer.

Samples and test data shall be supplied and approved by the Engineer before material is delivered on site.

Any added fines shall be non-plastic. The aggregate shall be free from vegetable and other deleterious matter. The presence of clay either free or in the form of a coating on the stone shall render aggregate non-acceptable.

The aggregate shall comply with the grading as set out below, in laboratory or in place.

(b) Grading

Passing	37.5 mm Standard Sieve	100 percent
Passing	19.0 mm Standard Sieve	74 - 90 percent
Passing	9.5 mm Standard Sieve	50 - 66 percent
Passing	4.75mm Standard Sieve	38 - 52 percent
Passing	2.36mm Standard Sieve	25 - 38 percent
Passing	1.18mm Standard Sieve	15 - 28 percent
Passing	600µm Standard Sieve	7 - 20 percent
Passing	425µm Standard Sieve	4 - 16 percent
Passing	300µm Standard Sieve	2 - 14 percent
Passing	150µm Standard Sieve	0 - 10 percent
Passing	75µm Standard Sieve	0 - 7 percent

Sand equivalent not less than 40.

310.6 **WORKMANSHIP**

310.6.1 All work shall be in accordance with TNZ Standards.

310.6.2 All work shall be executed to the entire satisfaction of the Engineer.

310.6.3 Work shall not be deemed complete until passed by the local Territorial Authority.

310.6.4 **Tolerance**

Plan

The dimensions to the edge of the pavement, measured at right angles to the designated centre line, shall nowhere be less than that shown on the drawings.

Vertical

The allowable tolerance for the design level at any point on the subbase shall be plus zero to minus 20mm provided that the deviation from a straight edge laid on the surface shall not exceed 12mm in 3 metres.

The allowable tolerance for the design level at any point on the basecourse shall be plus zero to minus 12mm provided that the deviation from a straight edge laid on the surface shall not exceed 12mm in 3 metres.

Where a course thickness is specified, the absolute minimum thickness permitted in any location will be 20mm less, provided that the average thickness over any 200mm length over the full width of pavement is as specified.

310.6.5 **Subgrade Preparation**

(a) Sub-Grade

The sub-grade shall be grader dressed and brought to a firm uniform surface by rolling with smooth wheeled roller of an approved weight. No portion of the sub-grade when completed shall vary more than 15mm from a 3m straight edge.

Under no consideration whatsoever shall the Contractor be permitted to work plastic clay or any portion of the work during rain or under wet conditions. Any such material shall be either allowed to dry out for the full depth or completely removed and replaced with approved dry material at the expense of the Contractor.

The Contractor shall dig such trenches and provide such other facilities as may be required to ensure that stormwater will drain quickly off the sub-grade. These must be constructed so as not to flood or damage any property and shall be filled in or removed on completion of the works.

(b) Testing Sub-Grade

On completion of the excavation to sub-grade level the Engineer may arrange for deflection, CBR or other tests to be carried out without cost to the Contractor. Construction of the sub-base shall not proceed until the testing has been completed to the Engineer's satisfaction. The Contractor will not be due for any payment for any delays which may occur due to the carrying out of any tests, although every reasonable effort will be made to reduce these delays to a minimum.

310.6.6 **Subbase Construction**

Sub-base construction shall be carried out in accordance with the requirements of TNZ B2 'Construction of Unbound Granular Pavement Courses' as applicable.

The Engineer may require that Clegg Impact Soil Tester or Nuclear Density meter measurement be made to ensure that compaction is satisfactory. The laying of the basecourse shall not proceed until the Engineer considers that compaction is satisfactory.

310.6.7 **Basecourse Construction**

(a) Construction

Basecourse construction shall be carried out in accordance with the requirements of TNZ B2 'Construction of Unbound Granular Pavement Courses'.

(b) Weedkiller

An approved weedkiller shall be sprayed on the basecourse metal at a rate of 1.8 litres per square metre over a strip 1m wide from each channel line or edging strip or wall or building.

The weedkiller shall be applied in accordance with the manufacturer's recommendations and shall be a type containing Simazine or Karbutilate.

(c) Maintenance of Basecourse

The finished metal surface shall be maintained at all times true to grade and cross-section by watering as required, blinding, rolling and placing drums or other barricades to ensure no damage is done by traffic using the existing parking area.

On no account shall the surface be allowed to pothole, ravel, rut or become uneven. However, if, for any reason, the surface does ravel or pothole, it shall be patched with suitable metal and completely scarified and recompacted.

(d) Testing

The Engineer may require that Clegg Impact Soil Tester or Nuclear Density meter measurements be made to ensure that compaction is satisfactory. On completion of laying and compaction of the base course material the Engineer may require that Benkleman beam testing be carried out. Surfacing shall not proceed until the Engineer considers that satisfactory and generally uniform deflection test results have been obtained.

310.6.8 Density Of Compaction

- (a) Compact to the following minimum ratios of in-situ compacted dry density to New Zealand standard compaction (NZS 4402 test 5.1.1), expressed as a percentage.

ITEM	LOCATION	
	Paved Areas	Landscape Areas
Basecourse & Subbase	95%	85%

- (b) In-situ compacted dry density to be measured as defined in NZS 4402.
- (c) The Engineer may give approval for the density of compaction to be measured as a ratio of in-situ compacted dry density to the solid density of the aggregate. Unless specified otherwise by the Engineer, a minimum ratio of 85% should be achieved. The saturated surface dry specific density shall be used to determine the solid density.
- (d) Should testing disclose a lack of uniformity and/or any areas compacted below standard the Contractor shall replace, further compact or otherwise strengthen the sub-standard areas in accordance with the Engineer's directions. Further testing will be undertaken to verify compliance with the Specification.
- (e) The cost of all testing shall be borne by the Contractor.
- (f) Test results shall be submitted to the Engineer within 24 hours. All test results shall be signed and dated by a representative of the testing agency.

310.6.9 Testing Of Compaction

- (a) Soil Classification tests: one set of tests for each distinguishable soil type used as

determined by the Engineer.

(b) In-situ Density and Water Content tests

: one set of tests for every 1000m² plan area of subgrade at locations specified by the Engineer.

: one set of tests for every 1000m² plan area of subbase and basecourse at locations approved by the Engineer.

(c) Clegg Hammer Tests. One test for every 200m³ of fill or as directed by the Engineer. A minimum reading of 40 is required when testing with the Clegg Hammer.

(d) Benkelman Beam Tests. One test for every 300m² of finished road base prior to sealing at locations approved by the Engineer. Maximum deflection 0.5mm.

(e) Proof Rolling with a vibratory roller or loaded rubber tyre as directed by the Engineer.

(f) The cost of all testing shall be borne by the Contractor.

320.0 KERBING, CHANNELLING AND EDGING

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- 320.6 Workmanship**
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 - 320.6.3 New Kerbs, Channels, Dished Channels And Edgings**
 - 320.6.4 Concrete Joints**
 - 320.6.5 Backfilling**
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 - 320.6.7 Existing Kerb**
 - 320.6.8 Tolerance**

320.0 KERBING, CHANNELLING AND EDGING

320.1 SCOPE

Work included in this section of the specification

- 1 Construction of subsoil drainage beneath channels.
- 2 Construction of kerbing and channels.
- 3 Construction of dish channels.
- 4 Construction of edges to pavements.

320.2 RELATED DOCUMENTS

Documents which relate to this section are:

NZS 3108 Concrete production - ordinary grade
NZS 3109 Specification for concrete construction
NZS 3124 Concrete Construction for Minor Works
NZS 3402 Hot rolled steel bars for the reinforcement of concrete
NZS 7604 High Density Polyethylene Drain and Sewer Pipe and Fittings
NZS 7643 Installation of Unplasticised PVC Pipe Systems
NZS 7649 Unplasticised PVC underground drain pipe and fittings
Transit New Zealand (TNZ) Specifications
 F/2 Pipe Subsoil Drain Construction
 F/5 Corrugated Plastic Pipe Subsoil Drain Construction

Documents listed above and cited in this Section are deemed to form part of this specification. However, this specification takes precedence in the event of it being of a higher standard than the cited documents. The latest edition of any such document (including amendments in force at the date of tender) applies to this Section.

320.3 SUBMISSIONS AND RECORDS

320.3.1 Method Statement

The method by which the Contractor proposes to construct under channel subsoil drains, kerbs and channels shall be submitted to the Engineer and shall not be used until approved.

320.4 TESTING

Concrete to be tested in accordance with NZS 3124.

320.5 MATERIALS

320.5.1 Pipes

Pipes for subsoil drains shall be HDPE corrugated pipe complying with NZS 7604:1981 'High Density Polyethylene Drain and Sewer Pipe and Fittings' with 240 punched slots per metre, and with a manufactured push fit coupler for jointing.
Subsoil drains shall be wrapped in a manufactured geotextile filter fabric.

320.5.2 Granular Subsoil Drain Bedding Material

Pipes shall be bedded on and backfilled with AP 20/7 drainage scoria or similar approved material.

320.5.3 In Situ Concrete Kerbs, Channels And Edge Restraints

Concrete to be in accordance with NZS 3124 and the concrete section of this specification.

320.5.4 Precast Concrete Kerbs and Edge Restraints

Products to have a smooth surface, free of marks or chips.

320.5.5 Timber Edge Restraints

Timber to be tanalised, Grade H5.

320.5.6 PVC Edge Restraints

System to comprise PVC extruded edge restraints with MDPE pipe dowels, held in place with galvanised steel spikes. Products to be approved by the Engineer before use.

320.6 WORKMANSHIP

320.6.1 Excavation

The Contractor shall carry out the necessary excavation and removal of spoil for the construction of kerbing and channelling to the width and depth required. The excavated area shall be prepared to provide a firm base and shall be inspected and approved by the Engineer before any further work is carried out.

320.6.2 Under-Channel Subsoil Drains

Where shown on the Drawings or at the direction of the Engineer, sub-soil drains shall be constructed to the dimensions as shown on the Drawings using 100mm diameter pipe laid true to line and level. Pipes shall be bedded on and backfilled with drainage scoria or similar approved, and wrapped in filter fabric.

Sub-soil drains shall be connected to sumps or to the stormwater system as shown.

320.6.3 New Kerbs, Channels, Dished Channels And Edgings

Setting out shall be carried out to the line and level pegs using a guide line. This shall be fixed to firmly positioned pins no further apart than 8m on straights, 2m on slow curves and 1m on short radius curves. The setting out must provide for horizontal and vertical curves to be accurately formed with the tangent points correctly located. The location of crossings and cesspits shall be pegged and clearly marked before kerb laying commences.

The kerbing shall be laid so that the vertical and horizontal alignments are within a tolerance of 5mm deviation from the true alignment in any 3m length. In addition to the above, the

gradients shall be such that water shall not pond in the channel at any point.

Kerbs and channels to be constructed in accordance with NZS 4404 Figure 5.

Machine laid kerb and channel construction shall be carried out using methods approved by the Engineer.

The granular base for kerbs and channels shall extend from the roadway to 150mm behind the back of the kerb. Prior to slip forming a minimum depth of 100mm of subbase shall be placed and compacted to the underside of the kerb.

Correctly shaped steel finishing tools shall be used to give a smooth finish to the finally exposed surfaces. A minimum of grout shall be worked into any cut away section of kerbing with a wooden float, when completing crossings and other incidental work. After the surface has hardened sufficiently it shall be lightly broomed longitudinally with a fine haired broom to remove any tool marks.

Construction of dished channels at road entrances along the line of the existing kerb and channel, and where shown within the site, shall all be in accordance with the detail drawings and to the local authority standards.

320.6.4 **Concrete Joints**

Contraction joints shall be made by cutting approximately one-third of the way through the freshly laid concrete so that a crack will only form in the undisturbed concrete below the cut. Contraction joints shall be spaced no further apart than 4m.

320.6.5 **Backfilling**

On completion of kerb construction and when all concrete work has thoroughly hardened, approved hardfill shall be placed at the back of the kerbing and compacted to form the sub-base for concrete or other surfacing. In garden areas topsoil shall be used for backfilling behind the kerb.

320.6.6 **Pram And Vehicle Crossings**

Where shown on the Drawings and as directed by the Engineer, crossings shall be constructed to the details and dimensions shown on the drawings and to the Territorial Authority standards.

320.6.7 **Existing Kerb**

Where new kerbs and channels are to join into existing kerbs and channels, existing kerbs and channels shall be saw cut as necessary and free from dirt. Pour in-situ concrete to form a smooth transition.

The existing kerb and channel is to be broken out and replaced as necessary to construct vehicle crossings.

320.6.8 **Tolerance**

Kerbs

- Plan alignment $\pm 10\text{mm}$ from design line
- Vertical alignment $\pm 5\text{mm}$ in any 3m length
 $\pm 10\text{mm}$ from design level

Channel

- Plan $\pm 10\text{mm}$ from design line
- Vertical $\pm 5\text{mm}$ in any 3m length
 $\pm 10\text{mm}$ from design level
No ponding to occur

340.0 ASPHALTIC CONCRETE PAVING

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340.0 ASPHALTIC CONCRETE PAVING

340.1 SCOPE

Work included in this section of the specification

- 1 Laying of an asphaltic concrete levelling course to areas as shown on the drawings.
- 2 Asphaltic concrete paving to areas as shown on the drawings.
- 3 Adjust existing service covers.
- 4 This section of works for Asphaltic Concrete Paving is a performance specification. The Contractor shall maintain the Works for a period of six months after completion of all asphaltic concrete paving.

340.2 RELATED DOCUMENTS

Documents which relate to this section are:

Transit New Zealand (TNZ) Specifications

M/1 Asphaltic Bitumen Binders

M/10 Asphaltic Concrete

P/9 Construction of Asphaltic Concrete Paving

T/1 Benkelman Beam Deflection Measurements

T/3 Measurement of Texture by the Sand Circle Method

T/5 Size, Shape and Grading of Grades 1 - 4 Sealing Chips

C/8 Adjusting Service Covers

Documents listed above and cited in this Section are deemed to form part of this specification. However, this specification takes precedence in the event of it being of a higher standard than the cited documents. The latest edition of any such document (including amendments in force at the date of tender) applies to this Section.

340.3 SUBMISSIONS AND RECORDS

340.3.1 Method Statement

The method by which the Contractor proposes to asphaltic concrete pave shall be submitted to the Engineer and shall not be used until approved.

- 340.3.2 Provide details of proposed quantities of components to be used in the asphaltic binders for the Engineer's approval before construction.

340.4 MATERIALS

340.4.1 Asphaltic Binder

To comply with TNZ M/1.

340.4.2 **Asphaltic Concrete Levelling Course**

To comply with TNZ M/10 Mix 10.

340.4.3 **Asphaltic Concrete Wearing Course**

Asphaltic concrete to be used shall be in accordance with TNZ M/10 Asphaltic concrete.

45mm thickness shall be as specified in Table 1, Mix 20.

340.5 **TESTING**

All testing to be in accordance with TNZ standards.

340.6 **WORKMANSHIP**

340.6.1 **Standard**

All work shall be in accordance with TNZ Specifications.

340.6.2 All work shall be executed to the entire satisfaction of the Engineer.

340.6.3 **Inspection**

Before starting asphaltic concrete paving inspect the basecourse to ensure that it is compacted to specification and that all kerbs, underground services, service outlets, gully traps and fittings are in place.

340.6.4 **Quality**

Hot-mix paving work shall be carried out by competent and experienced operators, familiar with the materials and techniques necessary to produce proper distribution and compaction of asphaltic concrete paving. Use automatic paver-laying machines for all areas, wherever possible.

340.6.5 **Consignment**

Deliver hot-mix asphaltic concrete directly from mixing plant to site with covers to reduce heat loss.

340.6.6 **Asphaltic Concrete**

The work shall be carried out in accordance with the requirements of the current issue of TNZ P/9 'Specification for Construction of Asphaltic Concrete Paving' as applicable.

A tack coat shall be applied immediately ahead of the asphaltic concrete surfacing material.

The mix shall be laid with an approved paving machine at a temperature of not less than 135°C or more than 150°C to a depth which when consolidated will ensure that the paving is nowhere less than the depth shown on the drawings or as specified.

The initial rolling of the mix should be carried out as soon as possible with a steel wheeled roller, preferably a tandem. The roller used for the initial rolling should be capable of

transmitting a pressure of 1.65 MPa of rolling width. The second rolling should be carried out with a self propelled rubber tyred roller of at least 13.60 tonnes gross mass before the mix has cooled below 135°C. Finally the mix should be rolled with a tandem roller before it cools below 40°C.

The standard of surface finish should be such that there should be no point on the surface where the deviation shall exceed 6mm from a 3m straight edge. Further, there shall be no area of the paved surface which will pond water. The finished level of the hot mix at the channel edge shall be 6mm higher than that of the channel.

340.6.7 Joints In Asphalt Surfacing

General

Plan the placing of the asphalt surfacing to minimise the number of joints. Make the joints so that they are well bonded and sealed and provide a smooth riding surface across the joint.

Longitudinal Joints

Form exposed edges of each spreader run while hot to a straight line with a dense face inclined between vertical and 45° to the vertical for the full depth of the layer. Tamp the unsupported longitudinal edges of spread material to raise the level of the asphalt surfacing slightly to secure maximum edge compaction from subsequent rolling. Do not damage the unsupported longitudinal edge by rolling.

Make good longitudinal edges which contain segregated or open textured material or which have been damaged by traffic or rolling by cutting back to expose a new straight dense inclined face. Do not cut with a diamond saw. Overlap the screed of the spreader on the adjacent run by 25mm to 50mm. At joints constructed against cold edges, the overlapping asphalt shall be removed to waste or crowded back at the joint but not thrown on to the layer being spread. Treat joints as 'cold' when the temperature of the first run has fallen below 60°C. Where directed, tack coat cold contact surfaces uniformly and thinly.

Transverse Joints

Construct transverse joints at right angles to the direction of spreading and cut to a straight vertical face for the full depth of the layer. Unless otherwise approved, construct transverse joints if the spreading operation is stopped for 20 minutes, or if the pavement temperature falls below 90°C, whichever occurs sooner. Before placing asphalt surfacing to constructed transverse joints, tack coat cold contact surfaces uniformly and thinly.

Abutting Structures

Place asphalt surfacing against abutting structures such as kerb, channel, manhole or adjoining pavement in the same manner as for longitudinal and transverse joints. Fill spaces left unfilled between the spreader run and abutting edges with sufficient material to the proper height prior to compaction.

Matched Junctions

Where asphalt surfacing is required to match an existing pavement place the material to

provide a smooth riding surface across the junction. Trim back the existing pavement, for the depth of the new surfacing, to a saw cut straight edge 300mm from and parallel to the new surfacing.

340.6.8 Protect

Protect adjoining work and fittings at all stages. Repair any damage at own expense as directed by the Engineer.

340.6.9 Tolerance

A minimum thickness of minus 5% and a maximum thickness of plus 20% from the thickness shown on the drawings will be accepted.

The surface levels shall be within 10mm of the design level as inferred from the drawings.

The deviation of the surface from a 3m long straight edge shall nowhere exceed 5mm.

The surface shall be graded such that no ponding of water can occur on the paved surface or adjacent to manholes, gullies and other structures.

At the channel lip, the level of the surfacing shall be within plus zero to plus 5mm of the lip level.

340.6.10 Damage To Property

Adequate protection shall be taken so as to prevent discolouration or damage to kerbs, channels, hydrants, and valve markers, fences, manholes, and surface covers, private and public property and individuals. In the event of damage occurring, remedial work shall be carried out as directed by the Engineer at the cost of the Contractor, and all claims for compensation or damage shall be met by the Contractor.

340.6.11 Fouling Of Sealed Surfaces

The sealed surface shall not be fouled by ash, oil or fuel droppings from construction plant or vehicles or from any other sources. Any areas so damaged shall be cut out and replaced at the Contractor's cost.

340.6.12 Alter Service Covers

All work to be in accordance with TNZ Specification C8 'Adjusting Service Covers'.

All existing manholes, fire hydrants and other service covers excepting survey monuments which will be more than or less than 40mm above the sealed surface are to be repositioned after the area has been paved.

The minimum area around the service cover to be raised shall be saw cut with 4 straight lines around the cover.

If a service cover protrudes more than 60mm above the chipseal level then it shall be repositioned to the finished level prior to paving as best as possible.

After the area around each cover has been patched, this area shall then be sand sealed.

340.7 COMPLETION

340.7.1 Any damage to property to be repaired at the Contractor's expense.

410 DRAINAGE

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- 410.7 Completion**

410.0 DRAINAGE

410.1 SCOPE

- 1 Construction of and stormwater drainage for the site as shown on the drawings. This includes the construction of pipework, manholes, catchpits, channel drains, outfall structures, soakage holes, silt traps, inspection chambers and all other ancillary structures.
- 2 Construction of subsoil drains as shown on the drawings.
- 3 This section includes all necessary excavation, bedding, backfilling, supply of materials, disposal of surplus material off site and reinstatement.

410.2 RELATED DOCUMENTS

Documents which relate to this section are:

NZS 3107 Precast concrete drainage and pressure pipes
NZS 3108 Concrete production - ordinary grade
NZS 3109 Specification for concrete construction
NZS 3402 Hot rolled steel bars for the reinforcement of concrete
NZS/AS 3725 Loads on buried concrete pipes
NZS 4402 Methods of testing soils for Civil Engineering Purposes
NZS 4452 Construction of underground pipe sewers and drains
NZS 6803 Measurement and Assessment of Noise from Construction
NZS 7604:1981 High Density Polyethylene Drain and Sewer Pipe and Fittings
NZS 7643 Installation of Unplasticised PVC Pipe Systems
NZS 7649 Unplasticised PVC underground drain pipe and fittings
BS 5228 Part 1 Code of Practice for Basic Information and Procedures for Noise Control
BS 2494 Elastomeric joint rings for pipes

Documents listed above and cited in this Section are deemed to form part of this specification. However, this specification takes precedence in the event of it being of a higher standard than the cited documents. The latest edition of any such document (including amendments in force at the date of tender) applies to this Section.

410.3 SUBMISSIONS AND RECORDS

410.3.1 Method Statement

The method by which the Contractor proposes to excavate, bed, lay, surround and backfill the pipes, construct manholes, sumps and stormwater outfalls shall be submitted to the Engineer and shall not be used until approved.

- 410.3.2 Provide an as built record of exact alignment, depth to invert and cover level on completion.

Plans shall be at a scale of 1:200.

410.4 TESTING

410.4.1 Soil tests shall comply with NZS 4402.

410.4.2 All soils testing shall be carried out by PWD registered laboratory or otherwise approved.

410.4.3 The pipe lines and manholes shall be water tested in accordance with NZS 4452 Section 11.3. Any leaks or defects shall be made good and the test reimposed. Territorial Authority testing requirements to take precedence over the NZS 4452 water test.

The Engineer and local authorities shall be notified 24 hours before tests are planned. The Engineer shall be provided with signed records on completion of each test.

410.4.4 The pipe bedding and surround material shall be tested in accordance with NZS 4452 Appendix A 'Compaction Test for Granular Bedding Material' as directed by the Engineer, and shall have a compaction fraction of 0.1 or less.

410.4.5 Compaction of beddings, surrounds and backfill shall be tested in accordance with NZS 4402 and NZS 4431 as directed by the Engineer.

410.5 **MATERIALS**

410.5.1 **Manholes**

- (i) Manhole risers to be centrifugally spun reinforced concrete to NZS 3107.
- (ii) Manholes bases, lids and lid rings to be precast concrete.
- (iii) Circular cast iron frames and covers with a 500mm minimum opening size and designed to prevent 'lid rock' shall be used. Heavy duty frames and covers to be used in roads and paved areas. Medium duty frames and covers may be used in landscaped areas.

410.5.2 **Inspection Chambers**

- (i) Inspection chambers shall comply with PWD Standards.
- (ii) Heavy duty frames and covers to be used in roads and paved areas. Medium duty frames and covers may be used in landscaped areas.

410.5.3 **Catchpits**

- (i) Catchpits in public roads to comply with the Territorial Authority standards.
- (ii) Catchpits on site to comply with the PWD Standards.
- (iii) Catchpits gratings to be heavy duty in all areas except for landscaping.

410.5.4 **Pipes**

- (i) PVC pipes shall be heavy duty grade, unless noted otherwise on the drawings, comply with NZS 7649 and have a spigot and socket rubber ring joints.
- (ii) Reinforced concrete pipes shall be class X, unless noted otherwise on the drawings, comply with NZS 3107 and have a spigot and socket rubber ring joints.
- (iii) Pipes for subsoil drains shall be HDPE corrugated pipe complying with NZS 7604:1981 'High Density Polyethylene Drain and Sewer Pipe and Fittings' with 240 punched slots per metre, and with a manufactured push fit coupler for jointing. Subsoil drains shall be wrapped in a manufactured geotextile filter fabric.

410.5.5 Channel Drains

- (i) Channels to be polymer concrete with in-built falls.
- (ii) Gratings to be ductile iron and bolted down onto the channel. Gratings to be heavy duty in all areas except for landscaping.

410.5.6 Granular Bedding Material

- (i) Material shall comply with NZS 4452, Appendix A. Compaction fraction shall be 0.1 or less.
- (ii) Material shall comply with the following specification for grading. Alternative gradings may be submitted to the Engineer for approval.

The following table sets the grading limits for each drainage bedding materials when tested for particle size distribution by the "Dry Sieving Method".

Sieve Size	Percentage Passing (by Dry Mass)	
	5 to 20mm Drainage	
26.5mm		100
19.0mm		98 - 100
9.5mm		12 - 30
4.75mm		0 - 5
150.0µm		0 - 3

410.5.7 Backfill Material

- (i) Imported Fill

General

Backfill material shall consist of clean sound particles of crushed stone, a mixture of crushed stone, a mixture of crushed stone and sand, or any other granular material approved of by the Engineer.

Source of material and gradings shall be supplied to and approved by the Engineer before material is delivered on site.

The aggregate shall be free from vegetable and other deleterious matter. The presence of clay either free or in the form of a coating on the stone shall render aggregate non-acceptable.

Gradation

The backfill aggregate shall be graded from coarse to fine and when tested on laboratory screens shall comply with the following grading:

Passing	100.0mm square screen opening	100 percent
Passing	65.0mm square screen opening	70 - 85 percent
Passing	40.0mm square screen opening	45 - 70 percent
Passing	20.0mm square screen opening	30 - 50 percent
Passing	10.0mm square screen opening	23 - 40 percent
Passing	5.0mm square screen opening	17 - 30 percent
Passing	2.4mm square screen opening	10 - 20 percent
Passing	420.0 micrometres	6 - 12 percent
Passing	75.0 micrometres	0 - 5 percent

Alternative gradings may be submitted to the Engineer for approval.

(ii) Excavated Material

The Engineer may approve clean excavated material that is free of vegetable or other deleterious material to be used as backfill in footpaths and landscape areas only.

410.5.8 Concrete

All concrete work shall be in accordance with the concrete section of this specification and NZS 3109.

410.6 WORKMANSHIP

410.6.1 General

All work shall be in accordance with NZS 4452 'Construction of Underground Pipe Sewers and Drains', NZS 7643 'Installation of Unplasticised PVC Pipe System' and the New Zealand Building Code.

All work shall be executed to the entire satisfaction of the Engineer.

410.6.2 Tolerances

Location in plan. Variation from true location. +50mm, -50mm

Level in trench. Variation from true invert level. +10mm, -10mm
(provided no pipe backfall occurs)

Level of covers and gratings at surface.
Variation from true level.

+5mm, -5mm

410.6.3 **Setting Out**

The Contractor shall employ a suitably qualified surveyor to set out the work as shown on the drawings.

410.6.4 **Inspection Of Construction**

The Engineer may inspect the work regularly on a daily basis and may check all aspects of the work as it proceeds.

410.6.5 **Excavation**

Excavate trenches to the depth shown on the drawings or to such other depth as may be considered necessary to secure a firm foundation to the satisfaction of the Engineer.

Where the Engineer directs that excavation shall proceed to a greater depth than that shown, extra depth shall be filled as instructed either with low grade concrete or with approved rock fill thoroughly consolidated. The Contractor shall supply a rate for greater depth excavation and backfilling.

410.6.6 **Pipe Laying**

The base of the trench shall be approved by the Engineer as a foundation before any bedding material is placed. The base shall be level and free of any extraneous matter and shall be thoroughly compacted to the satisfaction of the Engineer. Any fill material shall be approved for use by the Engineer.

Pipes shall be laid true to alignment and with inverts true to grade to give a continuous barrel with no ridge or unevenness at the joints.

The method which the Contractor proposes to use for setting the pipes to line and level shall be submitted to the Engineer and shall not be used until approved by him.

The pipes shall be bedded on 100mm minimum depth of approved granular material. The whole of the lower surface of the pipes up to a $\frac{1}{4}$ of the diameter shall be on the compacted bedding material. A depression shall be prepared to accommodate the pipe and joints. Above this, and up to at least 300mm over the crown of the pipe selected filling material with 20mm maximum particle size shall be thoroughly rammed and tamped in layers of not more than 150mm depth. Where a compacted granular surround is specified, approved granular material shall extend to at least 75mm over the crown of the pipe, and shall be tamped in layers of not more than 150mm depth.

The trench shall be kept dry during all phases of construction. The Engineer may approve work to proceed in a wet trench if an approved filter fabric is wrapped around the trench base and sides, and approved bedding and backfill materials are used. Pipeline to be tested in accordance with this specification.

Subsoil drains shall be laid with a minimum fall of 1 in 100 and wrapped in a manufactured geotextile filter fabric. The fabric shall be taped around the end of the pipe run.

410.6.7 Jointing Of Pipes

Rubber rings shall be used for pipe jointing and shall comply with BS 2494:1976 and shall be soft quality as specified therein. Joints shall be made in accordance with manufacturer's recommendations and where applicable the detail drawings.

Subsoil drains shall be jointed with a manufactured push fit connection.

410.6.8 Backfilling

On completion of each length of the work, and after it has been approved the trench shall be backfilled with approved imported fill as per the typical section on the Drawings. Care must be exercised to prevent damage to any pipe or structure and to prevent displacement of the pipe particularly in the placing of the bottom layers of the backfill.

Backfill shall be placed in layers not greater than 300mm in depth and each layer shall be thoroughly consolidated by approved means before the next layer is placed.

410.6.9 Density Of Compaction

- (i) Subgrade, bedding, surround and backfill to be compacted to 95% of NZ standard compaction (NZS 4402 Test 5.1.1)
- (ii) In-situ compacted dry density to be measured as defined in NZS 4402.

410.6.10 Testing Of Compaction

- (i) In-situ density tests: one set of tests on the subgrade and every layer of bedding, surround material and backfill, at 60m maximum lengths or as directed by the Engineer.
- (ii) The cost of all testing shall be borne by the Contractor.
- (iii) Test results shall be submitted to the Engineer within 24 hours. All test results shall be signed and dated by a representative of the testing agency.

410.6.11 Manholes

Manholes shall be constructed as detailed on the drawings.

Any visible infiltration leakage through the manhole walls or floor shall be remedied to the approval of the Engineer.

410.6.12 Inspection Chambers

Inspection chambers shall be constructed in accordance with the PWD Standards. Any visible infiltration leakage through the manhole walls or floor shall be remedied to the approval of the Engineer.

410.6.13 Catchpits

Catchpits shall be constructed as shown on the drawings. Any visible infiltration leakage through the manhole walls or floor shall be remedied to the approval of the Engineer.

410.6.14 Channel Drains

Channel drains shall be constructed as shown on the drawings.

410.6.15 Outfall Structure

Construct the outfall structure as shown on the drawings or as instructed by the Engineer to suit actual site conditions.

410.7 COMPLETION

410.7.1 On completion leave the whole system clean and in full working order.

410.7.2 Remove from site all materials not used. This shall include excavated material.