

Town of Redcliff

CONSTRUCTION STANDARDS

Prepared By:

TOWN OF REDCLIFF

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Abbreviations

The following abbreviations may be used in this document:

BC	-	Beginning of curve
BOW	-	Back of walk
BVC	-	Beginning of vertical Curve
CCC	-	Construction Completion Certificate
EC	-	End of Curve
EVC	-	End of vertical Curve
FAC	-	Final Acceptance Certificate
FOW	-	Face of walk
Ha	-	Hectare
ID	-	Inside diameter
Kg	-	Kilogram
lcd	-	Litres per capita per day
m ³	-	meter cubed
OC	-	On centre
OD	-	Outside diameter
PVI	-	Point of vertical intersection

Other abbreviations may be used or defined elsewhere in this document. Where undefined, an abbreviation shall carry a meaning consistent with industry standards. Ascertaining the meaning of a word or abbreviation in context is the responsibility of the Developer.



1. AGGREGATES GENERAL

1.1. GENERAL

This section specifies general requirements for supplying and processing of aggregates to be stockpiled or incorporated into work. Specific requirements for physical properties of aggregates not provided in this section are given in related work sections.

1.1.1. Source Approval

Source of materials to be incorporated into work or stockpiled requires approval.

Inform the Town of proposed source of aggregates and provide access for sampling at least two weeks prior to commencing production.

If, in opinion of the Town, materials from proposed source do not meet, or cannot reasonably be processed to meet specified requirements, produce an alternative source or demonstrate that material from source in question can be processed to meet specified requirements.

Should a change of material source be proposed during work, advise the Town two weeks in advance of proposed change to allow sampling and testing.

Acceptance of a material at source does not preclude future rejection if it is subsequently found to lack uniformity, or if it fails to conform to requirements specified, or if its field performance is found to be unsatisfactory.

1.1.2 Production Sampling

Aggregate will be subject to continual sampling during production.

Provide the Town with ready access to source and processed material for purpose of sampling and testing.

Bear the cost of sampling and testing of aggregates in order to meet design gradations and specifications.

1.2. PRODUCTS

1.2.1. General

All imported backfill, granular material, gravel and screened rock shall be suitable for the uses intended.

Aggregate shall be sound, hard, durable material free from soft, thin, elongated, or laminated particles, organic material, or other deleterious substances.

Flat elongated particles are those whose greatest dimension exceeds five times their least dimension.

Fine aggregates satisfying requirements of applicable section shall be one, or a blend of following:

- a) Natural sand
- b) Manufactured sand and/or fines
- c) Screenings produced in crushing of quarried rock, boulders, gravel or slag.



Course aggregates satisfying requirements of applicable section shall be one of following:

- a) Crushed rock or slag.
- b) Gravel composed of naturally formed particles of stone.

1.2.2. Materials

Gradation: To be within the limit and for the types of materials specified below, when tested to ASTM C117 and ASTM C136, and having a smooth curve without sharp breaks when plotted on a semi-log grading chart to ASTM E11

Production of Manufactured Fines: Manufactured fines are defined as that portion of the material passing the 5,000 sieve size which is produced by the crushing process.

In the event the manufactured fines in the total combined aggregate do not meet the requirement for the specified Asphaltic Concrete Mix, extra manufactured fines shall be produced by screening the pit run material so that the screened material contains no more than 5% material passing a 5,000 sieve. This screened material shall then be crushed so that 100% passes the 10,000 sieve and a minimum of 95% passes the 5,000 sieve. All material produced by this crushing process shall be placed in a separate stockpile and designated as manufactured fines.

Moisture Content: As specified in specific sections.

Bedding Sand: Bedding sand shall be free from organic material and meet the following gradation:

Sieve Size (mm)	%Passing by Mass
12.5	100
5	90 - 100
1.25	55 - 85
0.315	10 - 35
0.08	0 - 5

The liquid limit shall not exceed 25 and the Plastic Index shall not exceed 6.

Granular Material (imported Sand): Imported sand shall be free from rubbish, rubble, organic material, vegetation, clay lumps and meet the gradation of bedding sand.

Granular Material (Imported Gravel): Imported gravel shall be a well graded mixture of sand and gravel meeting the following gradation:

Sieve Size (mm)	% Passing by Mass
80	100
50	80 – 100
25	50 – 75
5	25 – 55
0.08	2 – 10



Screened Rock: Screened rock shall be composed of sound, hard uncoated particles free from clay lumps, flaky particles, soft shale, friable materials, roots, vegetable matter and frozen lumps meeting the following gradation:

Sieve Size (mm)	% Passing by Mass
50	100
40	95 – 100
20	5 – 10
10	0 – 5
5	0 – 5

1.3. EXECUTION

1.3.1. Processing

Process aggregate uniformly using methods that prevent contamination, segregation, and degradation.

Split and combine aggregates if required to obtain gradation requirements specified. Use approved methods and equipment. Do not blend in stockpiles.

Blending to increase percentage of crushed particles or decrease percentage of flat and elongated particles is permitted.

Wash aggregates, if required to meet specifications. Use only equipment approved by the Town.

1.3.2. Handling

Handle and transport aggregates to avoid segregation, contamination and degradation.

1.3.3. Stockpiling

Stockpile aggregates on site in location indicated or designated. Do not stockpile on completed pavement surfaces where damage to pavement may result.

Stockpile aggregates in sufficient quantities to meet project schedules.

Stockpiling sites shall be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials.

Except where stockpiled on acceptably stabilized areas, provide a compacted sand base not less than 300mm in depth to prevent contamination of the aggregate or, if permitted, stockpile aggregates on ground but do not incorporate bottom 300mm of pile into work.

Separate aggregates by substantial dividers or stockpile far enough apart to prevent intermixing.

Reject intermixed or contaminated materials. Remove and dispose of rejected materials as directed within 48 hours of rejection.

Stockpile materials in uniform layers of thickness as follows:

- a) Max 1m for course aggregate and base course materials
- b) Max 2m for fine aggregate and sub base materials.
- c) Max 1.5m for other materials



Complete each layer over entire stockpile area before beginning next layer.

Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.

Coning of piles or spilling of material over edges of pile will not be permitted. Stacking conveyors will not be permitted for stockpiling road base and graded seal coat aggregates.

During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

1.3.4 Stockpile Clean-up

Leave stockpile site in a tidy, well drained condition, free of standing surface water.

Remove any unused aggregates as directed.

END OF SECTION



2. TRENCHING AND BACKFILLING FOR UTILITIES

2.1. GENERAL

Trenching and backfilling to be carried out in accordance with Alberta Occupational Health and Safety Act & Regulations.

2.1.1 Work Included

Provide all labour, products and equipment for trenching and backfilling for utilities, including but not limited to:

- a) water mains
- b) sanitary sewers
- c) storm sewers
- d) manholes, valve boxes
- e) lot service connections
- f) shoring, sheet piling
- g) dewatering

2.2. EXECUTION

2.2.1 Excavation

Excavate to lines and to design depth shown or as required by the Town to provide satisfactory bearing. Excavate unsuitable soil from trench bottoms as required by the Town. Backfill with screened rock material specified to the required level and compact to provide uniform bearing.

No additional compensation will be paid for any changes due to deterioration of excavations caused by activities or neglect of the contractor.

Level and clean excavation bottoms free from loose material and debris.

Where excavation is made below depth shown through error, fill to required depth with 20 MPa compressive strength concrete or screened rock at no additional cost to Town.

Provide firm undisturbed earth or rock bearings for granular bedding below pipelines and structures.

Excavate for structures to widths sufficient for formwork construction. Place no concrete or masonry until the Town has inspected excavation.

Where concrete is to be placed, thaw excavation bottom if frozen, and protect from further freezing.

Maximum lengths for open trenches are 30 meters ahead of pipe laying crew and 200 meters behind, unless otherwise permitted by the Town.

Where trenches are excavated in existing pavements, saw cut the pavement to neat lines.



2.2.2 Rocks and Boulders

Remove boulders to provide 150 mm minimum clearance under pipes. Backfill with granular material and compact at required level to provide suitable bearing, at no additional cost, if boulders are less than 0.4 cubic meters.

Boulders larger than 0.4 cubic meters and material which cannot be removed with pick and bar will be classified as rock by the Town. Notify the Town when rock is encountered for classification and measurement.

Excavate rock to provide 150 mm minimum clearance on each side and under pipes. Backfill with granular material and compact at required level to provide suitable bearing capacity. Rock excavation will be paid for as unclassified work.

Prior to commencing blasting operations, obtain written approval from authorities having jurisdiction and from the Town. Employ licensed workers only.

2.2.3 Shoring, Bracing and Sheet Piling

Provide all shoring, bracing and sheet piling required for support and protection of earth banks at excavations.

Erect all shoring, bracing and sheet piling independent of utilities and structures.

Shore and brace sides of trenches and excavations in accordance with Workers' Compensation Board Regulations.

Maintain during backfilling and remove in stages as backfilling progresses or as approved by the Town.

Remove all shoring, bracing and sheet piling unless otherwise permitted by the Town. If shoring is allowed to remain, cut off to a level at least 600 mm below finish grade.

Pre-fabricated cages or shields may be used, at the discretion of the Town, to supplement or replace conventional shoring provided they conform to all applicable safety regulations, and permit the proper placing and tamping of bedding material under and around utility pipes.

2.2.4 Backfilling - General Requirements

Bedding of pipes and utilities and backfill to 300 mm above top of pipes and utilities is included in other sections.

Backfill trenches and excavations with excavated earth material. Remove all rocks larger than 200 mm in diameter from earth backfill.

Place and compact all backfill a maximum of 200 mm lift thickness.

Compact site material used as trench backfill in all areas from 300 mm above top of pipe to 300 mm below bottom of granular base for roads to a density not less than 98% of Standard Proctor Density, as defined herein, and carried out at moisture content of within 3% of optimum moisture content or less. Remove any free water in the trench prior to placing additional lifts. Note that if moisture content is too high and densities not initially attainable the contractor will make every reasonable attempt to dry the material by whatever means available (i.e. diskings, spreading, etc.) should the Town deem the material to be "unworkable" the use of imported granular backfill may be required. Compact the final 300 mm below road or lane granular base to not less than 100% of Standard Proctor Density.



Compaction results will be based on a minimum of one density test per 100 lineal meters per lift of trench for each 1.5 meters of depth. If a density test indicates insufficient compaction at any depth, then two more densities, which are proportionally representative of trench length, will be taken at that depth. Then, if the average of the three tests is below the required density, the contractor will re-excavate and re-compact to meet the specified density.

Place and compact evenly around structures to prevent damage or displacement. Grade the surface to direct water away.

Stockpile spread or remove excess excavated earth material where directed by the Town.

Remove and dispose of boulders off site at no additional cost.

Where additional pipes are to be, or have been laid, crossing the trench being backfilled and at a higher elevation, take special care to ensure the backfill is compacted to a minimum of 98% of Standard Proctor Density from the lower pipeline up to the obvert elevation of the higher pipeline.

Where imported material is called for by written direction of the Town, place the specified depth of granular material to the elevations provided and compact to specified Standard Proctor Densities.

Where filter fabric is called for by written direction of the Town, place fabric to the overall dimensions specified.

2.2.5 Settlement

Be responsible for all settlement of backfill that may take place during a period of two (2) years after date of completion certificate.

When notified of any such settlement, promptly repair same, or make arrangement for others to do so at the contractor's expense. Failure to do so will result in the Town making appropriate arrangements at the Contractor's expense and at no cost to the Town.

Pay the cost of all damages that may be caused by such settlements, including but not limited to repair and/or replacement of concrete sidewalks, curb and gutter and asphaltic concrete pavement.

END OF SECTION



3. SUBGRADE PREPARATION

3.1. GENERAL

3.1.1 Work Included

The work described in this section pertains to the preparation and construction of the subgrade.

3.2. DEFINITIONS

3.2.1 Subgrade

Subgrade is that material immediately beneath the compacted granular sub-base course as detailed on the standard drawings.

3.2.2 Common Excavation

Common excavation shall consist of all materials such as earth, topsoil, organic material, muskeg, clay, hardpan, shale, silt, sand, gravel, fractured bedrock, cobbles and frozen material, removed from the roadway and placed in fill or embankment areas, or otherwise disposed as approved by the Town. Excavation shall be to the lines and grades indicated on the plans, or as directed by the Town. Schedule work to utilize all excavation materials completely. Borrowing materials will be authorized only after excavated materials have been utilized.

3.3. EXECUTION

3.3.1 Scarify and Compact

In excavation areas, the top 150mm of the subgrade shall be scarified and compacted to 100% Standard Proctor Density at $\pm 2\%$ of optimum moisture content. In lieu of sub-grade preparation, a geotextile filter fabric may be accepted.

No stones or boulders larger than 100mm in diameter shall be left within the top 200mm of the subgrade unless otherwise directed by the Town.

In areas not accessible to rolling equipment, the Contractor shall use mechanical tampers to compact to the specified density.

3.3.2 Over excavation

Notify the Town whenever unsuitable materials are encountered.

Materials which cannot be compacted to the specified density due to high or low moisture content shall be dried or watered by the Contractor to their optimum moisture content in order to achieve the specified compaction.

All common excavation materials below subgrade elevation which, in the opinion of the Town, are considered unsuitable shall be removed and disposed in a site located by the Contractor, and approved by the Town.

3.3.3 Unstable Sub-Grade

Where the subgrade is un-stable, or where it contains materials such as ashes, cinders, refuse, vegetable or organic material, the Contractor shall excavate such material to the width, depth (minimum 300 mm) and length ordered by the Engineer and dispose of the material as directed. The subgrade



shall then be made stable by backfilling with approved native material or imported granular material. Material shall be placed in successive layers as directed by the Engineer and compacted to a minimum of 98% Standard Proctor Density at $\pm 2\%$ of the optimum moisture content.

3.3.4 Stockpiling of Material

To facilitate the Work, the Contractor may stockpile embankment material. Such material shall be piled at a location determined by the Contractor, approved by the Town, and in such a manner that it will not endanger persons, the Work, or adjacent properties, and ensure proper drainage is maintained. If the construction site does not facilitate stockpiling, the Contractor shall haul material to an approved location.

3.3.5 Excavation Waste

All common and rock excavation deemed unsuitable for use in embankments, or in excess of that required for embankment, shall be disposed at locations determined by the Contractor and approved by the Town.

All disposal areas shall be left in a neat and tidy condition satisfactory to the Town. Excavation materials shall be graded smooth to promote surface drainage and not to impede existing surface drainage by the Contractor to the approval of the Town.

3.3.6 Common Embankment (for site grading)

Embankment placed on lots and within the road right of way, but not under the road structure, shall be uniformly constructed to the typical cross-section and grades shown on the plans or as set out by the Town, and shall include the formation, compaction and shaping of the embankment.

The full depth of fills shall be constructed of suitable material in layers not exceeding 200mm compacted depth. Each layer shall be compacted to 98% Standard Proctor Density (SPD) at optimum moisture content. All fills greater than 1.0m are to be compacted to 95% SPD. The top 300mm of subgrade shall be compacted to 100% Standard Proctor Density at $\pm 2\%$ of optimum moisture content.

Do not place material in free standing water. Drain all areas before placing materials.

Materials which cannot be compacted to the specified density due to high or low moisture content shall be dried or watered by the Contractor to their optimum moisture content as necessary to achieve the specified compaction.

3.3.7 Shaping and Finishing

The finished compacted subgrade shall be constructed to within 30mm of the design section. Localized soft spots that develop in the finished subgrade due to poor work shall be corrected by excavating the material to a depth approved by the Town, and replacing it with suitable subgrade material compacted in place.

Subgrade shall be true to the design cross-section.

Maintain and keep ditches open and free from debris to permit ready flow of surface water, and until final acceptance of the Work.

3.3.8 Quality Control

Quality control is the responsibility of the Contractor throughout every stage of the Work until the final accepted product.



Tests performed by the Consultant / representative will not be considered as quality control tests; rather it will be considered quality assurance.

The Contractor shall be totally responsible for production of materials and construction that meet all specified requirements.

All quality control shall be conducted by qualified personnel. The Contractor shall bear the cost of all quality control testing and related consulting services.

Pre-Production testing and sampling and minimum frequencies are described in the following table.

3.4. TESTS

Field density and moisture content tests shall be carried out by a representative approved by the Town in accordance with the following ASTM standards:

Standard Proctor Compaction Test	ASTM D698, Methods (A) and (B) ASTM D1556 or
In-Place Density Test	ASTM D2167 or ASTM D2922 and D3017.

The frequency of field density and moisture content tests shall be at minimum 1 test per 100 metres of constructed roadway and at various locations left and right of centre line, or as directed by the Town. When subgrade is prepared using backfill material lift thickness should be a maximum of 150 mm and 1 test per 100 metres of every lift to be performed.

Before approval by the Town, the subgrade shall conform to the compaction requirements specified and shall show no visible subsidence or deflection under the wheels of the loaded truck with a minimum gross vehicle weight of 18,200kg. Such trucks shall be provided by the Contractor, as the Town requires, for proof rolling of the subgrade.

END OF SECTION



4. GEOTEXTILE

4.1. GENERAL

This section specifies requirements for the supply and installation of non-woven and woven geotextile filter fabric.

Non-woven geotextile filter fabric shall be used as a separate membrane for rip-rap or hydraulic filter for drainage systems.

Woven geotextile filter fabric shall be used when in the opinion of the Town the foundation conditions are considered soft and unstable.

4.1.1 Mill Certificates

At least one week prior to the commencement of Work the Contractor shall submit a sample of the geotextile filter fabric to be used in the Work with copies of mill test data and Manufacturers Certificate of Compliance that the geotextile filter material delivered to the job site meets the requirements of this section.

4.1.2 Approval

The Contractor shall obtain written approval of the Town for the geotextile filter fabric material to be used in the Work.

4.1.3 Delivery and Storage

During delivery and storage, protect the geotextile filter fabric from direct sunlight, ultraviolet rays, mud, dirt, dust, moisture, debris and rodents.

4.2. PRODUCTS

4.2.1 Material

The geotextile filter fabric shall be rot-proof, unaffected by the actions of oil or salt water and not subject to attacks by insects or rodents.

The geotextile filter fabric shall be supplied in rolls of minimum width of 3.0m and 50m lengths.

4.2.2 Physical Properties

The non-woven and woven geotextile filter fabric shall meet the specifications and physical properties in accordance with the following table of minimum average roll value properties (MARV's) for each.

Specifications and Physical Properties		
	Non- Woven	Woven
Grab Strength	650 N	1275 N
Elongation (Failure)	50%	15%
Puncture Strength	275 N	275 N
Burst Strength	2.1 MPa	3.6 MPa
Trapezoidal Tear	250 N	475 N
Minimum Fabric Lap to be	300mm	1000mm



4.3. EXECUTION

Where geotextile fabric is specified, the sloped or horizontal surface shall be graded to provide a smooth, uniform surface. All stumps, large rocks, brush or other debris that could damage the fabric shall be removed. All holes and depressions shall be filled so that the fabric does not bridge them. Loose soils shall be replaced.

The fabric shall be laid parallel to the slope direction in one continuous length from toe of slope to upper extent of fabric. It shall be placed in a loose fashion; however creases, folds, wrinkles and tensile stresses shall be avoided. Adjacent strips of fabric shall be overlapped a minimum of 0.5m, or as specified, except where placed underwater, the minimum lap width shall be 1m. Overlaps shall be pinned using 6mm diameter steel pins fitted with washers and spaced at 1m intervals along the overlaps.

The top edge of the filter fabric shall be anchored by digging a 300mm deep trench, inserting the top edge of the fabric and backfilling with compacted soil.

Rip-rap placement shall commence at the base of the filter fabric area and proceed up the slope. The height of drop of rip-rap shall be limited to 1.0m or less, and the rip-rap shall not be allowed to roll down the slope. Heavy equipment will not be permitted to operate directly on the geotextile.

4.4. PROTECTION

After installation the filter fabric shall be covered with overlaying layer within 3 days of placement.

Do not permit passage of any vehicle or equipment directly on geotextile at any time.

Protect geotextile material from displacement and damage until and during placement of the rip-rap, granular material or the gabion mat.

Care shall be taken to prevent puncturing or tearing the geotextile. Any damage shall be repaired by use of patches that extend at least 1m beyond the perimeter of the tear or puncture.

Remove and replace damaged or deteriorated geotextile, as directed by the Town.

END OF SECTION



5. GEOGRID

5.1. GENERAL

This section specifies requirements for the supply and installation of geogrid on unstable sub-grade soil conditions.

5.1.1 Mill Certificates and MARV Data

At least one week prior to the commencement of Work the Contractor shall submit a sample of the geogrid to be used in the Work with copies of mill certificate, MARV (Minimum Average Roll Value) and Manufacturers Certificate of Compliance that the geogrid material delivered to the job site meets the requirements of this section.

5.1.2 Approval

The Contractor shall obtain written approval of the Town for the geogrid material to be used in the Work.

5.1.3 Delivery and Storage

During delivery and storage, protect the geogrid from direct sunlight, ultraviolet rays, mud, dirt, dust, moisture, debris and rodents.

5.2. PRODUCTS

5.2.1 Material

The geogrid shall be rot-proof, unaffected by the actions of oil or salt water and not subject to attacks by insects or rodents.

The geogrid shall be supplied in rolls of minimum width of 3.0m and 50m lengths.

5.2.2 Physical Properties

Unless specified otherwise, the geogrid shall meet the specifications and physical properties in accordance with the following table of minimum average roll value properties (MARV's).

Physical Property	Requirements	Test Method
Ultimate Tensile Strength	12.4 kN/m minimum	ASTM D 6637
Tensile Strength @ 2% Strain	4.1 kN/m minimum	ASTM D 6637
Tensile Strength @ 5% Strain	8.5 kN/m minimum	ASTM D 6637
Junction Efficiency	90% minimum	GRI GG2
Aperture Dimensions	25 – 40 mm	Direct Measure
Flexural Stiffness	250,000 mg-cm minimum	ASTM D 1388

5.3. EXECUTION

Unroll geogrid as smooth as possible on the non-woven separation fabric and prepared sub- grade, in the direction of construction traffic. Install the geogrid in the longest continuous practical length, free



from tension, stress, folds, wrinkles and creases. Overlap joints a minimum of 900mm. Tie adjacent rolls with joint fasteners in accordance to the manufacturer's recommendations.

Construction vehicles are not permitted directly on the geogrid. After installation, place and compact sub-base material to a minimum depth of 300mm (or as specified). Avoid sudden stops or sharp turns by construction equipment during placement of sub-base materials.

Remove or replace geogrid improperly installed or damaged as directed by the Engineer.

5.4. PROTECTION

After installation the geogrid shall be covered with overlaying layer within 3 days of placement.

Do not permit passage of any vehicle or equipment directly on geogrid at any time. Protect geogrid material from displacement and damage until and during placement of the overlying granular material.

Care shall be taken to prevent puncturing or tearing the geogrid. Any damage shall be repaired by use of patches that extend at least 1m beyond the perimeter of the tear or puncture.

Remove and replace damaged or deteriorated geogrid, as directed by the Engineer.

END OF SECTION



6. RIP – RAP

6.1. GENERAL

6.1.1 Definition

Rip-rap is a protective covering consisting of hand-laid or randomly deposited rock, sacked concrete or sacked cement stabilized material which is placed on exposed surfaces for protection against erosion and wave action.

6.1.2 Work Included

Work of this Section consists of supplying, hauling, and placing of rip-rap as specified and as shown on Drawings.

6.1.3 Approval

The Contractor shall have the rip-rap material approved by the Town in writing prior to delivery to the site. The approval of rock samples from a particular source or quarry site shall not necessarily be construed as approval of all material from that location.

Delivery and handling of rip-rap shall be subject to the Town's approval and shall be as such as to minimize segregation and breakage and damage.

Material which has deteriorated or does not meet specified requirements shall be removed from site.

6.1.4 Quality Assurance

Sampling and testing of materials, as required by the Town for testing the quality of rip-rap.

6.1.5 Job Conditions

Suspend placement operations whenever climatic conditions, as determined by the Town, are unsatisfactory for placing rip-rap fill to requirements of this Specification.

Do not permit or cause material to slide or roll down slopes.

When placing rip-rap do not disturb satisfactorily placed material or structures already in place.

Sequence delivery of material to Site in a manner to minimize stockpiling and in any event obtain approval from Company to stockpile.

6.2. PRODUCTS

6.2.1 General

The rock supplied shall be hard, durable and angular in shape, resistant to weathering and water action, free of overburden, spoil, shale seams and organic material. No sandstone will be permitted. The minimum dimension of any single rock shall be not less than one third of its maximum dimension. The minimum acceptable unit weight of the rock is 2.5t/m³. The rock rip-rap shall be free from seams, cracks or other structural defects to meet the following specified size distribution.



		Class 1	Class 1m
Nominal Mass	Kg	40	7
Nominal Diameter	or mm	300	175
None heavier than:	Kg	130	40
	or mm	450	300
No less than 20% or more	Kg	70	10
than 50% heavier than:	or mm	350	200
No less than 50% or more	Kg	40	7
than 80% heavier than:	or mm	300	175
100% heavier than:	Kg	10	3
	or mm	200	125

Percentages are by mass. Sizes are equivalent spherical diameters, and are for guidance only.

6.3. EXECUTION

6.3.1 Preparation

Prepare surfaces to receive rip-rap to lines and grades as shown on the Drawings.

6.3.2 Inspection

Do not place rip-rap until foundation to receive it has been approved by the Town.

6.3.3 Installation

Placing:

The rock rip-rap shall be placed on a non-woven geotextile filter fabric unless otherwise noted on the drawings or in the specifications.

The hand laid rock rip-rap erosion protection shall be placed in the areas indicated on the drawings or as designated by the Town.

Place rip-rap by suitable mechanical equipment so that no intermixing of foundation material and rip-rap is allowed to occur during placing and that minimum breakage of rock fragments will occur and that the mass is stable.

Rip-rap need not be compacted but shall be dumped and graded off to same regular surface and in such manner that larger rock fragments are uniformly disturbed and smaller rock fragments fill voids between larger pieces.

Hand placing will be required only to extend to secure results specified above in the areas where mechanical equipment cannot operate adequately.

Do not place rip-rap against structures until permission is obtained from the Town.



The rip-rap stones shall be placed on the surface to be covered as shown by the plans or as directed by the Town, on slopes not exceeding $1\frac{1}{2}$ H:1V starting with the larger stones on the bottom row. Rip-rap shall be placed on the prepared surface such that the weight of the stone is carried by the subgrade and not by the underlying stones. Rip-rap shall be placed proceeding upward from the bottom. Voids between rip-rap shall be filled with broken rock fragments.

Care shall be taken not to puncture the geotextile filter fabric when placing the rip-rap. Any damaged filter fabric shall be repaired or replaced as requested by the Town.

END OF SECTION



7. WATERMAINS

7.1. GENERAL

7.1.1 Work Included

Provide all labour, products and equipment required for the work, including but not limited to:

- a) bedding under and over pipe
- b) watermain and appurtenances
- c) testing watermain
- d) flushing and disinfecting watermain
- e) connection to existing systems
- f) thrust blocks

7.1.2 Quality Standards and Assurances

Products, workmanship and testing shall conform to standards specified in this section.

All products and workmanship may be subject to inspection by the Town.

Perform all tests required by the specification and by authorities having jurisdiction.

Notify the Town and authorities in ample time before testing to permit inspection and allow tests to be witnessed.

Do not cover any work before inspection and testing unless authorized by the Town in writing.

Remove or repair defective products or work which fails to meet specified requirements as directed by the Town, at no additional cost to Town.

7.2. PRODUCTS

7.2.1 Polyvinyl Chloride (PVC) Water Pipe

Polyvinyl chloride water pipe shall be equivalent to cast iron pipe outside diameter meeting CSA CAN 313 137.3 (AWWA C900-97, or C905-97 for pipe sizes greater than 300mm in diameter). Pipe shall be Class 150 (dimension ratio 18) and pipe must be blue in colour and CSA certified.

Pipe joints shall be integral gasketed bell ends. Couplings shall be permitted only for closures or special connections. Gaskets shall conform to AWWA C111-12. An affidavit of compliance shall be provided if requested.

HDPE Pipe will also be allowed. Manufacturers' specifications for the proposed HDPE must be provided to the Town Engineer for approval prior to use. Information related to appurtenances and/or couplings, electro fusion technique, and qualifications of Contractor or his Subcontractor for installation of HDPE must also be submitted to the Town Engineer for approval.



7.2.2 Water Pipe Fitting

Cast iron or ductile iron fittings shall meet the requirements of AWWA Specification C110-12. Pressure rating shall be 1.1 MPa.

Joints on fittings shall be the same as specified for pipe.

Fittings shall be externally and internally coated with bituminous material approved by waterworks service.

PVC fittings shall be to CAN 3-B.137.3, pressure Class 150, which are designed to accommodate the pipe for which they are used.

PVC fittings shall be gasketed bell end type similar to pipe except where adaptors are required in which case flanged or threaded joints may be permitted subject to approval by the Town. Gaskets to conform to AWWA C111-12.

Cast ductile iron couplings to be robar couplings or approved equal complete with ANSI 303 stainless steel nuts & bolts compatible with outside diameters of pipes to be joined in locations approved or specified by the Town.

7.2.3 Gate Valves (Non Rising Stem)

Valves shall be iron body, bronze mounted, double disc or solid-wedge, with full 360 degree rubber to cast iron resilient seat gate valves approved for potable water use, meeting AWWA Specification C509-09 and the following:

Valves to be bronze mounted with a grade of bronze completely resistant to de-zincification by water having a ph of 9.0

Valve ends shall be consistent with the type of joint used for pipe and fittings except where otherwise detailed.

Valves to be supplied with either bronze or type 304 stainless steel stems.

Working pressure 1035 KPa.

Valve interior to be epoxy coated for corrosion protection.

Valves shall close by turning clockwise and be a non-rising stem type and be equipped with a 50 mm square operating nut. Valve stem shall be equipped with "O-Ring" type seals.

Exterior to be factory coated.

All exterior bolts and nuts must be T304 or type 3145.5 stainless steel.

7.2.4 Valve Boxes

Valve boxes shall be Trojan Industries Type C, or equal. Valve box shall consist of a cast iron bonnet of sufficient size to fit over the valve, and an adjustable cast iron top box with lid.

Valve boxes shall be of suitable length for depth of bury specified for mains with possible adjustment of 300 mm up or down from this length.

Valve box extensions shall be cast iron suitable for use with the valve box to be installed.



All cast iron surfaces to have a bituminous coating for corrosion resistance.

7.2.5 Hydrants

Hydrants are to be of the post type, dry barrel hydrant with compression shut-off conforming to AWWA Specification C502-05, having the following features:

Working pressure of 1035 kPa

Two hose connections at 180 deg., 63 mm ID with threads to Alberta Mutual Aid Standards

One pumper connection, 100 mm OD, outlet nozzles to be fastened by a thread connection to meet Redcliff Fire Department connectors

150 mm riser barrel, 125 mm bottom valve

Minimum distance from flange to bonnet will be 600 mm

Main connection to be 150 mm ductile iron size rubber gasketed bell end joint

Self-Draining hydrants (or as determined by site condition)

Number 6 operating nut with five sides

Hydrant to open counter clockwise

All hydrants will be painted Red

Ground line breakaway system: 2.75 m from invert to flange, including an extension spool section with hydrant rod coupled at extension to meet the required elevations

Minimum 710 mm from top of operating nut to bottom of base flange

All exposed nuts and bolts to be T304 or type 3145.5 stainless steel; and

Interface between removable parts of main valve and hydrant body shall be bronze to bronze.

All hydrants installed shall be of the same type and make as presently used by the Town of Redcliff (Brigadier, McAvity 67, or approved equal).

7.2.6 Watermain Plugs

Watermain plugs shall be of standard manufacture to suit type of pipe and pipe joint specified.

7.2.7 Air Relief Valve & Flushing Chamber

Valve and chamber shall conform to the detail drawing referenced or attached. Refer to standard construction drawing A – 105.



7.3. EXECUTION

7.3.1 Bedding Pipes

Excavate trenches to widths not less than 300 mm greater than pipe diameter. Maximum width at top of pipe zone shall not exceed outside pipe diameter plus 600 mm, plus allowance for timbering, if required.

Excavate below bottom of trench at joints as required to provide working space. Body of pipe to rest on minimum 100 mm firmly compacted sand bedding throughout its length.

Place sand bedding for PVC pipe as per trench bedding and installation and backfill Class B granular surround as detailed in the standards drawing C-101. If site material meets bedding sand specification requirements, it may be used to replace the top 200 mm of bedding sand.

For trench in rock, bed pipe on minimum of 150 mm of compacted sand.

7.3.2 Laying and Jointing Pipe

Carefully lower pipe and fitting into trench using proper equipment. While suspended, inspect for defects. Remove foreign materials from inside of pipe. Unless otherwise directed, lay pipe from lower end of line upward.

Lay pipe true to line and establish grading using laser level or measurement rod and sight rails.

Cut pipe accurately to bring valves, fittings and hydrants to correct position.

At all hydrants, plugs, tees, crosses, bends of more than 22 degrees and all other points of concentrated thrust, provide reaction blocking as detailed to prevent movement. Place reaction blocking against solid undisturbed ground. Details are based on soil load values of 7323 kg per square meter, or more. Where soil will not provide this load value, provide bands and clamps to take reaction. Refer also to special thrust block details. Place blocking to provide access to pipe and fittings for repairs or extensions of line.

Install turned wood or plastic plugs, properly sized, in pipe and fittings to prevent ingress of water, mud, dirt and debris at all times. Do not use rags, clothing or other means.

Install slip type rubber gasket joints to manufacturer's directions. If requested, provide copies of manufacturer's directions on site for reference and obtain technical assistance from manufacturer or representative.

Ensure that valve box can be adjusted up or down at least 300 mm. It is intended that valve boxes installed at this time to finished crushed gravel elevation, will be raised at the time of paving without having to supply a new upper extension.

7.3.3 Setting and Jointing Valves

Check and ensure stuffing glands on valves are properly packed before installation.

Set valves accurately in position, set valve box carefully over hood with shaft vertical and cap at proper level plus or minus 50 mm from elevations provided by the Town.

Anchor valves to prevent movement under unbalanced pressure conditions when recommended by pipe manufacturer. Include cost of anchorage in unit price for valves.



Check operation of valves in presence of the Town before testing and after testing.

7.3.4 Setting and Jointing Hydrants

Set hydrants and hydrant valves on concrete blocking as per the details.

Ensure hydrant stock and valve box are truly vertical.

Locate hydrants and valves as per the drawings within the following tolerances: 50 mm horizontal, 15 mm vertical.

Face pumper nozzles to roadway with hose nozzles parallel to roadway. No portion of the hydrant or nozzle cap shall be within 150 mm of the sidewalk.

Concrete thrust blocks will be required at hydrants and hydrant valves as detailed.

Ensure that regular maintenance of hydrants is carried out for the duration of the maintenance period. Pay all costs for maintenance such as repainting, draining prior to freeze-up, etc.

7.3.5 Thrust Blocks

Do concrete work in accordance with Section –Curb, Gutter and Sidewalks.

Cement to be sulphate resistant Portland cement.

Place concrete thrust blocks between undisturbed ground, tees, plugs, caps, bends, reducers, hydrants, and fittings.

Keep joints and couplings free of concrete.

Do not backfill over concrete within 24 hours after placing.

7.3.6 Testing Watermains

Watermain testing may be carried out when all the following conditions have been met:

- a) a section of watermain not exceeding 365 meters in length has been completed.
- b) the section has been carefully filled with water and allowed to sit for at least 24 hours.
- c) reaction or thrust blocking within the section has reached 25.0 MPa design strength.

If all the conditions have been met, apply a constant pressure of 1035 KPa (150 psi) or 150% of the normal working pressure whichever is the greater at the lowest elevation, and not less than 125 % of the normal working pressure or 860 kPa (125 psi) whichever is the greater at the highest elevation, a minimum of two hours to mains, hydrants, valves and services. Make good all defects at no additional cost to Town. The test pressure shall not exceed the Manufacturer's recommended maximum test pressure. Ensure all water service connections are turned off at curb stops to avoid damage to private plumbing.

Conduct leakage tests after completion of pressure testing at 1035 kPa (150 psi). Allowable leakage will be calculated using the following formula:

$$\text{Allowable leakage} = N \times D \times P^{0.5} \div 128,650 = \text{Litres per hour}$$

Where N = Number of joints; D = nominal diameter of pipes (mm); and P = average test pressure (kPa).



If test leakage in any section is greater than permitted, locate and repair defective pipe joints at no additional cost until leakage is within permitted allowance. Test pipelines in sections not exceeding 365m in length.

Provide all equipment and labour for tests and include costs in prices for watermain.

7.3.7 Flushing and Disinfecting Watermain

After completing satisfactory hydrostatic tests and before placing into service, flush all mains to remove as much foreign matter as possible from system. Flush at minimum velocity of 0.8 meters per second as required by AWWA C651-05 procedures (250mm line requires 2 - 50 mm openings to provide the required flushing velocity).

After flushing, disinfect mains by pumping chlorine solution into mains through a special main cock at beginning of line near source of water. Do not use hydrants at point of application for disinfectant.

Introduce disinfectant according to AWWA C651-05 and to approval of the Town and Provincial Ministry of Health.

Conform to AWWA C651-05 for quantity of disinfectant, method of distribution throughout system and final flushing.

After final flushing and before placing watermain in service, the Town will collect samples in sterile bottles from an approved sampling point. The sampling is to be witnessed by local authorities as necessary. Samples will be submitted to Provincial Ministry of Health for testing and test results forwarded to Local Authorities. Heterotrophic plate counts will be provided.

If initial disinfection fails to produce satisfactory results, repeat disinfection until satisfactory samples are obtained.

Include costs for flushing, disinfecting and testing, including any necessary repetitions, in the prices for watermain.

Dechlorination of the chlorinated water may be required in some circumstances before discharging the water to the environment in order to meet the regulatory requirements of The Town of Redcliff or Alberta Environment and Sustainable Resource Development (AESRD). Dechlorination, if required, is to be performed by adding neutralizing chemicals (AWWA C651-05, Appendix B) to the chlorinated water as it is flushed from the system and before it enters the receiving environment.

7.3.8 Markers

A 50 mm by 100 mm stake, from 600 mm below ground to 600 mm above ground level shall be placed at each water valve, the top 600 mm to be painted blue.

7.3.9 Tracer Wire

Insulated tracer wire; 2.0mm (14 gauge) shall be placed above the pipeline and directly over the center of the pipeline. The Contractor must ensure that the tracer wire is not cut, scraped, or nicked during installation. Termination points shall be installed on Pipeline Warning Sign Posts at approximately 2km spacing.

The contractor shall test and the Engineer shall check the tracer wire. It shall be the Contractor's responsibility to locate and repair any malfunctions discovered by either the Contractor or the Engineer.

END OF SECTION



8. SANITARY SEWER MAINS

8.1. GENERAL

8.1.1 Work Included

Provide all labour, products and equipment required for the work, including but not limited to:

- a) bedding under and over piping
- b) sanitary sewers and appurtenances
- c) culverts
- d) cleaning sewers
- e) testing sewers
- f) connection to existing systems

8.1.2 Quality Standards and Assurances

Products, workmanship and testing shall conform to standards specified in this section.

All products and workmanship are subject to inspection by the Town.

Perform all tests required by the specifications and by authorities having jurisdiction.

Notify the Town and authorities in ample time before testing to permit inspection and to allow tests to be witnessed.

Do not cover any work before inspection and testing unless authorized by the Town in writing.

Remove or repair defective products or work which fails to meet specified requirements as directed by the Town, at the Contractor's expense.

8.2. PRODUCTS

8.2.1 Sewer Pipe

To be type called for in the schedule of quantities or shown on drawings and meet the requirements noted in subsequent clauses of this section.

Non-reinforced pipe and fittings to CAN/CSA-A259.1 Class 3, designated for flexible rubber gasket joints to CAN/CSA-A257.3.

Reinforced concrete pipe meeting ASTM Specification C76M and CSA-A257.2-M92.

PVC Pipe and Fittings:

- Type PSM Poly Vinyl Chloride 200mm to 375 mm: to ASTM D3034
 - Standard Dimensional Ratio (SDR): 35
 - Locked-in gasket and integral bell system
 - CSA certified to CAN/CSA B182.1 and CAN/CSA B182.2



Type Poly Vinyl Chloride 450mm to 900 mm: to ASTM F679

- Standard Dimension Ratio (SDR): 35
- Locked-in gasket and integral bell system
- CSA certified to CAN/CSA B182.1 and CAN/CSA B182.2

Cement - sulphate resisting Portland for all concrete pipe, meeting Type 50 CSA-A5.

HDPE pipe and fittings shall conform to the AWWA C906-07 Standard and shall be PE 3408 with a dimension ratio (DR) 11 and working pressure rating (WPR) 160 psi, unless otherwise approved.

8.2.2 Pipe Joints

For all sewers - as recommended by pipe manufacturer, to produce watertight joints with infiltration within specified limits.

Concrete pipe - rubber gasket to ASTM C443, and CAN/CSA A257.3-M92

PVC - rubber gasket to ASTM 03212 or ASTM F477.

8.2.3 Pre-cast Concrete Manhole Units

To meet requirements of ASTM C478 and CSA A257.4 to dimensions shown on drawings.

Cement - sulphate resisting Portland, CSA A5, Type 50.

Manhole steps shall be 19 mm diameter, galvanized iron safety rungs spaced at a maximum distance of 400 mm center to center for full height.

Pre-cast bases to be minimum 20.7 MPa concrete.

8.2.4 Concrete Blocks and Bricks

Solid concrete, conforming to CSA A165.1 and 165.2 and ASTM C139, not less than 128 mm thick for block, standard dimensions for brick, true to shape, free from cracks and surface defects, compressive strength not less than 17.2 MPa, absorbing not more than 8% water by weight during 24 hours immersion test performed after drying.

Cement - sulphate resisting Portland CSA A5, Type 50.

8.2.5 Mortar

For pipe joints and all other parts of the work, one part sulphate resisting Portland cement to two parts clean sand, by volume.

8.2.6 Cast Iron Frames, Covers and Grates

For manholes and catch basins, close-grained grey cast iron, meeting ASTM A48, Class 20, true in form and dimension, free from faults, sponginess, cracks, blowholes and other defects. Cast steel to conform to ASTM A27, grade 70-36. Substitution of ductile iron meeting ASTM A536, grade 60-40-18 for cast iron or cast steel shall be subject to approval of Town.

Machine or grind frames, covers and grates to even non-rocking bearing surfaces.

Hot dip in asphaltic varnish.

Manhole frames and covers to be Trojan Industries Inc. Type TF-39. All manhole covers are to be clearly stamped "Sanitary Sewer" complete with the Town of Redcliff logo.



8.2.7 Manhole Steps

Safety type, 19 mm diameter solid steel bar, hot dip galvanized after fabrication.

8.2.8 Safety Platforms

Safety platforms shall be aluminum grates to MSU Mississauga or approved equal.

To be installed according to manufacturer's recommendations.

To be installed on manholes greater than 5.0 meters in depth when measured from the top of the frame to the lowest invert.

8.2.9 Concrete

Ready-mixed concrete, sulphate resistant, Portland cement CSA A5, Type 50, 30 MPa compressive strength at 28 days of age, to CSA CAN 3 - A23.1

8.2.10 Reinforcing Steel

CSA G30.18 Grade 400 minimum yield, 400 Mpa for all deformed except where noted otherwise. Use Grade 400 for ties. Welded Wire Fabric: Smooth Wire to CSA G30.5 $f_y=450$ MPa

8.2.11 Sewer Pipe Tests and Rejection

Include all costs for testing, supply and delivery of specimens to testing laboratory and replacing defective material.

The Town reserves the right to select, either on site or at the manufacturer's stockpile, 0.5% of total length of each category of pipe for testing, minimum number of lengths as follows:

- a) for each category of over 100 lineal meters - 4 lengths
- b) for each category of over 50 lineal meters and less than 100 lineal meters - 2 lengths
- c) for each category of less than 50 lineal meters - 1 length.

Where the Town has selected full sized pipe specimens for load tests, deliver these specimens to an approved testing laboratory. Results of the tests shall be mailed directly to Town in triplicate. Pipe will be accepted, based on certified factory tests, provided they are done under supervision of an independent testing agency. All pipe tests shall be performed in accordance with ASTM Specifications.

Should any specimens fail to meet test requirements, test two additional selected specimens for each failure. Pipe will be acceptable only if all re-test specimens meet requirements. Should test results be unsatisfactory, all or part of pipe supplied may be rejected and payment withheld until satisfactory tests of pipe in place are conducted.

Inspect pipe on delivery and reject any that fails to meet specified requirements. Replace rejected pipe with satisfactory pipe without delay. Mark all rejected pipe plainly as "Rejected" and immediately remove from site.

The Town may require submission of a manufacturer's report verifying satisfactory random testing of the pipe designated for this project.



8.3. EXECUTION

8.3.1 Bedding Sewers

Excavate trenches to widths not less than 300 mm greater than pipe diameter. Maximum width at top shall not exceed outside pipe diameter plus 600 mm.

Bed pipe per trench bedding and initial backfill Class "B" granular surround conditions for plastic pipe and Granular Foundation from concrete pipe, as detailed in the standards drawing C-101. Obtain Town's approval for all materials to be used in the pipe bedding zone.

8.3.2 Laying and Jointing Pipe

Commence laying at lower end of line, lay pipes and fittings true to line and grade, socket ends up grade, joints close and evenly butted all around pipe. Take special care to prevent sagging of spigot end in hub and provide true, even invert surface throughout entire length of sewer. Excavate at end of each pipe to provide rest for socket, sufficient to permit proper jointing. Clean pipe interior, remove all dirt, mud and other extraneous materials.

8.3.3 Infiltration/Exfiltration Testing

Construct sanitary sewer as watertight as possible using rubber gaskets to the pipe manufacturer's specifications. Infiltration of groundwater into the entire system shall not exceed the allowable infiltration / exfiltration limits specified by ASTM Standards or as per the limits noted below:

All concrete sanitary sewer trunk lines shall be tested by means of an air or water test according to ASTM C924M or C969M. Pipe larger than 600 mm will be accepted more conveniently by visual and individual joint testing according to ASTM C1103M.

For all PVC pipe, total infiltration of groundwater into whole of system or exfiltration, shall not exceed 5.0 liters per mm of internal pipe diameter per kilometer per day including manholes.

After the installation and backfilling of sewer pipe, services and manholes is completed, the Engineer shall have the right to require the Contractor to measure the leakage of groundwater. Should this leakage exceed the amount specified, the Contractor shall at his own expense, repair the sewer by replacing or otherwise until the leakage does not exceed the amount specified.

During construction and immediately on completion of a manhole, measure infiltration at new manhole. If amount exceeds specified limit, make necessary repairs immediately to reduce infiltration to allowable limit. Failure to comply with this requirement will be sufficient cause for the Town to stop sewer laying work until repairs have been made.

8.3.4 Cleaning Sewer Mains

On completion of construction of mains and services, flush and string, (in readiness for TV inspection) all mains until all deposits of earth or other material are removed. If new system connects to an existing system, plug outgoing line at manhole at junction and remove dirt and debris at that manhole. Do not permit debris from new construction to enter existing system. Pay all costs for repairs where damages occur due to negligence. Pay all costs of water from the municipal authority.

During flushing operations, check all manholes. If depth of flow in any manhole is greater than should be anticipated, bucket main and remove obstructions in pipe line. Pay all costs for required repairs.

Whenever practicable, flush out in runs not over 250 meters. Remove all foreign material from each run before proceeding with next.

**8.3.5 Testing**

If required by the Town, perform pill test after cleaning sewer mains. Through each section of main, pull wood or metal ball with diameter 50 mm less than inside pipe diameter. If pill does not readily pull through, uncover pipe and make good defects at no cost to Town.

Pill test is not required on lines 216 mm diameter and larger if they are visually inspected in a satisfactory manner.

CCTV Testing - the Contractor, at his cost will carry out a T.V. inspection of all sanitary and storm sewer mains. All defects identified by the T.V. inspection shall be corrected by the contractor at the contractor's expense. The contractor shall be responsible for the cost of flushing and stringing the mains prior to TV inspection. If additional TV inspection is required to verify correction of defective work, it will be at the contractor's cost. The Contractor shall provide a copy of the video tape recordings and a written report to the Town for record purposes.

8.3.6 Manholes

Construct manholes as shown on drawings, unless otherwise permitted in writing by the Town. Submit full details of any proposed alternative construction with bid.

For cast-in-place concrete for manholes, conform to CSA A23.1.

Place manholes accurately, plumb, in alignment and at exact plan location.

Construct manholes watertight and complete, including finishing flow bottoms, as work proceeds. Do not lay pipe in advance more than two manholes ahead of last completed manholes.

Shape bottoms accurately for necessary flows as shown on drawings or as directed by the Town. In manholes with sewers 610 mm in diameter and smaller, form invert through manhole with half-round pipe. In manholes containing lot services, shape bottoms to provide slopes required to ensure no buildup of sewage occurs in manholes.

Place stubs for future lines accurately and plug watertight. Shape flow bottoms to suit future lines.

The downstream invert in a manhole shall be a minimum of 30 mm lower than the lowest upstream invert. At a change in direction, the drop shall be at least 60 mm.

Support pipes at manholes to prevent shearing or settlement. Where not detailed use concrete fill, concrete or timber beam, or suitably compacted gravel.

During construction, plug pipes at manholes to prevent entry of concrete and mortar. Remove plugs immediately after construction is completed.

Set covers accurately within 15 mm of correct grade. On sloping streets, set covers to match slopes.

Set all precast concrete sections, bricks, blocks and frames in mortar. Tool joints smooth and point all voids after setting.

All sanitary manhole barrels are to be sealed with rubber neck to prevent infiltration.

END OF SECTION



9. LIFT STATIONS

9.1. LIFT STATIONS

Lift stations shall be designed in accordance with Alberta Environment and Sustainable Resource Development (AESRD). Lift stations shall be duplex Flygt Systems, with the following standard items:

- a) Overhead steel crane rail, to be comparable to existing Public Services lift stations (min 2.3m high).
- b) Logimatic duplex pump controller.
- c) Interior lighting and exterior street lighting.
- d) Dexon heater.
- e) Milltronics level controller with float backups.
- f) Automatic dial-up telephone alarm.
- g) Breaker and plug to match the Town's portable generator.
- h) Flow monitor if required.

END OF SECTION



10. STORM SEWER MAINS

10.1. GENERAL

10.1.1 Work Included

Provide all labour, products and equipment required for the work, including but not limited to:

- a) bedding under and over piping
- b) storm sewers and appurtenances
- c) culverts
- d) cleaning sewers
- e) testing sewers
- f) connection to existing systems

10.1.2 Quality Standards and Assurances

Products, workmanship and testing shall conform to standards specified in this section.

All products and workmanship are subject to inspection by the Town.

Perform all tests required by the specifications and by authorities having jurisdiction.

Notify the Town and authorities in ample time before testing to permit inspection and to allow tests to be witnessed.

Do not cover any work before inspection and testing unless authorized by the Town in writing.

Remove or repair defective products or work which fails to meet specified requirements as directed by the Town, at the Contractor's expense.

10.2. PRODUCTS

10.2.1 Sewer Pipe

To be type called for in the schedule of quantities or shown on drawings and meet the requirements noted in subsequent clauses of this section.

Non-reinforced pipe and fittings to CAN/CSA-A259.1 class 3, designated for flexible rubber gasket joints to CAN/CSA-A257.3.

Reinforced concrete pipe meeting ASTM Specification C76M and CSA-A257.2-M92.

PVC pipe and fittings - DR 35 meeting ASTM Specification D3034 and CSA-B182.2 and CSA-B182.1 may be utilized for mains up to and including 375 mm diameter with prior approval of the Town.

Ribbed PVC pipe and fittings to meet CSA B182.4, ASTM F794 with pipe stiffness of 320 kPa as measured in accordance with ASTM D2412. Maximum long term deflection is less than 7.5%

Cement - sulphate resisting Portland for all concrete pipe, meeting Type 50 CSA-A5.



10.2.2 Pipe Joints

For all sewers - as recommended by pipe manufacturer, to produce watertight joints with infiltration within specified limits.

Concrete pipe - rubber gasket to ASTM C443 and CSA A257.3.

PVC - rubber gasket to ASTM 03212 or ASTM F477.

10.2.3 Pre-cast Concrete Manhole Units

To meet requirements of ASTM C478 and CSA A257.4 to dimensions shown on drawings.

Cement - sulphate resisting Portland, CSA A5, Type 50.

Manhole steps shall be 19 mm diameter, galvanized iron safety rungs spaced at a maximum distance of 400 mm center to center for full height.

Pre-cast bases to be minimum 20.7 MPa concrete.

10.2.4 Concrete Blocks and Bricks

Solid concrete, conforming to CSA A165.1 and 165.2 and ASTM C139, not less than 128 mm thick for block, standard dimensions for brick, true to shape, free from cracks and surface defects, compressive strength not less than 17.2 MPa, absorbing not more than 8% water by weight during 24 hours immersion test performed after drying.

Cement - sulphate resisting Portland CSA A5, Type 50.

10.2.5 Catch Basins

To meet requirements of ASTM C478 and CSA A257.2, 910 mm diameter reinforced concrete riser, reinforced pre-cast concrete base slab, to details shown on drawings.

Cement - sulphate resisting Portland CSA A5, Type 50.

10.2.6 Catch Basin Lead Pipes

Catch basin lead pipes shall be:

- a) Non-reinforced concrete pipe to meet CSA A257.1
- b) PVC pipe DR 35 to meet ASTM D3034 or approved equivalent.

Pipe diameter shall be 250mm diameter for single catch basins and 300mm diameter for twinned catch basins with a minimum grade of 2%.

10.2.7 Mortar

For pipe joints and all other parts of the work, one part sulphate resisting Portland cement to two parts clean sand, by volume.

10.2.8 Cast Iron Frame, Covers and Grates

For manholes and catch basins, close-grained grey cast iron, meeting ASTM A48, Class 20, true in form and dimension, free from faults, sponginess, cracks, blowholes and other defects. Cast steel to conform to ASTM A27, grade 70-36. Substitution of ductile iron meeting ASTM A536, grade 60-40-18 for cast iron or cast steel shall be subject to approval of the Town.

Machine or grind frames, covers and grates to even non-rocking bearing surfaces.



Hot dip in asphaltic varnish.

Manhole frames and covers to be Trojan Industries Inc. Type TF-39. All manhole covers are to be clearly stamped "Storm Sewer" complete with the Town of Redcliff logo.

Catch basin frames and covers shall be:

- 1) Standard frame, grate and 2 piece side inlet curb component for use with 900 mm barrel by Trojan Industries Inc. TF-51 and K-1A for straight faced curb and gutter.
- 2) Top inlet standard round lane paving frame and grate by Trojan Industries Inc. TF-38 for swales or lanes.
- 3) Top inlet standard round top frame and grate by Trojan Industries Inc. Type TF-39 or T-K1 grate for landscaped areas.
- 4) Frame and grate by Trojan Industries Inc. Type K2 or K-7 catch basins for rolled curb and gutter.

10.2.9 Manhole Steps

Safety type, 19 mm diameter solid steel bar, hot dip galvanized after fabrication.

10.2.10 Safety Platforms

Safety platforms shall be aluminum grates to MSU Mississauga or approved equal.

To be installed according to manufacturer's recommendations.

To be installed on manholes greater than 5.0 meters in depth when measured from the top of the frame to the lowest invert.

10.2.11 Concrete

Ready-mixed concrete, sulphate resisting, Portland cement CSA A5, Type 50, 30 MPa compressive strength at 28 days of age, to CSA A23.1

10.2.12 Reinforcing Steel

CSA G30.18 - 400 MPa minimum yield, Grade 400 all deformed except where noted otherwise. Use Grade 40 for ties. Welded Wire Fabric: Smooth Wire to CSA G30.5 $f_y=450$ MPa

10.2.13 Sewer Pipe Tests and Rejection

Include all costs for testing, supply and delivery of specimens to testing laboratory and replacing defective material.

The Town reserves the right to select, either on site or at the manufacturer's stockpile, 0.5% of total length of each category of pipe for testing, minimum number of lengths as follows:

- a) for each category of over 100 lineal meters - 4 lengths
- b) for each category of over 50 lineal meters and less than 100 lineal meters - 2 lengths
- c) for each category of less than 50 lineal meters - 1 length.



Where the Town has selected full sized pipe specimens for load tests, deliver these specimens to an approved testing laboratory. Results of the tests shall be mailed directly to the Town in triplicate. Pipe will be accepted, based on certified factory tests, provided they are done under supervision of an independent testing agency. All pipe tests shall be performed in accordance with ASTM Specifications. Should any specimens fail to meet test requirements, test two additional selected specimens for each failure. Pipe will be acceptable only if all re-test specimens meet requirements. Should test results be unsatisfactory, all or part of pipe supplied may be rejected and payment withheld until satisfactory tests of pipe in place are conducted.

Inspect pipe on delivery and reject any that fails to meet specified requirements. Replace rejected pipe with satisfactory pipe without delay. Mark all rejected pipe plainly as "Rejected" and immediately remove from site.

The Town may require submission of a manufacturer's report verifying satisfactory random testing of the pipe designated for this project.

10.3. EXECUTION

10.3.1 Bedding Sewers

Excavate trenches to widths not less than 300 mm greater than pipe diameter. Maximum width at top shall not exceed outside pipe diameter plus 600 mm.

Bed pipe per trench bedding and initial backfill Class "B" granular surround conditions for plastic pipe and Granular Foundation for concrete pipe, as detailed in the standard drawing C-101.

10.3.2 Laying and Jointing Pipe

Commence laying at lower end of line, lay pipes and fittings true to line and grade, socket ends up grade, joints close and evenly butted all around pipe. Take special care to prevent sagging of spigot end in hub and provide true, even invert surface throughout entire length of sewer. Excavate at end of each pipe to provide rest for socket, sufficient to permit proper jointing. Clean pipe interior, remove all dirt, mud and other extraneous materials.

10.3.3 Infiltration /Exfiltration Testing

Total infiltration of groundwater into whole of system or exfiltration, shall not exceed 5.0 liters per mm of internal pipe diameter per kilometer per day including manholes, for PVC pipe, and 20 liters per mm of internal pipe diameter per km per day including manholes for concrete and clay tile pipe. Where such leakage is exceeded, repair sewer mains, at no additional cost to Town, so total infiltration are within specified limits.

During construction and immediately on completion of a manhole, measure infiltration at new manhole. If amount exceeds specified limit, make necessary repairs immediately to reduce infiltration to allowable limit. Failure to comply with this requirement will be sufficient cause for the Town to stop sewer laying work until repairs have been made.

10.3.4 Cleaning Sewer Mains

On completion of construction of mains and services, flush and string, (in readiness for TV inspection) all mains until all deposits of earth or other material are removed. If new system connects to an existing system, plug outgoing line at manhole at junction and remove dirt and debris at that manhole. Do not permit debris from new construction to enter existing system. Pay all costs for repairs where damages occur due to negligence. Pay all costs of water from the municipal authority.



During flushing operations, check all manholes. If depth of flow in any manhole is greater than should be anticipated, bucket main and remove obstructions in pipe line. Pay all costs for required repairs. Whenever practicable, flush out in runs not over 250 meters. Remove all foreign material from each run before proceeding with next.

10.3.5 Testing

If required by the Town, perform pill test after cleaning sewer mains. Through each section of main, pull wood or metal ball with diameter 50 mm less than inside pipe diameter. If pill does not readily pull through, uncover pipe and make good defects at no cost to Town.

Pill test is not required on lines 216 mm diameter and larger if they are visually inspected in a satisfactory manner.

CCTV Testing - the Contractor, at his cost will carry out a T.V. inspection of all sanitary and storm sewer mains. All defects identified by the T.V. inspection shall be corrected by the contractor at the contractor's expense. The contractor shall be responsible for the cost of flushing and stringing the mains prior to TV inspection. If additional TV inspection is required to verify correction of defective work, it will be at the contractor's cost. The Contractor shall provide a copy of the video tape, DVD, or CD-ROM recordings and a written report to the Town for record purposes.

10.3.6 Manholes

Construct manholes as shown on drawings, unless otherwise permitted in writing by the Town. Submit full details of any proposed alternative construction with bid.

For cast-in-place concrete for manholes, conform to CSA A23.1.

Place manholes accurately, plumb, in alignment and at exact plan location.

Construct manholes watertight and complete, including finishing flow bottoms, as work proceeds. Do not lay pipe in advance more than two manholes ahead of last completed manholes.

Shape bottoms accurately for necessary flows as shown on drawings or as directed by the Town. On manholes with sewers 610 mm diameter and smaller, form invert through manhole with half-round pipe. At manholes containing lot services shape bottoms to provide slopes required to ensure no buildup of sewage occurs in manholes.

Place stubs for future lines accurately and plug watertight. Shape flow bottoms to suit future lines.

The downstream invert in a manhole shall be a minimum of 30 mm lower than the lowest upstream invert. At a change in direction, the drop shall be at least 60 mm.

Support pipes at manholes to prevent shearing or settlement. Where not detailed use concrete fill, concrete or timber beam, or suitably compacted gravel.

During construction, plug pipes at manholes to prevent entry of concrete and mortar. Remove plugs immediately after construction is completed.

Set covers accurately within 15 mm of correct grade. On sloping streets, set covers to match slopes.

Set all precast concrete sections, bricks, blocks and frames in mortar. Tool joints smooth and point all voids after setting.



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All sanitary manhole barrels are to be sealed with rubber neck to prevent infiltration. Gaskets for storm manholes only, may be omitted at the discretion of the Town.

END OF SECTION



11. STORMDRAIN SYSTEMS

11.1. GENERAL

11.1.1 Work Included

This work shall consist of trenching, supplying and installing perforated pipe wrapped in filter fabric and backfill with select filter material at locations and to the depth and grade as established by the Engineer.

11.1.2 Quality Standard and Assurances

Products, workmanship and testing shall conform to standards specified in this section.

All products and workmanship are subject to inspection by the Town.

Perform all tests required by the specifications and by authorities having jurisdiction.

Notify the Town and authorities in ample time before testing to permit inspection and to allow tests to be witnessed.

Do not cover any work before inspection and testing unless authorized by the Town in writing.

Remove or repair defective products or work which fails to meet specified requirements as directed by the Town, at the Contractor's expense.

11.2. PRODUCTS

11.2.1 Perforated Pipe

To be perforated PVC SDR 35 drain tile, nominal inside diameter 100 mm. (hole)

For multi-flow drainage system – 150 mm diameter consisting of high density, polyethylene perforated tubes.

Armtec weeping tile consisting of 100 mm diameter corrugated High Density polyethylene Big 'O' tubing.

11.2.2 Filter Fabric

The Contractor shall supply filter sock or filter fabric material for wrapping the perforated pipe. Geotextile fabric to be interwoven, plastic, non-biodegradable type designed for separation of fill materials while permitting the movement of groundwater and shall be in accordance with the following:



PROPERTIES	ASTM TEST	REQUIREMENTS
PHYSICAL		
Grab tensile Strength	D4632	400 Newtons (N) Minimum
Grab Tensile Elongation	D4632	50% minimum
Mullen Burst	D3786	1275 KPa Minimum
Puncture	D4833	240 Newtons (N) Minimum
Trapezoid Tear	D4533	180 Newtons (N) Minimum
UV Resistance	D4355	70% @ 150 hr.
HYDRAULIC		
Apparent Opening Size	D4751	0.212 mm Minimum
Permittivity	D4491	2.1 sec ⁻¹
Flow Rate	D4491	102 l/sec/m ²

11.2.3 Filter Material

The Contractor shall supply filter material composed of hard, durable mineral particles free from organic matter, clay balls, soft particles and other deleterious materials and meeting the following gradation requirements:

Sieve Size (microns)	Percent Passing By Weight
40 000	100
10 000	78 – 95
5 000	60 - 85
1 250	27 - 57
315	5 – 29
160	0 – 15
80	0 – 5

11.3. EXECUTION

11.3.1 Trench Excavation

Trenches shall be excavated to depths and grades as established by the Engineer. The trench shall be kept as narrow as practicable and still permit jointing to be done. The minimum width of the trench shall be the inside diameter of the pipe plus 500 mm. The bottom of the trench shall be stable to afford a firm and uniform bearing throughout the entire length of the pipe. Where the bottom of the trench is in an impervious layer which has become wet and puddle, granular material shall be added to stabilize the trench bottom. However, the depth of gravel material shall be kept to a minimum to prevent possibilities of water flow under the subdrain pipe.

11.3.2 Pipe Installation

Perforated pipe shall be installed to the depth and grade as shown on the drawings or as directed by the Engineer. Perforations shall be oriented in directions as indicated by the Engineer, in accordance



with the requirements for either collecting or carrying of water. Perforated pipe shall be installed on a stable pipe bed and be free of sags or high points. The pipe shall normally be joined with external “screw-on” couplers or “split” couplers. Couplers shall be of sufficient width to cover at least two outside crest corrugations on each end of the pipe to be joined. Plug upstream ends of drainage system with PVC plugs or caps. Perforated pipe shall be grouted into outfall locations such as manholes and catch basins.

11.3.3 Fabric Installation

The perforated pipe shall be wrapped with filter fabric or fitted with a filter fabricsock prior to installation of the perforated pipe.

11.3.4 Trench Backfill

The subdrain trench shall be backfilled with pervious filter material conforming to Section 2. Filter material shall be placed in 200 mm layers, and shall be thoroughly tamped and carried to a minimum of 200 mm above the seepage zone, or to a height as directed by the Engineer. The remainder of the trench shall be backfilled with impervious material and thoroughly compacted.

END OF SECTION



12. LOT SERVICE CONNECTIONS

12.1 GENERAL

12.1.1 Work Included

Provide all labour, products and equipment required for the lot service connections, including but not limited to:

- a) water service piping
- b) sewer service piping
- c) corporation cocks, connection to main
- d) curb stops, service boxes, service markers

12.1.2 Quality Standards and Assurances

Products and workmanship shall conform to applicable municipal and provincial standards and to specifications.

All products and workmanship will be subject to inspection by the Town.

Perform all tests required by authorities having jurisdiction. Test water and disinfect services with mains.

Notify the Town and authorities in ample time before testing to permit inspection and to allow tests to be witnessed.

Do not cover work before inspection and testing unless authorized by the Town in writing.

Remove or repair defective products or work which fails to meet specified requirements as directed by The Town, at Contractor's expense.

12.2. PRODUCTS

12.2.1 Service Pipe, Fittings

IPEX or Kitec for a diameter of 25 mm and less, and approved PVC materials for diameters greater than 25 mm.

Main or corporation cocks – Compression type AWWA thread.

Curb stops – Brass to brass ball valve with or without a drain. Curb stops 38 mm or larger shall be ball bearing type.

Couplings – Standard Brass Compression type.

Service Boxes – Epoxy coated extension type for a maximum extension of 3.5 m, complete with stainless steel operating rod, brass clevis and key. Service box to be supported on a cast iron piece nailed to a pressure treated preserved wood plank.

Service Clamps – Bronze double strap conforming to Smith-Blair 323 or approved stainless steel clamp.



Service boxes to be adjustable from 2.4 m to 3.0 m bury, unless otherwise noted on drawings.

12.2.2 Sewer Service Pipe

PVC, SDR 28. Minimum size of 100mm diameter.

12.2.3 Sewer Saddles

Manufactured tee saddles, gasketed joints secured with double steel clamps.

12.2.4 Sand Bags

Bags to be new material and in a condition acceptable to the Town. Sand to be clean and free from debris, conforming to imported sand requirements as specified in Trenching and Backfilling for Utilities.

12.2.5 Rigid Foamed Urethane Insulation

Density (ASTM D1622) not less than 28.8 kg/cubic meter. (Nominal 32.0 kg).

Closed cell content (ASTM D2856) not less than 90%.

Water absorption (ASTM D2842) not greater than 0.34 kg/square meter.

Initial thermal conductivity (ASTM D2326) (K Factor) not greater than watts/meter degree Celsius.

Dimensional stability (ASTM D2126)

Compressive strength (ASTM D1621) not less than 206.8 kPa at 10% deflection.

12.3. EXECUTION

12.3.1 Water Services

Use tapping machine to drill, tap and thread corporation main stop into main. Use special care to prevent cuttings falling into main. Wherever possible, tap main under pressure and obtain written approval from the Town to do otherwise.

Lay service pipe to designated location and connect to existing service lines. Service connections shall be tapped into the upper portion of the watermain at an angle of at least 45 degrees from the horizontal.

Tappings shall have a minimum spacing of at least 600 mm. Attach curb stop and set service box to grade where required.

Brace boxes securely to keep plumb during backfilling. Test for operation both before and after pressure test.

Where curb stop is located under sidewalk, concrete slab or other structure, set top of extension service box flush with surface and fill hole around pipe neatly with concrete.

Use service clamps on all services tapped into all types of mains.

Place water service lines at least 2.7 m below final finished grade elevations, unless otherwise directed.

Lay water service lines in same trench with sewer service line. Install sanitary services on left side of water service as viewed from main towards property line. Install storm sewer service on right side of water service as viewed from main towards property line. Paint last 1 m of sanitary service pipe red.



Paint last 1 m of storm service pipe green. Make all connections to existing services using appropriate couplings.

The Town may require the delivery of curb stop risers to the Public Services yard. The Contractor shall confirm this requirement with the Town and shall provide evidence of a receipt signed by the Public Services employee accordingly.

12.3.2 Sewer Services

Connect services to mains with manufactured tee or wye fittings placed in mains, or by cutting into mains and installing manufactured tee saddles or wye saddles and 45 degree bends. Take care to avoid cracking pipe and remove all cuttings from pipe. Secure joint between saddle and main with mortar or other means acceptable to the Town. Minimum grade of 2%.

Do not allow spigots or other obstructions to project into main. Lay service pipe to an even gradient as directed.

Install service lines as detailed, at locations and to grade designated by grade sheet provided in field. Install services at right angle to main, unless otherwise specified.

Bends permitted only at three locations – 45 degree bend with wye or 22.5 degree bend with tee connection at main, 45 degree bend at top of riser and 22.5 degree bend maximum at property line for house service connection between these points.

The service line should be at least two sizes smaller than the main, if it is to be connected directly to the main. If this condition is not met, a manhole will be required.

Support service lines adequately to prevent dislocation, buckling or settlement. When water lines must be laid below sewer lines, ensure that backfill over water lines is adequately compacted to prevent settlement or dislocation of sewers.

When a connection cannot be made directly to a house service line, extend new service line a minimum of 4m inside property. Plug end of new sewer service line to prevent entry of water and dirt.

Install service risers only where noted on the lot grading plan. Ensure adequate support for the riser section utilizing sandbags or screened rock.

12.3.3 Markers

A 50 mm by 100 mm marker stake, from invert elevation to 700 mm above ground level shall be placed at the end of each water service line, the top 700 mm to be painted blue. Place a 100mm diameter white PVC pipe over the water service box from 600mm below ground to 600mm above ground.

END OF SECTION



13. ADJUSTMENT OF APPURTENANCES

13.1. GENERAL

13.1.1 Work Included

The work described in this section pertains to the adjustments of all appurtenances.

13.2. EXECUTION

13.2.1 Valve and Curb Boxes Adjustments

Valve box tops and curb box tops shall be adjusted so that the top of the box is set exactly to the required elevation. The Contractor shall shorten or lengthen the boxes and stems as required and block the boxes to prevent any settlement. The adjustments shall be made so that the boxes are plumb and the valves operate effectively. The rock guard and operating nut are to be located no closer than 300mm below the proposed finished grade.

13.2.2 Manhole and Catch Basin Adjustments

Manhole and catch basin frames shall be adjusted so that the top of the cover is set exactly to the required elevation.

Where it is necessary to raise manhole frames it shall be done with approved precast rings or blocks meeting the requirements of the current issue of ASTM C478. Joints between slab top blocks, and frame shall be mortared, and the joints finished flush and smooth. Joints between slab top, precast rings, and frame shall be made watertight utilizing preformed bituminous gaskets or other approved sealant. Under no circumstances shall the depth from the rim of the manhole to the first ladder rung be more than 800mm.

13.2.3 Damaged Appurtenances

The Contractor shall replace any appurtenances damaged by his work or forces. Any existing damaged appurtenances found within the proposed work zone shall be replaced by the Contractor as approved by the Town at an agreed lump sum price.

13.2.4 Final Adjustment Elevations

The tops of valve boxes, manholes, and catch basins shall be set to the design elevations, or as approved by the Town. Generally, the following shall apply for setting the final elevations of the tops of the appurtenances.

- a) in asphaltic pavement, 5mm below the finished surface elevation for manhole frames.
- b) in concrete curb & gutter, 10mm below gutter elevation for catch basin frames.
- c) in gravel roadways/lanes, 50mm below the surface.
- d) in landscape areas, 50mm above the final surface, providing a smooth transition to match the surrounding areas.

END OF SECTION



14. CULVERTS

14.1. GENERAL

14.1.1 Definition

Culverts shall mean galvanized corrugated steel pipes acting as drainage conduits to conduct the flow of surface drainage water.

14.1.2 Terminology

CSP mean Corrugated Steel Pipe.

CSP Arch means Corrugated Steel Pipe Arch.

SPCSP means Structural Plate Corrugated Steel Pipe

14.1.3 References

The latest version of the publications listed below form part of this Specification to the extent specified in this Section:

CSA Standard G401

Corrugated Steel Pipe Institute (CSPI):

501-78 Metric Specification for Corrugated Steel Pipe Products.

14.1.4 Quality Assurance

Supply, fabricate and install CSP culverts strictly in accordance with manufacturer's instructions and recommendations and as specified.

14.1.5 Product Delivery and Handling

Deliver to site, handle and store pipes, sections, fittings and hardware in a manner to prevent distortion or bending and damage to metal or galvanized coating.

14.1.6 Job Conditions

Protect CSP pipes before, during and after installation and protect installed work and materials.

In the event of damage, make repairs or replacements necessary to the Town's approval.

14.2. PRODUCTS

14.2.1 Materials

Culvert pipe shall be galvanized corrugated steel pipe complying with CSA Standard G4010.

Culvert pipes up to 600mm diameter shall have a wall thickness of 2.0 mm and larger pipe up to and including 900 mm diameter, shall have minimum 2.8 mm wall thickness. For diameter more than 900mm, the wall thickness will be 3.5mm.

Specified wall thicknesses shall not include the thickness of galvanized coating.

The zinc coating mass shall be not less than 610 g/m² when tested by the single spot test.

Corrugation profile for the pipes shall be 68 x 13 mm.



End sections (square or bevelled as indicated), couplers, fittings and hardware shall match the culvert pipe.

14.3. EXECUTION

Trench shall be properly drained and free of unsuitable material prior to placing and compaction of bedding material.

14.3.1 Trenching and Excavation

The excavation for the culvert base shall be carried to a depth of not less than 150 mm below the invert grade, as established by the Town and shall be of sufficient width to permit pipe assembly and to accommodate operation of compaction equipment on either side of the culvert.

14.3.2 Culvert Bedding

Place minimum 150 mm thick layer of compacted granular material on bottom of excavation. Place material in uniform layers not exceeding 150 mm thickness, and compact each layer to at least 95% Standard Proctor Density before placing succeeding layer. Any soft and yielding or other unsuitable material below this level shall be removed to the depth required by the Town and backfilled with approved granular material compacted to a uniform density of 95% of Standard Proctor Density throughout the entire length of the culvert.

The base for culverts installed along main water courses or through yielding areas shall consist of gravel bedding compacted to the excavated depth and extending over a width of three (3) times the diameter of the pipe. The depth of this base shall be not less than 300 mm. An impervious compacted bedding material shall be provided for a minimum length of 3 m or three (3) times the diameter of the pipe, whichever is greater, at the inlet end of the culvert to achieve a seal against seepage.

Trench line and grade requires the Town's approval prior to placing bedding material or pipe.

Do not backfill until pipe grade and alignment are checked and accepted by the Town.

14.3.3 Laying Corrugated Steel Pipe Culverts

Commence pipe placing at downstream end on the prepared granular bedding with separated sections securely joined together by means of a coupling band.

The couplers are to match thickness and corrugations of the pipe.

Corrugations of pipes and couplers must mate before tightening and joints shall be tapped with a mallet during tightening to ensure proper seating of couplers.

Do not allow water to flow through pipes during construction except as permitted by the Town.

All culverts shall be laid so that the horizontal seams fall at the sides of the culverts.

The pipe shall be laid true to line and grade as established by the Town and the pipe shall be carefully handled to prevent damage to the galvanized coating. Damaged pipe sections shall be immediately reported to the Town and repaired and replaced according to his direction. Damaged protective coating shall receive two coats of zinc rich paint.

Centreline of culvert shall not vary from the designated horizontal alignment by more than 75 mm. Invert grade shall not vary from the designated invert grade elevation by more than 12 mm provided positive flow is maintained.



Clay seepage cut off shall be constructed at both ends of the culvert and add the woven type geotextile under the rip rap and culvert.

14.3.4 Culvert Backfill

After assembly of the culvert on the bedding, the culvert shall be backfilled with approved granular and random backfill. Backfill shall be brought up on both sides of the culvert simultaneously in 150mm lifts and shall be compacted with a method approved by the Town to a minimum density of 95% Standard Proctor.

The backfill shall be spread and compacted in 150 mm layers and special care shall be taken to ensure proper filling and compacting under the haunches and within the culvert corrugations. Heavy equipment shall not be allowed over the culvert until a minimum of 0.5 m of fill is obtained above the crown of the pipe.

14.3.5 Rock Rip – Rap

The ends of the culvert shall be finished with the placement of rock rip–rap as shown in the detailed sketches.

14.3.6 Adjustment and Cleaning

Inlet and outlet ends and waterway through the pipe shall be kept free from debris or foreign matter, to prevent restriction to flow of water through the culvert.

END OF SECTION



15. GRANULAR SUB-BASE

15.1. 15.1 GENERAL

15.1.1 Work Included

The work described in this section pertains to granular sub-base material as detailed on the drawings.

15.2. PRODUCTS

15.2.1 Granular Sub-base

Granular sub-base is the material lying above the sub grade and below the base course. The gradation to be utilized shall be as designated by the Town.

15.2.2 Gradation

The granular sub-base material shall consist of crushed rock, gravel and sand consisting of hard, clean, durable material, free from coatings of silt, clay or other deleterious materials and contain no organic matter.

The following gradation shall apply to crushed granular sub-base courses:

Sieve Size (mm)	%Passing by Mass
40	100
25	70 - 94
16	55 - 85
10	44 - 74
5	32 - 62
1.25	17 - 43
0.630	12 - 34
0.315	8 - 26
0.160	5 - 18
0.08	2 - 10

15.2.3 Approval

Preliminary approval of the material as represented in the test results shall not constitute general acceptance of all material in the deposit or source of supply, and acceptance shall be subject to confirming field tests taken at the discretion of the Town. Materials may be considered unsuitable, even though particle sizes are within the limits of the gradation sizes required, if any characteristic precludes satisfactory compaction or if the material fails to provide a roadway suitable for traffic. The acceptability of the final material will be determined by the Town.

15.2.4 Quality

The material shall consist of durable rock or gravel. The granular sub-base shall not contain any organic or other deleterious materials. The material shall have a minimum California Bearing Ratio of 55% at the specified compaction as determined by the current issue of ASTM D1883.



15.3. EXECUTION

15.3.1 Placement

The granular sub-base material shall not be placed until the underlying sub grade has been inspected and approved by the Town.

Unless otherwise specified, the granular material shall be placed in uniform layers not exceeding 200mm in thickness before compaction. The material shall be placed by mechanical spreaders or deposited in windrows and levelled with a suitable motor grader.

15.3.2 Compaction

The material shall be compacted by rolling with a pneumatic-tired or vibrating roller of a type approved by the Town. The material shall be near optimum moisture content ($\pm 2\%$) and compacted to 100% Standard Proctor Density. The maximum lift thickness should be 150 mm.

If the moisture content exceeds the optimum during compaction, the material shall be aerated by mechanical means until the material has been dried sufficiently to obtain the specified density.

If the moisture content is below optimum, water shall be added by an acceptable applicator and in such quantities to achieve specified compaction.

15.3.3 Shaping and Finishing

A motor grader shall be used in conjunction with the compaction equipment to keep the finished surface of each layer even and uniform. The finished surface of the granular sub-base shall conform to the required cross-section and grades as shown on the drawings or as directed by the Town, within a tolerance of 30mm. The sub-base material shall be uniform and show no signs of segregation.

15.3.4 Quality Control

Quality control is the responsibility of the Contractor throughout every stage of the Work from aggregate processing to the final accepted product.

Tests performed by the Consultant / representative will not be considered as quality control tests; rather it will be considered quality assurance.

The Contractor shall be totally responsible for production of materials and construction that meet all specified requirements.

All quality control shall be conducted by qualified personnel. The Contractor shall bear the cost of all quality control testing and related consulting services.

Pre-Production testing and sampling and minimum frequencies are described in the following table.



15.3.5 Tests

Field density, moisture content and sieve analysis tests will be carried out by the representative approved by the Town.

The frequency of field density and moisture content tests shall be 1 test per approximately 100 metres per lift of constructed roadway and at various locations offset left and right of centre line, or as directed by the Town.

All sieve tests should comply with the gradation limits as stated in above.

The Contractor will, as the Town requires, provide a loaded truck with operator for visual checks of soft spots.

END OF SECTION



16. GRANULAR BASE COURSE

16.1. GENERAL

16.1.1 Work Included

The work described in this section pertains to base course gravel as detailed on the drawings.

16.2. PRODUCTS

16.2.1 Gradation

Granular base material shall consist of crushed rock and/or crushed gravel and sand consisting of hard, clean, durable material, free from coatings of silt, clay or other deleterious materials, and containing no organic matter. The base course aggregate shall meet the following gradation requirements when tested to ASTM C136 and C117, (AASHTO T11 and T27):

Sieve Size (mm)	Passing by Mass
20.000	100
16.000	84 - 94
10.000	63 - 86
5.000	40 - 67
1.250	20 - 43
0.630	14 - 34
0.315	9 - 26
0.160	5 - 18
0.080	2 - 10

A minimum of 60% by weight of the material retained on the 5,000 sieve shall have at least 2 fractured faces. Other properties shall be as follows:

Liquid Limit:	maximum 25, ASTM D423-66
Pastedown Index:	maximum 6, ASTM D424-59
Los Angeles Abrasion	
Gradation "B":	35% maximum loss by mass, ASTM C131-76
Sand Equivalent:	minimum of 35%, ASTM D2419-74

16.2.2 Approval

Preliminary approval of the material as represented in the test results shall not constitute general acceptance of all material in the deposit or source of supply, and acceptance shall be subject to confirming field tests taken at the discretion of the Town.

Materials may be considered unsuitable even though particle sizes are within the limits of the gradation sizes required, if particle shapes are thin or elongated, if any other characteristic precludes satisfactory compaction or if the material fails to provide a roadway suitable for traffic.

The acceptability of the final material will be determined by the Town.



16.2.3 Quality

The material shall consist of durable rock or gravel. The base course shall not contain any organic or other deleterious materials. The material shall have a minimum California Bearing Ratio of 55%, as determined by the current issue of ASTM D1883 at the specified compaction.

16.3. EXECUTION

16.3.1 Placement

The granular base course material shall not be placed until the underlying sub grade or granular sub-base course has been inspected and approved by the Town. The sub grade or sub-base shall be shaped to cross section shown on the drawings, or as directed by the Town, and shall be maintained free of ruts, waves, and undulations by whatever means are necessary.

Unless otherwise specified, the granular material shall be placed in uniform layers not exceeding a 200mm comp active depth. The material shall be placed by mechanical spreaders or deposited in windrows and levelled with a suitable motor grader.

When called in the contract temporary material shall be placed from the granular base course level to the lip of gutter, with a 1% crown. The following year this material shall be excavated, reshaped and recompacted prior to paving. Any additional material shall be used as sub-base material in lanes or as directed by the Town.

16.3.2 Compaction

The material shall be compacted by rolling with a pneumatic-tired or vibrating roller of a type approved by the Town. The material shall be near optimum moisture content ($\pm 2\%$) and compacted to 100% Standard Proctor Density.

For temporary material, compaction shall be 98% Standard Proctor Density.

If the moisture content exceeds the optimum during compaction, the material shall be aerated by mechanical means until it has dried sufficiently to obtain the specified compaction.

If the moisture content is below the optimum, water shall be added by an acceptable applicator and in such quantities to achieve the specified moisture content.

16.3.3 Shaping and Finishing

A motor grader shall be used in conjunction with compaction equipment to keep the finished surface of each layer even and uniform.

The finished surface of the granular base course shall conform to the required cross-section and grade as shown on the drawings or as directed by the Town, within a tolerance of plus or minus 20mm.

The granular base course shall be uniform and show no signs of segregation of the material placed.



16.3.4 Quality Control

Quality control is the responsibility of the Contractor throughout every stage of the Work from aggregate processing to the final accepted product.

Tests performed by the Consultant / representative will not be considered as quality control tests; rather it will be considered quality assurance.

The Contractor shall be totally responsible for production of materials and construction that meet all specified requirements.

All quality control shall be conducted by qualified personnel. The Contractor shall bear the cost of all quality control testing and related consulting services.

Pre-Production testing and sampling and minimum frequencies are described in the following table.

16.3.5 Tests

Field density, moisture content and sieve analysis tests will be carried out by the representative approved by the Town.

The frequency of field density and moisture content tests shall be 1 test per approximately 100 metres per lift of constructed roadway and at various locations offset left and right of centre line, or as directed by the Town.

The Contractor will, as the Town requires, provide a loaded truck with operator for visual proof rolling of soft spots. The granular surface course shall show no visible subsidence or deflection under the wheels of the truck.

END OF SECTION



17. ASPHALTIC CONCRETE

17.1. DESCRIPTION

This section specifies requirements for the hot mix asphalt concrete paving.

The work includes the supply of aggregates and asphalt cement, and reclaimed asphalt pavement and liquid anti-strip where applicable; asphalt plant mixing, transporting, placement finishing, and compaction to all requirements of this specification.

The work includes all materials certification, quality control, verification and mix design testing, analysis and reporting to be completed as required in this specification.

17.2. STANDARD MIX TYPES (FOR INFORMATION ONLY)

Mix Type Designations and typical applications are as follows (Note: Mix Types to be selected on a project specific basis, as required by the nature of the project and quantities):

- a) Mix Type S1 - Surfacing mix for high traffic applications, including arterial and industrial classified roadways, using either 120/150 A penetration/viscosity graded asphalt cement or Performance Grade (PG) 64-31 binder, as identified in the Tender Form.
 - PG 64-31 binder would be preferred for applications with high truck traffic and/or slower speed roadways with frequent signalized intersections.
 - 120/150 A penetration/viscosity graded asphalt cement could be utilized for low truck traffic applications and/or roadway sections with no, or few signalized intersections.
- b) Mix Type S2 - Surfacing mix for low to medium traffic applications, such as local and minor collector roadways, using 150/200 A penetration/viscosity graded asphalt cement.
- c) Mix Type B1 - Base course mix for all traffic applications using 150/200 A penetration/viscosity graded asphalt cement. Use for lanes and lane aprons. Mix Type S3 may be used as an alternative base course where Mix Type B1 is specified, upon approval from Town Engineer.
- d) Mix Type M1 - Maintenance mix for patching, levelling course, and thin overlay of low traffic pavements, using 150/200 A penetration/viscosity graded asphalt cement.

17.3. DEFINITIONS

Asphalt Concrete – Generally refers to the final HMA product in place.

End Product Specification (EPS) - A specification whereby the methods of construction are not defined. Under EPS the Engineer will monitor the Contractor's control of the process that produces the items of construction and will accept or reject the end product according to a specified acceptance plan.

The Contractor is responsible for quality control. End product acceptance, including quality assurance is the responsibility of the Engineer.

Engineer - As referenced to in this specification, applies to the Town of Redcliff or the designated project representative.

Hot Mix Asphalt (HMA) - Generally refers to the mixture of aggregates and asphalt cement, and other additives where applicable.



Job Mix Formula - The job mix formula (JMF) establishes the proportioning of aggregate, asphalt cement and reclaimed asphalt pavement (RAP) and/or liquid anti-strip where applicable, to be used for the production of hot mix asphalt (HMA).

Lot - A lot is a portion of the Work being considered for acceptance, and is defined as the following:

- a) **Category A Projects** - One day of plant production, per mix type, when the day's quantity is greater than 1000 tonne. When a day's production is less than 1000 tonne the material may be added to the previous or subsequent day(s) of production, at the Engineer's discretion. The maximum Category A lot size shall be 2000 tonne.
- b) **Category B Projects** - The entire project quantity for each mix type.
- c) At the Engineer's discretion, any portion of the Work may be deemed a Lot.

Post-Production Quality Control - Materials and construction quality control conducted in accordance with this specification during and after plant mixing.

Pre-Production Quality Control - Materials and process quality control conducted in accordance with this specification prior to plant mixing.

Project Category - For the purposes of this specification, projects are to be identified in the Contract Special Provisions as Category A or Category B. Generally, Category A projects have asphalt concrete quantities greater than 2000 tonne of any one mix type and Category B projects have quantities of any one mix type less than 2000 tonne. In all cases the Special Provisions govern with respect to the applicable Project Category.

Quality Control - Materials and process monitoring and testing conducted by, or on behalf of the Contractor.

Quality Assurance - Acceptance testing and monitoring conducted on behalf of the Owner.

17.4. PRODUCTS

17.4.1 Materials

Asphalt Cement: - to Section 5030, City of Medicine Hat Specifications

Aggregates:

Coarse aggregate is aggregate retained on the 5 000 μm sieve; fine aggregate is aggregate passing the 5 000 μm sieve.

Aggregate material shall be crushed stone or gravel consisting of hard, durable, angular particles, free from clay lumps cementation, organic material, frozen material and any other deleterious materials.

Gradations to be within limits specified, when tested to ASTM C-136 and ASTM C-117 with sieve sizes to CAN/CGSB 8-GP-2M rather than ASTM E11.

Aggregate shall be processed to meet the following requirements:

- Natural fines shall be pre-screened and stockpiled with not more than 20% of material retained on the 5 000 μm sieve and 100% passing the 10 000 μm sieve.



- Aggregate delivered to the crushing plant shall be pre-screened and shall contain no more than 5% passing the 5 000 μm sieve.
- If separating crushed aggregates, stockpiled the fraction or manufactured sand such that not more than 15% of material retained on the 5 000 μm sieve.

Physical properties of aggregates to meet the requirements in the following table.

17.4.2 Aggregate Physical Property Requirements

REQUIREMENT	ASTM TEST STANDARD	ALL MIX TYPES
Los Angeles Abrasion, Grading B (% Loss)	C131	32 max.
Magnesium Sulphate Soundness (% Loss) Coarse Aggregate: Fine Aggregate:	C88	12 max. 12 max.
Lightweight Particles (%)	C123	1.5 max.

Blend Sand:

- To consist of natural or manufactured sand passing the 5 000 μm sieve.
- Stockpile volumes shall be maintained to ensure a minimum of 5 000 tonne of plant mix production, or the entire project quantity.
- Blend sand shall be dried if necessary to provide a uniform feed.

Blended Aggregate Requirements:

- Aggregate Gradation Requirements, including RAP, to meet the requirements of the following table.

Blended Aggregate Gradation Requirements

SIEVE SIZE (μm)	PERCENT PASSING SIEVE SIZE			
	MIX TYPE S1	MIX TYPE S2	MIX TYPE B1	MIX TYPE M1
25 000	-	-	100	-
20 000	100	-	95 - 83	-
16 000	100 - 97	100	90 - 74	-
12 500	95 - 85	100 - 90	80 - 64	100
10 000	85 - 70	90 - 75	72 - 56	100 - 90
5 000	65 - 50	70 - 55	56 - 40	75 - 65
2 500	55 - 36	60 - 45	46 - 30	65 - 45
1 250	45 - 26	45 - 26	40 - 22	45 - 26
630	38 - 18	38 - 18	33 - 15	38 - 18
315	28 - 12	28 - 12	27 - 11	30 - 12
160	16 - 8.0	18 - 8.0	18 - 8.0	20 - 8.0
80	8.0 - 4.0	10 - 4.0	8.0 - 4.0	10 - 4.0



Coarse Aggregate Fracture: Of coarse fraction (retained on 5 000 μm sieve size) the percentage of particles with two (2) or more fractured faces shall be by mass:

- Mix Type S1 - 90% minimum
- Mix Type S2 - 80% minimum
- Mix Type B1 - 60% minimum
- Mix Type M1 - 60% minimum

Flat and Elongated Particles: Of coarse fraction (retained on 5 000 μm sieve size) the percentage of flat and elongated particles greater than a 5:1 ratio shall be by mass less than 10%.

Manufactured Sand: Of total fine fraction (passing 5 000 μm sieve size), manufactured sand shall be by mass:

- Mix Type S1 - 70% minimum
- Mix Type S2 - 50% minimum
- Mix Type B1 - 40% minimum
- Mix Type M1 - No minimum specified

For mixes incorporating RAP, 50% of the RAP sand portion shall be considered manufactured sand.

The sand equivalent value (ASTM D2419, mechanical method) determined for the fine aggregate portion shall be:

- Mix Types S1 and S2 - 45% minimum
- Mix Types B1 and M1 - 40% minimum

Of total aggregate, the maximum RAP portion shall be by mass shall be 15%.

Delivery and Storage

- Aggregates: Stockpile minimum of 50% of total amount of aggregate required before commencing trial mix designs.
- Reclaimed Asphalt Pavement (RAP): Stockpile minimum of 100% of total amount of RAP required before commencing trial mix designs.

17.4.3 Mix Design

An asphalt mix design must be prepared and submitted to the Engineer for review and approval at least one week prior to the Work. There should be separate and new design for each type of mix per job. However, as there is only one asphalt plant in Medicine Hat / Redcliff area, one design per mix type in a year would be acceptable provided there is no change in materials and its source. The Contractor shall use qualified engineering and testing services licensed to practice in the Province of Alberta.

The mix design shall follow the Marshall method of mix design as outlined in the latest edition of the Asphalt Institute Manual Series No. 2 (MS-2), and shall include five separate trial values of asphalt content.

Design of Mix:

Mix Types S1 and B1 - 75 Blows on each face of test specimens.

Mix Types S2 and M1 - 50 Blows on each face of test specimens.



Include the following data with mix design submission:

Aggregate specific gravity and asphalt absorption.

Sand equivalent, coarse aggregate fracture, flat and elongated particles, and percent manufactured sand values.

Asphalt cements supplier/refinery, specific gravity and mixing and compaction temperatures, based on temperature – viscosity properties of asphalt cement.

Job mix formula including aggregate gradation and blending proportions, and design asphalt content.

Maximum relative density at each trial asphalt content.

Where reclaimed asphalt pavement (RAP) is to be incorporated into the mix supply, RAP gradation, RAP asphalt cement content and design recycle percentage.

Data to satisfy the requirements of the following:

17.4.4 Mixture Physical Property Requirements

PROPERTY	REQUIREMENTS			
	MIX TYPE			
	S1	S2	B1	M1
Marshall Stability (kN)	12 min.	8 min.	10 min.	5.3 min.
Marshall Flow (mm)	2.0 - 3.5	2.0 - 4.0	2.0 - 4.0	2.0 - 4.0
Air Voids (%)	3.8 - 4.2	3.3 - 3.8	4.3 - 4.7	2.8 - 3.2
Voids in Mineral Aggregate (%)	13.5 - 15.0	14.0 - 16.0	12.5 - 14.0	14.5 - 16.5
Voids Filled With Binder (%)	65 - 75	70 - 80	60 - 70	70 - 80
Film Thickness (µm)	6.5 – 8.5	7.0 min.	6.0 – 8.0	7.0 min.
Retained Stability (%)	70 min.	70 min.	70 min.	70 min.

17.4.5 Job Mix Formula

Subject to approval by the Engineer, the aggregate proportioning (including RAP), target gradation, asphalt content and air void content from the Mix Design will become the Job Mix Formula for the supply of hot mix asphalt.

Once established, no alterations to the Job Mix Formula will be permitted unless a new Job Mix Formula is submitted by the Contractor and approved by the Engineer.

If the sum of any alterations to the Job Mix Formula are in excess of any one of the following limits, a new Mix Design is required.

- \pm 5% passing the 5 000 µm sieve size
- \pm 1% passing the 80 µm sieve size
- \pm 0.3% asphalt content

Any alteration to the Job Mix Formula shall not result in properties which do not meet the requirements of this Specification.

**17.4.6 Production Tolerances**

All mixtures shall be supplied to the Job Mix Formula within the range of tolerances specified.

Asphalt cement content: $\pm 0.3\%$ of JMF value.

Temperature: Mix temperature at point of plant discharge shall not vary from the mixing temperature identified in the mix design by more than ± 10 C.

Aggregate Gradation:

17.4.7 Aggregate Gradation Tolerances

AGGREGATE PASSING SIEVE SIZE (μm)	TOLERANCE (% BY MASS)
Max. size to 5 000	± 5.0
2 500 & 1 250	± 4.0
630 & 315	± 3.0
160	± 2.0
80	± 1.5

Air Voids: $\pm 0.8\%$ of the JMF value.

Mixture Properties: Marshall Stability, Marshall Flow, Voids Filled with Asphalt, and Voids in Mineral Aggregate as per requirements identified in the previous tables.

Film Thickness: For plant production, a $0.5 \mu\text{m}$ reduction in the minimum values identified in the previous tables will apply.

Moisture in Mix: Maximum permissible moisture, at point of plant discharge, is 0.2% by mass of mix.

Asphalt cement recovered from freshly produced hot mix by the Abson Method, ASTM D1856 and subsequently tested in accordance with ASTM D5, shall retain a minimum value of 50% of its original penetration value.

17.5. SAMPLING AND TESTING**17.5.1 General**

The Engineer shall have access to all production processes and materials used for the work to monitor material quality as often as deemed necessary. Such inspection and testing shall not in any way relieve the Contractor of the responsibility for meeting the requirements of this specification.

At least three (3) weeks prior to commencing work, inform the Engineer of the proposed source of aggregates and provide access for sampling, and provide samples of asphalt cement in accordance with Section 05130, City of Medicine Hat Specifications.

17.5.2 Quality Control

Quality control is the responsibility of the Contractor throughout every stage of the Work from aggregate processing to the final accepted product.



Tests performed by the Consultant / representative will not be considered as quality control tests; rather it will be considered quality assurance.

The Contractor shall be totally responsible for production of materials and construction that meet all specified requirements.

All quality control shall be conducted by qualified personnel. The Contractor shall bear the cost of all quality control testing and related consulting services.

Pre-Production testing and sampling and minimum frequencies are described in the following table.

17.5.3 Pre-Production Quality Control Requirements

Quality Control Requirement	Minimum Frequency
Asphalt Cement Certification	Once per Year or for change in supplier
Aggregate Physical Properties	Once every 3 Years, or for change in source
Crushed Coarse Aggregate Gradation Analysis and Fracture Content	One for every 1000 tonne of each class of material processed into stockpile, or one analysis for each material every production day when production rate is less than 1000 tonne
Manufactured Sand Aggregate Gradation	
Natural Fine Aggregate Gradation	
Blend Sand Aggregate Gradation	
Reclaimed Asphalt Pavement (RAP) Asphalt Content and Extracted Aggregate Gradation	One for each 500 tonne delivered to stockpile, or one for each location when delivery rate is less than 500 tonne
Penetration of asphalt cement recovered from RAP by Abson Method	One for each 2000 tonne delivered to stockpile
Trial Mix Design by Marshall Method	One per Year, or as required for a change in asphalt cement supply, aggregate gradation or aggregate source.
Plant Calibration	As required

Post-Production testing and sampling and minimum frequencies are described in the following table.

17.5.4 Post-Production Quality Control Requirements

Quality Control Requirements	Minimum Frequency
Hot Mix Asphalt Analysis (including Asphalt Content, Aggregate Gradation, Marshall Density and Void Properties)	One for every 500 tonne of each mix type supplied under this specification. See Note 1.
Quality Control Charts (including 3 test running average for Binder Content, Aggregate Gradation, Marshall Density and Void Properties)	For each hot mix analysis. Test results and updated 3 test running average to be submitted to the Engineer as they become available.
Hot Mix Asphalt Temperature	Minimum frequency not specified.
Cold Feed Aggregate Analysis	Minimum frequency not specified.



Maximum Relative Density of Hot Mix Asphalt	Minimum frequency not specified.
Compaction Monitoring (Core or Nuclear Density)	Minimum frequency not specified. See Note 2

Note 1: Where an individual test indicates non-compliance, another test shall be initiated immediately.

Note 2: Coring is subject to approval by the Engineer.

Pre-Production Quality Control test data as specified shall be reported to the Engineer for approval one week prior to commencing the project, or as requested. No Work shall commence until the Engineer approves submitted test data.

Post-Production Quality Control test data as specified shall be reported to the Engineer daily as the Work proceeds.

17.5.5 Quality Control Compliance with Specified Tolerances

Asphalt Content, Aggregate Gradation and Mixture Properties

The test data derived by Post-Production Quality Control mix testing shall be compared to the tolerances set forth in this specification. The Contractor shall suspend mix production when the 3 test running average for any property is outside of the specified tolerance limits.

Supply shall not commence again until it is demonstrated that corrective action has been taken.

Following initial supply, suspension of operations, or initiation of a new Job Mix Formula, a new 3 test running average is initiated and the subsequent mix production is subject to rejection until such time as an acceptable 3 test running average is attained.

Hot Mix Asphalt Temperature

Plant mix that does not meet temperature requirements specified at the point of plant discharge shall be subject to rejection at the discretion of the Engineer.

17.5.6 Acceptance Sampling and Testing

Within this specification, certain requirements, limits and tolerances are specified regarding supplied materials and workmanship. Compliance with these requirements shall be determined from acceptance testing as described in this section.

Acceptance testing is the responsibility of the Engineer.

Initial acceptance testing will be undertaken free of cost to the Contractor.

Sampling and acceptance testing is described in the following table:

**17.5.7 Acceptance Testing Requirements - Category A & B Projects**

17.5.8 Acceptance Testing	17.5.9 Minimum Frequency
Hot Mix Asphalt Analysis (including Binder Content, Aggregate Gradation, Marshall Density, Maximum Relative Density, Void Properties, Marshall Stability and Flow)	For each mix type, one test for each 3500 sq. m of placement, or three tests per lot, whichever is greater. See Note 1.
Compaction Testing (Core Density) and Thickness Determination	For each mix type, one test for each 2000 sq. m. of placement, or three tests per lot, whichever is greater.
Hot Mix Asphalt Temperature	No minimum frequency.

Note 1: For Category B Projects the Engineer may, at his/her discretion, acquire the minimum number of mix samples, but reduce the number of tests to a minimum of one. Should non-compliance be indicated by the sample(s) tested, the Engineer reserves the option to test the remaining samples.

17.5.10 Acceptance Sampling Procedures:

Loose mix samples shall be acquired from the Work site in accordance with Alberta Transportation Test (ATT) procedure ATT-37. Auger samples may be used if approved by both the Engineer and the Contractor.

The timing of mix sampling shall be stratified, with each sample representing a similar production quantity.

Core locations will be selected using stratified random sampling procedures. The lot will be divided into segments meeting or exceeding the minimum frequency specified and of approximately equal area. In each segment a test site will be located using random numbers to determine the longitudinal and transverse coordinates.

Areas within 3m of transverse joints or 0.3m of a mat edge are excluded from compaction acceptance sampling and testing.

Core sample areas must be filled immediately after sample has been taken. It is recommended that sample area be filled with redi-mix cement (Type 10).

17.6. APPEAL OF ACCEPTANCE TESTING RESULTS**17.6.1 General**

The Contractor may appeal the results of acceptance testing for Compaction Standard or Asphalt Content for any lot subject to rejection or unit price reduction. The notice of appeal shall be in writing and submitted to the Engineer within 48 hours of receipt of the acceptance testing results.

Appeals will only be considered if cause can be shown and the requirements specified have been satisfied.

Quality Control tests initiated after the Contractor's receipt of the acceptance test results will not be considered when evaluating cause for appeal.



For Category A Projects, only Quality Control testing during production for the subject project will be considered when evaluating cause for appeal. For Category B Projects, Quality Control test results from production prior to the subject project may be considered when evaluating cause for appeal.

17.6.2 Asphalt Content Appeal

A stratified random sampling plan shall be developed by the Engineer with the same number of segments as the original number of samples for the subject lot. Sufficient core sample (150mm diameter) will be acquired from each segment to enable asphalt content determinations.

For asphalt content appeal testing, the Contractor will have the option for the testing to be done by the testing laboratory undertaking the project acceptance testing, or an independent testing laboratory selected by the Engineer.

The average of the appeal test results will be used for acceptance and unit price adjustment, and shall be binding on both the Owner and the Contractor.

If the average appeal test result verifies that any unit price reduction or rejection applies for that Lot, the costs of the appeal sampling and testing will be borne by the Contractor. If the result show that a penalty or rejection no longer applies, the sampling and appeal costs will be the responsibility of the Owner.

17.6.3 Compaction Standard

The testing laboratory conducting the project acceptance sampling and testing will routinely retain companion samples sufficient for the determination of maximum relative density.

For compaction standard appeal testing, the Contractor will have the option for the testing to be done by the testing laboratory undertaking the project acceptance testing, or an independent testing laboratory selected by the Engineer.

The average of the appeal tests will be used for acceptance and unit price adjustment, and shall be binding on both the Owner and the Contractor.

If the new compaction standard verifies that any unit price reduction or rejection applies for that Lot, the costs of the appeal sampling and testing will be borne by the Contractor. If the result shows that a unit price reduction no longer applies, the appeal testing costs will be the responsibility of the Owner.

17.6.4 Core Density and Thickness Appeals

Core density and thickness appeals will only be considered if a case can be made that the stratified random sampling plan was biased or testing was in error.

17.7. EXECUTION

17.7.1 Continuity of Production

During the time period that work is in progress on any project for which this specification is in effect, and at the Engineers' discretion, the plant may be limited to producing only the mix type required for that project.

17.7.2 Mix Production

Preparation of Mineral Aggregate



The mineral aggregates shall be at as low a temperature as is consistent with proper mixing and laying and in no case to exceed 175 C.

17.7.3 Composition of Mixture

The mineral aggregate, reclaimed asphalt pavement (where applicable) and asphalt cement shall be mixed in a manner to produce a homogeneous mixture in which all particles of the mineral aggregate are uniformly coated.

Incorporate RAP such that it does not come in direct contact with the burner flame.

Plant emissions shall not exceed the limits set by Alberta Environment and Sustainable Resource Development (AESRD).

17.7.4 Preparation for Paving

The Contractor shall provide the Engineer a minimum of six hours notice of the intention to commence paving over any previously approved primed or tacked surface.

The hot asphalt mixture shall be laid upon a dry firm surface, true to grade and cross-section and free from all loose or foreign material. No hot mix shall be placed when the surface is wet or when other conditions prevent proper spreading, finishing or compaction.

If undercutting, and subsequent backfill with asphalt concrete is done, the backfill operation shall be performed sufficiently far ahead of the paving operation to allow the asphalt concrete time to cool down enough to support equipment.

17.7.5 Hot Mix Asphalt Placing - Ambient Air Temperature

No hot mix asphalt shall be dispatched to the field unless the ambient air temperature, as issued by Environment Canada is rising and meets the following minimum requirements:

Thickness less than 50mm - 7°C

Thickness greater than 50mm - 2°C

A tolerance will be permitted for plant start-up.

No surface lift asphalt shall be placed regardless of ambient air temperature until the road surface is 5°C or higher.

17.7.6 Hours of Operation

No loads of hot mix asphalt shall be dispatched from the plant after sunset or during hours of darkness unless loads can be placed and compacted in accordance with these specifications, and suitable artificial illumination is provided, all subject to the Engineers' approval.

17.7.7 Transportation of Hot Mix Asphalt

Trucks shall be equipped with tarpaulins of sufficient weights and size to cover the entire open area of the truck box. Regardless of weather conditions, tarpaulins shall be used.

Vehicles used for the transportation of hot mix asphalt from the plant to the site of work shall have tight metal boxes previously cleaned of all foreign matter. The inside surface may be lightly lubricated with a soap solution just before loading. Excess lubrication will not be permitted.

For purposes of checking asphalt mixture temperatures, trucks shall have an accessible 13 mm diameter hole drilled into the driver's side of the truck box, at a distance of 0.3 metres from the bottom of the box and 150 mm clear of the reinforcing ribs.



The speed and weight of hauling trucks shall be regulated so that, in the opinion of the Engineer, no damage will occur to any portion of the work underway. Any damage to the tack coat, prime coat or the existing surface caused by the Contractor's equipment shall be repaired by the Contractor at their own expense.

Any load of hot mix with a temperature less than 120 °C, will be considered reject.

17.7.8 Hot Mix Asphalt Spreaders

The spreading machine shall be self-propelled and capable of placing a uniform layer of asphalt mix to the depth and grades as shown on the plans or as indicated by the Engineer.

The screed shall include a tamping bar or vibratory strike-off device for use when required. The screed shall strike-off the mix to the depth and cross-section specified and produce a finished surface of uniform texture.

Control of the screed shall be by automatic sensing devices. Longitudinal control shall be accomplished by a sensor, which follows a string-line, ski, or other reference. The grade sensor shall be moveable and mounts provided so that grade control can be established on either side of the paver. A slope control sensor shall also be provided to maintain the proper transverse slope of the screed. Use of manual screed control may be used subject to approval by the Engineer.

17.7.9 Hand Tools

Only lutes shall be used during the spreading operation and when the asphalt is worked by hand in areas in which the paver cannot reach.

Tamping irons may be used to consolidate the material along structures inaccessible to the rollers. Mechanical compaction equipment, satisfactory to the Engineer, may be used instead of tamping irons.

For purposes of checking the finished surface, Contractors must provide and carry on each paving machine a 3 metre straight edge and slope measuring level.

17.7.10 Pre-levelling for Asphalt Concrete

Pre-levelling of uneven surfaces over which asphalt concrete is to be placed shall be accomplished by the use of asphalt concrete placed with a grader, paver, and hand or by a combination of these methods as directed by the Engineer.

After placement, the asphalt concrete used for pre-levelling shall be compacted thoroughly with pneumatic-tired rollers.

17.7.11 Paving Operations

The asphalt concrete shall be placed to the design thickness as shown on the contract drawings. On new construction where an established reference is lacking, a string-line reference will be required. Adjacent mats on the same lift are to be controlled by use of the grade sensor. No relaxation of the above procedure will be permitted without written approval of the Engineer.

The spreader shall be operated in such a manner as to distribute the asphalt concrete mix to proper cross-section, width and thickness without causing segregation of the mix. Segregated areas, which may occur, shall be corrected immediately. The forward motion of the spreader shall be controlled so that no irregularities in the pavement surface are caused by excessive speed. The rate of placement of the mixture shall be uniform, and shall be co-ordinated with the production rate of the asphalt plant without intermittent operation of the spreader.



Any failure of the machine or operation to produce a smooth, uniformly dense mat, free from irregularities, shall be corrected immediately to the satisfaction of the Engineer.

17.7.12 Areas Inaccessible to the Paving Machine

Areas that are inaccessible to the paving machine may be paved by other methods, as approved by the Engineer.

In small areas or where the use of mechanical equipment is not practical, the mix may be spread and finished by hand. The asphalt mixture shall be dumped on the area and immediately thereafter distributed into place by shovels and spread with lutes in a loose uniform layer of uniform density and correct depth. Material must be handled so as to avoid segregation.

17.7.13 Compaction

The Contractor shall supply sufficient compaction equipment to:

- Provide a compaction rate that will equal or exceed the placing rate of the spreader.
- Ensure the specified compaction is attained before the temperature of the mat falls below 80 ° C.

17.7.14 Longitudinal and Transverse Joints

Longitudinal and transverse joints shall be made in a manner consistent with industry standards. Coarse aggregate removed from the hot mix during joint preparation shall not be broadcast on to the mat.

Paving joints shall not be placed in the same vertical plane. Longitudinal joints shall be offset at least 150 mm and transverse joints shall be offset at least 2 m.

Longitudinal joints shall not be located within travel lanes, unless approved by the Engineer.

Edges where additional pavement is to be placed shall be vertically formed to true line. A lute shall be used immediately behind the paver when required to obtain a true line and vertical edge.

The exposed edges of all cold asphalt joints and the face of concrete curb and gutter shall be cleaned and painted with a thin coat of asphalt tack.

At the end of each day's paving of the surface course and upper lift of the base course mix, the uncompleted paving mats shall be provided with vertically cut transverse joints. Joints between old and new pavements or between successive days' work shall be carefully made in such a manner as to ensure a thorough and continuous bond between the old and new surfaces.

17.7.15 Utility Appurtenances

Pavement incorporating utility appurtenances, including water valves, manholes and other surface utility fixtures shall be constructed in a manner satisfactory to the Engineer.

A tack coat shall be provided to the vertical surface of utility appurtenances prior to paving.

The paved surface adjacent to utility appurtenances shall be free of segregation with a tight uniform surface.

**17.7.16 Opening to Traffic**

Prior to any application of traffic, paving mats shall be sufficiently cool to resist any deformation or surface scuffing.

The Engineer may, at their discretion, require means of cooling (e.g. application of water) completed pavements prior to opening to traffic.

At their discretion, the Engineer may prohibit traffic from travelling on newly paved surfaces for any length of time deemed necessary.

17.8. END PRODUCT ACCEPTANCE OR REJECTION**17.8.1 General**

The Contractor shall provide an end product conforming to the quality and tolerance requirements of this specification. Where no tolerances are specified, the standard of workmanship shall be in accordance with accepted industry standards.

Acceptance of any Lot at full payment will occur if there are no obvious defects and the Lot mean results for asphalt content, pavement density, and thickness meet or exceed the specified tolerances.

Unit price reductions will only be applied on the basis on full acceptance testing.

Failure to satisfy the Post-Production Quality Control requirements of this specification will result in the mix supplied during such period to be subject to rejection.

Mix supplied during periods when the Post-Production Quality Control 3 test running average is outside the specified tolerances is subject to rejection.

Mix not meeting the plant discharge or on-site temperature requirements specified herein shall be subject to rejection.

17.8.2 Asphalt Content

For full payment, the Lot Mean Asphalt Content must be within + 0.30% of the approved JMF value, as specified.

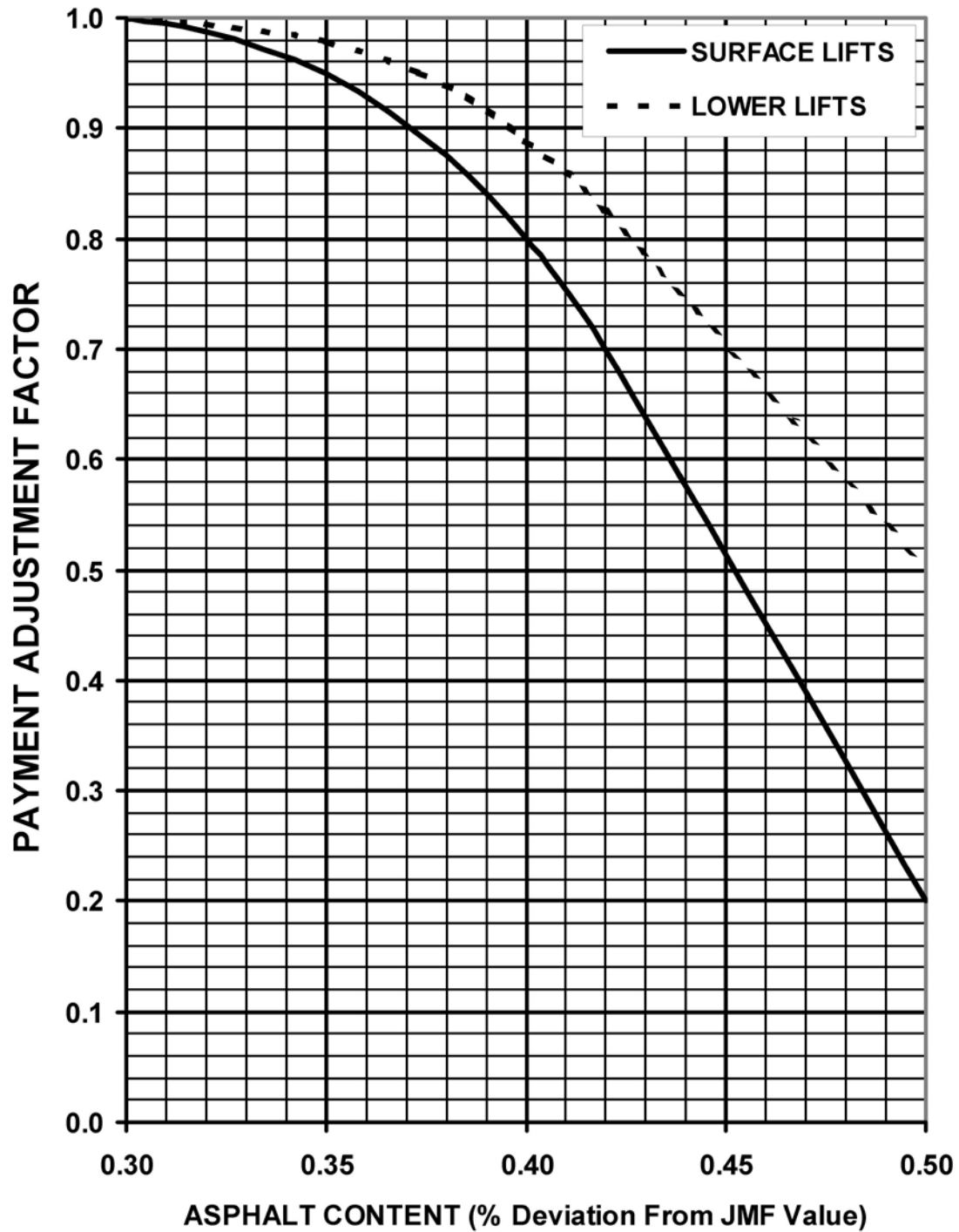
Payment adjustment for asphalt content is as follows:

Asphalt Content 17.8.3 Deviation from JMF Value (%)	17.8.4 Payment Adjustment Factor
± 0.30 or less	1.00
± 0.31 to ± 0.50	As per Chart A
Greater than ± 0.50	Reject (Note 1)

17.8.5 Note 1: Subject to removal and replacement at the discretion of the Engineer.



CHART A
ASPHALT CONTENT
PAYMENT ADJUSTMENT FACTOR



**17.8.6 Air Void Content**

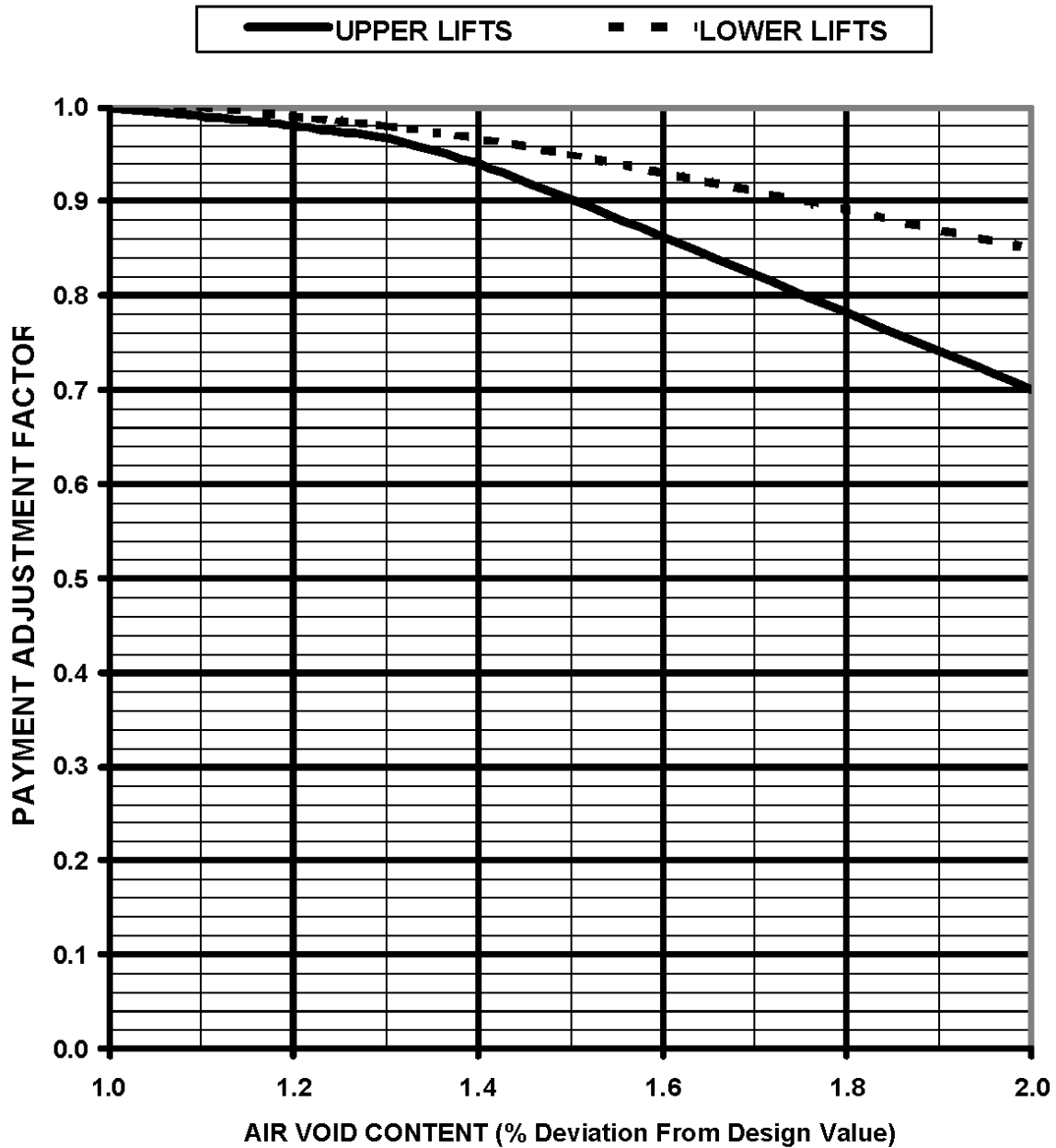
For full payment, the Lot Mean Air Voids must be within + 1.0% of the approved JMF value, as specified.

Payment adjustment for air void content is as follows:

Air Void Content % Deviation from JMF Value	Payment Adjustment Factor
Less than 1.0	1.00
1.0 to 2.0	As per Chart C
Greater than 2.0 (Lower Lifts)	0.80
Greater than 2.0 (Upper Lifts)	0.60



CHART C
AIR VOID CONTENT
PAYMENT ADJUSTMENT FACTOR





17.8.7 Thickness

Pavement found to be deficient in thickness by more than 13mm shall be removed and replaced by pavement of specified thickness, at the Contractor's expense.

The Lot Mean Thickness for any Lot will be determined on the basis of the acceptance cores described in Section 16.5.4. If the deficiency of any individual core exceeds 13 mm, additional cores may be extracted in the proximity to the location of the core of excessive deficiency, to identify the extremities of the pavement area subject to be removed and replaced. The Contractor shall pay for such additional coring.

For full payment, the Lot Mean Thickness must be equal to, or greater than, the specified thickness.

Payment adjustment for thickness is as follows:

Average Thickness Compared to Specified Thickness	Payment Adjustment Factor (Note 1)	
	Total Thickness (Single or Multiple Lifts)	Top Lift Thickness (Multiple Lifts)
Compliant or Greater	1.00	1.00
1mm to 5mm Deficient	0.90	0.95
6mm to 12mm Deficient	0.80	0.90
13mm or more Deficient	Reject (Note 2)	Reject (Note 2)

Note 1: A single Thickness Payment Adjustment Factor shall be applied, Total Thickness or Top Lift Thickness, whichever is less.

Note 2: Subject to removal and replacement at the discretion of the Engineer.

17.8.8 Pavement Compaction

For full payment, the Lot Mean Pavement Compaction must be equal to or greater than 93% of the Lot Mean Maximum Relative Density.

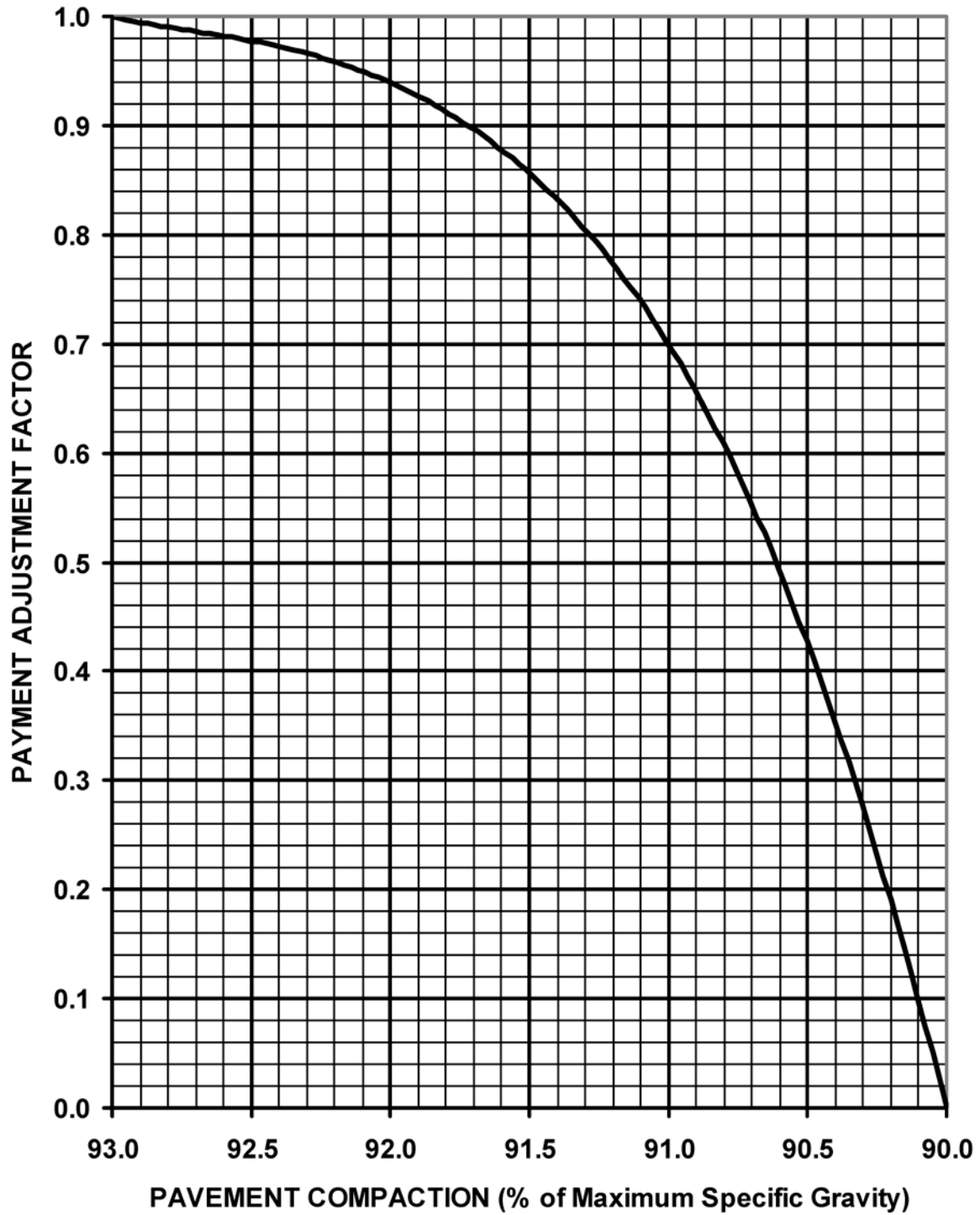
Payment adjustment for pavement compaction is as follows:

Pavement Compaction % of Maximum Relative Density	Payment Reduction Factor
93.0 to 95.5	1.00
90.0 to 92.9	As per Chart B
Less than 90.0	Reject (See Note 1)

Note 1: Subject to removal and replacement at the discretion of the Engineer.



**CHART B
COMPACTION
PAYMENT ADJUSTMENT FACTOR**





17.8.9 Smoothness

The completed asphalt concrete surface shall be true to the dimensional and tolerance requirements of the specifications and drawings. Unless detailed otherwise in the contract documents, the tolerances in both profile and crown are:

Base Course - 10 mm in 3 m

Surface Course - 5 mm in 3 m

When deviations in excess of the above tolerances are found, the pavement surface shall be corrected by methods satisfactory to the Engineer. Correction of defects shall be carried out until there are no deviations anywhere greater than the allowable tolerances.

17.8.10 Segregation

The finished surface shall have a uniform texture and be free of segregated areas. A segregated area is defined as an area of the pavement where the texture differs visually from the texture of the surrounding pavement.

All segregation will be evaluated by the Engineer to determine repair requirements.

The severity of segregation will be rated as follows:

Slight - The matrix of asphalt cement and fine aggregate is in place between the coarse aggregate particles, however there is more stone in comparison to the surrounding acceptable mix.

Moderate - Significantly more stone than the surrounding mix, and exhibit a lack of surrounding matrix.

Severe - Appears as an area of very stony mix, stone against stone, with very little or no matrix.

Segregated areas shall be repaired by the Contractor as directed by the Engineer. The following methods of repair are identified:

Slight - Squeegee asphalt to completely fill the surface voids.

Moderate - slurry seal for full mat width.

Severe - removal and replacement or overlay.

All repairs shall be regular in shape and finished using good workmanship practices to provide an appearance suitable to the Engineer.

Any other methods of repair proposed by the Contractor will be subject to the approval of the Engineer. Repairs will be carried out by the Contractor at their expense.

17.8.11 Measurement and Payment

Measurement



Asphalt Concrete supplied will be measured in square meters or tonnes of material placed, as detailed in the Tender Form.

The unit price for Asphalt Concrete shall be full compensation for all the materials, labour, tools, equipment and incidentals necessary to complete the work in accordance with these specifications.

The material shall be scaled and recorded by the Contractor on duplicate weight slips. Weight slips must be supplied at the time of delivery and a copy supplied to the Engineer.

The weight scale shall be inspected and certified by Weights and Measures Inspection Services of the Federal Department of Consumer and Corporate Affairs, at the Contractors' expense and as often as the Engineer may direct.

Payment

The Unit Price applicable to each Lot quantity of asphalt concrete will be calculated as follows:

$$\text{LOT UNIT PRICE} = \text{CONTRACT UNIT PRICE} \times \text{PA}_{\text{AC}} \times \text{PA}_{\text{COM}} \times \text{PA}_{\text{AV}} \times \text{PA}_{\text{T}}$$

Where:

PA_{AC} = Asphalt Content Payment Adjustment

PA_{COM} = Compaction Payment Adjustment

PA_{AV} = Air Void Payment Adjustment

PA_{T} = Thickness Payment Adjustment

END OF SECTION



18. PRIME, TACK AND FOG COATS

18.1. GENERAL

18.1.1 Definitions

Prime Coat:

Prime coat shall be the application of bituminous material to previously prepared granular base course, prior to placing bituminous surfacing materials.

Tack Coat:

Tack coat shall be the application of bituminous material to a previously constructed paving surface of any type in preparation of placing bituminous surfacing materials, and against curb and gutter faces, manholes, valves and other appurtenances in the street to be paved.

Fog Coat:

Fog coat shall be the application of bituminous material to seal small cracks and surface voids on surface materials.

Fog coat shall only be required if, in the opinion of the Town, the asphalt is open in texture.

18.2. PRODUCTS

18.2.1 Prime Coat

The bituminous material for priming the base course shall be liquid asphalt. The asphalt types may vary from medium curing (MC) type MC-30 to MC-250; from slow setting (SS) type SS-1 to SS-1H or a special emulsified asphalt primer S.E.P. to suit the condition of the base.

18.2.2 Tack Coat

The bituminous material for tacking the existing asphalt surface shall be liquid asphalt. The asphalt types may vary from rapid curing (RC) type RC-30 to RC-250; from slow setting (SS) type SS-1 to SS-1H depending on conditions to suit the base. The SS emulsion shall be diluted by adding an equal amount of water prior to application.

18.2.3 Fog Coat

The bituminous material for sealing the surface course if specified shall be liquid asphalt. The asphalt types may be slow setting (SS) type SS-1 or medium curing (MC) type MC-30 depending on the surface material to be sealed.

18.2.4 Sand Blotter

The materials for sand cover shall consist of clean granular mineral material approved by the Town, all of which shall pass a 5,000 sieve.

18.3. EXECUTION

18.3.1 Equipment

Cleaning equipment shall consist of power brooms, flushers, and whatever hand scrapers may be necessary to remove all foreign material.



The pressure distributor used for applying asphaltic material shall distribute the asphaltic material at an even temperature, uniformly on variable widths of surface up to 5 metres. Uniform spray without atomization shall be determined and controlled from 0.2 to 5.4 litres per square meter (L/m^2) with uniform pressure, and with an allowable variation from any specified rate not exceeding $0.1 L/m^2$.

Suitable means for accurately indicating the temperature of the asphaltic material shall be provided at all times. The thermometer well shall be so placed as not to be in contact with a heating tube.

If provided with heating attachments the distributor shall be so equipped and operated that the asphaltic material shall be circulated or agitated throughout the entire heating process.

18.3.2 Preparation

Immediately prior to applying the asphalt primer, tack or fog coat, the surface shall be brought to uniform cross-section by patching all depressions and defective areas using an approved patching material and by removing all bumps and irregularities.

All loose and foreign material shall be removed by light sweeping.

18.3.3 Application

Obtain Town's approval of existing surface before applying asphalt prime, tack or fog coats. Clean surface as required.

Upon the prepared surface the asphalt shall be applied uniformly at a rate of from 0.50 to 1.50 litres/square metre (L/m^2) for asphalt primer, and at a rate of from 0.25 to 0.90 L/m^2 for tack coat. The asphalt primer, tack or fog coat shall be applied only when the surface is dry or slightly damp, unless otherwise allowed by the Town in writing, or only when the air temperature in the shade is above $10^\circ C$.

The application temperature of the asphalt primer, tack or fog coat shall be as follows:

Rapid Curing Asphalt:

RC-30	51 – 68°C
RC-70	74 – 88°C
RC-250	100 – 110°C

Medium Curing Asphalt:

MC-30	51 – 68°C
MC-70	74 – 88°C
MC-250	100 – 110°C

Emulsified Asphalt:

SS-1	20 – 50°C
SS-1H	20 – 50°C

Special Emulsified Primer Asphalt:

S.E.P.	15 – 50°C
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Coat contact surfaces of curbs, gutters, headers, manholes and like structures with a thin uniform coat of asphalt material. Do not prime or tack surfaces that will be visible when paving is complete. Work



adjacent to the roadway shall be completely protected from the application operation by a suitable covering. Any unnecessary splashing of the concrete shall be cleaned.

Do not apply asphalt coat when air temperature is less than 5°C, when wet, or when rain is forecast within 2 hours.

The Contractor shall maintain the primed surface until the surface course has been placed. Maintenance shall include spreading any additional sand and patching any breaks in the primed surface with additional asphaltic material.

The asphalt primer should preferably be entirely absorbed by the base course and therefore require no sand cover. If, however, the asphalt has not been completely absorbed 24 hours after application, just sufficient sand shall be spread over the surface to blot up excess asphalt and prevent it from being picked up by any traffic.

Traffic shall not be permitted to travel on tack or fog coat until cured. The Contractor shall use flagmen, if required, and signage to control traffic until the tack or fog coat has cured.

Traffic shall not be permitted to travel on prime coat until 6 hours after application or until it has cured. After this period of time, excess asphalt material remaining on the surface shall be blotted by sand before traffic is permitted to travel on the surface.

END OF SECTION



19. PAVEMENT MARKINGS GENERAL

19.1. GENERAL

19.1.1 Samples

If requested by the Town, submit the following material sample quantities at least 4 weeks prior to commencing work.

- a) Two 1 L samples of each type of paint.
- b) One 1 kg sample of glass beads.
- c) Sampling to CGSB 1-GP-71.

Mark samples with name of project and its location, paint manufacturer's name and address, name of paint, CGSB specification number and formulation number and batch number.

19.2. PRODUCTS

19.2.1 Painted Markings

To CGSB 1-GP-74M, alkyd traffic paint.

Colour: to CGSB 1-GP-12C, yellow 505-308, white 513-301.

Thinner: to CAN/CGSB-1.5.

Glass beads: See Section 18.2.2

19.2.2 Permanent Markings

Cold Plastic Marking: two-component, cold-extruded and cold-curing, having a specific gravity of 1.9 minimum at 25°C.

Hot Thermoplastic Marking: hot-extruded, having a specific gravity of 2.0 minimum at 25°C, having a softening point of 90°C minimum according to ASTM E28.

Both cold and hot plastic markings shall conform to the following:

- a) Water Absorption: 0.5% maximum by mass retained water after 24 hour immersion, according to ASTM D570 Procedure A.
- b) Impact Resistance: minimum 1.13 J at 25°C when material is cast into bar of 25 mm² cross-section by 75 mm long, with 25 mm extending above vice jaws in a cantilever beam (Izod type) tester using the 2.82 J scale, according to ASTM D256 Method C.
- c) Abrasion Resistance: maximum weight loss of 0.50 g when subjected to 200 revolutions on Taber abrader at 25°C using H-22 Calibrate wheels weighted to 500 g with sample kept continuously wet with distilled water. Prepare test sample with representative material placed on 100 mm square plate, 3 ±0.1 mm thick.
- d) Chemical resistance to anti-freeze, brake fluid, motor oil, diesel fuel, gasoline, calcium chloride, sodium chloride, and transmission fluid.
- e) Reheating: The thermoplastic compound shall maintain proper performance properties when heated 4 times to the application temperature. After heating to 800° C for 6 hours



while continually stirring at 50 to 100 RPM, the Brookfield viscosity shall not exceed 16,000 cps at 12 RPM.

- f) No deterioration when in direct contact with asphalt cement in asphaltic concrete materials, or with sodium chloride, calcium chloride or other de-icing chemicals.
- g) Non-toxic and not harmful to persons or property when in hardened state.
- h) No discoloration from sunlight, ultraviolet exposure and no bond failure for the warranted life of the materials.
- i) Safety: In the plastic state, the material shall not give off fumes that are toxic or otherwise injurious to persons or property.
- J) Mix Formulation:

White Colour: Conforming to U.S. Federal Standard 595B Colour Number 37925, 70% minimum when measured with the colour Guide Reflectometer 0, 45° daylight luminous directional reflectance, with a green filter.

Yellow Colour: Conforming to U.S. Federal Standard 595B Colour Number 33538, 40% minimum when measured with the colour Guide Reflectometer 0/45° daylight luminous directional reflectance, with a green filter.

No formulation change unless approved by the Engineer. Any significant change will be subject to field trials.

Glass Beads: Surface of spheres shall be smooth and free from film, scratches and pits. At least 90% shall be true spherical shape, and free from milkiness, dark or air inclusions and other defects.

- a) Index of Refraction: liquid immersion method at 25° C may be used to determine refraction index of glass spheres according to CGSB 1-GP-71 Method 49.1. A refractive index of 1.50 to 1.60 is required.
- b) Gradation of glass beads for mixing with and for surface application on thermoplastic material, tested according to ASTM D1214:

Spheres included in manufacture of thermoplastic material:

Sieve Size (Microns)	% Passing
250	80 – 100
100	0 - 10

Spheres for application on molten thermoplastic material:

Sieve Size (Microns)	% Passing
850	90 – 100
300	20 - 50
180	0 - 10

Beads shall show resistance to corrosion after exposure to a 1% solution (by weight) of sulphuric acid.



19.3. EXECUTION

19.3.1 Equipment Requirements

Paint applicator shall be an approved pressure type distributor capable of applying paint in single, double and dashed lines. Applicator to be capable of applying marking components uniformly, at rates specified, and to dimensions as indicated, and to have positive shut-off.

Paint applicator shall be capable of adjusting the paint application for the length of dashed line required. Each spray gun shall have independent controls and adjustment mechanisms and shall be operated from the operator's compartment.

Bead dispensers shall be electrically controlled, air operated, gravity fed with controls to adjust the bead flow. The bead dispensers shall be fed from tanks capable of holding a minimum of 45 kilograms of beads.

The painting truck shall be equipped with a television vehicle guidance or a vehicle guidance system mounted on a retractable A-frame with a guide wheel and pointer system, to assist the truck driver in maintaining alignment on the existing lines.

The painting truck shall be equipped with an overhead revolving beacon with an amber lens a minimum of 180 mm high and 180 mm wide. The beacon shall be mounted on the top of the vehicle fully visible to traffic approaching from both front and rear.

A "slow moving vehicle" and "wet paint keep off" sign shall be mounted at the rear of the vehicle and be visible to the public only when the painting truck is applying paint.

Grooving machine subject to the Town's approval.

19.3.2 Condition of Surfaces

Pavement surface to be dry, free from ponded water, frost, ice, dust, oil, grease and other foreign materials. Sweeping or air blowing when required shall be completed by the Contractor.

Remove conflicting existing markings.

19.3.3 Traffic Control

Conduct all traffic control to the requirements as specified.

19.3.4 Paint and Bead Application

Lay out pavement markings and line locations and review with Engineer.

Apply painted markings and painted lines only when air temperature is above 10°C, wind speed is less than 60 km/h and no rain is forecast within next 6 hours.

Apply traffic paint evenly at rate of 3.3 l/m². The first application of paint to new asphalt pavement surfaces shall be increased by 25% over the specified rate or as directed by Engineer.

Do not thin paint unless approved by Engineer.

Paint lines and markings to be of uniform colour and density with sharp edges.



Glass beads shall be applied immediately following the paint application at a uniform application rate of 600g/l of paint. The glass beads shall be applied to the wet paint so that the beads are embedded and retained in the paint and uniformly cover the painted surface.

19.3.5 Cold Plastic Application

Mix components and apply cold plastic marking according to manufacturer's surface application procedure.

Thickness: minimum thickness of 2.0 mm and a maximum thickness of 3.0 mm above pavement surface.

Apply when ambient temperature is between -10°C and 30°C .

Apply glass beads to surface of extruded material before it has set, at a rate of 140 to 250 g/m².

Trim surplus material to give clean straight edges.

Let marking cure into a hardened state.

19.3.6 Hot Thermoplastic Application

Cut groove into pavement surface to designated width and depth. Remove grindings and haul to designated location. Sweep or air blast groove clean and dry.

Heat material and apply according to manufacturer's hot extrusion process.

Fill groove with hot molten material. Do not overfill more than 3.0 mm above pavement surface.

Apply glass beads to surface of extruded material while it is still molten at a rate of 140 to 250 g/m².

Trim surplus material to give clean straight edges.

Let marking cool to a hardened state.

19.3.7 Protection and Cleanup

Provide traffic control measures with adequate warning signs and traffic channelization devices to prevent tracking by vehicles.

Do not permit traffic over applied painted markings and lines until they have adequately dried.

On completion of work, clean up and leave site free of debris and waste matter.

Repair any damage as directed by the Engineer.

19.3.8 Tolerance

Painted Markings and Lines:

Painted pavement markings and lines shall be within plus or minus 12 mm of dimensions indicated in the contract documents.

Deficient pavement markings and lines shall be removed and replaced at the Contractors expense to the satisfaction of the Engineer. The method and equipment used by the Contractor to remove incorrectly painted markings and lines will be subject to the approval of the Engineer.



Cold Plastic Marking:

Measurement: The quality assurance laboratory will measure suspect markings with a surface micrometer. The average of 5 measurements will represent 300 m of marking, or one job site, whichever is less.

Thickness Deficiencies: Where a significant number of deficiencies occur in the work, involving average thicknesses greater than 3.0 mm or less than 1.8 mm, the Town may order removal and replacement, or application of additional material.

If surface dishing deeper than 0.5 mm occurs, the Town may order removal and replacement.

The quality assurance laboratory will determine the width of suspect markings by the average of 5 measurements representing 300 m of marking, or one job site, whichever is less.

Hot Thermoplastic Marking:

Measurement: The quality assurance laboratory will core suspect markings. The average thickness of 3 cores will represent 300 m of marking, or one job site, whichever is less.

Overfill Thickness: That portion of marking above pavement surface will receive no additional payment. If overfill exceeds 3.0 mm, the Town may order removal and replacement of marking.

Groove Thickness Deficiencies: Where a significant number of deficiencies occur, involving average thicknesses less than 70% of that specified, the Town may order removal and replacement.

If surface dishing deeper than 0.5 mm occurs, the Town may order removal and replacement. Variations in asphalt surface profile may be taken into consideration.

The quality assurance laboratory will determine the groove width of suspect markings by average measurement of 3 cores representing 300 m of marking, or one job site, whichever is less.

Width Deficiencies:

Where a significant number of deficiencies occur greater than 10 mm in average widths of cold plastic, or in average groove widths of hot thermoplastic, the Town may order removal and replacement.

19.4. PROTECTION OF COMPLETED WORK

Protect pavement markings until dry.

19.5. PAVEMENT MARKING REMOVAL

19.5.1 General

This section specifies requirements for pavement marking removals.



19.5.2 Materials

Abrasives used for removal of painted pavement markings to be products specially designed for sand blasting.

Type M1 Asphalt Concrete Pavement to Section 05140 Asphalt Concrete.

Tack coat as specified in Section 17.2.2 (Prime, Tack and Fog Coats).

19.5.3 Execution

Removals:

In areas designated:

Thermoplastic in-laid lines by grinding out marking material and underlying asphalt to the width and length of the lines to a depth of 25 mm below the adjacent pavement surface or as directed by Engineer.

Spray type and cold plastic lines and symbols by grinding off marking material. Do not damage underlying asphalt.

Paint markings by sand blasting, do not damage underlying asphalt.

Exercise care to avoid dislodgment of coarse aggregate particles, excessive removal of fines, damage to bituminous binder, or damage to joint and crack sealers.

Heater milling equipment not to be used.

All residues from operations to be removed from site and disposed of by Contractor.

Repair:

No repair is required for removal of painted, spray type and/or cold pavement markings.

Grooves remaining after removal of thermoplastic inlaid pavement markings are to be filled using Type M1 asphaltic concrete pavement to Section 05140 Asphalt Concrete. Apply tack coat prior to placing asphalt mix. Other fill materials are subject to prior written approval by the Engineer.

19.6. PERFORMANCE LIFE / ACCEPTANCE

19.6.1 General

A warranty period is not applicable for Painted Pavement Markings.

Plastic Pavement Markings shall be warranted against failure due to:

Poor adhesion.

Defective materials.

Improper installation.



19.6.2 Initial Acceptance of Plastic Pavement Markings

All plastic pavement markings shall have the following initial acceptance requirements:

Following initial completion of all pavements marking, there will be a 180 day observation period before initial acceptance. During the observation period, the Contractor, at no additional cost to the Town, shall replace markings that the Engineer determines are not performing satisfactorily due to defective materials, workmanship, in manufacture and application. At the end of the observation period, the minimum required retention percentage, by area, for markings installed will be 95%.

Determination of Percentage Retained: The percentage retained shall be calculated as the nominal area of the strip less the area of loss divided by the nominal area and expressed as a percentage of the nominal area.

The Contractor shall be notified, in writing, within 30 calendar days after the 180 day observation period if there is a failure to achieve the required percentage retained. When such a notification is made prior to September 1, the replacement material shall be installed during the same construction season. Replacement materials for any notification after September 1 shall be installed prior to June 1 of the following year.

Initial Acceptance: Initial acceptance of the pavement markings will be:

- 180 days after the initial completion of all pavement marking work, or
- Upon completion of all corrective work, whichever occurs last.

19.6.3 Final Acceptance / Warranty Period

The warranty for the plastic pavement marking material shall be subject to traffic and normal summer and winter roadway maintenance procedures.

During the warranty period, the Contractor, at no additional cost to the Town, shall replace markings that the Engineer determines are not performing satisfactorily due to defective materials, workmanship, in manufacture or application. During the warranty period, the minimum required retention percentage, by area, for markings installed will be as follows:

Year One: 90%

Year Two: 80%

END OF SECTION



20. CURB, GUTTER & SIDEWALKS

20.1. GENERAL

Products, Concrete Materials, Execution and Methods of Concrete Construction shall be in accordance with CSA CAN3-A23.1 or as modified in this section.

20.1.1 Work Included

The work described in this section pertains to the construction of concrete curbs, gutters, sidewalks, crossings and paving stones.

20.2. PRODUCTS

20.2.1 Portland Cement

Portland cement shall meet the requirements of CSA Standard Portland A5-M cement and shall be Type 10 normal, or type 50 sulphate resistant, as required by the Town.

20.2.2 Aggregates

The fine and coarse aggregate used in the concrete mix shall conform to the following specifications:

- a) Fine Aggregate: CSA CAN3-A23.1, Clause 5.3.
- b) Coarse Aggregate: CSA CAN3-A23.1, Clause 5.4. Table 2 Group 1 (28-5)

<u>Sieve Size (mm)</u>	<u>% Passing by Weight</u>
40	100
28	95 – 100
14	30 – 65
5	1 – 10
2.5	0 - 5

20.2.3 Admixtures

All admixtures used to enhance the concrete shall conform to the following specifications:

- a) Air Entrainment: ASTM C260
- b) Chemical: ASTM C494
- c) Calcium Chloride: ASTM C494

The use of calcium chloride shall only be used when approved by the Town, but in no case will the amount added be greater than 2% of the cement weight. It shall not be used when the air temperature is above 4°C.

- d) Fly ash shall not exceed 10% by weight of cement, and it shall conform to the requirements of CAN/CSA-A23.5. Only approved compatible super plasticizing admixtures and air entraining agents shall be used with the fly ash. The Town may require characteristic data for fly ash to prove conformance to the standards. After September 1st no portion of the specified cement content may be replaced with fly ash unless approved in writing.



20.2.4 Reinforcing Steel

Reinforcing bars shall be deformed bars in accordance with CSA Standard Specification G30.12-M1977.

Cold drawn wire or welded wire fabric for concrete reinforcement shall be 150x150 and conform to the requirements of CSA Standard Specification G30.3-1972.

20.2.5 Expansion Joint Filler

Joint filler shall conform to CGSB Standard Specification for polyurethane sealing compound #19-GP-15 or ASTM Standard Specification for SIKA FLEX 1A.

20.2.6 Membrane Curing Compound

Resin-base impervious curing compound shall conform to ASTM Standard Specification C309 Type 1D-Type B. The curing compound shall contain white fugitive dye.

20.2.7 Preformed Expansion Joint Filler

Preformed expansion joint filler shall conform to ASTM Standard Specification D-1752.

20.2.8 Concrete

Concrete mixes shall be designed by a qualified testing laboratory engaged by the Contractor. The mix design shall be submitted to the Town for approval a minimum of 10 days prior to delivery of any concrete to the site. The specified compressive strength at 28 days shall be 30Mpa. The strength level of 30Mpa shall be considered to be achieved if averages of all sets of 3 consecutive strength tests equal or exceed the specified strength, and no individual strength test is less than 20Mpa.

The concrete shall contain not less than 315kg of Portland Cement per cubic metre of concrete produced.

The air content of the concrete shall be maintained between the limits of 5-7%.

The minimum slump permissible will be that which will allow the concrete to be placed efficiently and provide a homogeneous mass. The maximum allowable slump shall be 70mm +/- 10mm for all hand-poured concrete and 40mm +/-10mm for all machine-poured concrete.

20.2.9 Retempering With Air

If, due to a low air entrainment percentage, as specified, the Town feels it is necessary to add an approved air-entraining agent on site, placement of concrete shall stop to allow the concrete truck's drum to turn at mixing speed for a minimum of 3 minutes. Should the air content of the concrete not conform to specifications after retempering, then the concrete shall be rejected.

The Town has the right to withdraw permission to add an air-entraining agent to the mix and reject the concrete if this practice is being abused.

20.2.10 Retempering With Water

If, due to a low slump as specified, the Town feels it is necessary to add water to the mix, it shall be injected into the drum under such pressure and direction of flow that it conforms to the specifications in ASTM C-94, Appendix XI. Placement of concrete shall stop at that point to allow the concrete truck's drum to turn at mixing speed for a minimum of 3 minutes. Should the slump of the concrete not conform to specifications, after retempering, then the concrete shall be rejected.



The Town has the right to withdraw permission to add water to the mix and reject the concrete if this practice is being abused.

20.3. EXECUTION

20.3.1 Placing Concrete

Concrete shall not be placed until the subgrade, sub-base and base course materials have been completed, and approved by the Town. The base shall be sufficiently moist to prevent absorption of water from the concrete, and free from mud or water pondage.

The concrete shall be placed within 90 minutes of initial mixing at the plant, or before the drum on the concrete truck has turned 300 revolutions. Complete discharge of concrete shall not exceed 2 hours. The concrete shall be transported by methods which will prevent segregation and deposited on the subgrade so that as little handling as possible is required.

Concrete shall be placed continuously until a complete section between expansion joints has been poured. Use the winter concreting methods in accordance with CAN CSA A23.1 when the mean temperature falls below 5 °C.

The concrete shall be thoroughly consolidated against and along the faces of the forms. Hand spreading shall be done with shovels, not with rakes, in order that the concrete will not be segregated. Precautions should be taken to prevent overworking of the concrete.

Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which shall prevent the separation or loss of the ingredients. It shall be deposited in the forms as near as practicable to its final position to avoid rehandling.

The sequence of concrete placement shall be arranged so that concrete which has partially hardened shall not be subjected to injurious vibration.

The vertical free fall height of concrete shall not exceed 1.0m. For falls greater than 1.0m chutes or tremies shall be used.

During placement, concrete shall be sufficiently tamped or vibrated with suitable equipment to secure a close bond with the reinforcement, eliminate entrapped air voids and ensure a homogeneous structure with adequate consolidation.

The rate of delivery of mixed concrete shall be such that the interval between the placing of successive truck loads shall not exceed 30 minutes. If the time exceeds 30 minutes, then a construction joint shall be formed.

After the initial set of the concrete, neither the forms nor the concrete structure shall be jarred and no strain shall be placed on the ends of projecting reinforcement.

Construct all pararamps and crossings monolithically to the dimensions and at locations specified.

20.3.2 Joints

Curb, gutter and sidewalk contraction joints shall be constructed at 3.0m intervals and as detailed on the standard drawings, and shall not be less than 50mm deep. Contraction joint widths shall not be greater than 5mm.



Midway between each contraction joint on the sidewalk, a surface joint, 13mm deep, shall be constructed. These joints shall not extend into curb and gutter.

A surface joint shall be constructed longitudinally at the location shown on the standard drawings and shall continue through all driveways and lane crossings.

A construction joint shall be formed at the end of every pour. This joint shall be constructed in a “V” shape, as directed by the Town, and using 10 M rebar 600mm long, spaced every 500mm.

10 M bars at 500mm on centre shall be dowelled and epoxied into the back of the existing curb prior to placing concrete.

20.3.3 Finishing

Sidewalk surfaces, either separate or monolithic with curb and gutter, shall be struck off and screed to the slope, cross-section and elevation shown on the drawings or as directed by the Town. The surface shall be consolidated and smoothed using a wood float. Light-steel trowelling shall be used followed by a uniform brush finish. Sidewalk shall be edged at all joints to prevent chipping of the concrete.

The exposed surfaces of concrete curbs and gutters, either separate or monolithic with sidewalks, shall be finished by means of a wood floating, light-steel trowelling and uniform brushing, and all edges shall be rounded to the required radius. No patching will be allowed.

Pararamps, and crossings to lanes and private property shall be struck off and screed to the required slope and cross-section. The finished surface shall be brushed as specified above.

All edges, including contraction or surface joints, shall be tooled for a width of 50mm and rounded to a radius of 6mm. The brush grooves shall be transverse on the sidewalk and longitudinal on the curb and gutter. The finished surface shall have no exposed aggregate or honeycomb.

If there is evidence of excess water on the concrete surface, finishing shall be delayed until the excess water has evaporated. Protect the concrete finished surface from drying if temperature above 25 °C and wind conditions.

Surface grooves made by the broom shall not be more than 3 mm deep. Before brushing, all surplus water shall be removed from the brush.

20.3.4 Curing

Immediately after finishing, the concrete surface shall be protected by applying a membrane curing compound. After finishing and removal of forms if necessary, all exposed surfaces shall be wetted with water and then thoroughly sprayed with membrane curing compound. The membrane curing compound shall be applied in accordance with the manufacturer's instructions with an approved pressurized spray.

The curing compound shall be applied in such a manner as to cover the entire surface thoroughly and completely with a uniform film at a rate which shall depend on the roughness of the surface of the concrete, but in no case at less than 0.25 litres per square metre of concrete surface.

20.3.5 Backfilling

Unless otherwise directed by the Town, the Contractor shall backfill along the back of the curb edges, to the top of the concrete, within 3 to 7 days of the placing of the concrete. The backfill shall be mechanically tamped in maximum lifts of 150mm, to a minimum of 95% Standard Proctor Density and to a distance of 300mm from the back of the walk or curb.



Where landscaping is to be carried out immediately after completion of the walks or curbs and gutters, the backfilling shall be left 100mm low to allow for the topsoil.

20.3.6 Forming

Forms shall be steel or wood of sufficient strength to resist the pressure of wet concrete, and the supply shall be sufficient to permit their remaining in place until hydration has occurred, or longer if the Town considers it necessary. The Contractor shall remove all face forms to allow for a smooth brush finish. The use of bent, twisted, battered or worn-out forms will not be permitted. Forms will be checked for alignment and elevation by the Town before concrete is poured, and shall be cleaned and oiled before each use.

Where required, reinforcement shall be secured in the location shown on the standard drawings and shall be free from mill scale, grease and rust prior to placing concrete. Forms shall be held securely by approved methods to prevent movement and bulging when the concrete is placed. Forms must be approved by the Town before concrete is poured.

Curbs having a radius of less than 40m shall be constructed with flexible forms. A sufficient length of form (not less than 50 metres) shall be placed and checked before concrete is poured to ensure true line and grade. The forms shall be well staked, braced or otherwise held rigidly true to the established line and grade. The Town may, at any time, reject the use of any forms considered unsatisfactory.

20.3.7 Mechanical Extruding Machines

Slip-form paving machines or concrete, extruding machines may be used for placing concrete provided they have received the approval of the Town prior to commencement of the work and meet the following requirements:

- a) The vibrators on the equipment shall be capable of producing a dense mass with a smooth surface, free of honeycombing.
- b) The equipment shall include automatic grade and line controls which shall be used at all times.

Commence placement of concrete only after the subgrade has been prepared and approved by the Town.

Any special grading or preparation of the base required by the Contractor to accommodate equipment shall be the responsibility of the Contractor, and shall restore the roadway and boulevards to their original condition within 3 to 7 days of the initial disturbance.

The extruded concrete shall be checked for alignment and elevation by the Town while the concrete is being placed. All incorrectly placed or misaligned work shall be immediately removed while the concrete is still wet, and the work redone to the proper specifications using whatever means are required.

Whenever possible, the forming and placing of concrete by conventional hand pouring methods (as may be required at corners, crossings and catch basins) shall be carried out in conjunction with the extruding machine operation. Where this procedure is not practical, the "tie-ins" shall be completed within 3 days of construction of the adjacent extruded section, using 10 M rebar at all joints. All "tie-ins" shall be completed in 1 continuous pour.

20.3.8 Consolidation

The concrete shall be consolidated by means of an approved vibrating screed or, in the case of curb and gutter only, by means of a poker or pencil vibrator not exceeding 50mm in diameter.



Particular care shall be given to placing and tamping along the faces of the forms to ensure a dense, smooth surface.

Vibrations shall be of sufficient duration to thoroughly compact the concrete but not long enough to cause segregation. Vibrators shall not be used for moving concrete.

20.3.9 Inspection

All exposed concrete surfaces shall be checked by the Contractor with a 3m straight-edge, and any water pockets or deviations in line or grade exceeding a total of 6mm shall be corrected immediately.

Differences in elevation at any given point from that given by the design shall not exceed 13mm, and the maximum variation shall not be greater than 13mm.

Deviations in horizontal alignment at any given point from that given by the design shall not exceed 25mm, and the fluctuations in the horizontal alignment shall not be greater than 25mm.

Concrete not meeting the above criteria shall be replaced.

20.3.10 Quality Control

Quality control is the responsibility of the Contractor throughout every stage of the Work until the final accepted product.

Tests performed by the Consultant / representative will not be considered as quality control tests; rather it will be considered quality assurance.

The Contractor shall be totally responsible for production of materials and construction that meet all specified requirements.

All quality control shall be conducted by qualified personnel. The Contractor shall bear the cost of all quality control testing and related consulting services.

Pre-Production testing and sampling and minimum frequencies are described in the following table.

20.3.11 Field Tests

Testing shall be performed by a CSA qualified testing laboratory / technician in accordance with the following:

- a) Samples of concrete shall be obtained in accordance with CSA Test Method A23.2-1C for sampling plastic concrete.
- b) Test cylinders shall be made and stored in accordance with CSA Test Method A23.2-3C. No less than 1 strength test shall be made from samples from each 50 cubic metres of concrete placed, and in no case shall there be less than 1 test from each day's pour. Each strength test shall consist of 3 test cylinders, 1 tested at 7 days and 2 at 28 days.
- c) Air content determinations shall be made in accordance with CSA Test Method A23.2-7C, air content of plastic concrete by the volumetric method.

During construction start-up, every load or batch of concrete shall be tested until such time as satisfactory control of the air content has been established. Air content tests taken with the test cylinders will be sufficient once satisfactory control has been established. Whenever a test falls outside the specified limits, the testing frequency shall revert to 1 test per load or batch until satisfactory control is re-established. Any concrete that falls outside specified air control levels shall be rejected from use.



Slump tests made in accordance with CSA Test Method A23.2-5C, Slump of Concrete, shall be made in conjunction with each strength test.

20.3.12 Clean-up

As the work progresses, the Contractor shall clean up the site and all areas in which work has been done shall be left in a neat and presentable condition. All gutters and street drainage ditches that have been blocked as a result of the Contractor's operation shall be restored or repaired.

The Contractor shall dispose of all surplus excavated material, organic soil, rock, boulders and pieces of concrete and masonry at an approved location.

20.3.13 Protection

The Contractor shall be responsible for keeping all animals and pedestrians off the newly constructed sidewalks or curb until completely set. The Contractor shall also be responsible for keeping all vehicles off the work for a period of 3 days after the concrete has been finished.

20.3.14 Deficiency Penalty

Where there are variations from specified design strength, the following Deficiency penalty shall be assessed based on the 28-day, laboratory-cured cylinders.

- a) When the concrete strength of any set exceeds 95% of design strength, no deficiency penalty will be administered.
- b) When the concrete strength of any set is greater than 80% but less than 95% of design strength, the deficiency penalty will be administered as follows:

$$Q \left[P \times \frac{2(A - B)}{A} \right]$$

Where:

P = unit price

A = specified strength

B = average 28 day cylinder strength

Q = quantity of deficient concrete

- c) If the concrete strength of any set is less than 80% of design strength, the work represented by that set of cylinders will be rejected and replaced by the Contractor.

END OF SECTION



21. REGULATORY ROADWAY SIGNS

21.1. GENERAL

21.1.1 Design Requirements

Sign supports and appurtenances to be capable of withstanding summation of following loads:

- a) Wind and ice loading specified to be consistent with anticipated loads in locality of installation. Refer to National Building Code of Canada and/or applicable provincial building code.
- b) Dead load of signboards, sign supports and appurtenances.
- c) Ice load on one face of signboards and around surface of all structural members and appurtenances.

Structural deflections and vibration in accordance with American Association of State Highway and Transportation Officials (AASHTO), "Specifications for the Design and Construction of Structural Supports for Highway Signs".

21.1.2 Shop Drawings

Submit shop drawings for signage structures indicating product data and design.

21.2. PRODUCTS

21.2.1 Sign Supports

Steel posts: to CAN_G40.21, 3.1 m long, flanged "U" shaped in cross section, measuring 65 mm wide by 30 mm deep or round 2 5/8" diameter. Metal thickness: 4.5 mm. Hot dipped galvanized: to CAN/CSA_G164.

Base plates for mounted signs: to ASTM B209M.

Fasteners: bolts, nuts, washers and other hardware for roadside signs to be cast aluminum alloy, or galvanized steel.

21.2.2 Signboards

Aluminum sheet shall be tension levelled, sign grade aluminum and conform to ASTM B209M, Alloys 6061-T6 or 5052-H38 pre-cut to required dimensions. Minimum thickness to be 1.6 mm for signboards up to 750 mm wide. Minimum thickness to be 2.0 mm for signboards 750 to 1200 mm wide.

Connecting straps and brackets to ASTM B209M.

Reflective sheeting shall meet or exceed the minimum requirements specified in ASTM-D4956 Performance Requirements Type III, High Intensity Retro reflective Sheeting.

21.2.3 Fabrication

Signboards:

Aluminum blanks: Degrease, etch and bonderize with chemical conversion coating. Clean surfaces with xylene thinner. Dry. Aluminum signboards are to be painted before installation. Spray and bake face of signboards with two coats of enamel in accordance with CAN/CGSB_1.104.

Sign identification:



Apply sign number and date of installation with 25 mm high stencil painted black letters on lower left back face of each signboard.

21.3. EXECUTION

21.3.1 Installation

Sign Support:

- a) Erect supports as indicated with concrete footings. Erect posts with base plates resting on aluminum nuts and restrained with nuts and washers.
- b) Coat underside of base plate with corrosion protective paint before installation.
- c) Close open aluminum tubes and posts with aluminum cap.
- d) Erect posts plumb and square to details as indicated.
- e) Single channel steel posts are to be driven to required depth without damage to posts. If rock or concrete is encountered, auger hole to required depth and set post in sand.
- f) In finished concrete or asphalt surfaces, backfill with concrete or grout. Protect from adverse conditions until cured.
- g) Permissible tolerance is ± 12 mm departure from vertical.

Signboard:

- a) Fasten signboards to supporting posts and brackets as indicated.
- b) Use strapping with crimped or bolted connections where signs fastened to utility poles.

21.3.2 Protection

Place temporary covering on signboards where required. Covering to be capable of withstanding rain, snow and wind and be non-injurious to signboard. Replace deteriorated covering and remove covers as reviewed by the Town.

21.3.3 Correcting Defects

Correct defects, identified by the Town, in consistency of reflectivity, colour or illumination.

END OF SECTION



22. ASPHALT CONCRETE PAVEMENT MILLING

22.1. GENERAL

This section specifies requirements for milling or grinding existing asphalt pavement to lines, grades, and typical cross sections indicated on plans or as established by the Town.

22.1.1 Protection

Protect existing pavement, utility appurtenances, traffic detector loops, home runs, light units, and structures from damages. In event of damage immediately replace or make repairs to approval of the Town and at no additional cost to the Town.

22.2. EXECUTION

22.2.1 Preparation

Inspect site and verify with the Town areas designated for milling. Arrange for temporary traffic control in areas where signal light traffic detector loops and home runs are to be removed.

22.2.2 Equipment

Use cold milling or grinding equipment capable of removing part of asphalt pavement surface to depths or grades indicated with a tolerance of +/- 10mm within areas designated.

Sweeping and collecting equipment capable of removing all residues from planning operation. Apply water as necessary during milling operation to suppress dust.

22.2.3 Asphalt Removal

Mill asphalt pavement to grade and cross section dimensions indicated or as directed by the Town.

Exercise care to avoid disturbance to pavement or other work designated to remain.

Keep drainage system clear of loose and waste materials. Asphalt is to be removed to a uniform level including areas surrounding valves, manholes or other appurtenances.

Remove all residue materials resulting from milling operation.

Milling may be restricted on designated roads and streets with particular time frames throughout the week. The Contractor shall abide by these restrictions.

Surface to be left in a condition that can be reopened to traffic following removal of grindings.

22.2.4 Disposal of Materials

Removed pavement material is the property of the Town and is to be stockpiled at a location designated by the Town.

22.2.5 Finish Tolerances

Milled surfaces to be within +/- 10mm of specified grade but not uniformly high or low.

END OF SECTION



23. ASPHALT PAVEMENT CRACK ROUTING AND SEALING

23.1. GENERAL

The Work Consists of routing, cleaning and drying cracks in pavement surfaces, supplying crack sealant material and sealing the routed cracks with the sealant.

23.2. MATERIAL

Hot poured rubberised asphalt products generally accepted for this work are Husky 1G11, CRAFCO 522, KOCH 9030 or Beram 195LM.

The use of other materials will be subject to the approval of the Town. In situations where the Contractor obtains approval to use a material not included in the above list, he shall provide the Town with the following information 5 days prior to commencing the Work:

- a) Name and mailing address of the crack sealant supplier and manufacturer
- b) Name of crack sealant product to be supplied
- c) Written confirmation from the manufacturer that the crack sealant to be supplied meets all specified requirements along with test results that demonstrate that the product meet all specified requirements.

The Contractor shall verify that the crack sealant delivered and used in the Work is the type and grade ordered.

23.3. PROCEDURE

No Work shall be performed during rain or snow or when the pavement surface is wet.

The crack sealant shall not be applied when the pavement temperature is below 10 Celsius.

Unless otherwise directed by the Town, all cracks between 2mm and 12mm in width shall be routed and sealed. All cracks shall be routed to a minimum width of 20mm and a depth of 10mm.

Prior to the application of crack sealant, the entire road surface shall be cleaned ensuring all loose material and moisture is removed from the routed cracks and surrounding areas.

Crack sealant shall be heated and applied in accordance with the manufacturer's recommendations. Routed cracks shall be filled with crack sealant such that upon cooling the sealant shall not be more than 3mm below the pavement surface.

Excessive crack sealant shall be removed from the pavement surface immediately following application. Traffic shall be kept off sealed cracks until the crack sealant has cured. At locations such as intersections where this is not practical, the Contractor shall prevent tracking by applying a blotting agent to the crack sealant. When a blotting agent is used, it shall not be applied until the sealant has cooled sufficiently to prevent inclusion of the blotting agent into the sealant.



When necessary, the Contractor shall supply one of the following blotting agents:

- a) Screened sand with a maximum top size of 2mm
- b) Cement
- c) Fly ash

The use of other blotting agents shall be subject to the approval of the Town.

Fuel, asphalt and any other spills shall be cleaned up to the satisfaction of the Town at the Contractor's expense.

23.4. SAMPLING AND TESTING

The Contractor shall supply material samples to the Town for QA (Audit) testing purposes when requested.

23.5. ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection by the Town. To be acceptable, the Work must conform to the following:

- a) All routed cracks conform with the specified rout profile
- b) The rout conforms to the path of the crack with no part of the crack outside or touching the edge of the rout cross section
- c) All routed cracks have been sealed
- d) At least 95% of the cracks treated have been filled with an adequate amount of crack sealant material.

Failure to comply with the acceptable criteria will result in the Contractor re-treating all failed cracks at his own expense.

END OF SECTION



24. ASPHALT PAVEMENT CRACK SEALING

24.1. GENERAL

The work consists of supplying crack sealant and sealing cracks in asphalt concrete pavement.

24.2. MATERIALS

The type and grade of asphalt/emulsified asphalt material generally accepted for this work are Alberta Transportation designated EC101 or HC200.

The use of other materials will be subject to the approval of the Town. In situations where the Contractor obtains approval to use a material not included in the "Recognized Products List", he shall provide the Town with the following information 5 days prior to commencing the Work.

- a) Name and mailing address of crack sealant supplier and manufacturer
- b) Name of crack sealant product to be supplied
- c) Written confirmation from the manufacturer that the crack sealant to be supplied meets all specified requirements along with test results that demonstrate that the product meets all specified requirements.

The Contractor shall verify that all crack sealant delivered and used in the Work is the type and grade ordered.

24.3. PROCEDURE

No Work shall be performed during rain or snow or when the pavement surface or cracks are wet.

Crack sealant shall not be applied when the atmospheric temperature at the work site is below 10 degrees Celsius.

All cracks within the entire width of the pavement surface, which are between 5mm and 25mm in width, shall be sealed.

Prior to the application of crack sealant, the Contractor shall ensure that the road surface adjacent to the cracks is clean.

Hot Pour crack sealant shall be heated to the temperature specified by the manufacturer. Overheating will not be permitted.

Crack sealant shall be applied within the manufacturer's specified temperature range. Crack sealant shall be applied so that the crack is flush filled immediately following application and a thin over band of sealant extends approximately 25mm beyond the edges of the crack. Excess crack sealant shall be removed from the pavement surface immediately following application. Removal shall involve the use of a squeegee, starting from the centreline and proceeding to the shoulder.

Traffic shall be kept off sealed cracks until the crack sealant will not track under action of traffic. At locations such as intersections where this is not practical, the Contractor shall prevent tracking by applying a blotting agent to the crack sealant.



When necessary, the Contractor shall supply one of the following blotting agents:

- a) screened sand with a maximum top size of 2mm
- b) cement
- c) fly ash

The use of other products shall be subject to the approval of the Town.

Fuel, asphalt and other spills shall be cleaned up to the satisfactory of the Town at the Contractor's expense.

24.4. SAMPLING AND TESTING

The Contractor shall supply material samples to the Town for QA (Audit) testing purposes when requested.

24.5. ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection by the Town. To be acceptable, all applicable cracks must be treated as specified herein and at least 95% of the treated cracks must contain an adequate quantity of crack sealant material.

Failure to comply with the acceptable criteria will result in the Contractor re-treating all failed cracks at his own expense.

EC101 Specification for Cold Pour Rubber Filled Bituminous Emulsified Pavement Crack Sealant

Cold pour rubber filled bituminous emulsified pavement crack sealant shall conform to the requirements specified in the following table, for the grade designated by the Town:

Asphalt Grade	EC-101		Test Method	
Requirements	Minimum	Maximum	Alberta Transportation	A.S.T.M
Uniformity	Pass		9.1	-
Viscosity @ 25°C, Krebs units	70	90	9.2	D562
Solids Content by Evaporation, % by mass	59	-	9.3	D244
Ash Content, % by mass	-	2.0	9.4	-
Rate of Curing, %	-	-	9.5	-
24 hour	50	-	-	-
6 days	80	-	-	-
Low Temperature Flexibility	Pass		9.6	-
Elastic Recovery, %	40	-	9.7	-

**HC200****Specifications for Hot Pour Bituminous Crack Sealant**

Hot pour bituminous crack sealant shall conform to the requirements specified in the following table, for the grade designated by the Town:

Asphalt Grade Requirements	HC200		A.S.T.M Test Method
	Minimum	Maximum	
Softening Point, °C	80	95	D36
Flash Point, C.O.C. , °C	230	-	D92
Penetration	-	-	D5
@ 0 °C, 200g, 60 sec.	30	-	-
@25 °C, 100g, 5 sec.	55	60	-
@46 °C, 50g, 5 sec.	-	150	-
Ductility @ 25 °C	45	-	D113
Solubility in Trichloroethylene, % by mass	98	-	D2042
Viscosity @ 177 °C, mm ² /s	-	1200	D2170

END OF SECTION



25. TOPSOIL

25.1. GENERAL

No placing of topsoil shall take place until the subgrade trimming has been approved by the Engineer.

A minimum depth of 150 mm (6 inches) of topsoil shall be placed on all sites unless otherwise indicated. Where subgrade materials are porous and subject to high percolation rates, an additional amount of loam up to 225 mm (9 inches) may be required.

Topsoil shall be friable, neither heavy clay nor of very light sandy nature, consisting of approximately 45% sand, 35% silt, 20% clay and a pH value ranging from 6.5 to 7.5. Topsoil shall be free from subsoil, roots, vegetation, debris, toxic materials, and stones over 25mm (one inch) in diameter. Topsoil minimum organic content shall be six (6) percent. Topsoil shall consist of a homogeneous mixture of topsoil and compost within the top 150 mm (6 inches).

The Contractor shall notify the Engineer as to the source of the organic material. A sample will be taken within one (1) working day. A laboratory test will be conducted to ensure that the organic material meets the requirements for pathogens and heavy metal content. No placement of the organic material shall take place until the laboratory results of the test are received, and evaluated. The cost of the initial test shall be paid for by the Town. The Contractor shall be invoiced for the costs of any re-tests, if the initial tests do not meet the requirements.

The Contractor shall notify the Engineer when the organic material has been incorporated into the topsoil. A soil sample will be taken within one (1) working day. No further development shall take place until the laboratory results of the soil test are received, evaluated and the topsoil meets the criteria for 6% organic matter as noted above. The cost of the initial soil test shall be paid for by the Town. The Contractor shall be invoiced for the costs of any soil re-tests, if the initial soil tests indicate an organic matter deficiency.

When the seeding does not take place within one week of the preparation of the soil bed, the soil bed shall be re-scarified to a minimum depth of 150 mm (6 inches) prior to seeding taking place. The soil bed shall be loose and friable.

25.2. INSPECTION

Have all subgrade preparation complete, finished grades established and results of soil test meet the topsoil criteria.

Give one (1) working day notice to the Engineer when work is available for inspection.

Receive in writing from the Engineer, approval of the subgrade before proceeding with the placement of topsoil.

END OF SECTION



26. SEEDING SPECIFICATIONS

26.1. SEEDING PRODUCT DELIVERY, STORAGE AND HANDLING

Deliver grass seed, fertilizer mulch and other materials in standard containers clearly marked with contents, weight, analysis and name of supplier or manufacturer.

In case of grass seed show quantities of difference types of seed mixture as well as the original seed lot number tag complete with supplier's name.

26.2. JOB CONDITIONS

Proceed with seeding operations only during favourable weather conditions in accordance with good horticultural practice.

Installation of seed prior to inspection by the Project Manager shall be the Contractor's responsibility. The Project Manager reserves the right to reject seed, after it has been installed, if seed does not conform to specifications.

Remove all rejected materials from site immediately.

26.3. MATERIALS

Grass Seed - Certified Canada No. 1 seed, having a minimum purity of 97% and germination of 75%, meeting the requirements of the Seeds Act and mixed as specified below:

For all manicured turf areas, a grass mixture of:

- 35% Kentucky Bluegrass - any two of the following: Touchdown, Nugget, America or Midnight
- 25% Creeping Red Fescue - either Boreal or Jasper
- 30% Chewing's Fescue - either Victory or Banner
- 10% Redtop or turf-type perennial ryegrass

This seed mixture shall be applied at a rate of no less than 2.93 kg per 100 sq. m. (6.0 lb. Per 1,000 ft²).

Seed of the various species shall be furnished in a mixture in standard containers on each of which the following information shall be clearly shown:

- Supplier's name and address
- Lot Number of each individual grass species/cultivars
- Net Weight of each container
- Names and percentages of individual seed species/cultivars

Mulch for Hydro seeding

Mulch: Approved wood fibre mulch manufactured from whole wood chips and containing no growth or germination inhibiting factors. The following specifications shall apply: Percent moisture content 10.0%; Percent organic matter 99.2%; Percent ash content 8.0%; Ph 4.8; Water holding 1,000 gms/100 gms of fibre.



Percent of moisture content is determined in accordance with the Canadian Pulp and Paper Association, Technical Section Standard A.2. Apply at a rate of 13.5 – 18.2 kg (30 - 40 lbs). per 1,400 - 2,000 kg/ha (1000 feet²), depending on slope.

Tackifier: Acceptable colloidal polysaccharide tackifier, adhering to mulch ring manufacturing, non-toxic and without growth or germination inhibiting factors. Apply at a rate of .45 kg -.90 kg (2 lbs.) per 50 - 100 kg/ha, (1000 feet²) depending on slope.

26.4. PREPARATION

Provide a finished topsoil surface that is smooth and firm with a fine loose texture. Thoroughly loosen soil, just prior to seeding to a minimum depth of 150 mm (6 inches).

Ensure that finished grade meets flush and smooth with adjacent grades and surface structures such as curbs, manholes, sidewalks, etc.

Apply 11-54-0 fertilizer at the following rate: 2.44 kg per 100 sq. metres (5 lbs. per 1000 sq. feet). Equivalent fertilizer may be applied provided the Contractor consults with the Project Manager prior to application.

26.5. INSTALLATION

Preferably do all seeding during the period from May 15 until September 30, or as weather permits, when wind speeds are minimal and site conditions are approved by Project Manager.

Two means of applying seed are acceptable to the Owner:

hydro-seeding and
mechanical or "Brillion" seeding

Hand broadcasting of seed shall not be acceptable under any conditions except for isolated repair work.

Upon completion of all seeding work, arrange for inspection by the Project Manager. Give timely notice for such inspection.

Protect all newly seeded areas as required.

Remedy all damages, wash-outs and eroded areas resulting from weather, improper protection or other causes.

END OF SECTION



27. IRRIGATION INSPECTION

27.1. INSPECTION AND TESTING

The Contractor shall have an approved set of drawings and specifications available prior to calling the Engineer for an inspection.

Flushing of Irrigation System - the Contractor shall, in the presence of the Engineer, flush all of the irrigation piping, and then fill it with water.

Backflow Prevention Assembly Certification

- a) The Backflow Prevention device must be tested by a Certified Backflow Prevention Tester to ensure that it is working properly. The person testing the backflow preventer must be a registered Cross Connection Control (CCC) and Backflow Prevention Tester and registered with the City of Medicine Hat, Environmental Utilities Department. This testing must be done prior to the activation of the irrigation system.
- b) The Certified Tester shall test the device and complete the City of Medicine Hat Cross Connection Control Testing and Inspection Report. The CCC Testing and Inspection Report must confirm that the backflow prevention device has successfully passed the test. The report is completed in triplicate and copies are provided to:
 - 1) Town of Redcliff - Top white copy
 - 2) Certified Tester - Yellow copy
 - 3) Owner of the property or department - Pink copy.
- c) Once the device is tested, the certified tester is responsible for attaching a Backflow Prevention Assembly Tag to the device and indicating the results of the test on the tag.

Irrigation Installation with Open Trenches/Pressure Test

- a) The Engineer shall be given one (1) working day notice when an open trench/pressure test inspection is required.
- b) The following procedures shall be followed when pressure testing an irrigation system:
 - 1) All irrigation systems to be tested from downstream of the backflow preventer.
 - 2) The Town of Redcliff is to inspect the installation of the backflow preventer before testing takes place or before the water meter is installed and provide the Contractor with written approval of the installation.
 - 3) The testing of the backflow preventer shall be the responsibility of the Contractor.
 - 4) Before pressure test is to take place, the Contractor shall contact the Public Services Department to confirm that the service valve is in the off position.
 - 5) The Contractor shall NOT operate the service valve. The Contractor shall contact the Public Services Department to operate the service valve.
- c) Items which must be in place and complete for the open trench/pressure test inspection include:
 - 1) trench depth and alignment
 - 2) bedding material
 - 3) pipe alignment joints and expansion couplers, valves



- 4) valves and gravel bed
 - 5) fittings/connections and head locations
 - 6) thrust blocking and conduit where specified
 - 7) pressure test without heads
 - 8) confirm pressure on furthest head of the furthest zone
 - 9) electrical wiring
- d) At the discretion of the Engineer a pressure gauge shall be placed on any point in the system and a reading shall be taken to confirm expected pressure loss in the system. The pressure gauge shall be provided by the Town. The Contractor shall supply all of the connections and requirements to conduct the test.
- e) Receive, in writing, from the Engineer, approval of the irrigation system before proceeding with backfill operation.

Irrigation Wiring Inspection

- a) The Engineer shall be given one (1) working day notice when an irrigation wiring inspection is required.
- b) Items which must be in place and complete for the irrigation wiring inspection include:
- 1) irrigation wire laid in the trench
 - 2) any wire splices must be visible for inspection
 - 3) wire connections at the controller

Irrigation System Inspection (after installation is complete)

- a) Items which must be in place and complete for the irrigation system include:
- 1) backfilling
 - 2) irrigation head adjustment
 - 3) valve boxes in place and clear of debris
 - 4) water pressure on and flowing freely through the system
 - 5) all heads activated and operating as per manufacturer's recommendations and the irrigation design.
 - 6) cabinet and controller
- b) At the Engineer' discretion, a pressure gauge shall be placed on any point in the system and a reading shall be taken to confirm expected pressure loss in system. The pressure gauge will be supplied by the Town. The Contractor shall supply all of the connections and requirements to conduct the test.
- c) Receive, in writing, from the Engineer, approval of the irrigation system before proceeding with landscape development.



Total Completion Inspection (prior to acceptance of the project)

- a) Items which must be in place and complete for the Total Completion Inspection include:
- 1) Activation of each individual zone
 - 2) Adjustment of any irrigation heads that are improperly adjusted

END OF SECTION



28. IRRIGATION INSTALLATION

28.1. MATERIALS

28.1.1 General

Materials shall be new and without flaws or defects of any type.

For substitutions, supply material with descriptive literature and samples, at least ten (10) working days before commencement of work. Any substitutions must meet or exceed specifications and performance standards of the proposed system, without any additional cost to the owner.

All major components used in the system must have the entire manufacturer's identification, i.e. make, model and serial number clearly shown on the equipment. Electrical or mechanical equipment used in the system which is subject to Federal, Provincial or Municipal standards must be installed to comply with the standard and where required, clearly be identified as approved by the **Canadian Standards Association**.

28.1.2 Piping and Fittings

The piping and fittings at the point of connection at the water service riser to the exit points of the vault shall be galvanized. Exit points include only the piping on the downstream side of the water service components (i.e.) isolation valve or electric zone valve. Fittings shall all be galvanized. The Contractor shall use the manufacturer's recommended fittings to convert from the water service riser to the mainline piping.

Irrigation mainline piping shall be:

- a) C.S.A. low density polyethylene series 75; or
- b) C.S.A. B137.3 certified series 160 P.V.C. with schedule 40 fittings and schedule 80 nipples.

All lateral lines on the downstream side of the electric zone valves shall be no larger than 50 mm (2 inches) whenever possible.

All lateral lines on the downstream side of the electric zone valves shall be C.S.A. low density polyethylene pipe series 75.

The use of any size or type of pipe that is different from that specified must be approved by the Engineer.

Any piping and fittings used inside the vault shall be galvanized.

28.1.3 Controllers, Cabinets and Concrete Bases

All automatic controllers used shall be C.S.A. Certified as a Class II power limiting circuit capable of handling the zones as noted on the drawings.

Interior controller mount shall consist of a 19mm (3/4 inch) thick piece of G1S fir plywood.

For exterior installation, the controller shall be mounted in a weatherproof, lockable, 16 gauge stainless steel enclosure.



The standard controller cabinet shall be fitted with a single door mounted on stainless steel piano hinges with a mechanism mounted with rivets on both doors capable of securing each door individually in the closed position. The door shall have a 75mm (3 inches) lip on the bottom and is to be fitted to ensure that the interior of the cabinet is weatherproof. The door is to be fitted with hardware to facilitate locking the cabinet with a key. Closure brackets, hinge attachments and plywood mounts are to be welded from the inside wherever possible to eliminate openings and protrusions. The exterior of the cabinet should be smooth and rounded with no protrusions or sharp edges evident. Any point of entry into the cabinet wall shall be sealed with a waterproof sealer.

The size of the irrigation cabinet for a standard controller shall be 450 mm (18 inches) wide, 60 mm (24 inches) tall and 300 mm (12 inches) in depth. Adjustments in size shall be made depending on the number of controllers housed in the cabinet.

The Contractor shall provide the following conduits to the controller cabinets:

Standard Controller

- a) 1 – 50 mm (2 inch) conduit for wire (Additional conduit may be required depending on number of wires)
- b) 1 – 38mm (1 1/2 inch) conduit for power supply
- c) 1 – 25mm (1 inch) conduit for grounding rod

The Contractor is responsible for contacting the Engineer, prior to the start of the work to confirm the size of the controller box that is required.

Concrete mix shall be in accordance with the following:

Minimum 28 Day Strength	25 MPa*
Designated Aggregate Size.....	maximum 25 mm (1 inch)
Slump.....	25-75 mm (1-3 inches)
Air Entrainment	5 - 7 %
Cement	Type 10 Normal Portland Cement
Calcium Chloride.....	ASTM D98, 2% maximum, with Engineer's approval

28.2. SPRINKLER HEADS

All full circle (360 degrees) sprinkler heads and all part circles (less than 360 degrees) shall be as indicated on the drawings.

Any alternatives must receive prior written approval of the Project Manager and the request for alternatives must be accompanied by documentation indicating matched precipitation rates and coverage and an operating pressure range in the middle of the manufacturer's indicated range. Spacing of the sprinkler heads shall not exceed the manufacturer's minimum specifications and must provide head to head coverage.

The specified irrigation heads shall be covered by manufacturer warranty against defects in material and workmanship for a period of five (5) years from the date of installation.

28.2.1 Wire Requirements

Wiring to and from controllers and valves shall conform to the Canadian Electric Code and any other regulatory conditions which govern this type of installation.



Control wire used shall be minimum 14 Gauge TWU, Copper, Solid Core.

Wire shall be furnished in minimum 762m (2,500-ft) reels and splicing shall be minimized, with such splices made waterproof with the use of the following:

- a) **3M DBY** Direct Burial Waterproof splice kit. No alternate is acceptable.
- b) **3M DBR-6** Direct Burial Waterproof splice kits where 3 or more wires need to be spliced. No alternative is acceptable.

28.2.2 Double Check Valve Assembly and Water Meter

Double check assemblies must be installed. The double check valve used shall be CSA approved and clearly labelled. The installation must meet all Federal, Provincial and Municipal requirements.

All double check valves shall be Watts Series 007-QT.

All test cocks are to be removed, once the double check valve assembly has been tested and approved. Each test cock is to be replaced by a brass plug. Test cocks shall then be placed in a plastic bag with the location noted, and shall be passed on to the Engineer, in a clean condition.

Irrigation design will indicate whether a standard or computerized water meter is required. For locations that require a standard water meter, the contractor shall contact the Public Services Department who will supply the water meter.

28.2.3 Ball and Gate Valves

All ball valves for drainage and flow control shall be Bronze body with replaceable seals, and have a removable handle with a minimum pressure rating of 10-kg/cm² (150 p.s.i.). All ball valves shall be full ported.

All ball valves shall have standard pipe threaded ends or adapters provided for proper installation in the lines in which they are located. All valves to be of same size as the lines in which they are used.

Valves up to 75 mm (3 inches) in diameter shall be 10 kg/cm² (150 p.s.i.) Bronze ball valves.

Valves 100 mm (4 inches mm) in diameter and larger shall be iron body Bronze or brass mounted gate valves conforming to standard specifications and meeting local standards.

28.2.4 Fittings & Unions

All fittings shall be connected to the pipe utilizing the appropriate clamping or glueing method and materials.

All fittings for polyethylene pipe shall be either brass saddles, polyethylene insert fittings, or galvanized insert fittings. All fittings for PVC pipe shall be PVC fittings.

Swing joints or flexible pigtail connections shall be used to attach the sprinkler heads to the lines. Swing joints shall consist of three 90 degree elbows. They shall have a minimum diameter of 19 mm (3/4 inch) for sprinkler heads with a flow rate of up to 6 gpm, one inch for sprinkler heads with a flow of up to 12 gpm, or as indicated on the drawings for sprinkler heads with flow rates exceeding 12 gpm.

All fittings on swing joints shall be P.V.C. Schedule 40 threaded elbows or street elbows.



28.2.5 Electric Zone Valves

Electric zone control shall be C.S.A. Certified as Class II power limiting circuit low voltage (i.e. 24-volt) operated only. Closing time for zone valves shall be not less than 5 seconds.

Zone control valves shall be electrically operated and self-cleaning, **Rain Bird PEB Series**.

Valves sizes shall be the same size as the line size.

28.2.6 Irrigation Enclosure Boxes

Where manufactured irrigation enclosure boxes are used, they shall be of heavy weight polyolefin and shall be capable of withstanding the weight of a heavy tractor on their surface, and shall have a locking capability.

Zone valves shall be housed in a "Jumbo" sized (500mm x 350 mm) irrigation enclosure box. The size of the irrigation box shall be such that there is of a minimum of 150 mm (six (6) inches) of vertical and horizontal clearance between the box and any point of the valve.

Gravel bed in boxes or vault shall consist of 300 mm (12 inches) of clean, washed 19 mm (3/4 inch) gravel with area marginally larger than box opening.

28.2.7 Clamping Systems

All C.S.A. series 75 low density polyethylene pipe 32mm (1 1/4 inch) or greater is to be double clamped with stainless steel gear clamps.

All C.S.A. series 75 low density polyethylene pipe less than 32mm (1 1/4 inch) is to be single clamped with stainless steel gear clamps.

28.2.8 Miscellaneous Systems Components

All miscellaneous systems components such as air relief valves, concrete vaults, meter boxes, shall be of the type and size as indicated on the drawings or details.

Install according to approved manufacturer's directions or at the direction of the Engineer.

28.2.9 Thrust Blocks

Local conditions shall determine the type and extent of thrust blocking to be used. Approval from the Engineer on the best method (whether concrete, rock, rebar or a combination of the former) shall be required before proceeding.

28.2.10 Booster Pump

Where a water service requires a booster pump, the pump and all the other irrigation water service components shall be installed above grade in a 14 gauge stainless steel or anodized aluminum box.

The booster pump shall be the brand name and model as specified on the drawings.

The enclosure box shall be constructed of 14 gauge stainless steel or anodized aluminum. It shall have vents on 2 sides of the box, with openings not exceeding 100 cm² (16 inches²). The vents shall have stainless steel mesh, attached from the inside and the vents shall have covers installed inside the cabinet which can be manually closed.



The door(s) of the enclosure box shall be constructed of the same material. The door(s) are to be mounted/welded with heavy duty pipe hinges. The door(s) shall be lockable and have handles for ease of opening. The door(s) should be weatherproof.

The enclosure box and door(s) shall be painted a medium to dark green colour with a rust inhibitive, weather resistant paint.

The size of the concrete base for the booster pump will be constructed such that there will be a 100 mm (4 inches) overhang on all sides of the cabinet. The bases shall be installed 50 mm (2 inches) above grade.

The concrete base shall be constructed with 4 (four) 200 mm (8 inch) cardboard tubes (Sono tubes or equivalent) filled with concrete, 600mm (24 inches) in depth.

The concrete base shall be formed and shall be a minimum of 150 mm (6 inches) in depth, with wire mesh or rebar in the concrete.

The Contractor shall use L - shaped rebar to tie the base and sono tube together.

Concrete mix shall be in accordance with the following:

Minimum 28 Day Strength	25 MPa*
Designated Aggregate Size	maximum 25 mm (1 inch)
Slump	25-75 mm (1-3 inches)
Air Entrainment	5 - 7 %
Cement	Type 10 Normal Portland Cement
Calcium Chloride	ASTM D98, 2% maximum, with Engineer's approval

28.2.11 Irrigation Vault

The wooden vault shall be constructed of pressure treated 100 mm x 100 mm (4 inches x 4 inches) lumber, and constructed in continuous lengths with no piecing of any sides of the vault.

The vault shall be a minimum of 500 mm in height. The corners should be alternately overlapped for stability. The end cuts of the lumber shall be coated with a wood preservative material. Each layer of 100 mm x 100 mm (4 inches x 4 inches) should be nailed together at regular intervals with 150mm (6 inch) galvanized ardox nails.

The lid(s) shall be constructed of 3.18 mm (1/8 inch) checker plate split at 1.22 m (4 feet) intervals and have a bent offset/overlap where a split occurs. A 50 mm x 50 mm (2 inch x 2 inch) angle iron metal support shall be welded into the vault under the split in the lid(s) for support. The lid(s) are to be mounted/welded with heavy duty pipe hinges onto a 75mm x 75mm x 6.35 mm (3 inch x 3 inch x 1/4 inch) angled frame dropped over the outside of the frame of the vault and is then lag bolted to the vault at regular intervals. The lids shall be lockable and have recessed handles for ease of opening. The lids and metal frame shall be painted a medium to dark green colour with a rust inhibitive weather resistant paint. The lids shall not be larger than 1.22 m by 1.22 m (4 feet x 4 feet) in size.

All piping and conduit openings shall be cut around the pipe or conduit with 50 mm (2 inch) of clearance between the pipe or conduit and the vault. The pipe or conduit shall be centred in the opening. Any patching of the openings shall be done with 3/4 inch pressure treated plywood which is to be screwed with wood screws, not nails to the interior of the vault.



28.2.12 Conduit

In ground conduit 160 Series PVC shall be a minimum of double the size of the pipe being sleeved.

Roadway conduit PVC Series 900 shall be a minimum of double the size of the pipe being sleeved. There shall be two conduits placed for all road crossings, one for the pipe and one for the wire.

All irrigation piping or wire running under an asphalt trail, shale trail or concrete sidewalk shall be sleeved with Series 160 PVC.

28.2.13 Backfill Material

Backfill material for irrigation pipe trenches within 150 mm (6 inches) of pipe shall be clean sand or fill, free of organic matter, stones and sharp objects capable of damaging pipe.

28.2.14 Job Conditions

Proceed with irrigation installation only during suitable weather conditions.

Report to the Engineer, prior to commencing work, of any conditions or defects encountered on the site upon which work of the section may depend and which may adversely affect the performance of the work.

Do not commence work until such conditions or defects have been investigated and corrected.

Protect the system from being contaminated during construction by enclosing all open ends on all lines.

28.3. LAY OUT

Stake out entire system, including locations of sprinkler heads and/or quick coupler valves. Confirm that lay out is within project boundary and property lines. Heads shall be spaced according to what is specified on the drawing to ensure adequate coverage. Heads shall not be installed any more than 150 mm (6 inches) off the property line.

Verify, on-site, the location of all conduits under asphalt, shale and concrete and adjust to suit.

Verify the location of all underground utilities and use standard precautions when working near such. Make good all damages to same at Contractor's expense.

Have lay out inspected and approved by the Engineer before commencement of work.

Due to changes in landscape elements, it may be necessary to adjust the spacing of the sprinklers in the field. These changes shall be approved by the Engineer. Such changes that do not require extra materials or labour shall be done at no extra cost to the Owner. If such changes result in extra cost, all such changes shall be approved, in writing, by the Engineer before proceeding with work.

Water Service Schematic

- a) Water Service Schematic (with a booster pump): The irrigation components shall be installed according to the following schematic: water service, main shut off valve (ball valve), galvanized union, hydrometer/ water meter/galvanized metal spool, galvanized union ; double check assembly; galvanized union; booster pump; galvanized union; isolation valve no. 1, quick coupler turf valve and an isolation valve no. 2.
- b) Water Service Schematic (without a booster pump): The irrigation components shall be installed according to the following schematic : water service, main shut off valve (ball



valve), galvanized union, hydrometer/ water meter/galvanized metal spool; galvanized union; double check assembly, galvanized union, quick coupler turf valve and isolation valve.

28.4. SERVICING

28.4.1 Electrical

Contractor to contact Electric Customer Service Office (529-8270) to confirm service point location and available voltage details.

Contractor to complete City Electric Department “Electric Service Request Form” for a Commercial Service and forward same to Electric Department at 2172 Brier Park Place NW (fax 502-8061).

A service point will normally consist of either a conduit stub, service box, pad mounted transformer or power pole.

Contractor to obtain electrical permit and cost of electric permit to be paid for by the Contractor.

The Public Services Department shall be responsible for any charges by the Electric Department for the final connection at the service box.

The Contractor is responsible for:

- a) all trenching, backfilling and compaction to 85-90% Standard Proctor Density. Minimum depth of service cable trench to be 1.0 meters (3.28 feet) below final grade.
- b) supply, installation and connecting of main service equipment.
- c) supply and installation of electrical service cable from main disconnect in panel to Electric Utility service point.
- d) supply and installation of 2 – 3.05m (10 feet) galvanized or copper clad ground rods or a suitable ground plate at main panel location. This applies to both unmetered and metered services.
- e) connection of main service cables at service panel

Service conduit, when required to be 50mm (2 inches) rigid PVC, DB-2 or FRE buried at a depth of 1.0 meter (3.28 feet) below final grade.

For 30 amp services and less (metered and unmetered), the service conductors are to be 3 - No. 10 copper x-link colour coded or colour taped as follows:

- black - line for 120 or 240 volt service
- red - line for 240 volt service
- white - for neutral 120 volt service
- green - ground for both 120 and 240 volt service

If service size is 31 - 60 amps use No. 6 copper x-link conductors.

If service size is 61 - 100 amps use No. 3 copper x-link conductors.

NMW-10 bundled cable can be used instead of single conductors.

Contractor to allow 1.0 meter (3.28 feet) length per service conductor for connection at cable stub, submersible service box or pad mount transformer for use by Electric Utility to connect service.



Contractor to provide cable, conduit and straps for pole risers. Cable and conduit lengths will be determined in field after contact with Electric Utility.

At conduit stub locations:

- a) Stub location will be indicated with a .61m x 1.22 m (2 foot x 4 foot) above ground and or an electronic cable marker supplied and installed below ground by the Electric Utility. Contractor will contact Electric Utility to locate below ground cable marker if 61m x 1.22 m (2 foot x 4 foot) is not visible.
- b) Contractor must supply and install adapter (if required) for connecting service conduit to Electric Utility conduit stub.
- c) Contractor will dig down and connect his 50mm (2 inch) conduit to the Electric Utility conduit stub.
- d) Contractor will pull service cables from main disconnect in controller to service point from which conduit stub originates. Contractor to notify Electric Utility 48 hours before cable is pulled to arrange for opening of underground service box or pad mount transformer into which service cables will be installed.
- e) Contractor will provide additional pulling points, if required, to install the service cables from the main disconnect to the Electric Utility service box or pad mount transformer.
- f) Electric Utility will connect service cables at service box or pad mount transformer.

At underground service box, pad mount transformer and power pole locations:

- a) Contractor will contact Electric Utility (phone 529-8270) 48 hours prior to installing service cables and conduit at the above locations
- b) Contractor will not dig into a service box or pad mount transformer unless under the supervision of the Electric Utility.

For an unmetered service, the Contractor is responsible for all work which will include but not be limited to:

- a) supply and install 1-15 amp single pole breaker (main disconnect) to operate at 120 volts single phase.
- b) supply and install service cables and conduit as required from main disconnect to Electric Utility service point.
- c) supply and install grounding.

For a metered service, the Contractor is responsible for all work which will include but not be limited to the following:

- a) supply and install 60 amp 2-pole main service disconnect to operate at 120/240 volts or 120/208 volts single phase 3-wire.
- b) supply and install 4-jaw (for 120/240 volt service) or 5-jaw (for 120/208 volt service) Jumbo meter base. Meter base to be located on load side of main disconnect unless special permission given by Electric Utility to install on line side of main disconnect.
- c) supply and install subpanel as required.
- d) supply and install booster pump starter.
- e) supply and install grounding.

**28.5. EXECUTION****28.5.1 Trenching**

Excavate trenches to 450 mm (18 inches) depth to ensure adequate coverage, regardless of pipe size. Width of trench shall be a minimum of three times the diameter of the pipe.

All trenching shall have a level base to ensure proper drainage of the whole irrigation system and minimize trapped water. In the event of over excavation the trench shall be backfilled to the proper elevation and compacted to 85% - 90% Standard Proctor Density prior to installing pipe.

All main and lateral lines shall have a depth of 450 mm (18 inches).

In the following spring, the Contractor shall repair any settlement of the trenches by bringing them to grade with topsoil and sodding.

Place conduit as required to enclose piping under asphalt, shale or concrete. Depths of conduit shall be a minimum of 450 mm (18 inches) under amenity areas, 0.84 metres (36 inches) under roadways.

Extend conduit a minimum of 91 m (3 feet) beyond edge of pavement or amenity area. Enclose ends to prevent debris intrusion.

28.5.2 Installation**Controllers, Cabinets and Concrete Bases**

- a) Controllers mounted indoors shall be securely mounted inside a lockable, metal enclosure, securely mounted to the wall and easily accessible for maintenance with a minimum of 150 mm (6 inches) of horizontal and vertical clearance between the walls of the irrigation cabinet and the controller. The size of the plywood will be such that there is 250 mm (10 inches) of clearance around the perimeter of the controller.
- b) Controllers mounted outdoors shall be installed in a cabinet and securely mounted on a concrete base. The cabinet shall be bolted/anchored on all four corners. The controller shall be easily accessible for maintenance with a minimum of 150 mm (6 inches) of horizontal and vertical clearance between the walls of the irrigation cabinet and the controller. A 3.05 metres (10 foot) copper clad grounding rod with wire connecting to the controller shall be installed. The grounding rod shall protrude a minimum of 100 mm (4 inches) above the top of the concrete base inside the cabinet or outside the cabinet in an irrigation enclosure box, at a location designated by the Engineer.
- c) No doubling up of zones on the controller shall be allowed.
- d) Each controller shall be installed at a location approved by the Engineer.
- e) The size of the concrete bases for the controller cabinets will be constructed such that there will be a 100 mm (4 inch) overhang on all sides of the cabinet. The bases shall be installed 50 mm (2 inches) above grade.
- f) The concrete base for a standard cabinet shall be constructed with 2 (two) 150 mm (6 inch) sono tube filled with concrete, 69mm (2 feet) in depth.
- g) The concrete base shall be formed and shall be a minimum of 150 mm (6 inches) in depth, with wire mesh or rebar in the concrete. The Contractor shall use L - shaped rebar to tie the base and sono tube together.



- h) Conduit shall stick out 38 mm (1 1/2 inches) above the concrete base and shall be smooth and rounded. Cut cabinet around individual conduits.

110 Volt Electric Wiring

- a) All 110 volt wiring shall be installed in accordance with local electrical codes.
- b) 110 volt wiring shall be colour coded to differentiate from 24 volt wire.
- c) The power supply shall be connected thru a ground fault receptacle.

Wire Requirements

- a) The control wire from the controllers to the zone valves and hydrometer valves shall be placed in the trench alongside or underneath the water line.
- b) The control wire must be capable of acting as a tracer wire for the main lines from the source of water supply to each of the zone valves.
- c) A minimum of 900 mm (36 inches) of slack wire must be left at each control valve, the end of every length of wire and at every change in direction and at each junction to allow for ease of maintenance. Lay wire with sufficient slack to accommodate backfill operation.
- d) White is to be used only as the common wire. The signal wire shall be coloured wire, following the colour coded sequence in these specifications. The use of black wire shall be minimized whenever possible.
- e) All splices shall be housed in a minimum 350 mm x 475mm (14 inches x 19 inches) irrigation enclosure box or incorporated into the zone valve box.
- f) The wire in the cabinet shall be neatly bundled with plastic tie wraps at 100 mm (4 inch) intervals, shall be secured with screws that do not penetrate the exterior of the cabinet, shall be secured at every third tie wrap to the cabinet and shall follow the perimeter of the boards and cabinet, allowing a minimum of 300 mm (12 inches) of slack. Zone wires shall be sorted and identified separately from the hydrometer wires.
- g) One additional wire shall be installed from the controller to the farthest zone. This wire shall be red and shall be identified according to the standards in these specifications. Where the zones split in more than one direction from a controller, an additional wire shall be run in both directions. The wire shall be placed in the zone valve box, with a minimum slack of 1 meter (36 inches) and left bare.
- h) Wiring within the controller cabinet shall be neatly bundled, securely mounted to cabinet and colour coded according to the following standard:
 - 1) Starting from the furthest station the colour sequence shall be black, red, blue for #12 gauge feeds and black, red, blue, orange, yellow, brown for #14 gauge feeds.
 - 2) Spare zone wire: 1 Red wire
 - 3) The Contractor shall be responsible for confirming correct gauge of wire, prior to the start of work.
 - 4) If and where necessary, the same colour coding sequence shall be repeated. All of the wires shall be marked with numbered tabs to differentiate the zones. The markings will be made with a permanent waterproof marker. No duplicate colours which do not follow the standard will be allowed.



- 5) Other equivalent colour coding standards may be approved, subject to prior written approval of the Engineer.
- 6) The Contractor shall be responsible for removing and replacing (at no cost to the Town), any wire that does not conform to the wire colour coding standards, or where he has not received prior written approval.
- 7) The two pairs of wires for the hydrometer and 1 spare wire for the hydrometer shall be colour differentiated from the zone wires. The colour coding sequence is as follows:

For the Pulse: 2 Blue wires

For the Valve Control: 1 Yellow wire and 1 White (Common) wire

For the Hydrometer Spare 1 black wire

- i) A terminal strip shall be supplied and installed for the field wire to terminate in the cabinet, interconnect wiring from terminal strip to the Controller.

Double Check Valve Assembly and Water Meter

- a) The Contractor is responsible for obtaining the appropriate permits. The double check assembly and the installation shall be approved, in writing, by the Engineer. All back flow prevention assemblies must be installed in accordance with the Federal, Provincial and Municipal requirements.
- b) Double check assemblies and water meters shall be installed with the rest of the water service components in an irrigation vault.
- c) The double check assembly shall be supported by concrete blocks.

Ball and Gate Valves

- a) All ball valves shall be installed with the handle parallel to the length of the cover of the enclosure for ease of accessibility, with no obstructions and enough room to operate the valve.
- b) A ball or butterfly valve shall be installed on the pressurized side of each electric zone valve.
- c) Ball valves shall be the same size as the electric zone valve in that line.

Fittings & Unions

- a) A galvanized union shall be installed between the zone isolation valve (ball valve) and the electric zone valve.

Irrigation Heads and Piping

- a) Make all joints and connections tight in accordance with manufacturer's recommendations. Use expansion couplers where required. Protect system from being contaminated during construction by enclosing all open ends on all lines.
- b) Install risers with saddle tees as detailed, firmly connected and plumbed.
- c) All sprinklers are to be adjusted and set flush with final grade using the three street elbow swing joint as detailed. Ensure that horizontal pipe is no more than 45 degrees out of level when setting sprinklers. Where utility easements or property lines preclude the standard assembly, a "pig tail" swing joint shall be used as detailed or specified on the approved irrigation plan.



- d) Ensure that heads are set at the proper height to ensure adequate coverage.
- e) Leave a minimum of 1.5 metres (5 feet) from a T-intersection or cross intersection before changing pipe sizes.
- f) Sprinkler heads shall be set plumb and level with the turf.
- g) After turf is established and the ground has settled, the Contractor shall, within ten (10) working days of notification, adjust the heads to finished grade.

Irrigation Enclosure Boxes

- a) The manual ball valves shall be installed with the handle parallel with the length of the cover.
- b) Top level of gravel in the boxes or vaults shall be kept a minimum of 150 mm (6 inches) below lowest point of irrigation system. Where necessary, the components shall be supported by bricks to prevent any stress on the system.
- c) All valve enclosure boxes shall be stacked on top of another box for support. Large enough holes must be cut in the boxes to ensure that the boxes do not settle on or rest on the irrigation piping.
- d) Wherever possible, 2 or more electric zone valves at the same location shall be enclosed in a common enclosure or vault in order to reduce the total number of enclosures at any one Park location.

Thrust Blocks

- a) Thrust block all changes of direction and pipe endings of all pipe 75mm (3 inch) and larger. If concrete thrust blocks are used protect pipe from concrete spill over.

Tracer Wiring

- a) Tracer wire (orange wire colour) shall be installed in the trench from each zone valve to the end of each run of pipe.
- b) The tracer wire shall be marked and identified according to the standard in these specifications.
- b) The tracer wire is to be left bare rather than being terminated on all bare ends with the specified splice kits. The end in the zone valve box shall be left unattached in the valve box and have a minimum of 900 mm (36 inches) of slack.

Booster Pump

- a) The piping shall be looped in the enclosure and alignment of the irrigation components shall be installed such that size of the enclosure box is minimized while ensuring a minimum of .45 m (1.5 feet) clearance around the perimeter of the components, inside the enclosure box.
- b) The booster pump shall be bolted to a concrete pad, with the concrete pad overhanging enclosure box by a minimum of 100 mm (4 inches) on all sides. The concrete pad shall be constructed to the same specifications as a controller box concrete pad.
- c) The enclosure box shall be bolted to the concrete base such that the entire enclosure box can be removed. The enclosure box should also be locked onto the frame to prevent the accidental movement of the enclosure box.
- d) All Electrical breakers for the booster pump shall be located in the controller cabinet.



Irrigation Vault

- a) All irrigation components including the hydrometer or water meter, the double check valve and the blow out quick coupler shall be installed below grade in an irrigation vault.
- b) The size of the vault shall be as site hardware configuration dictates to ensure that there is 0.3 m (1.0 foot) clearance around all components. Prior to the construction of the vault, the Contractor shall contact the Engineer to confirm the service configuration and the size of the vault.
- c) There shall be a minimum of 0.3 metre (1.0 foot) clearance around the vault perimeter between the downstream side of the required components, and the inside the vault.
- d) The bottom of the vault shall have 300 mm (12 inches) of 19 mm (3/4 inch) washed gravel with the top of the gravel a minimum of 150 mm (6 inches) below the lowest point of the water service. All water service components shall be supported by bricks.
- e) The vault shall be level with the finished grade.
- f) The lids shall not open onto roadways or other obstructions. There shall be a minimum of 2 metres (6.6 feet) clearance between the open lid and any obstructions.

Conduit

- a) Run all necessary wiring through conduit as required. Conduit must be double the size of the group of wires. Any group of wires that is larger than 50 mm (2 inches) shall be run through two, 50 mm (2 inch) conduit. If located outdoors, ensure that storage chamber is waterproof and lockable.

28.5.3 TESTING

Prior to backfilling at joints and connections, the piping is to be flushed and then filled with water, ensuring that any entrapped air has been completely expelled. The Contractor shall flush the system in the presence of the Engineer.

Once the lines have been completely filled with water, the Contractor is to test the system in the presence of the Engineer.

All pipes, whether main lines or laterals shall be tested for a minimum period of one (1) hour at 100 psi (6.5 kg/cm²) or at the pressure equivalent to the pressure of the water main to which the irrigation system is connected, whichever is higher, and upon visual inspection of all joints, should any leak be found, it shall be repaired and testing continued until all visible leaks have been eliminated from the entire system or the part of the system under test.

Adjustment of the sprinkler heads and controllers shall be carried out by the Contractor upon completion of the installation so as to obtain maximum performance from all parts of the system.

Adjustment of the controllers shall be done by the Contractor to ensure the system is operating properly. The final commissioning of the system shall be done in the presence of the Engineer.

All sprinkler heads, valve enclosures and other system component enclosures shall be adjusted to the proper relative elevation relative to the final turf grade by the Contractor.

28.5.4 BACKFILLING

After Open Trench inspection and written approval by the Engineer, backfill with approved fill. Excavated material may be used for backfilling only when approved by the Engineer.



Place backfill in 150 mm (6 inch) lifts, placing and compacting all lifts until 150 mm (6 inches) below finished grade. Place topsoil, seed or sod as required.

Adjust sprinkler heads to the correct spray angle and height to provide adequate coverage without excessive over-spray.

The Contractor shall level off any trenches that have slumped, fill with topsoil and reseed the area.

Remove off site all debris and excess material left over from installation at the end of each working day or as required.

END OF SECTION



29. SODDING

29.1. SODDING PRODUCT DELIVERY, STORAGE AND HANDLING

Cut sod by approved methods in accordance with recommendations of the Alberta Nursery Trades Association (A.N.T.A.). Cut in pieces approximately 0.84 square metres (1 square yard) in area with minimum soil and root thickness of 25 mm (1 inch). Where oversized rolls are utilized, the pieces shall be cut as per manufacturer's recommendations.

Roll or fold sod prior to lifting, in such a manner as to prevent tearing or breaking.

Protect sod during transportation to prevent drying out and ensure its arrival at the site in a fresh and healthy condition.

Sod should be installed upon arrival. If there is a delay in installation due to weather, keep sod moist and cool and protected from direct exposure to the sun until installation. Engineer shall reject sod that has dried out.

Provide fertilizer in standard manufacturer's containers, clearly marked with the name of the manufacturer, weight and analysis. 16-20-0 fertilizer shall be applied at the rate of 3.5 (8 lbs.) per 400 kg/ha, (1000 feet²).

29.2. JOB CONDITIONS

Proceed with sodding operations only during favourable weather conditions and in accordance with good horticultural practice.

29.3. INSPECTION

Make all materials available for inspection, upon arrival on the site, or at source of supply when requested.

Submit name of sod supplier.

Give one (1) working day notice, when materials are available for inspection.

Ensure written approval of finished topsoil surface is obtained from the Engineer before proceeding with sodding.

The Engineer reserves the right to reject sod, after it has been installed, if sod does not conform to the specifications and/or drawings.

Remove all rejected materials immediately from the site.

Give one (1) working day notice to the Engineer when all sodding work has been completed. All sodding work is to be inspected upon completion.

29.4. MATERIALS

Grass Sod: Certified No. 1 grade cultivated turf grass sod, grown and sold in accordance with A.N.T.A. classifications. At the time of sale, it must have a strong, fibrous root system and be free of stones and burned or bare spots.



Wooden Pegs: 25 mm x 25 mm x 225 mm (1 inch x 1 inch x 9 inches) minimum length pegs. Ensure pegs are long enough to securely anchor sod.

29.5. PREPARATION

Apply fertilizer at the following rates: 16 - 20 - 0 at 3.5 kg (8 lbs.) per 400 kg/ha, (1000 feet²). Equivalent fertilizer may be applied provided the Contractor consults with the Engineer prior to application.

Spread the fertilizer at the specified rate prior to laying sod.

29.6. INSTALLATION

Lay sod with tight butt joints. Do not leave any open joints or overlap adjacent pieces of sod. Ensure that adjacent rows are laid in a staggered sequence.

Ensure finished sod surface is flush with adjoining grass areas, pavement or top surface of curbs.

On slopes steeper than 4H:1V, lay sod across the face of the slope and peg each row at intervals of not more than 600 mm (24 inches). Drive pegs flush with surface of sod.

Lay sod to a width of 3 m (10 feet) in swales and place perpendicular to direction of swale, unless otherwise noted on drawings.

Immediately after installation of sod, water area with sufficient amounts to saturate sod and underlying topsoil to a minimum depth of 100 mm (4 inches).

After sod and soil have dried sufficiently to prevent damage, roll area with 8gk (18-lb.) roller to ensure good bond between sod and soil and to remove minor irregularities. Clean up and remove off site all waste and extra sod at the end of each day or as directed.

Upon completion of all sodding work, arrange for inspection by the Engineer. Give timely notice for such inspection.

Protect all newly sodded areas as required.

Repair all damages, wash-outs and eroded areas resulting from weather, improper protection or other causes.

END OF SECTION



30. TREE PLANTING

30.1. GENERAL

30.1.1 Guarantee

The Work shall be inspected by the Engineer, and those plant material whose health and vigour has deteriorated, shall be replaced at the Contractor's expense.

The Contractor shall replace any materials required within 30 days of written notice from the Engineer, prior to the expiration of the guarantee period.

30.1.2 Maintenance

The Contractor shall commence the maintenance of all plant material immediately after the work has been substantially completed and shall continue until the date of the Total Completion of the Work.

30.1.3 Inspection

The Engineer may, at its discretion, inspect all deciduous and coniferous trees at the source of supply prior to shipping to site.

Approval of plant materials at source of supply will not impair the right of the Engineer to inspect plants upon arrival at the site or during the course of construction reject plants which have been damaged or which, in any way, do not conform to the specifications.

The Contractor shall stake the location of the trees, then notify the Engineer who will then inspect the locations of the trees. There shall be a minimum distance of 3 metres (9.5 feet) from any irrigation system components.

Inspection of material will be conducted within thirty (30) days after substantial completion of the work.

Final inspection of all plantings will be made prior to the end of the specified guarantee period.

At the time of inspection, all plants shall be alive and in a healthy, satisfactory growing condition.

30.2. PLANTING MATERIALS

30.2.1 Plant Materials

All plant materials shall meet the horticultural standards of the Canadian Nursery Trades Association with respect to grading and quality.

They shall be nursery grown in Alberta, under proper cultural practices as recommended by the Canadian Nursery Trades Association.

Nomenclature of specified plants shall conform to the International Code of Nomenclature for Cultivated Plants and shall be in accordance with the approved scientific names given in the latest edition of Standardized Plant Names. The names of varieties not named therein are generally in conformity with the names accepted in the nursery trade.



Any plants dug from native stands, wood lots, orchards or neglected nurseries and which have not received proper cultural maintenance as advocated by the Canadian Nursery Trade Association, shall be designated as 'collected plants'.

The use of 'collected plants' will not be permitted unless approved in writing, in advance, by the Engineer.

Plants shall be true to type and structurally sound, well-branched, healthy and vigorous and free of disease, insect infestations, rodent damage, sun scald, frost cracks and other abrasions or scars to the bark. They shall be densely foliated when in leaf and have a healthy, well developed root system. Pruning wounds shall show vigorous bark on all edges and all parts shall be moist and show live, green cambium tissue when cut. Trees shall have straight stems unless that would be uncharacteristic and shall be well and characteristically branched for the species or variety.

All plant materials shall conform to the measurements specified in the Plant List except that the plants larger than specified may be used if approved by the Engineer.

All plants shall be measured when the branches are in their normal position. Heights and spread dimensions specified refer to the main body of the plant and not from branch tip to root base or from branch tip to branch tip. Where trees are measured by calliper, it will be in accordance with the Canadian Nursery Trades Association specifications for Nursery stock. The types of species of trees shall be as indicated on the approved drawings. Trees shall conform to the quality, and measurements shall be in accordance with the 'Guide Specifications for Nursery Stock' of the Canadian Nursery Trades Association and following specifications.

Trees are to be supplied by a grower or nursery in a similar climatic zone unless approved by the Engineer.

Any plant material not in accordance with specifications will be a deficiency and will be rejected by the Engineer or his designate.

The Contractor shall be required to indicate the source of plant material and supply the Engineer with a list of where the plant material was grown and/or purchased. The Engineer shall reject any plant material that is not an Alberta source.

30.2.2 Substitutions

All plants shall be supplied as specified on the plant list. Substitutions will not be allowed unless approved in writing by the Engineer.

Notice, in writing, must be supplied in a timely manner to the Engineer when applying for substitutions.

Proof that plant species and sizes specified are unobtainable prior to making substitutions must be supplied in a timely manner.

Substitution of plants larger than specified may be permitted with no increase in contract price.



30.2.3 Planting Media

Materials

- a) Peat moss - decomposed plant material, fairly elastic and homogeneous, free of decomposed colloidal residue, wood, sulphur and iron, with a pH value ranging from 6.5 to 7.5.
- b) Sand - Clean, sharp sand passing 2 mm (.08 inches) sieve, free of impurities, chemical or organic matter.

Soil mix shall be one (1) part fertile topsoil, two (2) parts existing soil, one (1) part horticultural peat moss and one (1) part sharp sand.

30.2.4 Digging of Plants

All plants shall be dug and delivered to the site as specified on the plant list. Immediately after digging, the root system shall be kept moist to prevent drying out until planted.

Plants specified 'Bare Root' shall be dug and moved while dormant, with the major portion of the fibrous root system provided. The root system shall extend a minimum of 380 mm (15.0 inches) diameter per 25 mm (1.0 inches) of tree calliper. Immediately after digging, wrap the roots in wet burlap and keep burlap wet during transport and storage.

All plants specified 'Ball & Burlap' shall be dug and moved while dormant, with the major portion of the fibrous root system provided.

All root balls less than 45 cm (17.65 inches) in diameter shall be bur lapped. Balls from 45 cm to 75 cm (17.65 inches to 29.55 inches) in diameter shall be double bur lapped, or bur lapped and wire basketed.

The sizes of root balls for trees shall be as specified in the Canadian Nursery Trades Association specifications for nursery stock.

All plants specified may be moved with a mechanical tree spade providing adequate roots are kept as specified.

Container grown plants must have been grown in containers for a minimum of three months, and have established a root system which will hold the soil when removed from container.

Before removing plants from containers for planting, the plants shall be well watered to reduce injury.

All plant material in containers shall be checked to ensure that there are no encircling or girdling roots. If encircling roots are present, use a sharp knife to make two vertical cuts opposite each other on the sides of the root ball through the encircling roots and roughen up sides by massaging root ball to encourage root growth into planting hole.

Tree hole size shall be 150 mm (6 inches) larger than the root ball size except at the bottom. The root ball diameter shall coincide with the Canadian Nursery Trades Association specifications for nursery stock.

30.2.5 Handling of Plants

Trees (in foliage), moved by the Tree Spade Method, may be moved up to 35 km (20 miles) without wind protection, provided road speed does not exceed 30 km/hr. (20 mph). If moved at higher speeds or from a greater distance than specified above, trees must be protected from the wind by an enclosed truck or tarpaulin.



Trees that are moved by the Basket Method or Balled and Burlap Method must be covered with a tarp if transported on an open vehicle.

Plants with broken or abraded trunks or branches are not acceptable.

Root balls, trunks, branches and leaves shall be protected from drying, frost or damage and be kept moist until planted.

Container stock should be handled as much as possible by the pot or basket only, in order to reduce breakage.

Trees are not to be lifted by the trunks.

All plants should be unloaded and checked immediately upon arrival and should be watered if necessary. Trees with cracked or broken root balls will not be accepted.

All plant material which cannot be planted immediately upon arrival shall be well protected with soil or similar material to prevent drying out or if necessary stored in a dry, weatherproof place in such a manner that their effectiveness will not be impaired. Plants shall not remain unplanted for longer than three (3) days after arrival on site.

Plant material shall not be moved under the following conditions:

- a) temperatures in excess of 25°C (77°F)
- b) extreme windy conditions
- c) bare root material must be moved while dormant.

30.2.6 Mulch

Random sized wood chips, twigs and leaves collected from a wood chipper being fed tree limbs, branches and brush.

Mulch to be supplied by the Parks and Outdoor Recreation Department. Contractor is responsible for loading, hauling and spreading of mulch.

30.3. EXECUTION

30.3.1 Planting

Plant trees, only during periods that are normal for such work as determined by local weather conditions, to ensure success with the plant material.

All trees shall have at least 150 mm (6.0 inches) of growing medium surrounding the sides of the root ball. Excess excavated material shall be removed from the site. Measure minimum depth of plant pit from downward side of slope when planting on incline.

Where necessary, holes dug by a mechanical tree spade shall be scarified to ensure that they do not have glazed sides.



The Contractor shall contact the Utility Companies 48 hours prior to the start of work, and coordinate the locates for all underground obstructions such as electric, gas, water, communication and irrigation lines.

After the Contractor has completed the utility locates, the Contractor shall stake the location for the trees and then notify the Engineer who will then inspect the locations for the trees. There shall be a minimum of 3 metres (9.85 feet) away from any irrigation system components.

Plants shall be set exactly in the centre of the pits and at the same relation to grade as originally grown.

Plant material shall be faced to give the best appearance or relationship to adjacent structures, walkways or park features.

Planting medium shall be firmly tamped in place in such a manner that the plant retains its vertical position. Particular care shall be taken to ensure that no air pockets remain under or around the roots. The planting medium shall be thoroughly watered immediately after tamping. All non-porous containers shall be removed, including top ring of wire basket. If a fibre or peat pot remains, it must not be left above the soil surface as this promotes "wick" evaporation.

When growing medium is up to about two-thirds of the root ball height, ties shall be cut and the top portion of the burlap on Ball & Burlap, plants shall be folded back carefully, not disturbing the root ball. All types of ties or wrappings and burlap are to be removed.

The top ring of the wire baskets are to be folded below grade and the burlap removed.

Damaged or broken roots should be cut back with a sharp knife to living parts remaining.

Bare-root plants are to be placed on a cone-shaped mound of soil at the bottom of the hole, roots must not be doubled over, crowded or crossed. Spread roots out gently and evenly in the planting pit.

In exceptional cases where a tree spade cannot be used to dig holes, the following shall apply:

- a) holes shall be dug by hand or backhoe
- b) the soil from such holes shall be removed by the Contractor, at his expense, to an approved disposal site.

Each plant other than those in planting beds shall have an earth saucer at its base which shall have a dish as large as the excavated area. The saucer shall be constructed so as to retain water around the roots of the plant. The retaining ring around the saucer shall be 100 mm (4.0 inches) and constructed to retain water.

There shall be 200 mm (8 inches) of mulch placed in the tree pit, with a 1 m diameter circle around the base of the tree. The mulch shall be level with the adjacent turf. The mulch shall not be placed immediately adjacent to the tree trunk and shall be placed a minimum of 50 mm (2 inches) away from the trunk of the tree.

Tree wraps consisting of plastic tree guards, requiring no staples or fasteners, available 760 mm (30 inch) lengths shall be installed around each tree trunk.

30.3.2 Watering

Watering In - Trees shall be placed upright in the tree hole supported by 150 mm (6.0 inches) of planting media between the ball and each side of the tree hole. Planting media shall be watered in to remove all



air spaces. Tree holes shall then be filled to grade with planting media and watered in. The 100 mm (4.0 inch) retaining ring of planting media constructed around the perimeter of the tree hole must be kept intact to ensure adequate retention of water. Ensure the tree ball is at the same height that it was growing at in the nursery.

Watering shall be carried out when required and with sufficient quantities to prevent plants and underlying growing medium from drying out.

30.3.3 Staking and Tying

Tree Support

- a) Trees shall be braced upright in position by metal stakes in accordance with the following table:

Coniferous:

Tree Height	Tree Support Method
-------------	---------------------

1.5 - 2.5 m (4 ft. 10.7 in. - 8 ft. 2.0 in.)	1 stake with 1 tie
2.5 - 3.0 m (8 ft. 2.0 in. - 9 ft. 10.1 in.)	2 stakes with 2 wires
3.0 - 3.5 m (9 ft. 10.1 in. - 11 ft. 5.8 in.)	3 stakes, 3 ties

Deciduous:

Tree Calliper	Tree Support Method
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30 mm (1.20 inch)	1 stake with 1 tie
30 - 60 mm (1.20 in. - 2.50 in.)	2 stakes with 2 ties
60 - 120 mm (2.50 in. - 4.5 in.)	2 stakes with 2 ties

- b) Stakes for support of trees shall be metal stakes 50 mm x 50 mm x 2.5 m (2" x 2" x 8' 2.0") long. Tree stakes shall be installed 2 feet away from the tree trunk and the ties shall be installed in the top one third of the tree. Ties shall be placed around the trunk to provide adequate support and to prevent damage.

New black rubber hose, two ply, reinforced and 3 mm (.125 in.) in diameter, or wire encased in rubber, shall be used to encase wires where they circle the trunk or branches to protect the tree.

30.3.4 Restoration

Any damage that may be caused by the Contractor, his employees, his equipment or subcontractors shall be restored to pre-construction condition at the Contractor's expense and to the satisfaction of the Engineer. Disposal of all excess material to be done at an approved disposal site. Broom cleaning of pavement, concrete and sidewalks. Rake grass to ensure it is free of planting materials and/or loam. Leave site in a neat condition.

END OF SECTION

**31. LIST OF STANDARD DRAWINGS**

	<u>Revised Date</u>
A-101 Typical Hydrant Detail	October 2005
A-102 Standard Main Valve Detail	October 2005
Trojan Type 'C' Valve Box	April 2008
Trojan 12.7mm Stainless Steel Service Box Rod	April 2008
Trojan SSBI	April 2008
A-103 Thrust Block Details	October 2005
A-104 Typical Anode Installation At Valves - Iron Fittings and Hydrants	February 2004
A-105 Air Relief Valve and Flushing Chamber	March 2014
A-106 Steel Cattle Guard (for Air Relief Valve and Flushing Chamber)	March 2014
Trojan TF-39 Manhole Cover	April 2008
Trojan TF-39 Frame, Solid Cover, and Grated Cover	July 2001
Trojan Type T-K1/TF-51 Three Piece Catch Basin Frame and Grate with Side Inlet	Dec 2001
Trojan K-1A 2-Piece Side Inlet Standard with Locking Insert and Lower Lugs	February 2014
Trojan Type K-7 Single Frame and Grate	January 2004
Trojan Type K-7 Double Frame and Grate	January 2004
Trojan TF-38 Lane Paving Frame and Grated Cover	April 2003
B-101 Manhole Detail – Type 5A Pre-Cast	October 2005
B-102 Interior Drop Manhole	October 2005
B-102A External Drop Manhole	February 2005
B-103 Catch Basin Manhole	October 2005
B-104 Storm Catch Basin Assembly	October 2005
B-104A Catch Basin Typical 900mm	February 2004
B-105 Manhole Safety Platform	February 2004
B-106 Trash Grate Inlet	February 2004
C-101 Pipe Bedding Details	February 2004
C-102 Typical Service Layout	October 2005
C-102A Water Service Connection Profile View	July 2006
C-103 Pipe Support at Utility Crossing	February 2004
C-104 Water & Sanitary Main Pipe Installation Detail	March 2014
D-100 Cross Section – Undivided 2 Lane Major Road - Urban	May 2014
D-101 Cross Section – Undivided 2 Lane Major Road - Downtown	May 2014
D-102 Cross Section – Undivided 4 Lane Major Road – Urban	May 2014
D-103 Cross Section – Undivided 2 Lane Major Road – Rural	May 2014
D-104 Cross Section – Industrial / Commercial Collector Roadway – Urban with Sidewalk and Trail Options	May 2014
D-105 Cross Section – Low Impact Development – Industrial / Commercial Collector Roadway – Urban	May 2014
D-106 Cross Section – Industrial / Commercial Collector Roadway – Urban Two Way Lane	May 2014
D-107 Cross Section – Industrial / Commercial Collector Roadway – Urban 4 Lane Road	May 2014



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LIST OF STANDARD DRAWINGS

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D-108	Cross Section – Industrial / Commercial Collector Roadway – Rural	May 2014
D-109	Cross Section – Low Impact Development – Industrial / Commercial Collector Roadway – Urban	May 2014
D-110	Cross Section – Residential Collector Roadway – Urban with Sidewalk and Trail Options	May 2014
D-111	Cross Section – Residential Collector Roadway – Rural	May 2014
D-112	Cross Section – Local Industrial / Commercial Roadway – Urban	May 2014
D-113	Cross Section – Low Impact Development – Local Industrial / Commercial Roadway – Urban	May 2014
D-114	Cross Section – Local Residential Roadway – Rural	May 2014
D-115	Cross Section – Local Residential Roadway – Monolithic Sidewalks	May 2014
D-116	Cross Section – Local Residential Roadway – Separate Sidewalks	May 2014
D-117	Cross Section – Local Residential Roadway – Parking on One Side	May 2014
D-118	Cross Section – Local Residential Roadway – Low Impact Development	May 2014
D-119	Cross Section – Local Residential Roadway – Rural	May 2014
D-120	Cross Section – Local Residential Roadway – Rural with Expanded Ditches	May 2014
D-121	Cross Section – Local Residential Roadway – Downtown	May 2014
D-122	Cross Section – Local Residential Roadway – Public Service	May 2014
D-123	Typical Lane Cross Sections	May 2014
D-124	Lane Paving Details	May 2014
D-125	Typical Trail Cross-Sections	May 2014
D-126	Industrial / Commercial Curb and Gutter Crossing	May 2014
D-127	Typical Monolithic Lane and Driveway Crossing	May 2014
D-128	Asphalt Speed Bump	May 2014
D-129	Wheel Chair / Bike Ramp Locations	May 2014
D-130	Paraplegic Ramp Details on Tangent	May 2014
D-131	Paraplegic Ramp Details at Both Curb Returns	May 2014
D-132	Paraplegic Ramp Details at Centre of Curb Return – Rolled Curb	May 2014
D-133	500mm Standard Curb & Gutter	May 2014
D-134	250mm Standard Curb & Gutter	May 2014
D-135	250mm Low Profile Rolled Curb and Gutter	May 2014
D-136	Low Profile Rolled Monolithic Sidewalk	May 2014
D-137	Separate Sidewalk	May 2014
D-138	Concrete Drainage Swales	May 2014
D-139	Typical Concrete Swale Between Adjoining Properties	May 2014
D-140	Post and Chain Fence	May 2014
D-141	Removable Steel Bollard Detail	May 2014
D-142	Barrier Posts	May 2014
D-143	Culvert / Rip-Rap Detail	May 2014
D-144	Wood Screen Fence	May 2014
D-145	Wooden Barrier Posts	May 2014
D-146	Wood Bollard and Chain Fence	May 2014
E-001	Unmetered 120 Volt Connection for Irrigation Controller	June 2004
E-002	Unmetered U/G Electronic Service for Irrigation Controller (Typ.)	June 2004
E-003	Irrigation Water Service - Hardware Material Alignment	June 2004
E-004	Tree Support Method using Tree Stakes C/W Mulch	June 2004
E-005	Concrete Pad for Standard Irrigation Controller Cabinet	June 2004
E-006	Concrete Pad for Double Scorpio Irrigation Controller Cabinet	June 2004



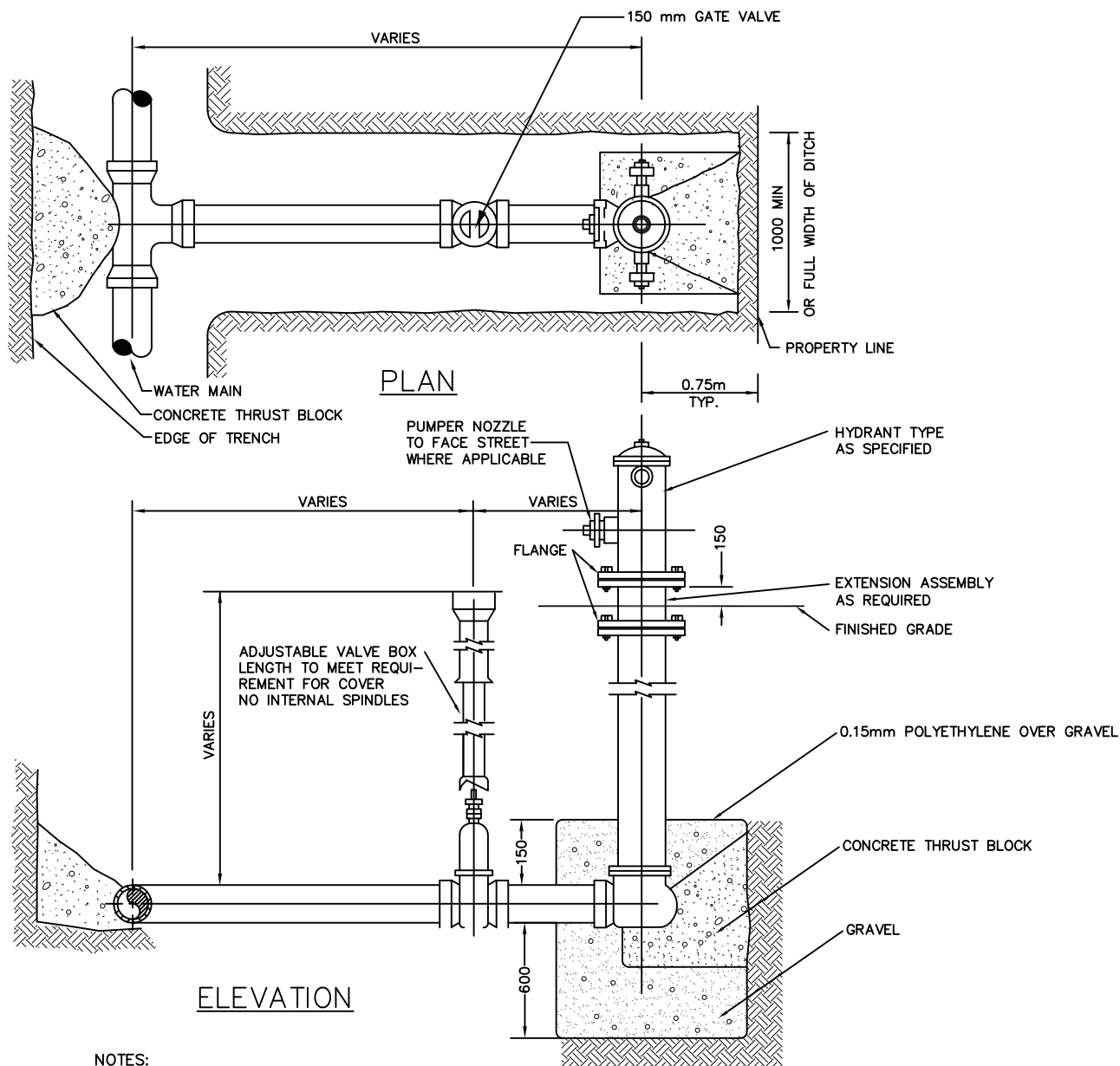
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E-007	Concrete Pad for Irrinet Irrigation Controller Cabinet	June 2004
E-008	Concrete Encased Support Post (Minimum Installation Guidelines)	June 2004
E-009	Irrigation Controller Cabinet	June 2004
E-010	Scorpio Cabinet Pedestal	June 2004
E-011	Vault Detail for Irrigation Valve System	June 2004

END OF SECTION



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.
2. CONCRETE TO BE 25 MPa @ 28 DAYS.
3. HYDRANTS SHALL BE COMPRESSION TYPE CONFORMING TO AWWA C502 STAINLESS STEEL BOLTS AND ASPHALTIC COATED HYDRANT COMPONENTS.
4. PROVIDE CATHODIC PROTECTION AS SHOWN ON STD. DWG. NO. A-104
5. THRUST BLOCKS TO BE PLACED AGAINST UNDISTURBED GROUND HAVING A MINIMUM BEARING OF 7300 kg/m²
6. CONCRETE TO BE POURED CLEAR OF ALL FLANGES, JOINTS, AND HYDRANT DRAIN.
7. APPROVED BACKFILL TO BE COMPACTED TO A MINIMUM OF 98% SPD.
8. DO NOT ALLOW PONDING OR STANDING WATER AROUND HYDRANT
9. PLACEMENT OF HYDRANT AND ORIENTATION OF PUMPER NOZZLE TO BE APPROVED.



TITLE:

TYPICAL HYDRANT DETAIL

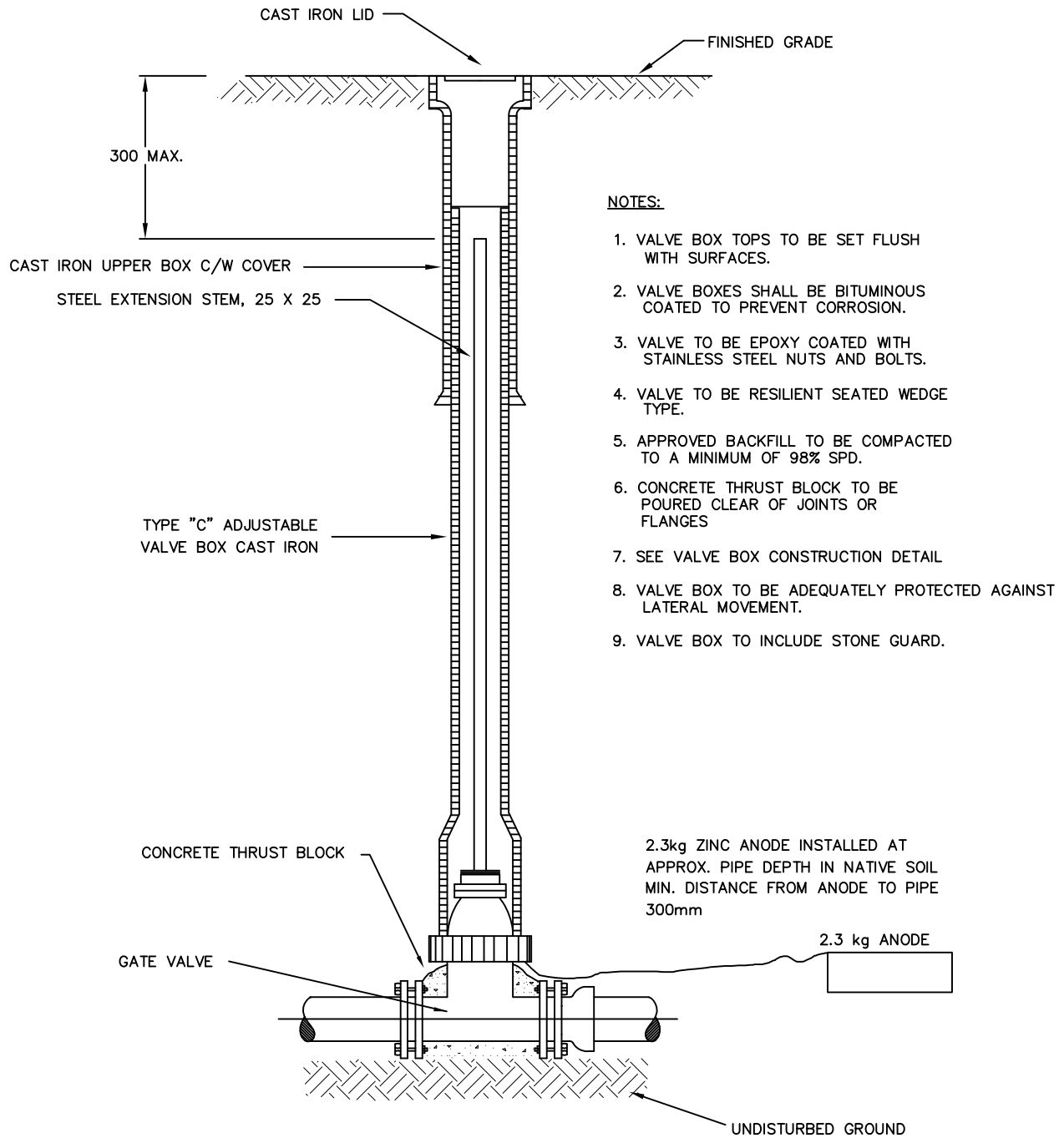
STANDARD DETAILS

SCALE: N.T.S.

DATE: OCTOBER 2005

STD. DWG NO.

A-101



TITLE:

STANDARD MAIN VALVE DETAIL

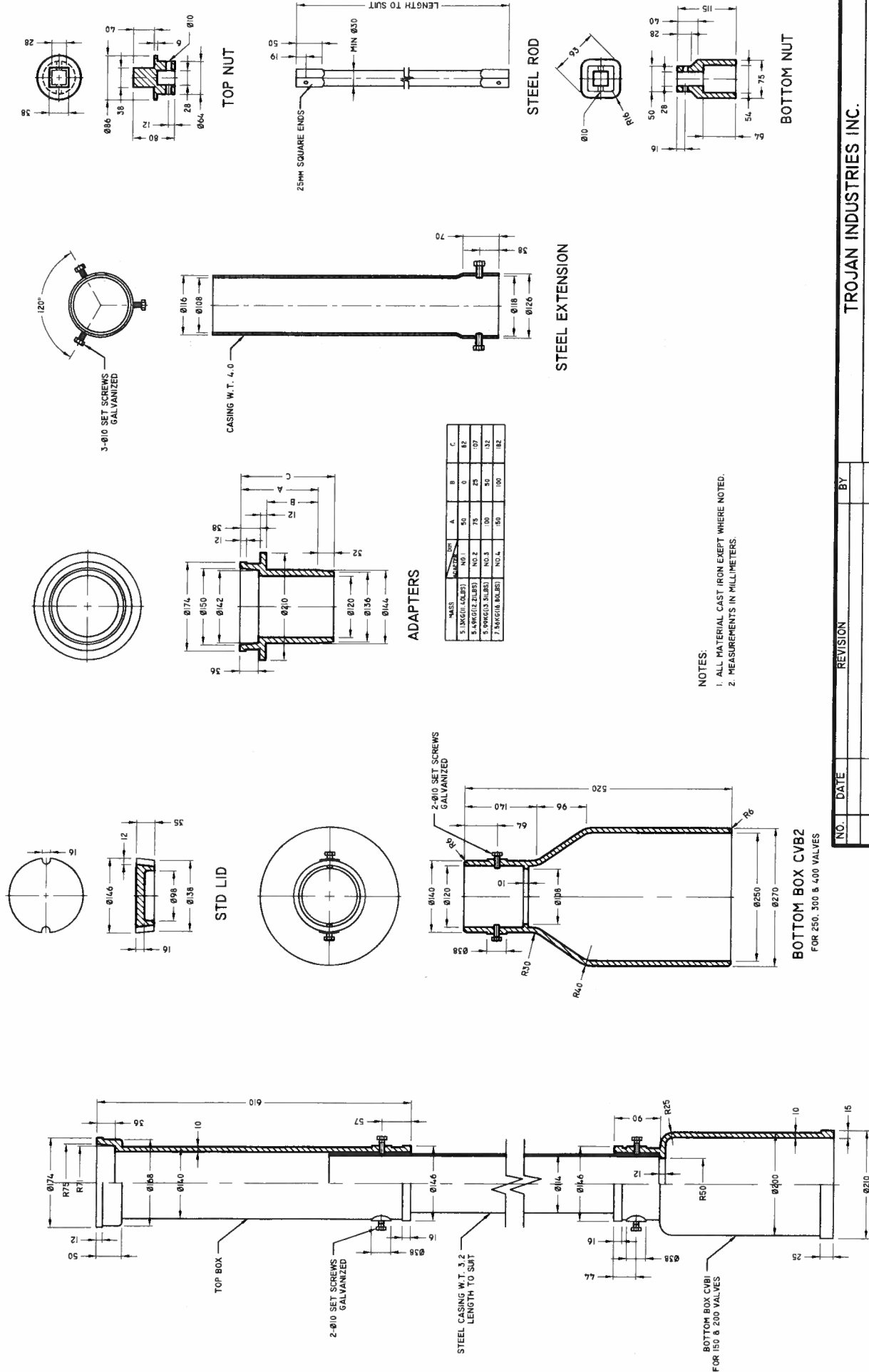
STANDARD DETAILS

SCALE: N.T.S.

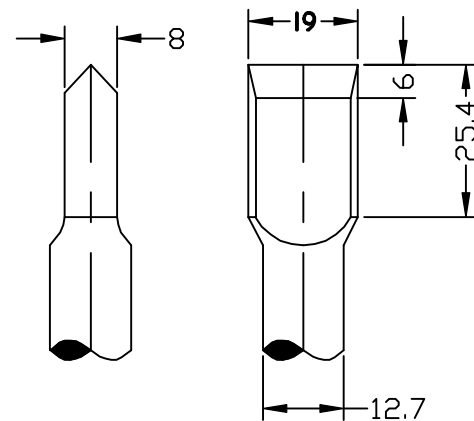
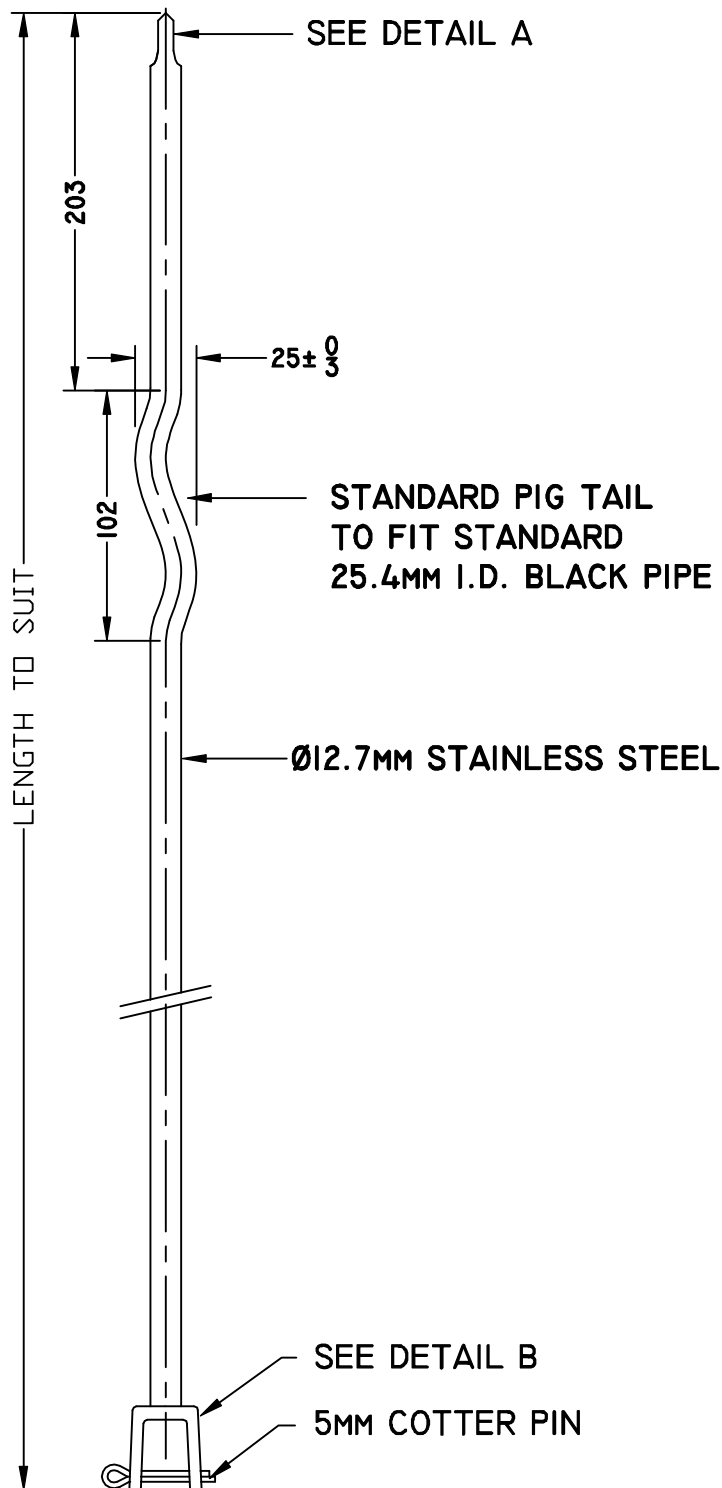
DATE: OCTOBER 2005

STD. DWG NO.

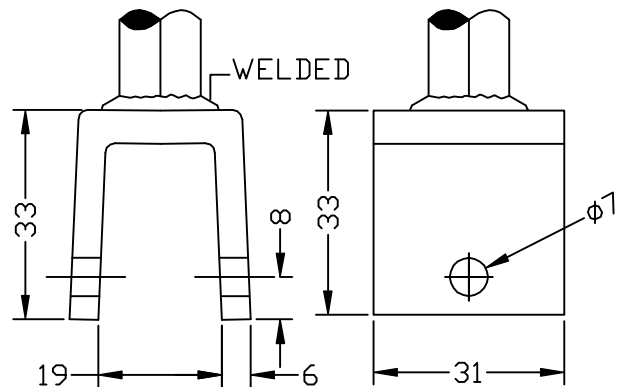
A-102



12.7MM STAINLESS STEEL SERVICE BOX ROD SSRWC



DETAIL A

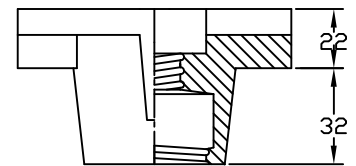
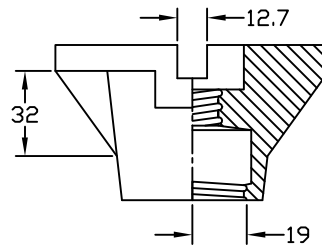
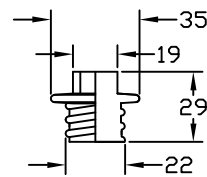
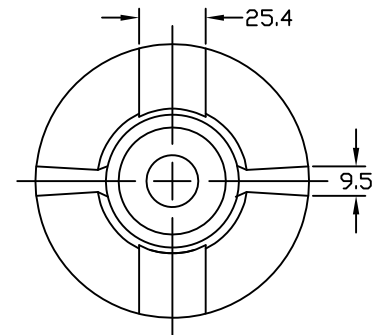
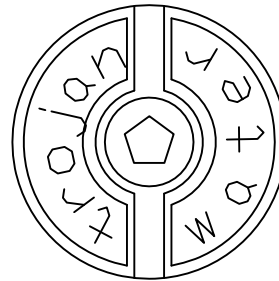
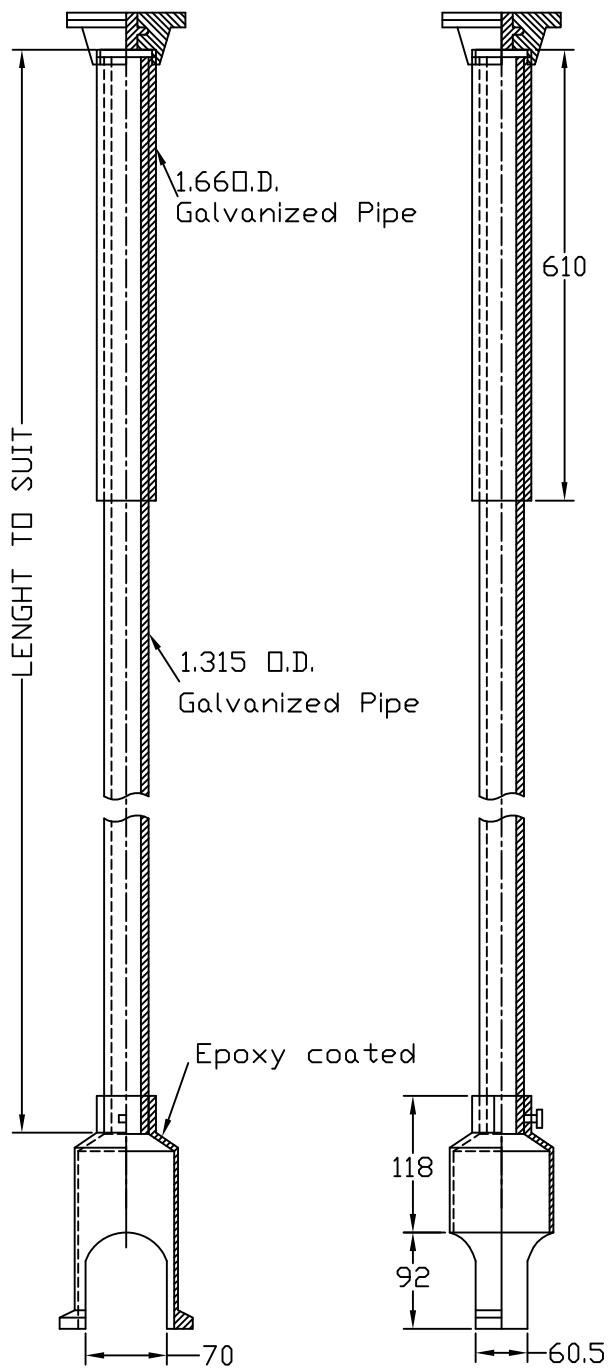


DEATIL B

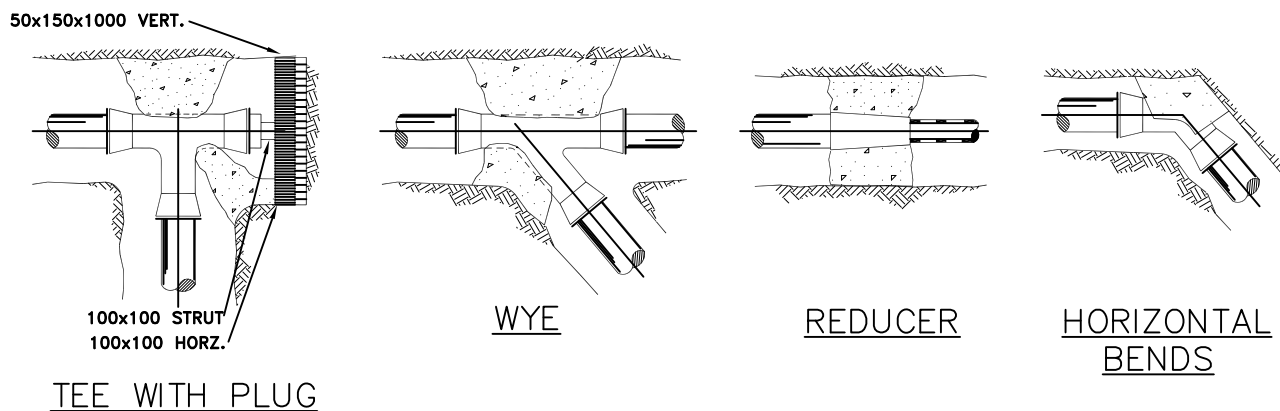
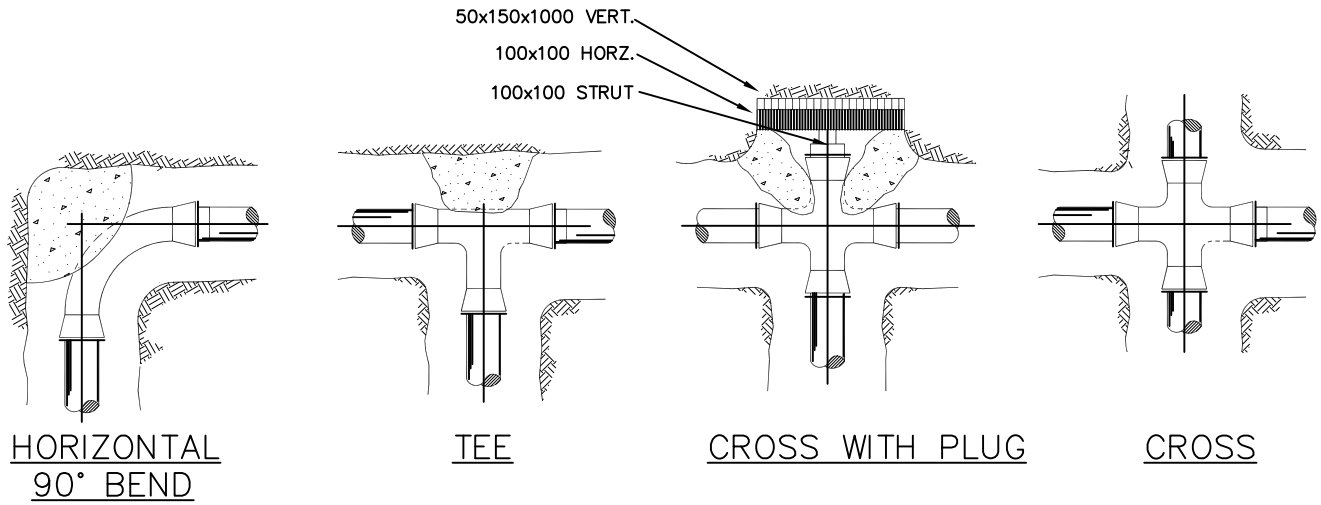
MATERIAL:
DIN 50.049/2.3 TYPE 304
HRR STAINLESS STEEL

MEASUREMENTS IN MILLIMETERS

SSBI



Material:
 1.66 O.D. Upper section 1.315 O.D. Casing-ASTM A-500 Type 1 HRR Steel
 Cast Iron Cap and Boot- ASTM A-48 Class 20 Grey Iron
 Brass Pentagon Plug - CDA 60-40 Yellow Brass



NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. ALL FITTINGS TO BE WRAPPED IN 6 ML POLYETHYLENE PRIOR TO POURING CONCRETE.
3. ALL CONCRETE TO BE MIN. 25 MPa @ 28 DAYS.
4. THE REQUIRED BEARING AREA SHALL BE DETERMINED BY THE CONTRACTOR TO SUIT SOIL CONDITIONS.



TITLE:

THRUST BLOCK DETAILS

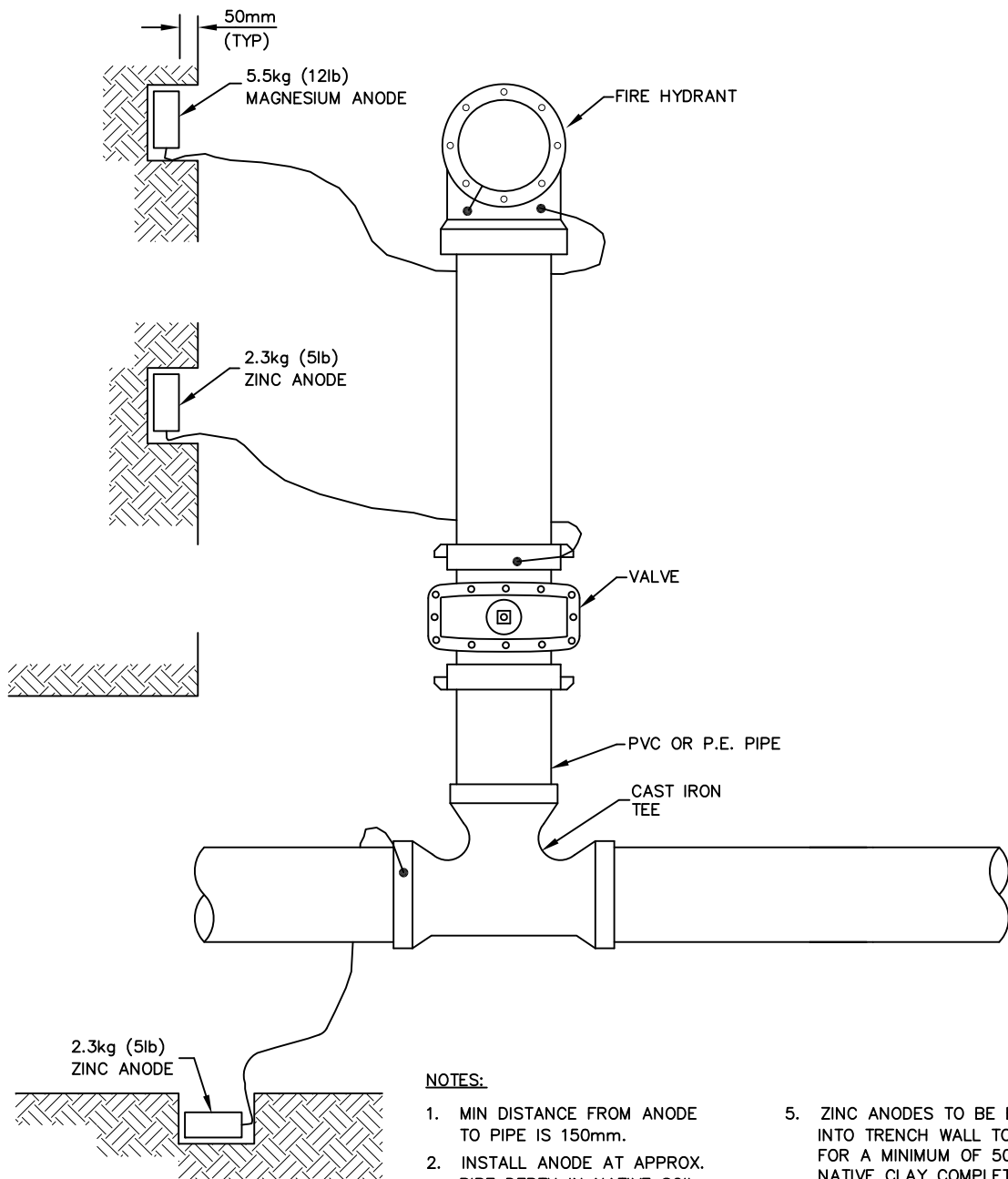
STANDARD DETAILS

SCALE: N.T.S.

DATE: OCTOBER 2005

STD. DWG NO.

A-103



NOTES:

1. MIN DISTANCE FROM ANODE TO PIPE IS 150mm.
2. INSTALL ANODE AT APPROX. PIPE DEPTH IN NATIVE SOIL.
3. ALL ZINC ANODES ON FITTINGS AND VALVES ARE 2.3 kg (5lb).
4. ALL ZINC ANODES ON HYDRANTS ARE 5.5 kg (12lb).
5. ZINC ANODES TO BE EMBEDDED INTO TRENCH WALL TO PROVIDE FOR A MINIMUM OF 50mm OF NATIVE CLAY COMPLETELY SURROUNDING THE ANODE.
6. ANODES TO BE AT LEAST 300mm CLEAR OF THRUST BLOCK.
7. REPLACE CLAY OVER ANODES AND COMPACT.



TITLE:

TYPICAL ANODE
INSTALLATION AT VALVES
IRON FITTINGS & HYDRANTS

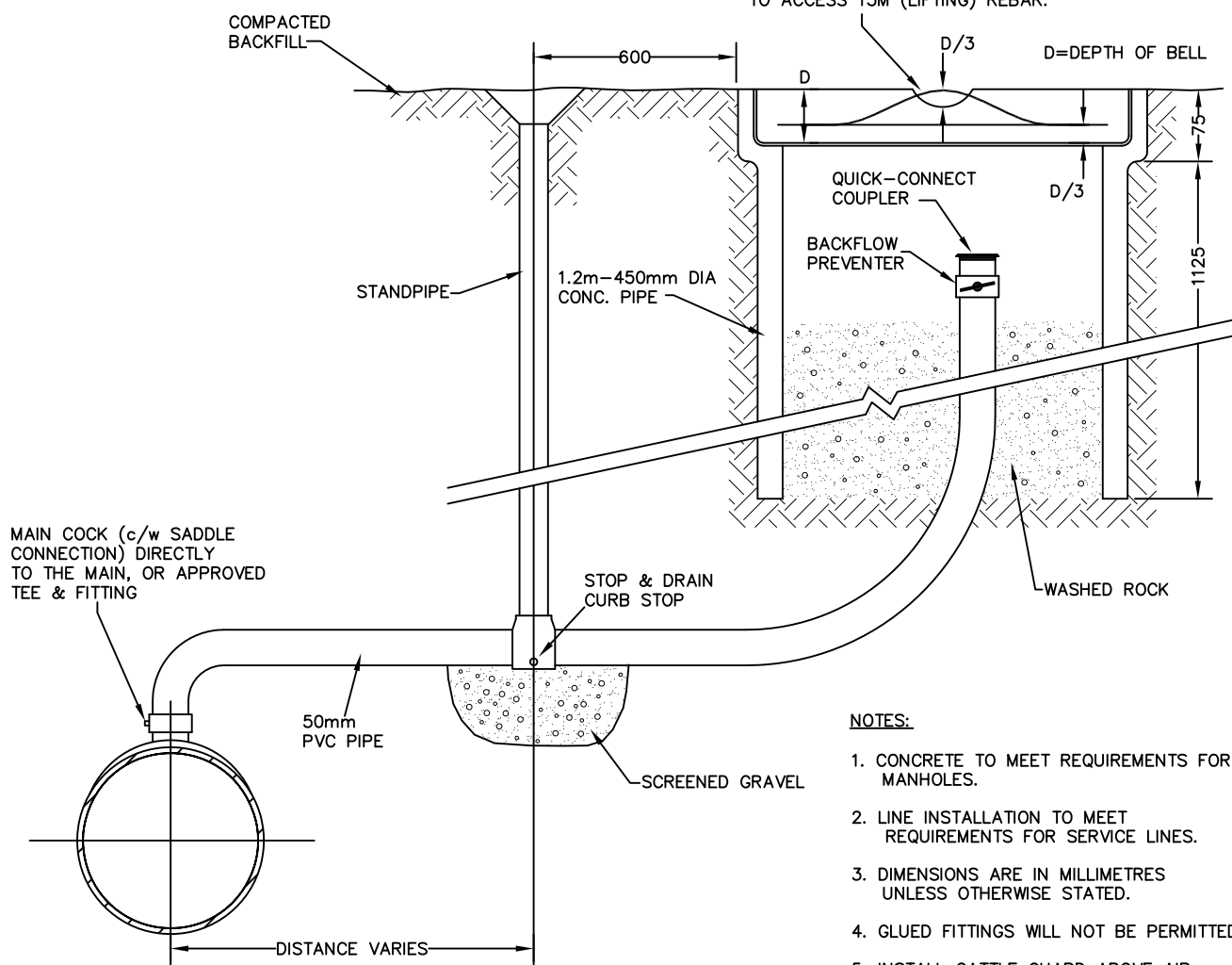
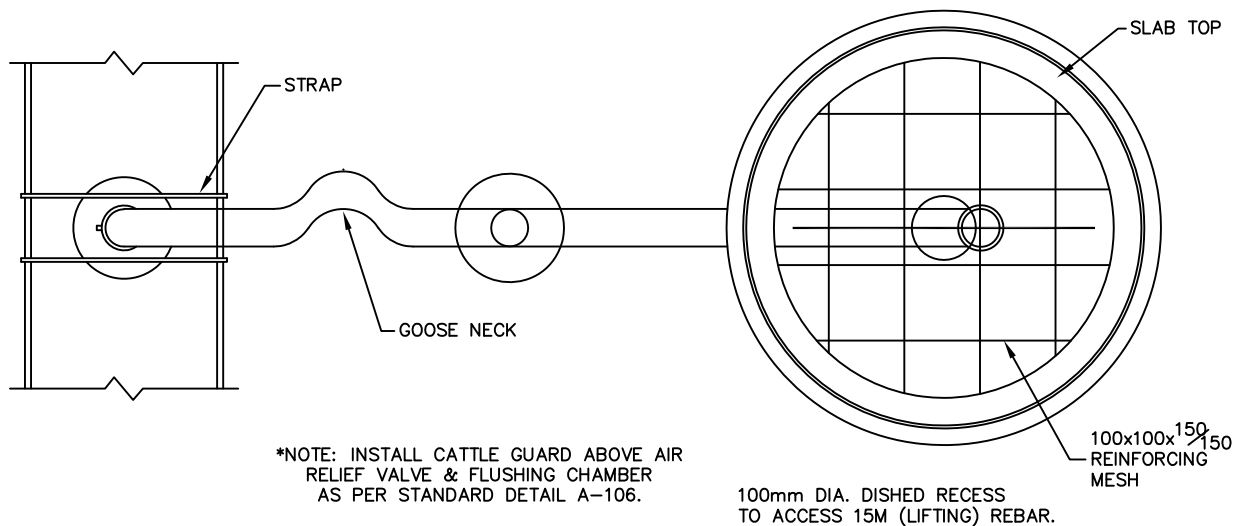
STANDARD DETAILS

SCALE: N.T.S.

DATE: FEBRUARY 2004

STD. DWG NO.

A-104



NOTES:

1. CONCRETE TO MEET REQUIREMENTS FOR MANHOLES.
2. LINE INSTALLATION TO MEET REQUIREMENTS FOR SERVICE LINES.
3. DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.
4. GLUED FITTINGS WILL NOT BE PERMITTED.
5. INSTALL CATTLE GUARD ABOVE AIR RELIEF VALVE & FLUSHING CHAMBER AS PER STANDARD DETAIL A-106.



TITLE:

AIR RELIEF VALVE AND FLUSHING CHAMBER

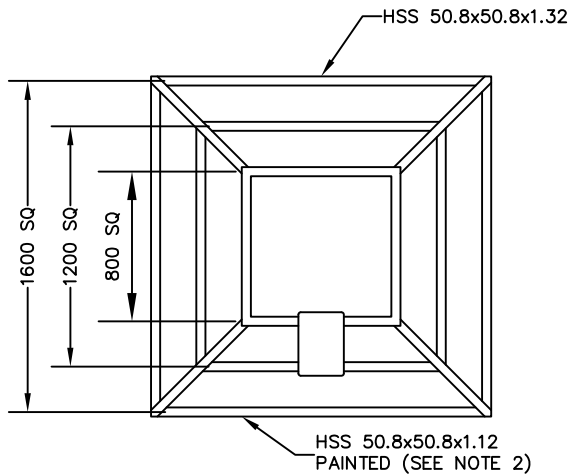
STANDARD DETAILS

SCALE: N.T.S.

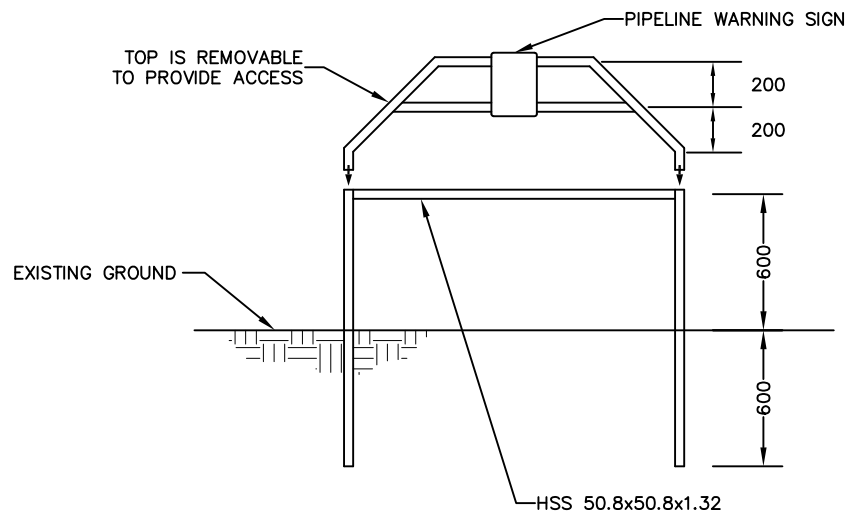
DATE: MARCH 2014

STD. DWG NO.

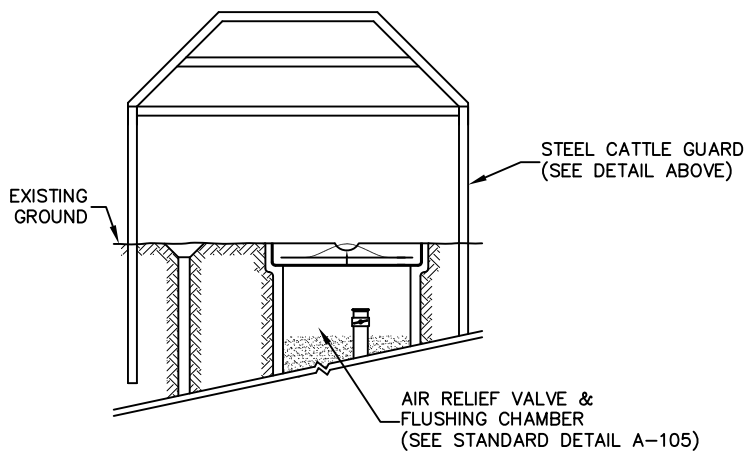
A-105



PLAN



ELEVATION



NOTES:

1. DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.
2. BENJAMIN MOORE SUPER SPEC HP D.T.M. ACRYLIC GLOSS ENAMEL (P28) COLOR - SAFETY BLUE.



TITLE:

STEEL CATTLE GUARD
(FOR AIR RELIEF VALVE AND
FLUSHING CHAMBER)

STANDARD DETAILS

SCALE: N.T.S.

DATE: MARCH 2014

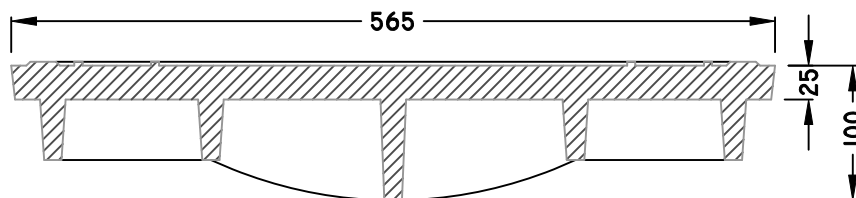
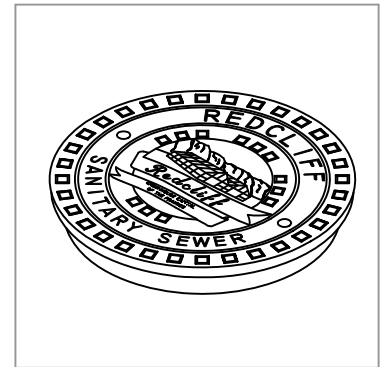
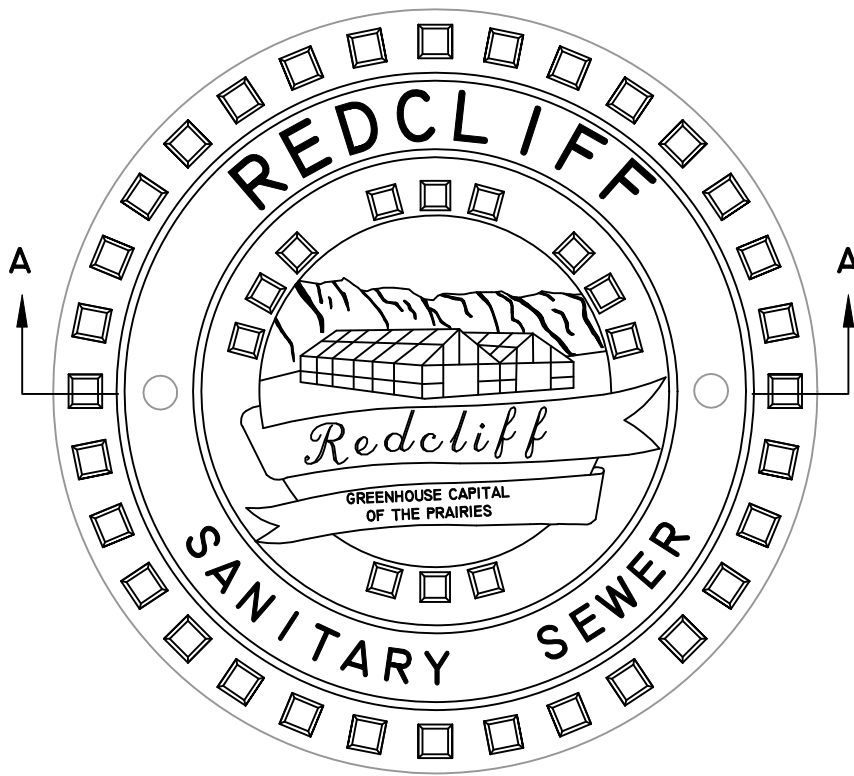
STD. DWG NO.

A-106

MANHOLE COVER

TF-39

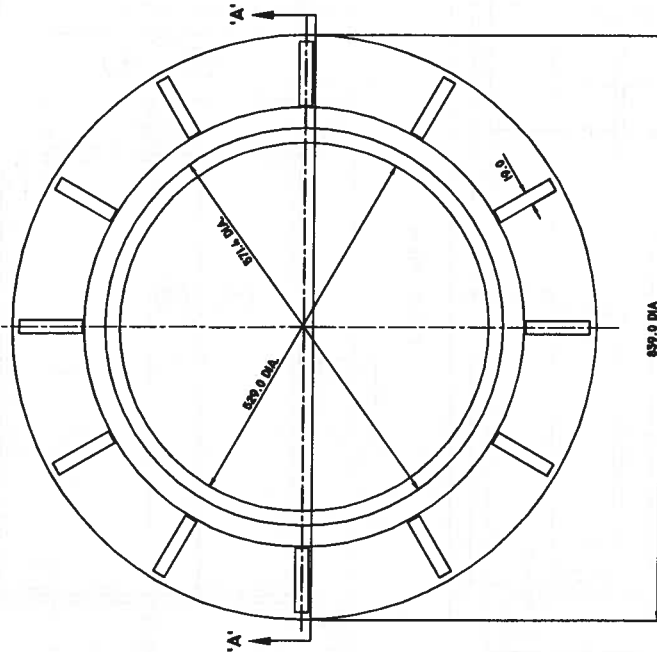
PLAN



SECTION A-A

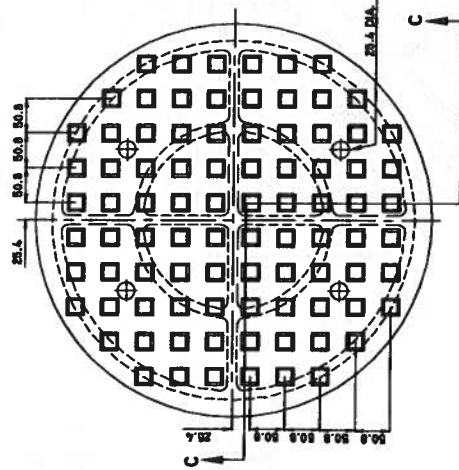
TF-39 STANDARD FRAME
MASS: 76.96KG (171.00LBS)

PLAN



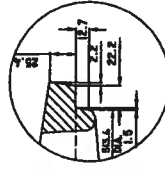
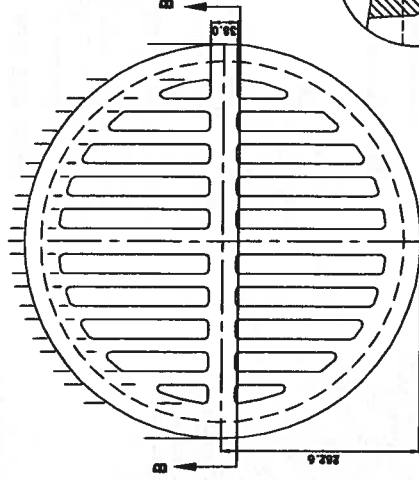
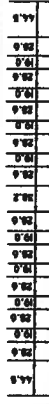
TF-39 STANDARD COVER
MASS: 46.28KG (102.00LBS)

PLAN



TF-39 STANDARD GRATE
MASS: 49.20KG (109.00LBS)

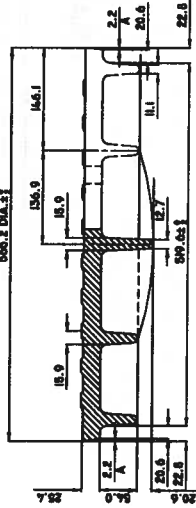
PLAN



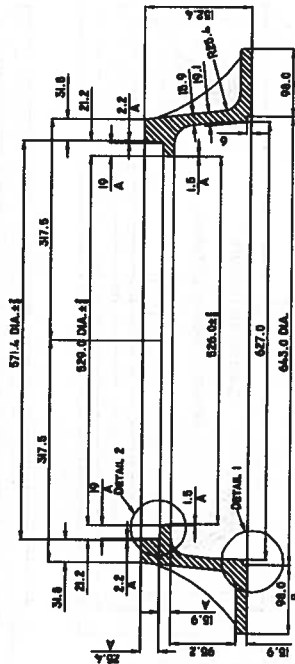
DETAIL 3



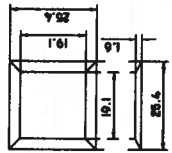
SECTION B-B



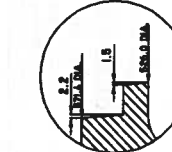
SECTION C-C



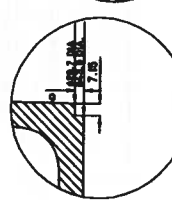
SECTION A-A



DETAIL OF CHECKERS
(FULL SIZE)



DETAIL 1



DETAIL 2

MEASUREMENTS IN MILLIMETERS

TABLE I

MANUFACTURING TOLERANCE

- ALL DIMENSIONS SHALL CONFORM TO ± 0.13 TOLERANCE EXCEPT:
- (1) AS NOTED.
 - (2) DIMENSIONS MARKED "W" SHALL CONFORM TO A ± 0.13 TOLERANCE.
 - (3) DIMENSIONS MARKED "S" SHALL CONFORM TO A ± 0.13 TOLERANCE.

SPECIFICATIONS

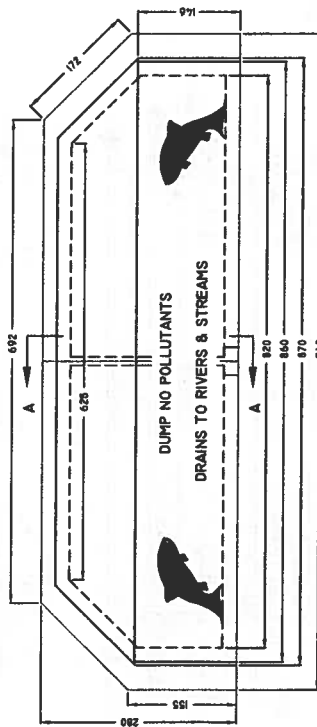
- (1) CASTINGS SHALL CONFORM TO ALL REQUIREMENTS OF A.S.T.M. DESIGNATION AND CLASS DESIGNATION CITY OF ENHANCEMENT CLASS OR BEHIND.
- (2) ALL DIMENSIONS SHALL BE PRODUCED TO THE DIMENSIONS AND WITHIN THE TOLERANCES NOTED IN THE TABLE.
- (3) CASTINGS SHALL BE MARKED WITH THE MANUFACTURER'S MARKING.
- (4) ALL DIMENSIONS SHALL BE TAKEN AT THE TIME OF CASTING.
- (5) ALL DIMENSIONS SHALL BE TAKEN AT THE TIME OF CASTING.
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TROJAN INDUSTRIES INC.

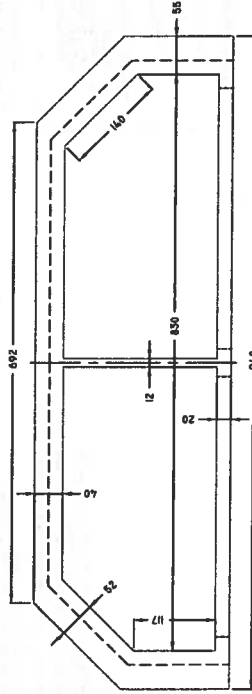
TF-39 FRAME, SOLID COVER AND GRATED COVER

SCALE:	1 : 5	DATE:	JULY 2001	DRAWING NO.:	TF-39F/TF-39C/TF-39G
DRAWN BY:	M.P.	CHIEF:	J. MOONEY	REV.:	
				REV.:	

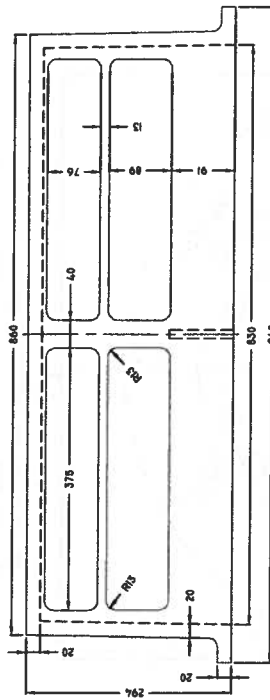
PLAN



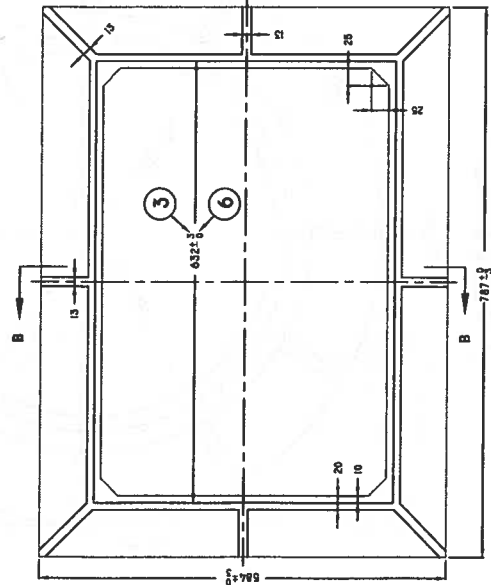
SIDE INLET



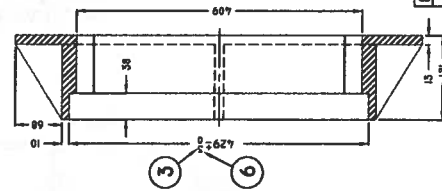
BOTTOM VIEW



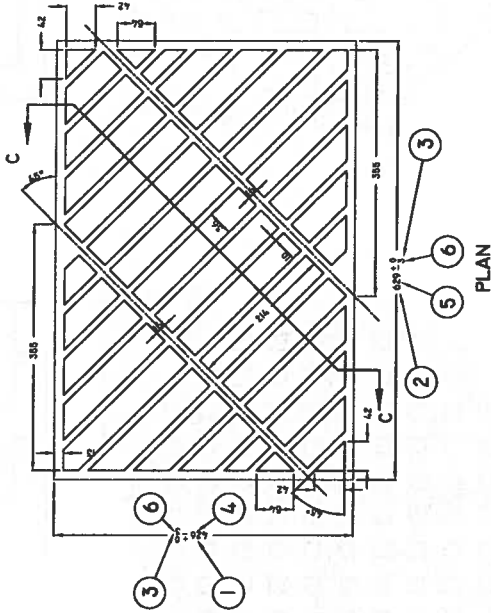
FRONT VIEW



SECTION B-B



GRATE

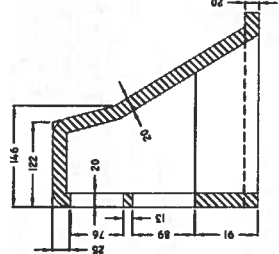


PLAN

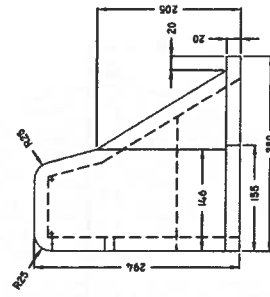
SECTION C-C



SECTION A-A



RIGHT SIDE VIEW



MEASUREMENTS IN MILLIMETERS

NO.	DATE	REVISION	BY
1	22 MAY, 2004	CHANGED DIMENSION 427 TO 426	J.P.R.
2	22 MAY, 2004	CHANGED DIMENSION 430 TO 428	J.P.R.
3	22 MAY, 2004	CHANGED DIMENSION 435 TO 424 AND -3 TO -2	J.P.R.
4	5 OCT. 2004	CHANGED TOLERANCE 435 TO 42 AND 436 TO 439	J.P.R.
5	5 OCT. 2004	CHANGED DIMENSION 438 TO 439	J.P.R.
6	5 OCT. 2004	CHANGED DIMENSION 438 TO 439	J.P.R.
7	5 OCT. 2004	CHANGED TOLERANCE 42 TO 43 AND -2 TO -3	J.P.R.
8			
9			
10			

TROJAN INDUSTRIES INC.

**TYPE T-K1/TF-51 THREE PIECE CATCH BASIN FRAME
AND GRATE WITH SIDE INLET**

DATE: DEC 04 2006

DRAWING NO:

Y M I , T F F I

DRAWN BY:

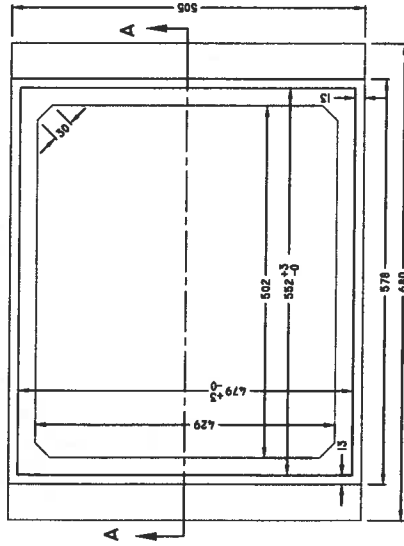
22

:REV:

T-K7 SINGLE FRAME

MASS: 92.07KG (204.60LBS)

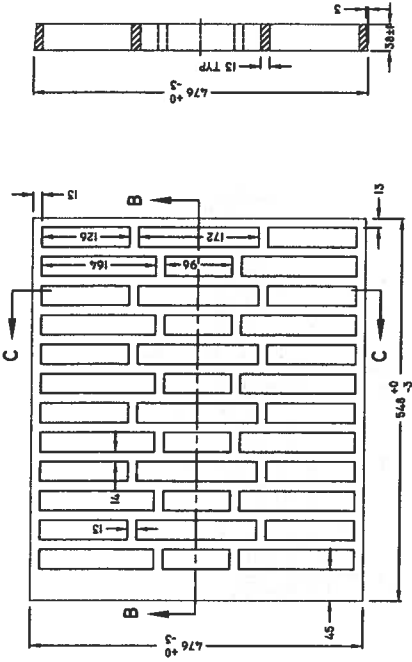
PLAN



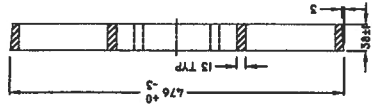
T-K7 GRATE

MASS: 22.77KG (50.60LBS)

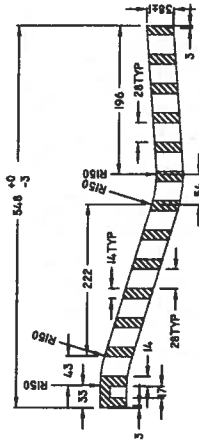
PLAN



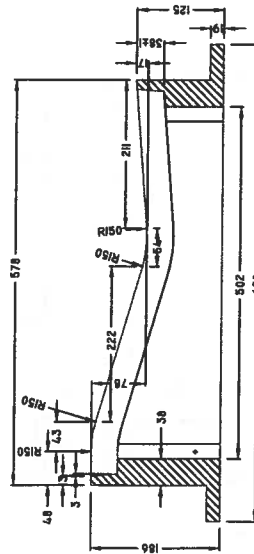
SECTION C-C



SECTION B-B



SECTION A-A



MATERIAL SPECIFICATIONS:

- FRAME
GREY CAST IRON TO CONFORM
TO CLASS 25B A.S.T.M. A48
(LATEST EDITION)
FOR CITY OF EDMONTON CLASS 30
REQUIRED.
- GRATE
DUCTILE IRON TO CONFORM
TO A.S.T.M. A536(LATEST EDITION)
GRADE 60-40-18

MEASUREMENTS IN MILLIMETERS

TROJAN INDUSTRIES INC.

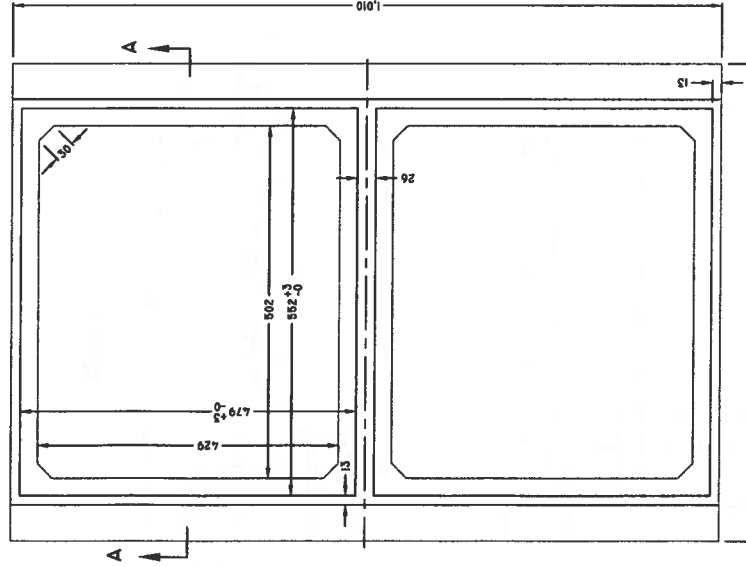
TYPE K-7 SINGLE FRAME AND GRATE

SCALE:	1 : 5	DATE:	JAN 11, 2004	DRAWING NO:	T-K7FS/T-K7G
DRAWN BY:	J.P	ENGINEER:	J. MOONEY	REV:	REV:

T-K7 DOUBLE FRAME

MASS: 184.14KG (409.20LBS)

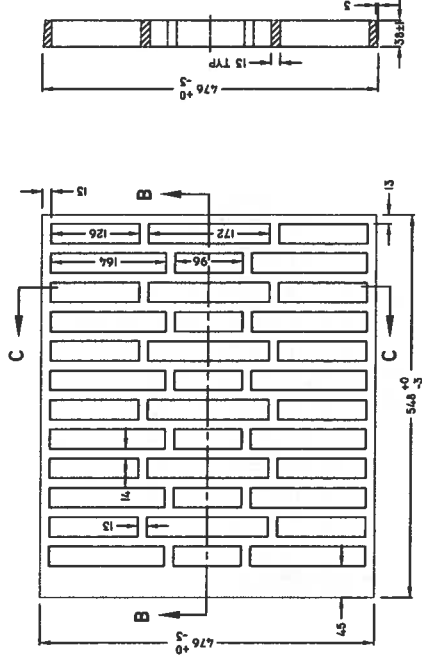
PLAN



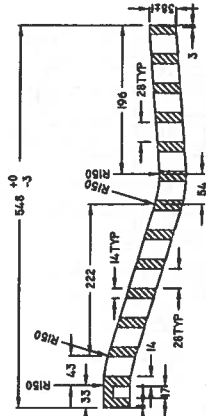
T-K7 GRATE

MASS: 22.77KG (50.60LBS)

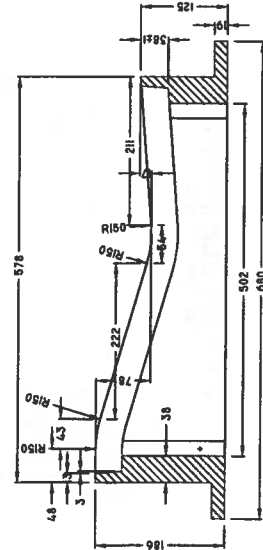
PLAN



SECTION C-C



SECTION B-B



SECTION A-A

MATERIAL SPECIFICATIONS:

- * FRAME
GREY CAST IRON TO CONFORM
TO CLASS 25B A.S.T.M. A48
(LATEST EDITION)
FOR CITY OF EDMONTON CLASS 30
REQUIRED.
- * GRATE
DUCTILE IRON TO CONFORM
TO A.S.T.M. A536(LATEST EDITION)
GRADE 60-40-18

MEASUREMENTS IN MILLIMETERS

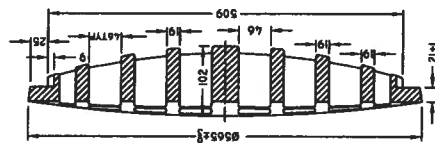
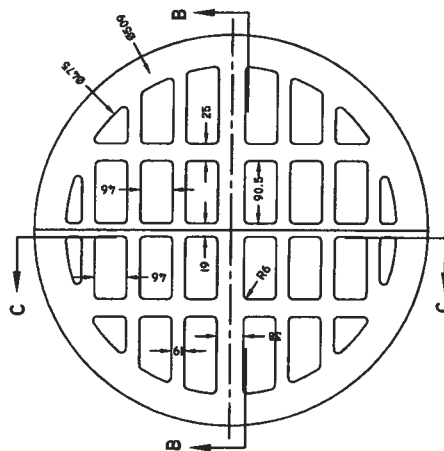
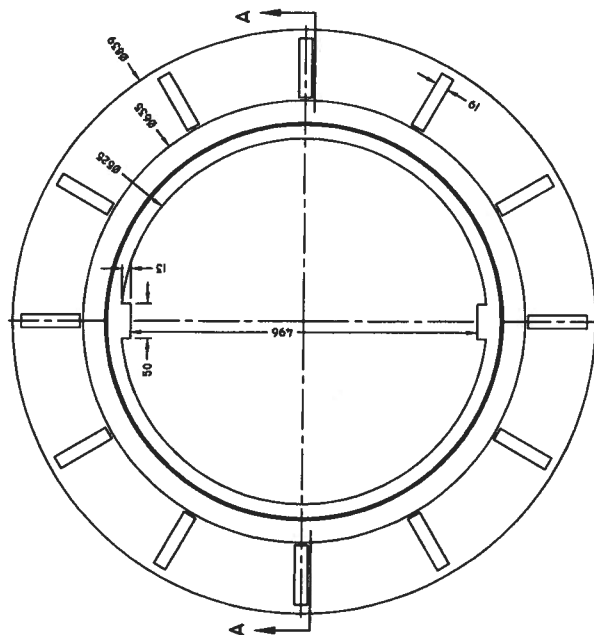
TROJAN INDUSTRIES INC.

TYPE K-7 DOUBLE FRAME AND GRATE

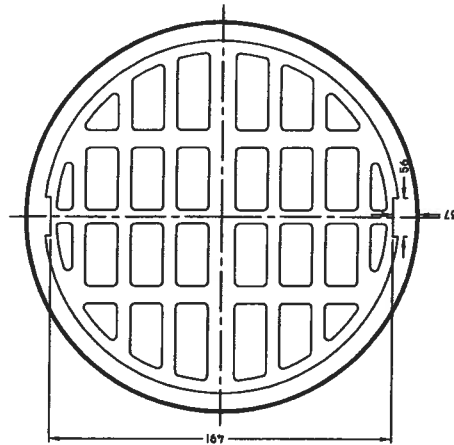
SCALE:	1 : 5	DRAWN BY:	J.P	ENGINEER:	J. MODNEY	REV:		REF:	
DRAWING NO:	T-K7FDU/T-K7G	DATE:	JAN 13, 2004	REV:					

MASS: 90.01KG(217.80LBS)

MASS: 66.53KG(147.40LBS)

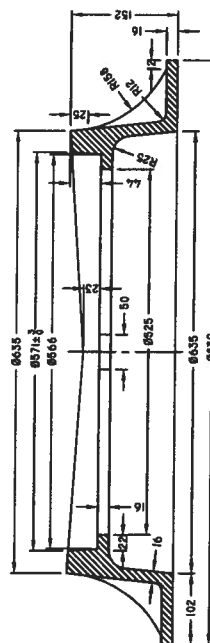
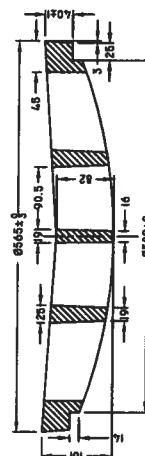


SECTION C-C



BOTTOM VIEW

SECTION B-B



SECTION A-A

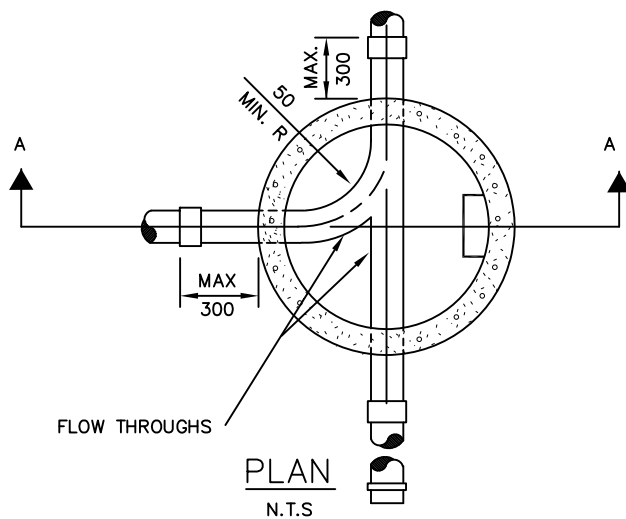
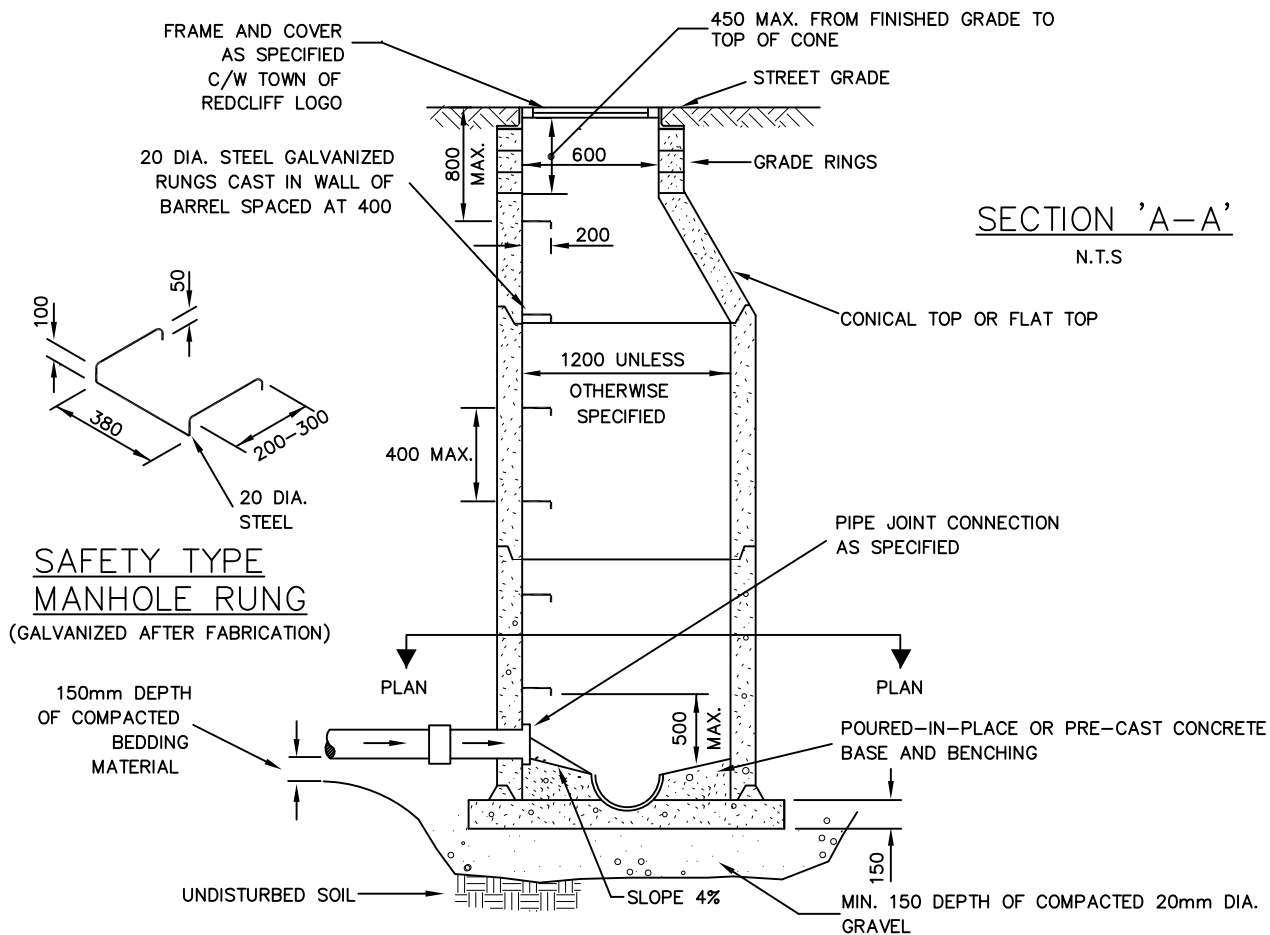
MEASUREMENTS IN MILLIMETERS

TABLE I
MANUFACTURING TOLERANCE

- ALL DIMENSIONS SHALL CONFORM TO A201 TOLERANCE EXCEPT:
- (b) AS NOTED.
- (c) NO DIMENSION SHALL BE ACCEPTABLE FOR DIMENSIONS WHICH ARE LIES THERE.

- THE TABLE I
- (1) CASTINGS SHALL CONFORM TO ALL REQUIREMENTS OF A.S.T.M. DESIGNATION AND CLASS 30.
- (2) CASTINGS SHALL BE PROVIDED TO THE DRAWING AND SPECIFICATION REQUIREMENTS.
- (3) CASTINGS SHALL BE MARKED WITH THE PROPER IDENTIFICATION MARKINGS WHICH WILL INCLUDE:
- (a) MARKINGS AS REQUESTED AT TIME OF ORDER.
 - (b) POURING IDENTIFICATION MARKING AND DATE OF CASTING.
 - (c) FOUNDRY IDENTIFICATION MARKING.
 - (d) SIZE OF EACH CASTING THAT THEY ARE EASILY IDENTIFIABLE AFTER INSTALLATION.
- (4) ALL CASTINGS WILL BE FREE OF DEFECTS, BE TRUE TO PATTERNS AND BE FREE OF CRACKS, FRACTURES, PLAINS AND EXCESSIVE SPRINGAGE. SURFACES OF CASTINGS SHALL BE FINISHED TO A SMOOTH, FINISHED, SMOOTH.
- (5) CASTINGS SHALL BE FINISHED TO A SMOOTH, FINISHED, SMOOTH.
- (6) CASTING SHALL NOT BE USED WHEN INSTALLED. THE HAND-APPLIED SHALL BE THE CASTINGS AGAINST A STANDARD FRAME.

[illegible]



NOTES:

1. ALL PRE-CAST MANHOLES MUST CONFORM TO A.S.T.M. SPECIFICATIONS C478.
2. POURED-IN-PLACE CONCRETE SHALL HAVE 28 DAYS COMPRESSIVE STRENGTH OF AT LEAST 25 MPa.
3. ALL JOINTS TO BE SET WITH RUBBER GASKET AND SET WITH NON-SHRINK GROUT, INSIDE AND OUT, FOR THE FULL CIRCUMFERENCE.
4. FORM FLOW TROUGH IN PARTIALLY SET CONCRETE AND TROWEL SMOOTH.
5. ALL DIMENSIONS GIVEN IN MILLIMETRES UNLESS OTHERWISE STATED.
6. MAX. DIST. FROM RIM TO TOP RUNG IS 800 mm.
7. BACKFILL AROUND MH. WITH SELECT NATIVE MATERIAL. COMPACT TO 98% S.P.D.
8. FLAT TOP SECTION TO BE USED FOR MANHOLES UP TO 1.8 m BURY.
9. ALL JOINTS TO BE WATERTIGHT. METHODS TO BE CONSISTENT WITH SITE CONDITIONS.
10. FOR MANHOLES 5.0 m IN DEPTH OR GREATER, A SAFETY PLATFORM SHALL BE INSTALLED.
11. MANHOLES TO MEET REQUIREMENTS OF MANHOLE DETAILS AND SPECIFICATIONS.
12. SAFETY STEPS TO BE PROVIDED, SPACED AT 400 MAX. FIRST STEP 150 MAX. BELOW FRAME, LAST STEP 300 MAX. ABOVE BASE.



TITLE:

MANHOLE DETAIL TYPE 5A PRE-CAST

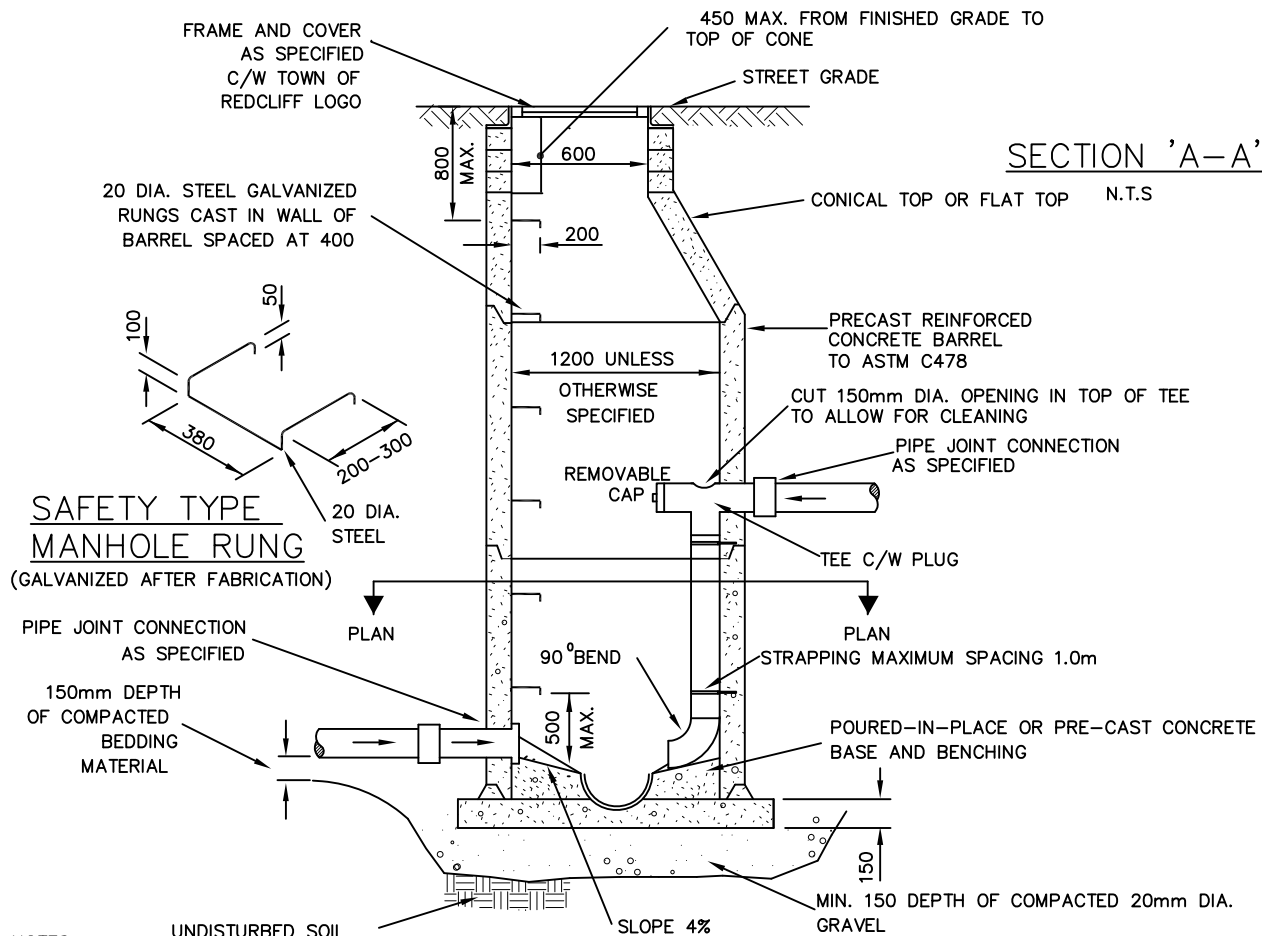
STANDARD DETAILS

SCALE: N.T.S.

DATE: OCTOBER 2005

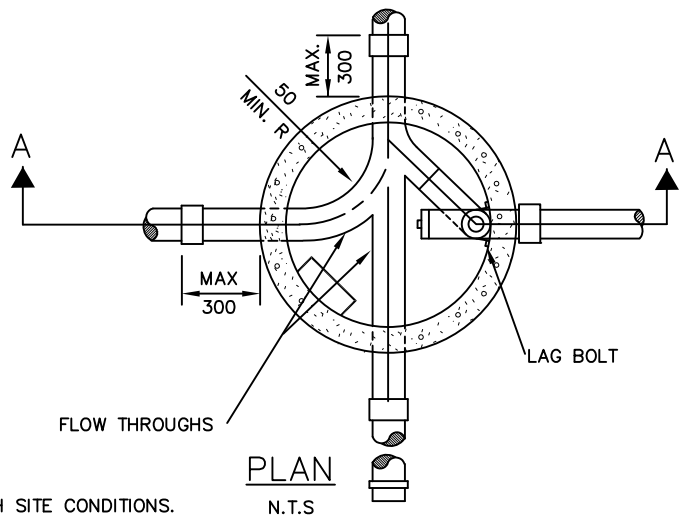
STD. DWG NO.

B-101



NOTES:

1. ALL PRE-CAST MANHOLES MUST CONFORM TO A.S.T.M. SPECIFICATIONS C478.
2. POURED-IN-PLACE CONCRETE SHALL HAVE 28 DAYS COMPRESSIVE STRENGTH OF AT LEAST 25 MPa.
3. ALL JOINTS TO BE SET WITH RUBBER GASKET AND SET WITH NON-SHRINK GROUT, INSIDE AND OUT, FOR THE FULL CIRCUMFERENCE.
4. FORM FLOW THROUGH IN PARTIALLY SET CONCRETE AND TROWEL SMOOTH.
5. ALL DIMENSIONS ARE GIVEN IN MILLIMETRES UNLESS OTHERWISE STATED.
6. MAX. DIST. FROM RIM TO TOP RUNG IS 800 mm.
7. BACKFILL AROUND MH. WITH SELECT NATIVE MATERIAL AND COMPACT TO 98 % S.P.D.
8. FLAT TOP SECTION TO BE USED FOR MANHOLES UP TO 1.8 m BURY.
9. ALL JOINTS TO BE WATERTIGHT. METHODS TO BE CONSISTENT WITH SITE CONDITIONS.
10. FOR MANHOLES 5.0 m IN DEPTH AND GREATER, A SAFETY PLATFORM SHALL BE INSTALLED.
11. MANHOLES TO MEET REQUIREMENTS OF MANHOLE DETAILS AND SPECIFICATIONS.
12. LAG BOLTS AND STRAPPING ARE TO BE INSTALLED IMMEDIATELY BELOW THE TEE AND A CONTINUAL 1.0 m VERTICAL SPACING TO THE BASE.
13. DIAMETER, SIZE, AND TYPE OF VERTICAL PIPE TO MATCH INLET PIPE.
14. SAFETY STEPS TO BE PROVIDED, SPACED AT 400 MAX. FIRST STEP 150 MAX. BELOW FRAME, LAST STEP 300 MAX. ABOVE BASE.



TITLE:

INTERIOR DROP MANHOLE DETAIL

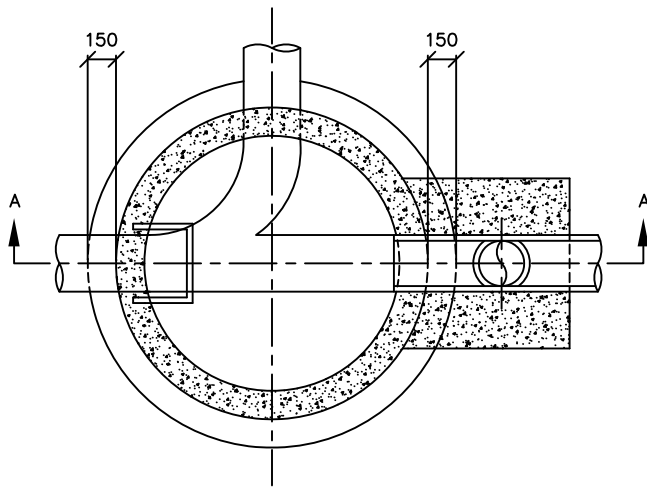
STANDARD DETAILS

SCALE: N.T.S.

DATE: OCTOBER 2005

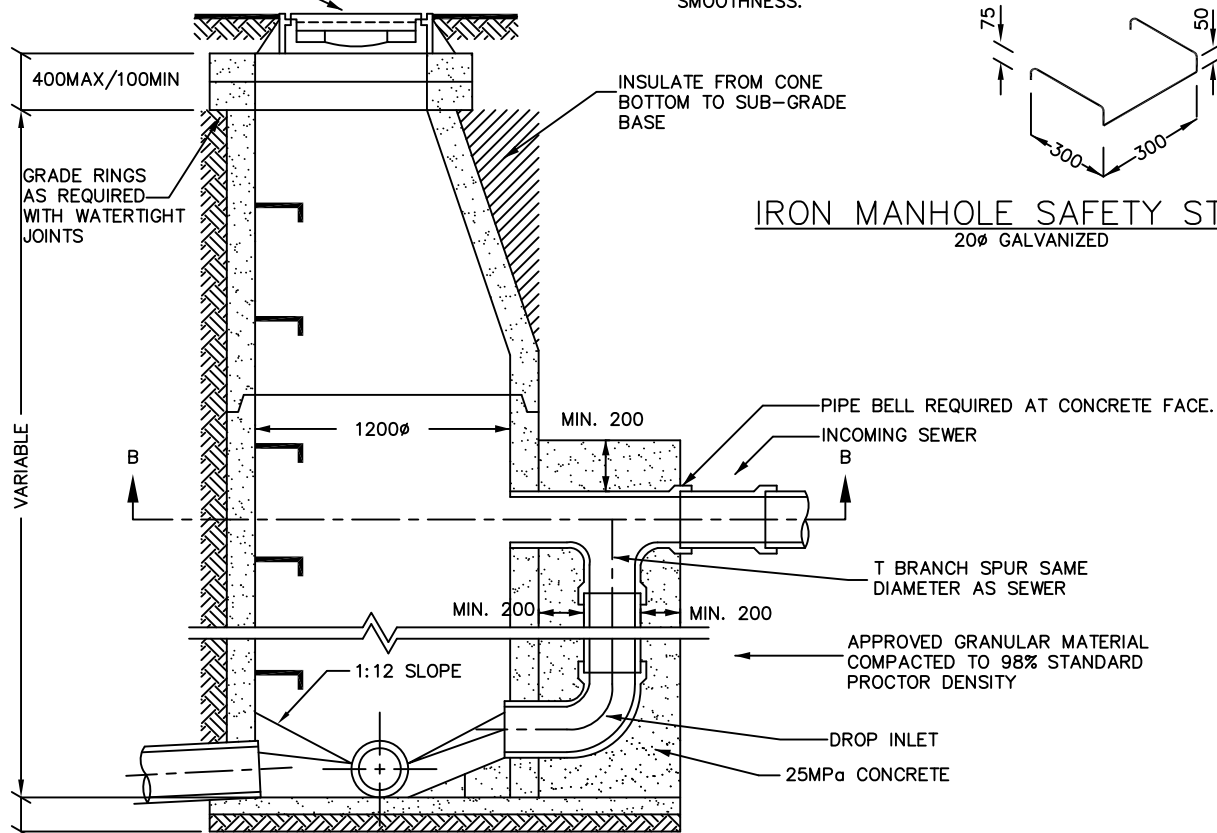
STD. DWG NO.

B-102



PLAN SECTION B-B

MANHOLE FROM & COVER
AS SPECIFIED - TOP ELEVATION
AS SPECIFIED IN STREET SPECIFICATIONS

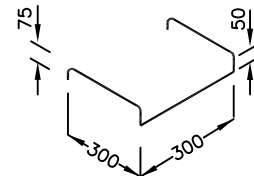


SECTION A-A

UNDISTURBED SUITABLE SOLID SOIL
OR MECHANICALLY COMPACTED TO
98% STANDARD PROCTOR DENSITY

NOTES:

1. ALL PRE-CAST MANHOLES MUST CONFORM TO A.S.T.M. SPECIFICATIONS C478.
2. POURED-IN-PLACE CONCRETE SHALL HAVE 28 DAYS COMPRESSIVE STRENGTH OF AT LEAST 25 MPa.
3. ALL JOINTS TO BE SET WITH RUBBER GASKET AND SET WITH NON-SHRINK GROUT, INSIDE AND OUT, AROUND FULL CIRCUMFERENCE.
4. FORM FLOW THROUGH IN PARTIALLY SET CONCRETE AND TROWEL SMOOTH.
5. ALL DIMENSIONS ARE GIVEN IN MILLIMETRES
6. MAX. DIST. FROM RIM TO TOP RUNG IS 800 mm.
7. BACKFILL AROUND MH. WITH SELECT NATIVE MATERIAL AND COMPACT TO 98 % S.P.D.
8. FLAT TOP SECTION TO BE USED FOR MANHOLES UP TO 1.8 m BURY.
9. ALL JOINTS TO BE WATERTIGHT. METHODS TO BE CONSISTENT WITH SITE CONDITIONS.
10. FOR MANHOLES 5.0 m IN DEPTH AND GREATER, A SAFETY PLATFORM SHALL BE INSTALLED.
11. MANHOLES TO MEET REQUIREMENTS OF MANHOLE DETAILS AND SPECIFICATIONS.
12. SAFETY STEPS TO BE PROVIDED, SPACED AT 400 MAX. FIRST STEP 150 MAX. BELOW FRAME, LAST STEP 300 MAX. ABOVE BASE.
13. CHANNELING AND BENCHING TO BE FINISHED TO TROWEL SMOOTHNESS.



IRON MANHOLE SAFETY STEPS
20# GALVANIZED



TITLE:

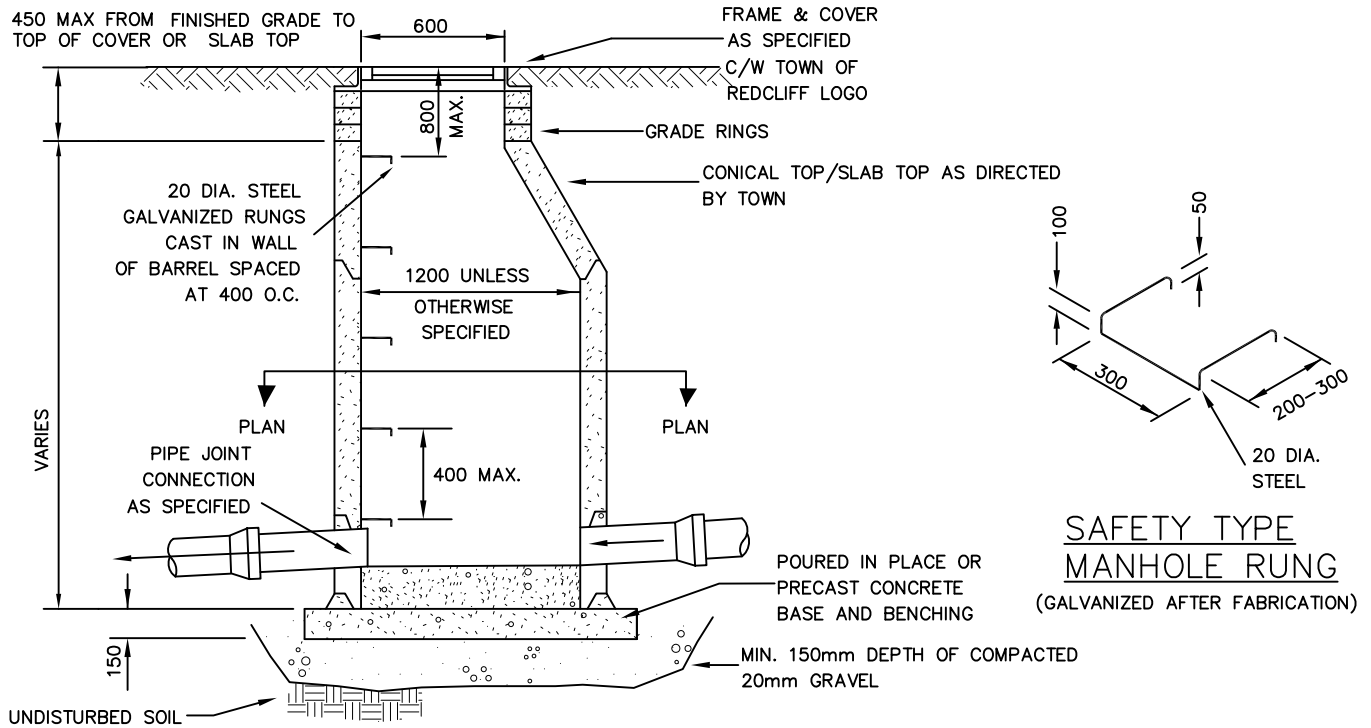
EXTERNAL DROP MANHOLE

STANDARD DETAILS

SCALE: N.T.S.

DATE: FEBUARY 2005

STD. DWG NO. B-102A

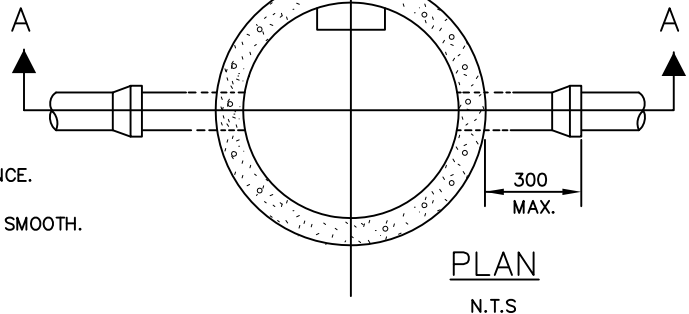


NOTES:

1. ALL PRE-CAST MANHOLES MUST CONFORM TO A.S.T.M. SPECIFICATIONS C478.
2. POURED-IN-PLACE CONCRETE SHALL HAVE A 28 DAYS COMPRESSIVE STRENGTH OF AT LEAST 25 MPa.
3. ALL JOINTS TO BE SET WITH RUBBER GASKETS AND SET WITH NON-SHRINK GROUT, INSIDE AND OUT, FOR THE FULL CIRCUMFERENCE.
4. FORM FLOW TROUGH IN PARTIALLY SET CONCRETE AND TROWEL SMOOTH.
5. PIPES TO BE FLUSH WITH WALL.
6. MAX. DIST. FROM RIM TO TOP RUNG IS 800 mm.
7. BACKFILL AROUND MH. WITH SELECT NATIVE MATERIAL AND COMPACT TO 98% S.P.D.
8. FLAT TOP SECTION TO BE USED FOR MANHOLES UP TO 1.8 m BURY.
9. ALL JOINTS TO BE WATERTIGHT. METHODS TO BE CONSISTENT WITH SITE CONDITIONS.
10. FOR MANHOLES 5.0 m IN DEPTH OR GREATER, A SAFETY PLATFORM SHALL BE INSTALLED.
11. MANHOLES TO MEET REQUIREMENTS OF MANHOLE DETAILS AND SPECIFICATIONS.
12. DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.
13. CHANNELING AND BENCHING TO BE FINISHED TO TROWEL SMOOTHNESS.
14. SAFETY STEPS TO BE PROVIDED, SPACED AT 400 MAX. FIRST STEP 150 MAX. BELOW FRAME, LAST STEP 300 MAX. ABOVE BASE.

SECTION A-A

N.T.S.



TITLE:

CATCH BASIN MANHOLE

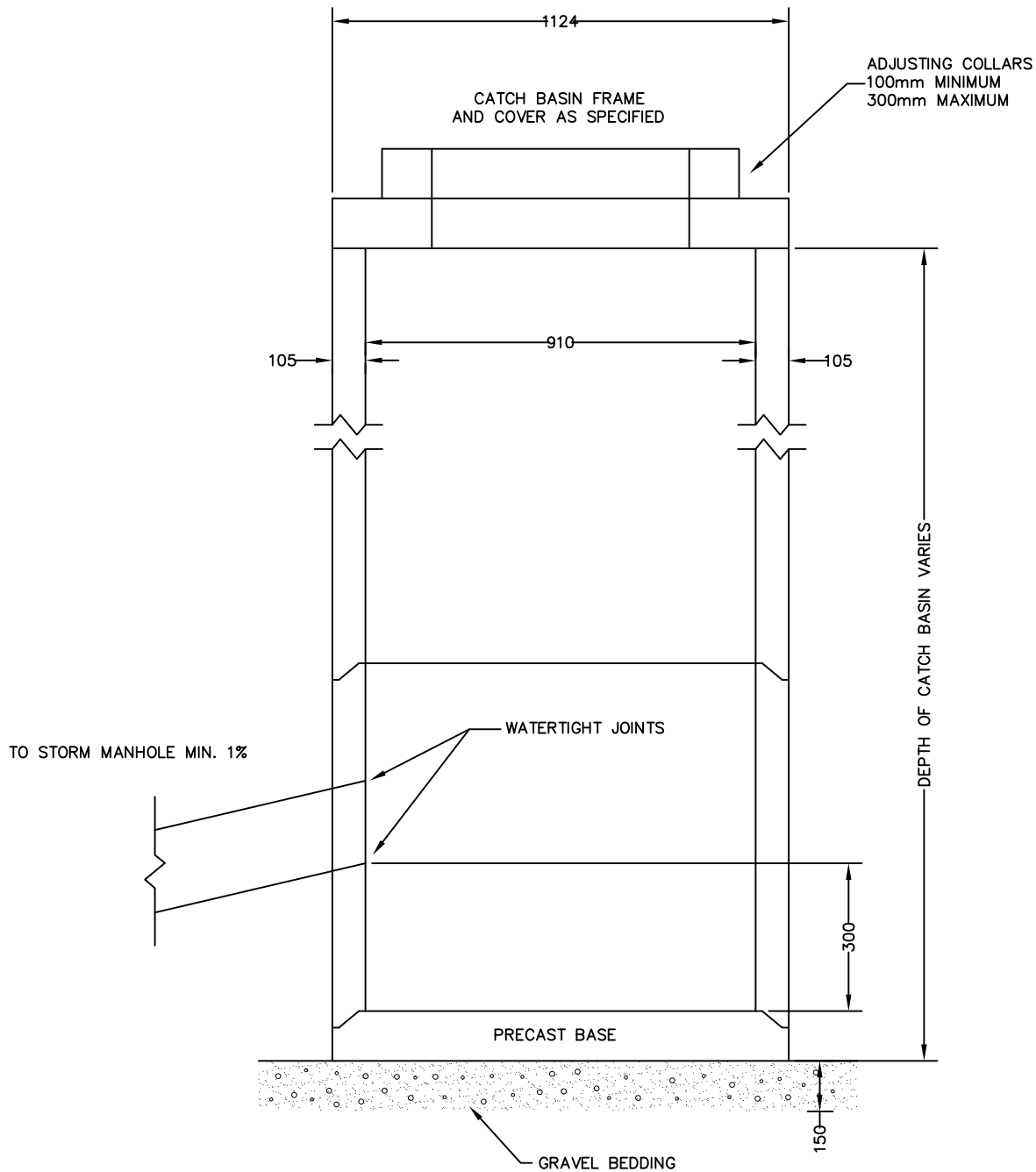
STANDARD DETAILS

SCALE: N.T.S.

DATE: OCTOBER 2005

STD. DWG NO.

B-103



NOTES:

1. SAFETY STEPS TO BE PROVIDED, SPACED AT 400 MAX. FIRST STEP 150 MAX. BELOW FRAME; LAST STEP 300 MAX. ABOVE BASE.
2. PRE-CAST CONCRETE COMPONENTS MUST CONFORM TO A.S.T.M. SPECIFICATIONS C478.
3. POURED-IN-PLACE CONCRETE SHALL HAVE A 28 DAYS COMPRESSIVE STRENGTH OF AT LEAST 25 MPa.
4. ALL JOINTS TO BE SET WITH RUBBER GASKETS AND NON-SHRINK GROUT, INSIDE AND OUT, FOR THE FULL CIRCUMFERENCE.
5. ALL DIMENSIONS IN MILLIMETRES, UNLESS OTHERWISE STATED.
6. ALL JOINTS TO BE WATERTIGHT. METHODS TO BE CONSISTENT WITH SITE CONDITIONS.



TITLE:

STORM CATCH BASIN ASSEMBLY
c/w 300mm SUMP

STANDARD DETAILS

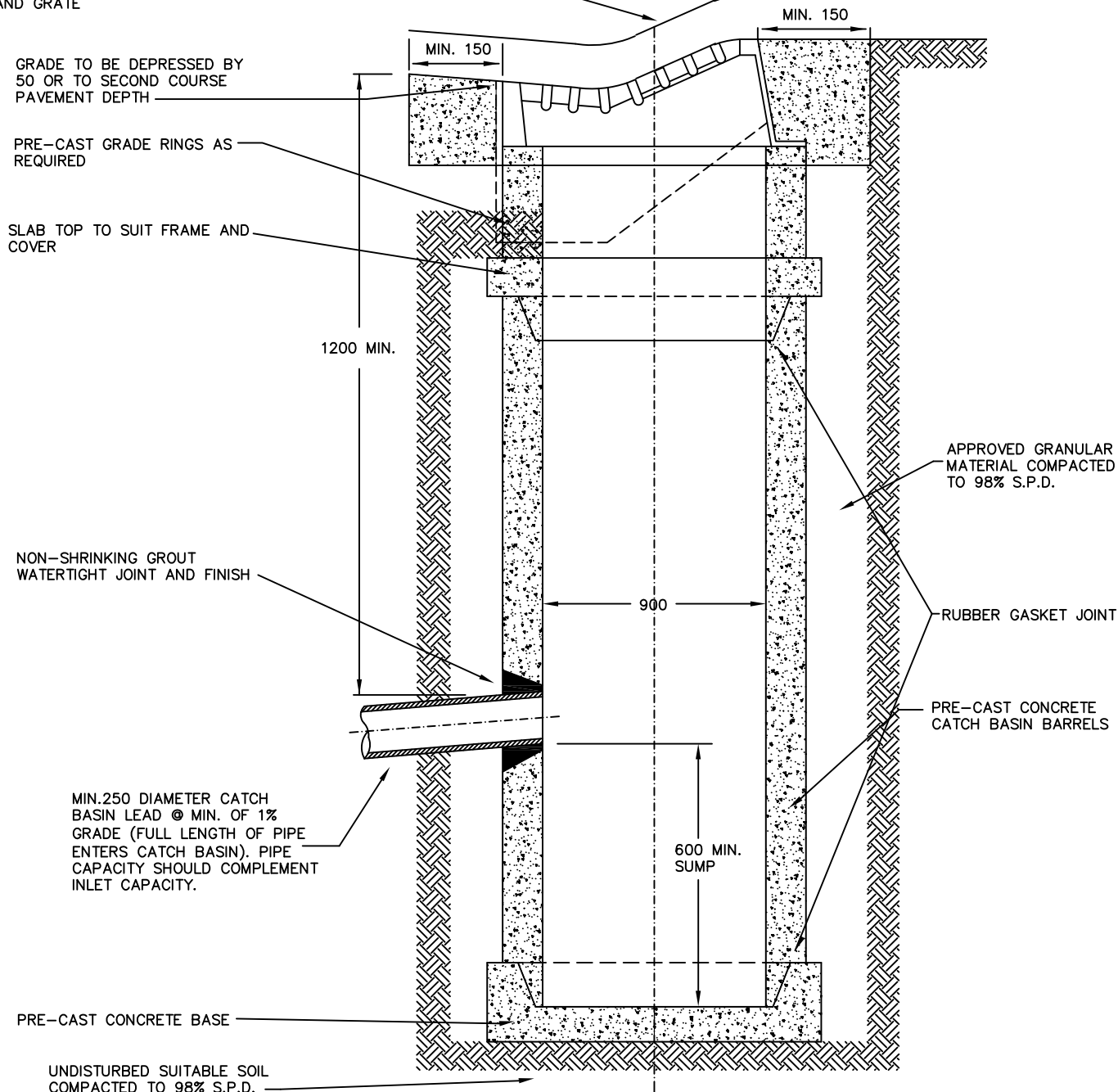
SCALE: N.T.S.

DATE: OCTOBER 2005

STD. DWG NO.

B-104

F33, F36A, OR K-2 TYPE CATCH BASIN DOUBLE FRAME AND GRATE



NOTES:

1. PRE-CAST CONCRETE COMPONENTS TO MEET CURRENT A.S.T.M. C478 STANDARDS.
2. CAST-IN-PLACE CONCRETE TO BE 25MPa AT 28 DAYS
3. ALL JOINTS TO BE SET WITH RUBBER GASKETS AND NON-SHRINK GROUT, INSIDE AND OUT, FOR THE FULL CIRCUMFERENCE. THIS INCLUDES JOINTS BETWEEN GRADE RINGS, GRADE RINGS AND FRAMES, AND BETWEEN GRADE RINGS AND SLAB TOPS.
4. PRE-CAST CONCRETE BASE THICKNESS AND REINFORCEMENT MUST BE DESIGNED FOR THE SPECIFIC CATCHBASIN DEPTH AND SOIL
5. JOINTS BETWEEN GRADE RINGS, GRADE RINGS AND CONES, AND RINGS AND FRAMES MUST BE WATERTIGHT. RAM NECK MATERIAL FINISHED MATERIAL FINISHED WITH NON-SRINK GROUT MAY BE USED IF WATERTIGHT JOINTS CAN BE ACHIEVED.
6. ALL DIMENSIONS IN MILLIMETRES, UNLESS OTHERWISE STATED.



TITLE:

CATCH BASIN
TYPICAL 900mm

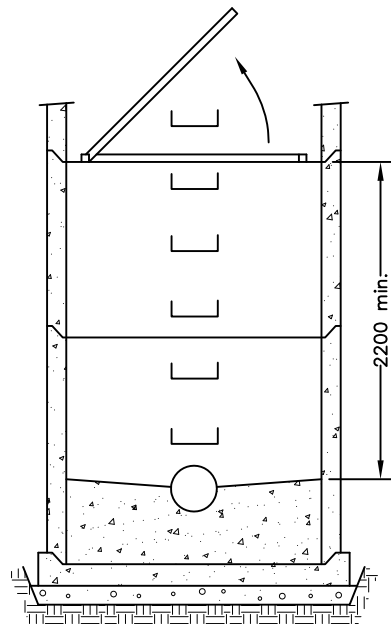
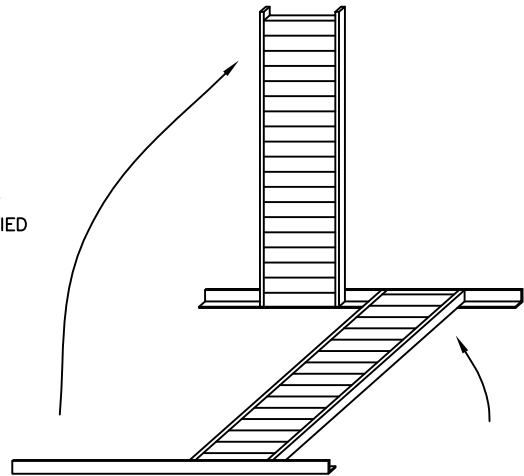
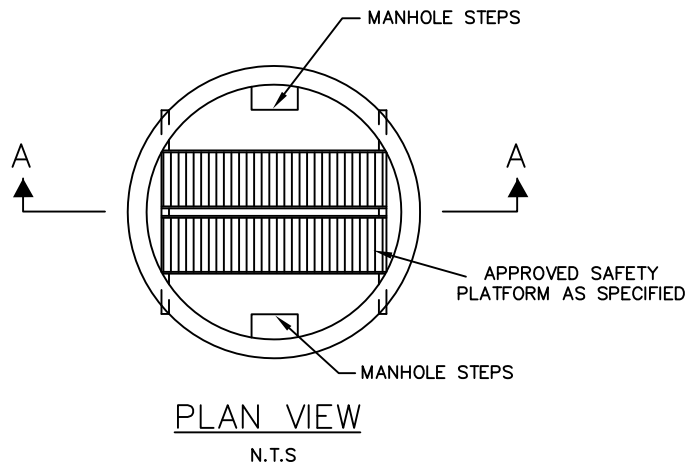
STANDARD DETAILS

SCALE: N.T.S.

DATE: FEBRUARY 2004

STD. DWG NO.

B-104A



NOTES:

1. TO BE INSTALLED ON MANHOLES GREATER THAN 5.0m DEEP.
2. MAXIMUM SPACING BETWEEN PLATFORMS TO BE 5.0m.
3. ALUMINUM GRATES TO BE MSU MISSISSAUGA OR APPROVED EQUAL.
4. TO BE INSTALLED ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.



TITLE:

MANHOLE SAFETY PLATFORM

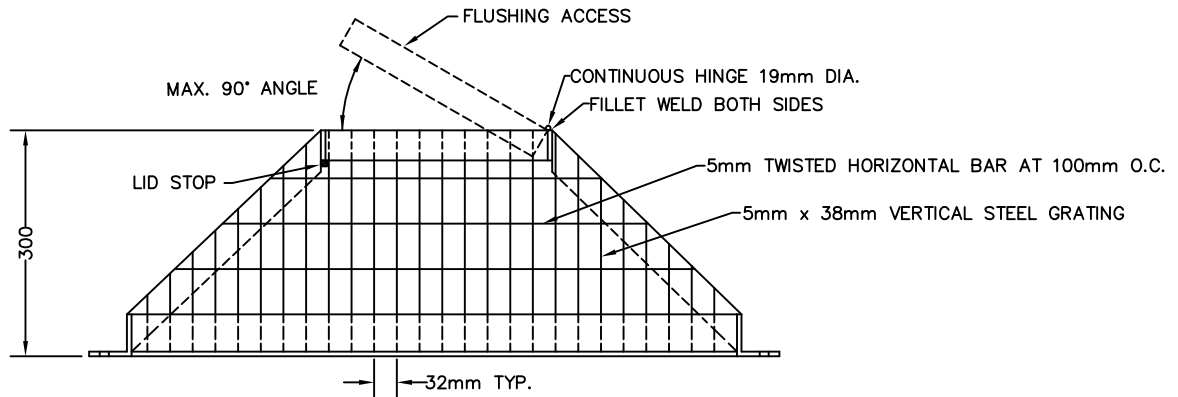
STANDARD DETAILS

SCALE: N.T.S.

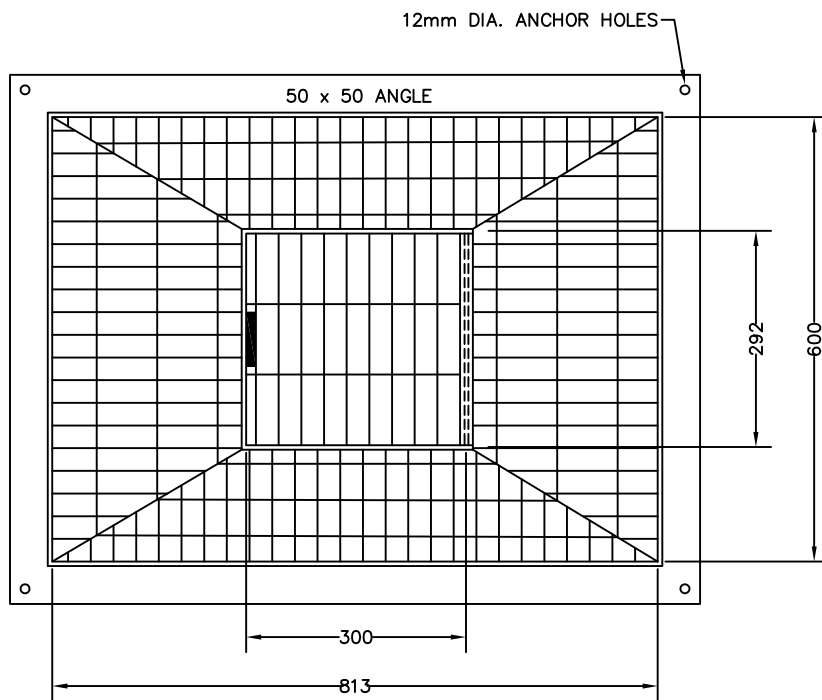
DATE: FEBRUARY 2004

STD. DWG NO.

B-105



PROFILE



PLAN VIEW

NOTES:

1. DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.



TITLE:

TRASH GRATE INLET

STANDARD DETAILS

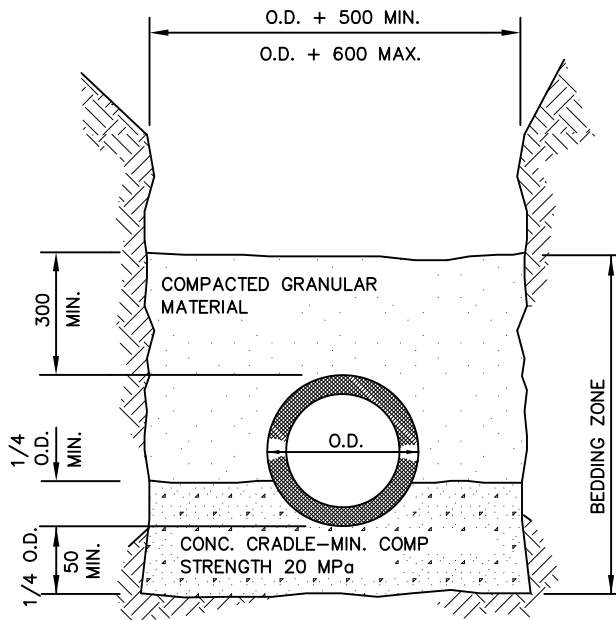
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DATE: FEBRUARY 2004

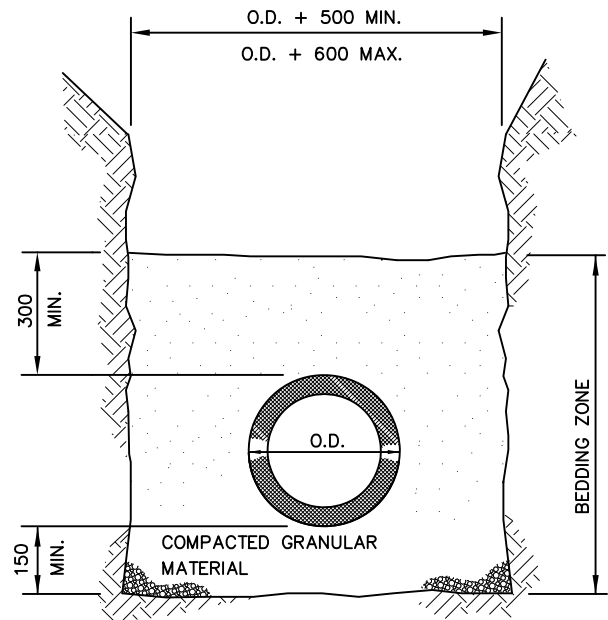
STD. DWG NO.

B-106

CLASS 'A' BEDDING



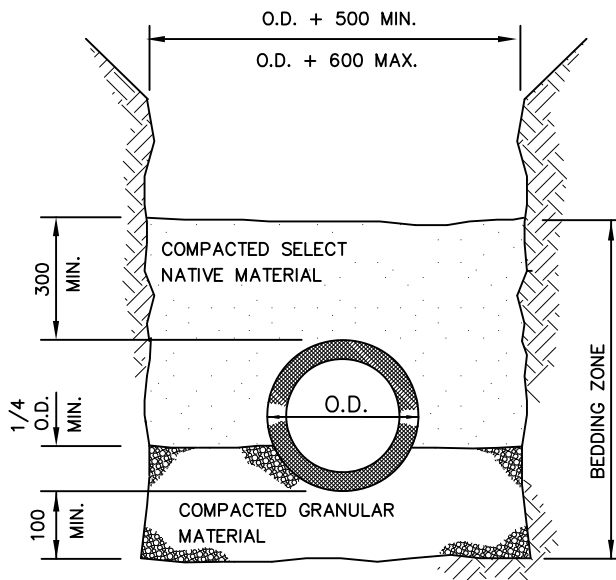
CLASS 'B' BEDDING



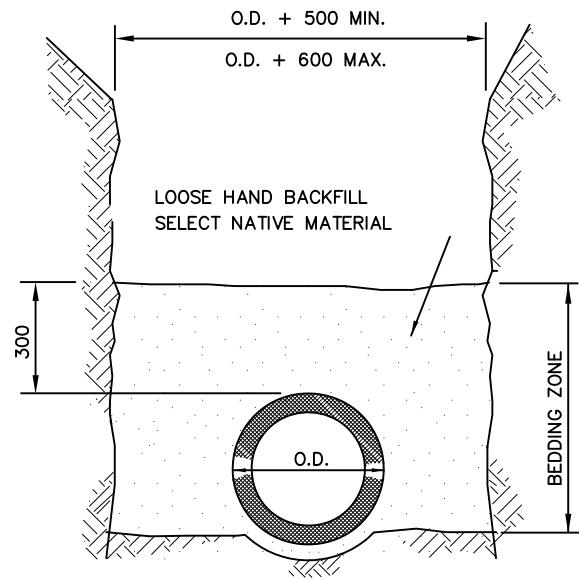
NOTE:

1. COMPACTION OF BEDDING ZONE SHALL BE AS PER SPECIFICATIONS. (MIN. 95% S.P.D.)
2. ALL DIMENSIONS ARE GIVEN IN MILLIMETRES UNLESS OTHERWISE STATED.
3. BACKFILL COMPACTION REQUIREMENTS WILL VARY. BACKFILL ABOVE PIPE ZONE TO BE APPROVED MATERIAL.
4. TRENCH SIDE SLOPES TO BE CONSISTENT WITH OCCUPATIONAL HEALTH AND SAFETY REQUIREMENTS

CLASS 'C' BEDDING



CLASS 'D' BEDDING



TITLE:

PIPE BEDDING DETAILS

STANDARD DETAILS

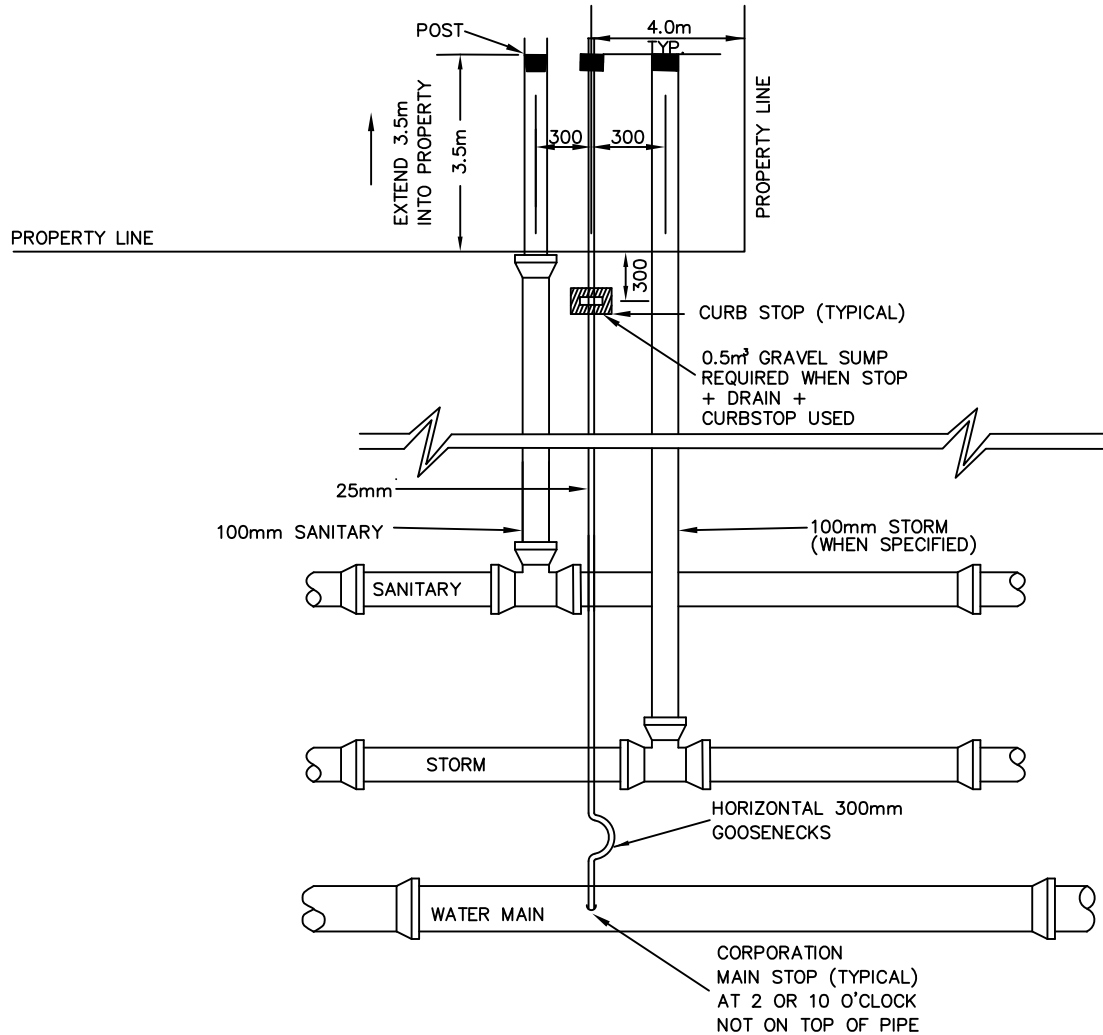
SCALE: N.T.S.

DATE: FEBRUARY 2004

STD. DWG NO.

C-101

TYPICAL SERVICE



NOTES:

1. ENDS OF SERVICES TO BE MARKED WITH A 50mm x 100mm STAKE PROTRUDING 700mm ABOVE GROUND PAINTED AS FOLLOWS:
 - A. CURBSTOP – BLUE
 - B. END OF SERVICE IN SEPERATE TRENCH – GREEN
 - C. END OF WATER SERVICE INSIDE PRIVATE PROPERTY – BLUE
2. WHERE STORM SEWER SERVICE IS TO BE INSTALLED, PLACE 0.3m FROM WATER.
3. SEWER SERVICES MUST BE PROPERLY CAPPED.
4. ALL DIMENSIONS GIVEN IN MILLIMETRES UNLESS OTHERWISE STATED.
5. SINGLE SERVICE TO ENTER LOT WITHIN 4.0m OF CENTER. UNLESS SHOWN OTHERWISE.



TITLE:

TYPICAL SERVICE LAYOUT

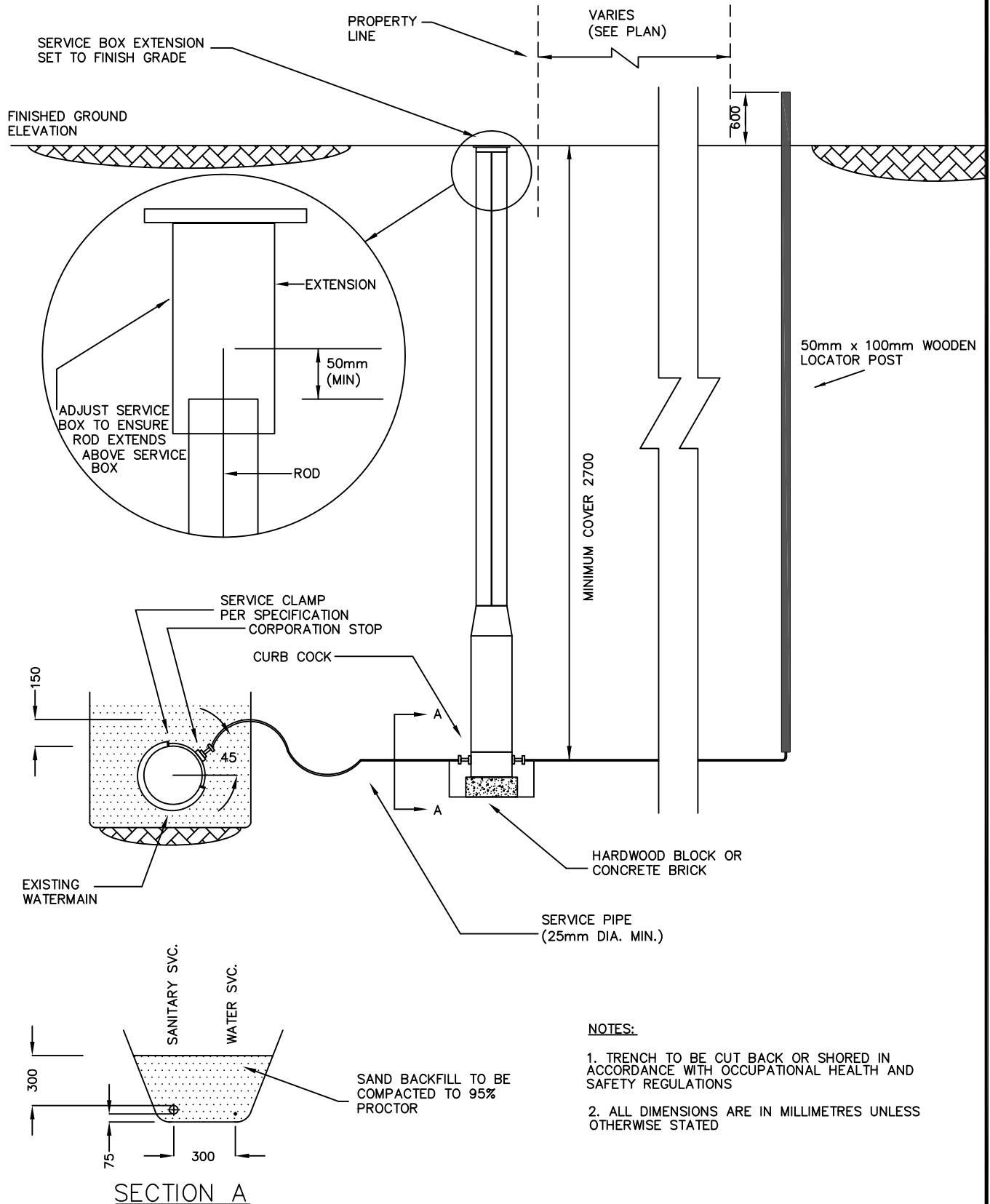
STANDARD DETAILS

SCALE: N.T.S.

DATE: OCTOBER 2005

STD. DWG NO.

C-102



TITLE:

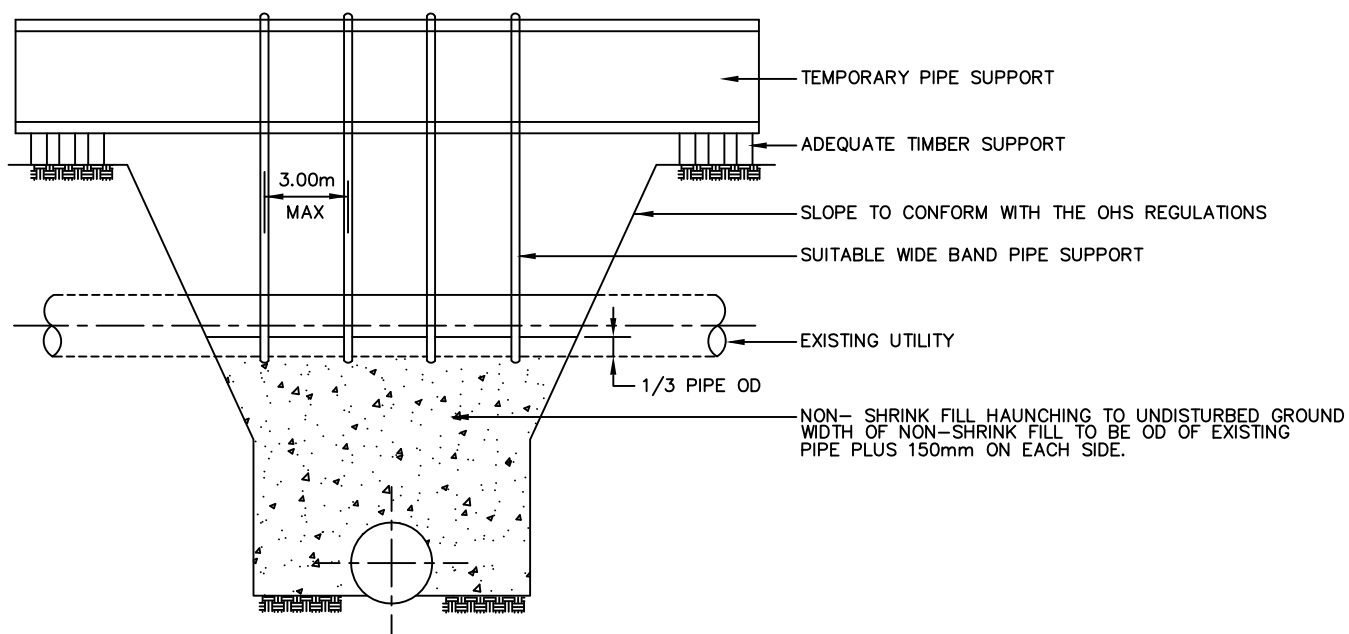
WATER SERVICE CONNECTION PROFILE VIEW

STANDARD DETAILS

SCALE: N.T.S.

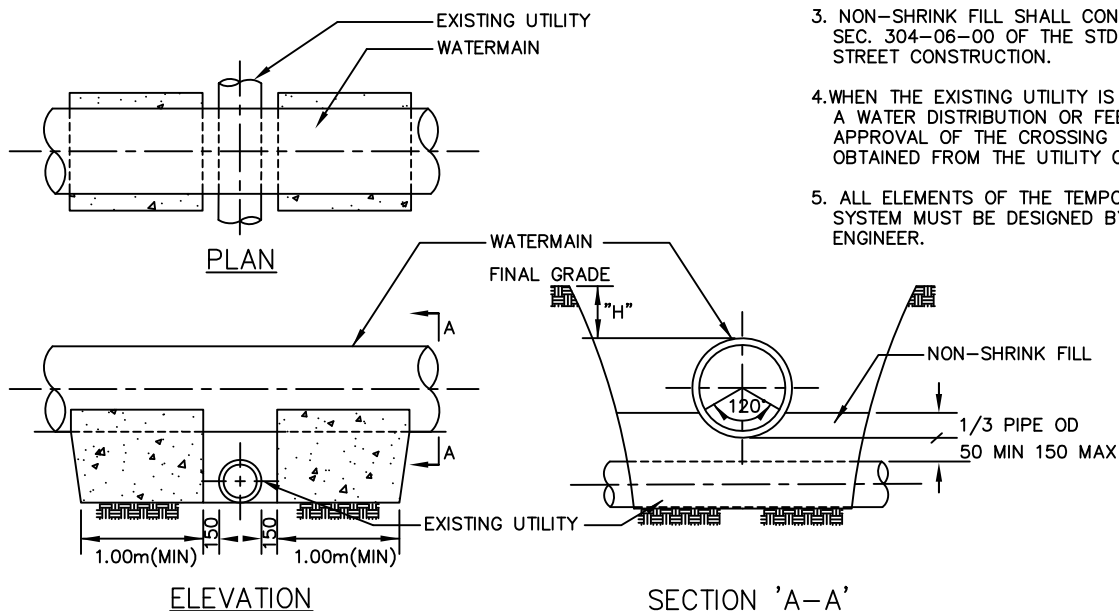
DATE: JULY 2006

STD. DWG NO. C-102A



PIPE INSTALLATION CROSSING
BELOW AN EXISTING UTILITY

PIPE INSTALLATION CROSSING
ABOVE AN EXISTING UTILITY



NOTE:

1. THE PIPE SHOULD BE INSTALLED BEFORE THE CONCRETE BLOCK HAS SET.
2. PROVIDE 2-PLY 0.15mm POLYETHYLENE FILM TO PREVENT BONDING OF CONCRETE TO PIPE.
3. NON-SHRINK FILL SHALL CONFORM TO SEC. 304-06-00 OF THE STD. SPECS. STREET CONSTRUCTION.
4. WHEN THE EXISTING UTILITY IS OTHER THAN A WATER DISTRIBUTION OR FEEDER MAIN. APPROVAL OF THE CROSSING DETAIL BE OBTAINED FROM THE UTILITY CONCERNED.
5. ALL ELEMENTS OF THE TEMPORARY SUPPORT SYSTEM MUST BE DESIGNED BY A PROFESSIONAL ENGINEER.



TITLE:

PIPE SUPPORT
AT UTILITY CROSSING

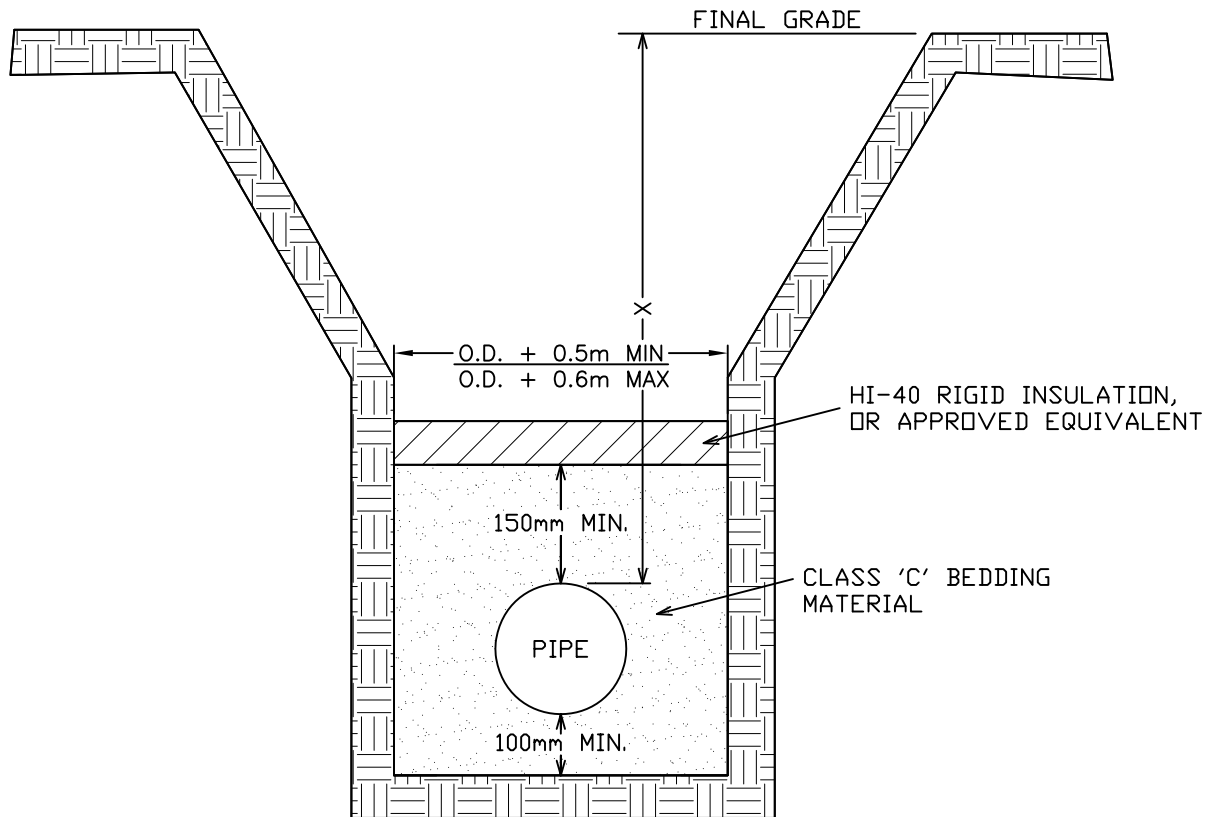
STANDARD DETAILS

SCALE: N.T.S.

DATE: FEBRUARY 2004

STD. DWG NO.

C-103



TOP COVER INSULATION

DEPTH FROM FINISHED GRADE TO THE TOP OF PIPE "X" (METERS)	0.7-1.2	1.2-2.00	2.00-2.49	2.50 OR GREATER
INSULATION THICKNESS (mm)	100	75	50	0

PIPE INSULATION DETAIL
(NOT TO SCALE)



TITLE:

WATER & SANITARY MAIN
PIPE INSULATION DETAIL

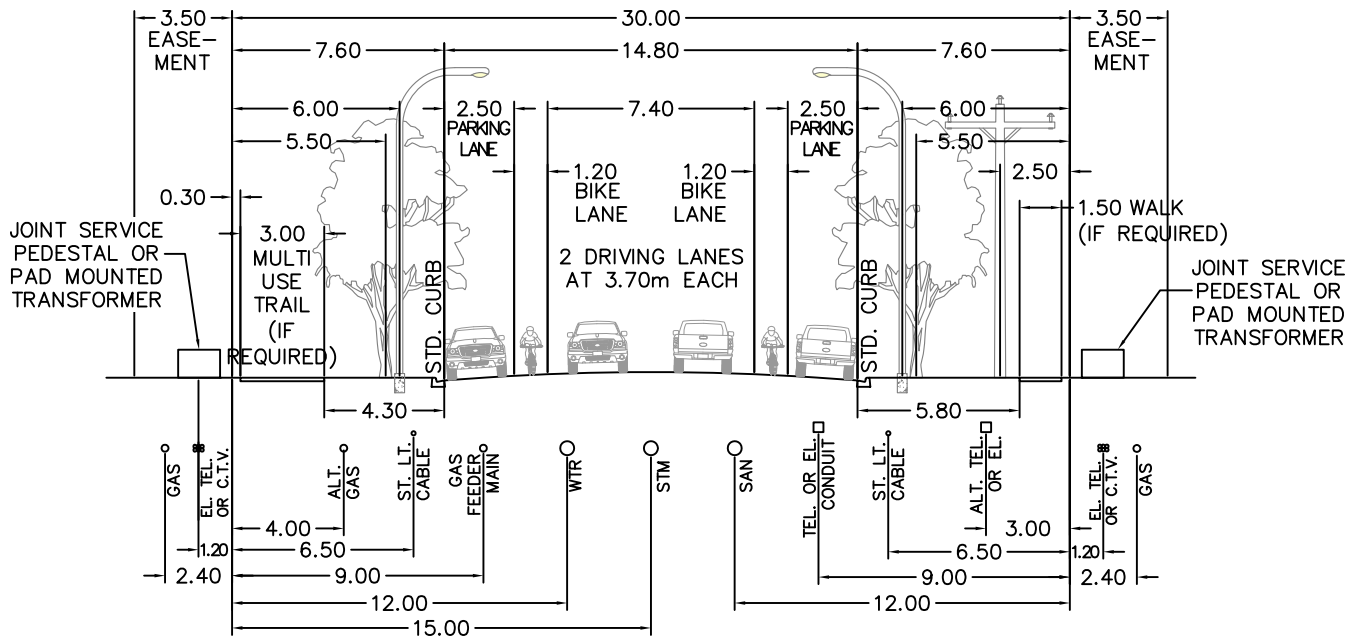
STANDARD DETAILS

SCALE: N.T.S.

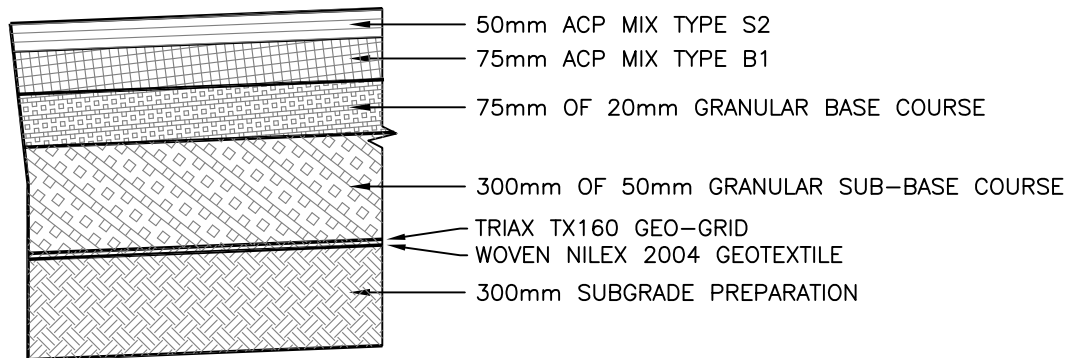
DATE: MARCH 2014

STD. DWG NO.

C-104



UNDIVIDED 2 LANE MAJOR ROAD – URBAN



MINIMUM ROAD STRUCTURE
(NOT TO SCALE)



TITLE:

CROSS SECTION
UNDIVIDED MAJOR ROADWAY – URBAN

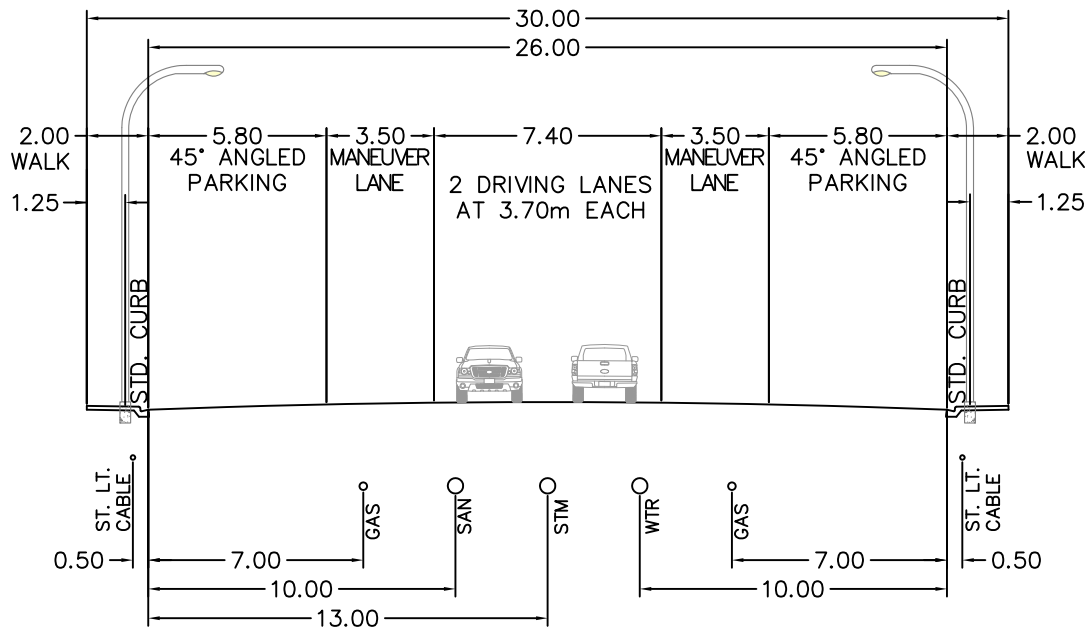
STANDARD DETAILS

SCALE: N.T.S.

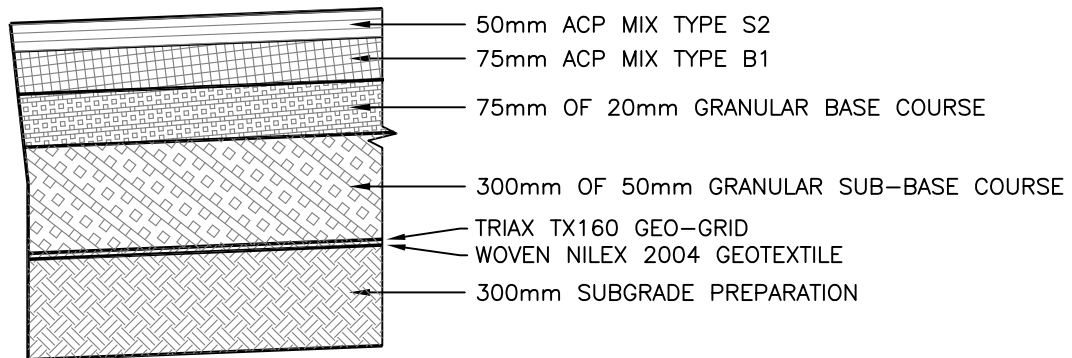
DATE: MAY 2014

STD. DWG NO.

D-100



DOWNTOWN UNDIVIDED COMMERCIAL MAJOR ROADWAY
(BROADWAY AVENUE)



MINIMUM ROAD STRUCTURE
(NOT TO SCALE)



TITLE:

CROSS SECTION
UNDIVIDED MAJOR ROADWAY –
DOWNTOWN

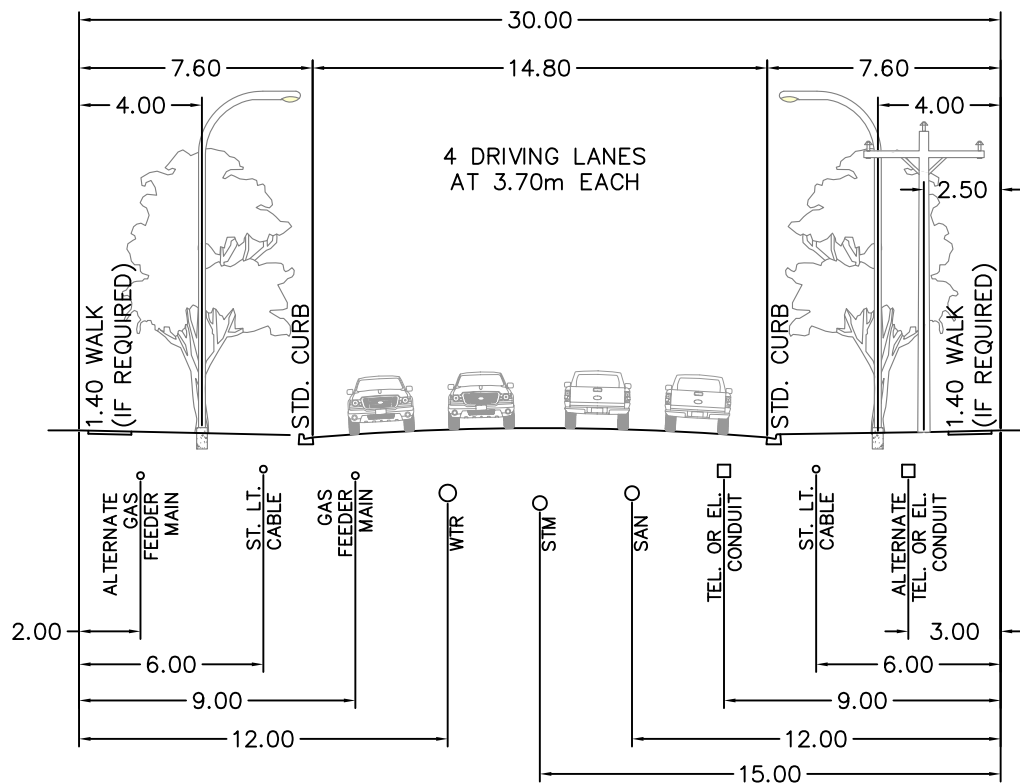
STANDARD DETAILS

SCALE: N.T.S.

DATE: MAY 2014

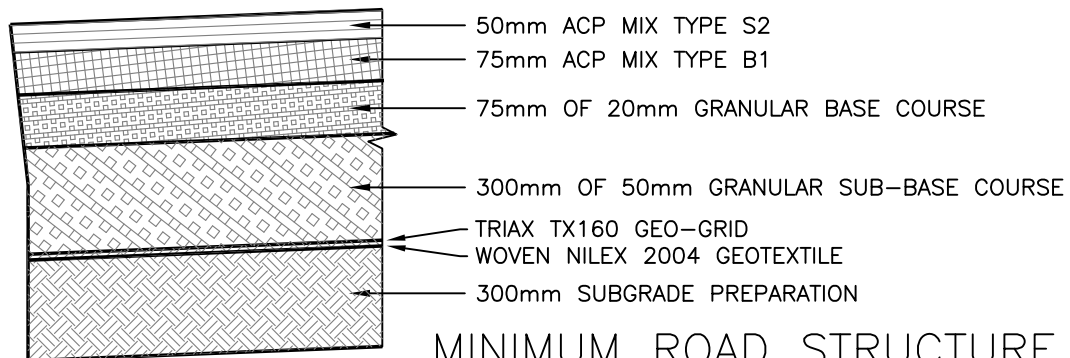
STD. DWG NO.

D-101



UNDIVIDED MAJOR ROADWAY 4 LANE ROAD

- NOTES:
- HYDRANTS ON 4.00 LINE.
 - HYDRANT VALVES ON 11.00 LINE.
 - SERVICE VALVES ON 2.50 LINE.
 - TREES ON 4.00 LINE.
 - POWER POLES, STREETLIGHT POLES, TRANSFORMER BOXES AND ALL OTHER SURFACE STRUCTURES SHALL MAINTAIN A MINIMUM OF 3.0 m CLEARANCE FROM HYDRANT.
 - GAS FEEDER MAINS IN CARRIAGE WAY. DISTRIBUTION LINE IN BOULEVARD. OPPOSITE SIDE FROM OVERHEAD.
 - ALL TREES TO BE SHALLOW ROOT SPECIES.
 - GAS-U/G ELECTRIC HAS BEEN PLACED IN LANES AND REAR OF LOTS FOR STANDARD ACCESS AT 1.5 m OFF PROPERTY LINE.



MINIMUM ROAD STRUCTURE (NOT TO SCALE)



TITLE:

CROSS SECTION UNDIVIDED MAJOR ROADWAY 4 LANE ROAD

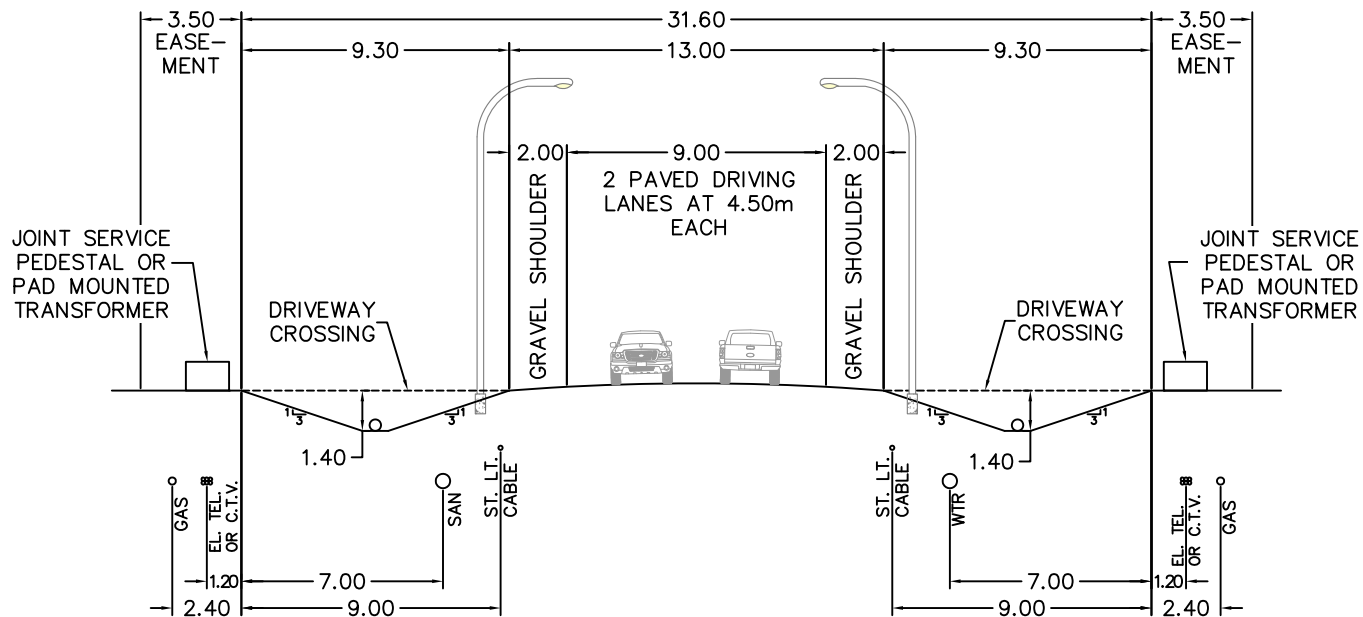
STANDARD DETAILS

SCALE: N.T.S.

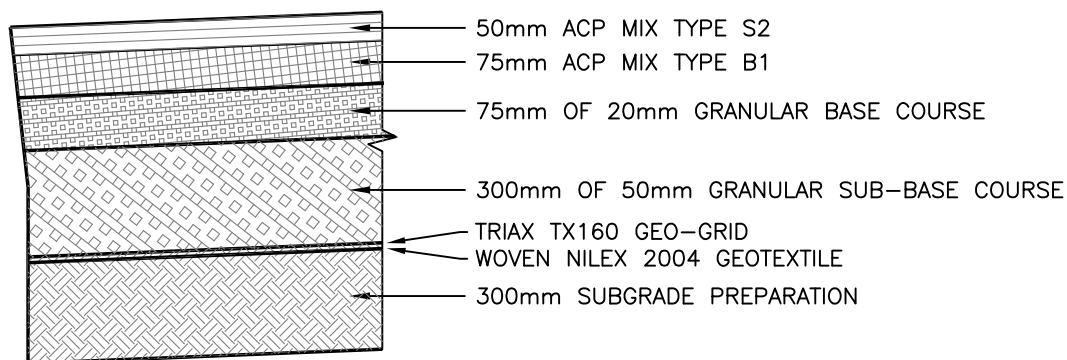
DATE: MAY 2014

STD. DWG NO.

D-102



UNDIVIDED 2 LANE MAJOR ROAD – RURAL



MINIMUM ROAD STRUCTURE

(NOT TO SCALE)



TITLE:

CROSS SECTION
UNDIVIDED MAJOR ROADWAY – RURAL

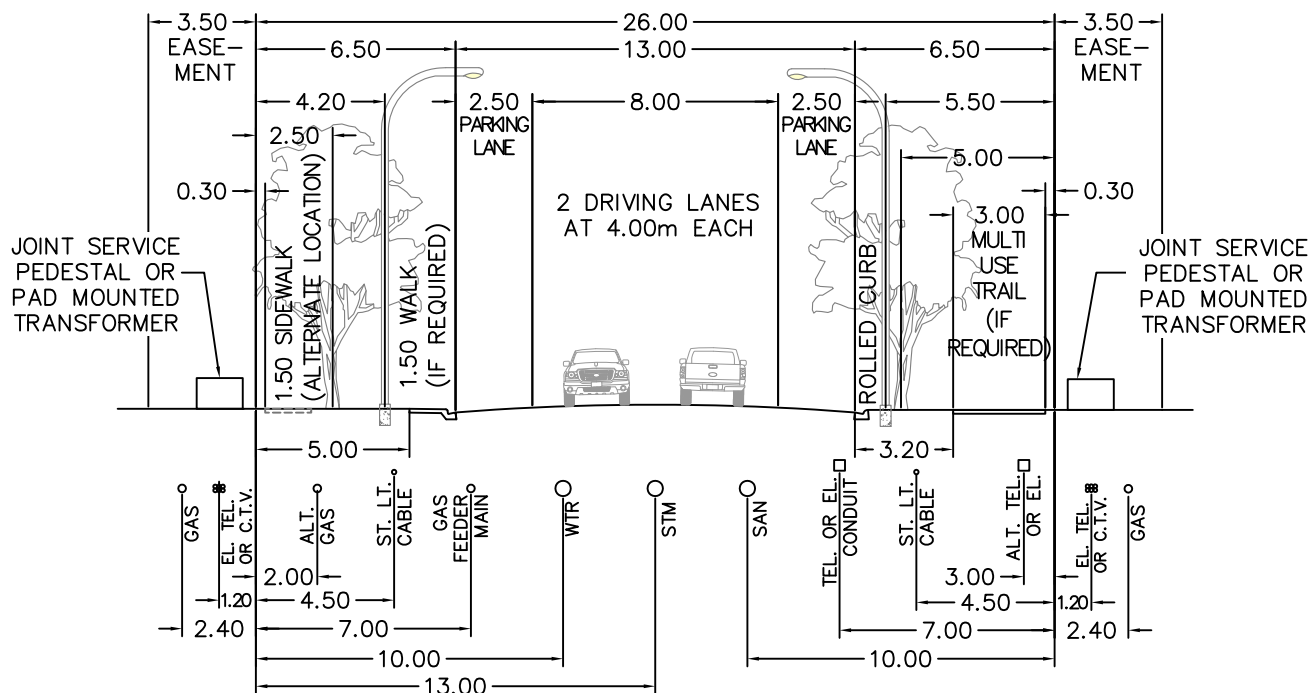
STANDARD DETAILS

SCALE: N.T.S.

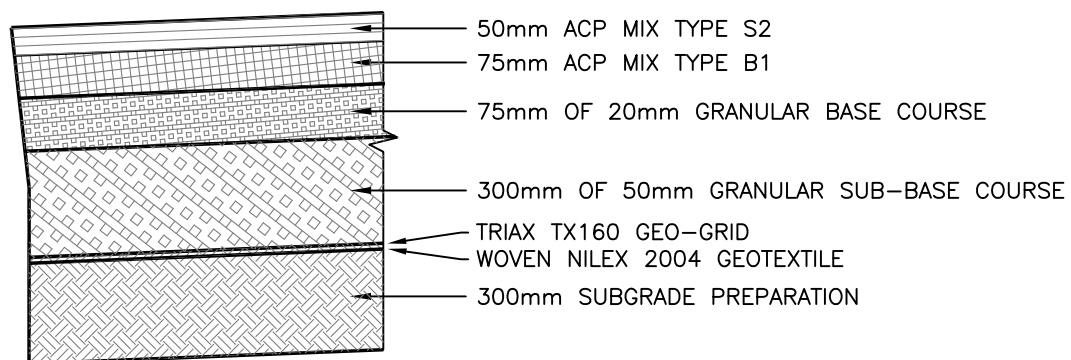
DATE: MAY 2014

STD. DWG NO.

D-103



INDUSTRIAL / COMMERCIAL COLLECTOR ROADWAY – URBAN



MINIMUM ROAD STRUCTURE (NOT TO SCALE)



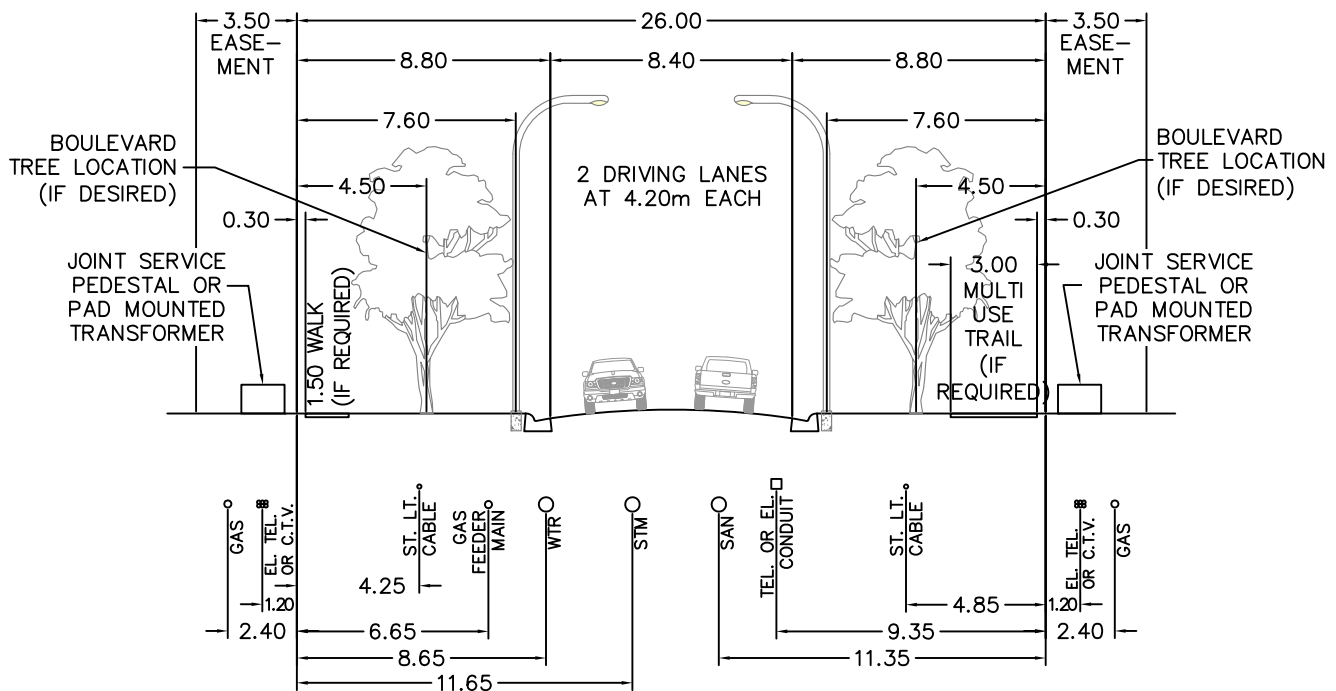
TITLE:
CROSS SECTION
INDUSTRIAL / COMMERCIAL COLLECTOR
ROADWAY – URBAN WITH SIDEWALK
AND TRAIL OPTIONS

STANDARD DETAILS

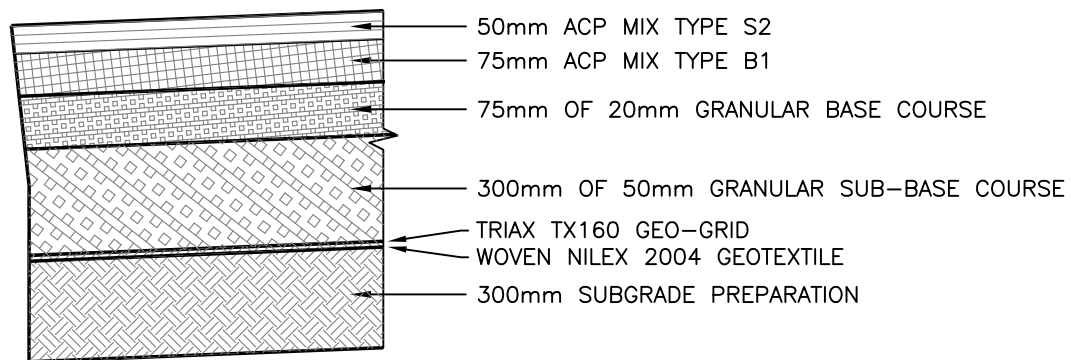
SCALE: N.T.S.

DATE: MAY 2014

STD. DWG NO. D-104



INDUSTRIAL / COMMERCIAL COLLECTOR ROADWAY – URBAN
LOW IMPACT OPTION
SEPARATE SIDEWALK AND NO PARKING



MINIMUM ROAD STRUCTURE
 (NOT TO SCALE)



TITLE: CROSS SECTION
 INDUSTRIAL / COMMERCIAL COLLECTOR
 LOW IMPACT WITH SIDEWALK & TRAIL
 OPTIONS

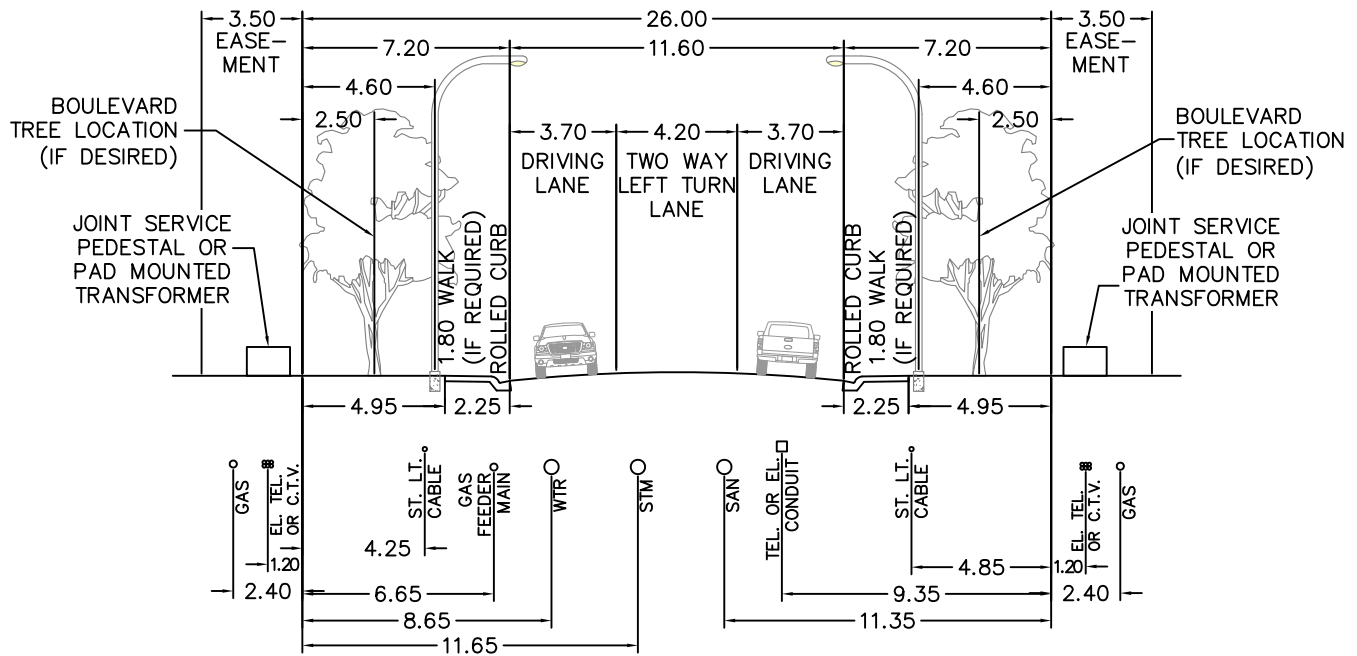
STANDARD DETAILS

SCALE: N.T.S.

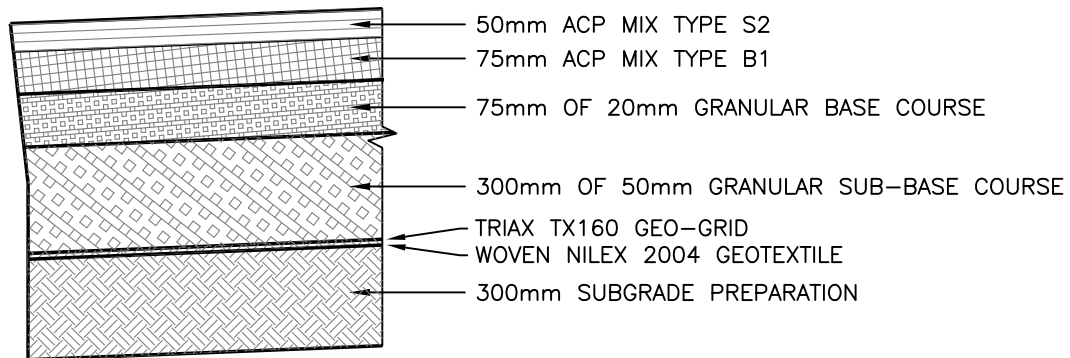
DATE: MAY 2014

STD. DWG NO. D-105

*IT IS RECOMMENDED
THAT ALL COLLECTOR
ROADS BE BUILT WITH
SEPARATE SIDEWALK



INDUSTRIAL / COMMERCIAL COLLECTOR ROADWAY – URBAN
TWO WAY LEFT TURN LANE WITH
MONOLITHIC SIDEWALK & NO PARKING



MINIMUM ROAD STRUCTURE
(NOT TO SCALE)



TITLE:

CROSS SECTION
INDUSTRIAL / COMMERCIAL COLLECTOR
ROADWAY – URBAN TWO WAY LANE

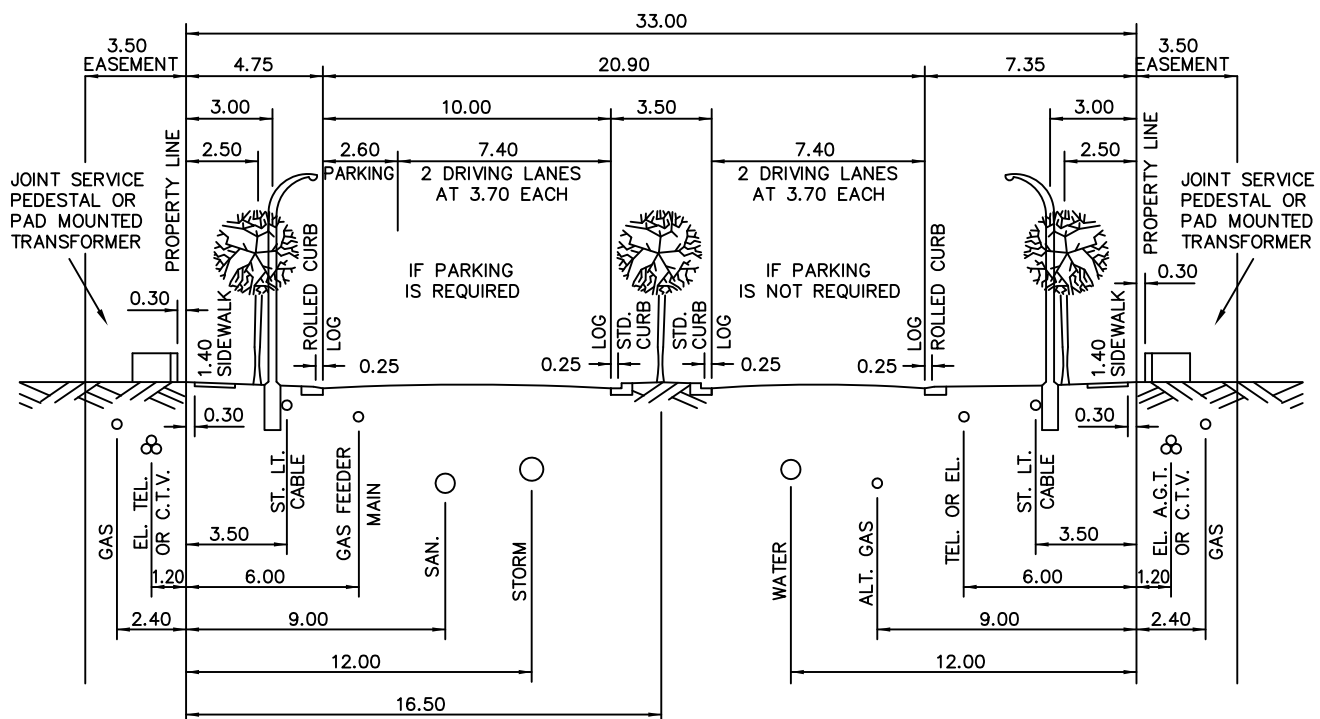
STANDARD DETAILS

SCALE: N.T.S.

DATE: MAY 2014

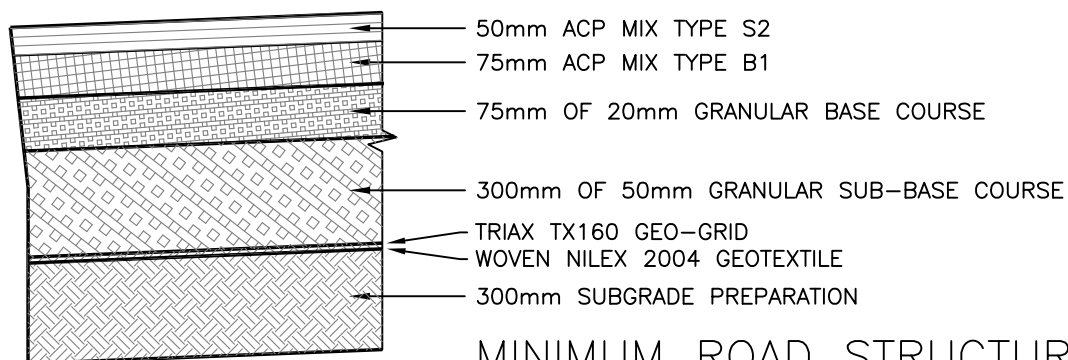
STD. DWG NO.

D-106



OPTION WITH OR WITHOUT AN ADDITIONAL PARKING LANE

- NOTES:
- HYDRANTS ON 3.00 LINE.
 - HYDRANT VALVES ON 11.00 LINE.
 - SERVICE VALVES ON 2.50 LINE.
 - TREES ON 2.50 LINE IN BOULEVARD AND ON CENTRE LINE IN MEDIAN.
 - TREES SHALL BE SHALLOW ROOTED DECIDUOUS SPECIES AS APPROVED BY PARKS/RECREATION DEPARTMENT.
 - HYDRANT & SERVICE VALVES SHALL MAINTAIN A MIN. 2.50 SEPARATION TO THE CENTRE LINE OF POWER POLES & STREET LIGHTING POLES.
 - HYDRANT & SERVICE VALVES SHALL MAINTAIN A MIN. 3.00 SEPARATION TO THE EDGE OF TRANSFORMER, PULL BOX / JUNCTION TERMINALS & OTHER SURFACE STRUCTURES.
 - WATER MAIN SHALL BE INSTALLED ON THE OPPOSITE SIDE OF THE ROAD FROM SANITARY AND STORM LINES.
 - PRE-INSTALLED SERVICE CONNECTIONS TO BE INSTALLED 3.50 INSIDE P.L. OR 5.00 INSIDE THE P.L. WHEN CROSSING GAS AND ONE OTHER SHALLOW UTILITY.



MINIMUM ROAD STRUCTURE
(NOT TO SCALE)



TITLE:

CROSS SECTION
INDUSTRIAL / COMMERCIAL COLLECTOR
ROADWAY – URBAN 4 LANE

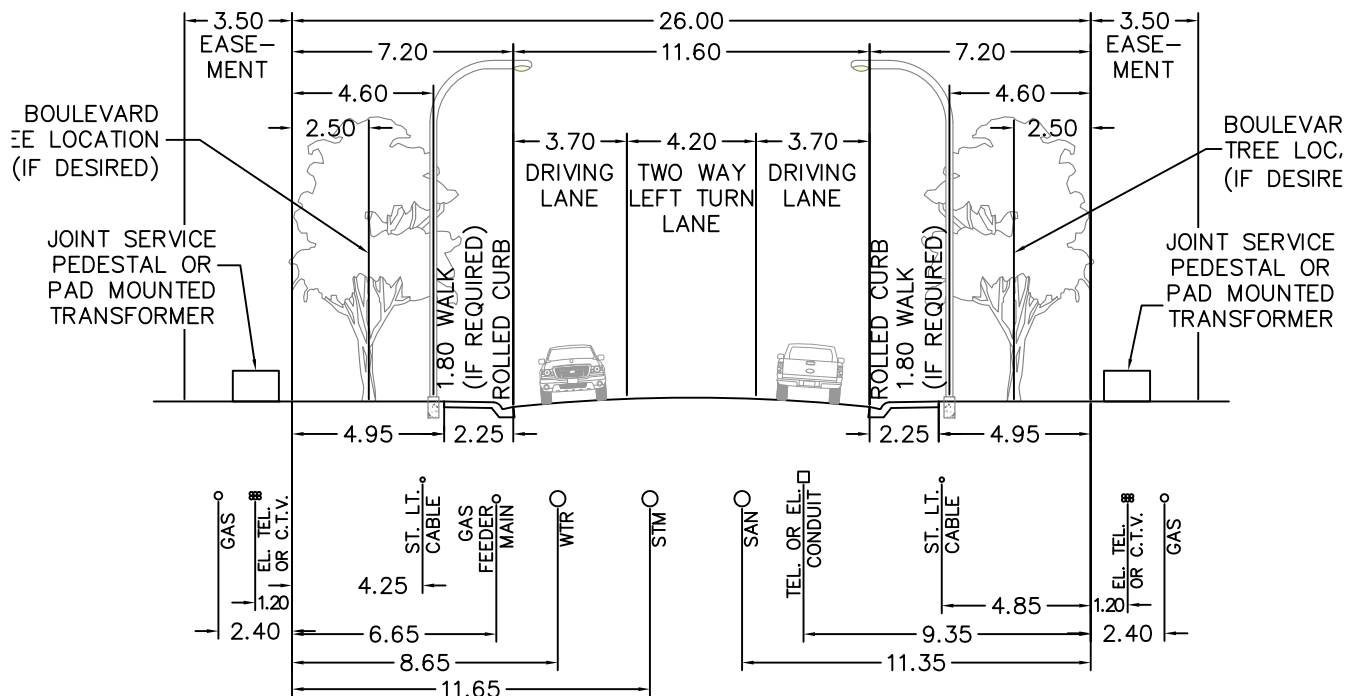
STANDARD DETAILS

SCALE: N.T.S.

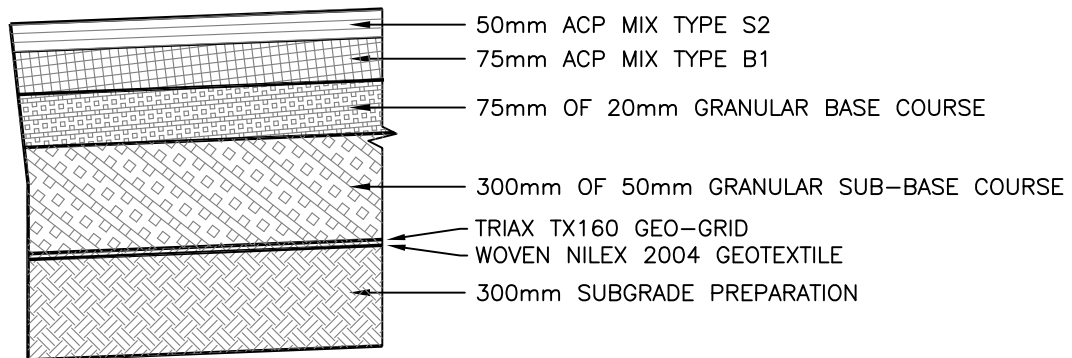
DATE: MAY 2014

STD. DWG NO.

D-107



INDUSTRIAL / COMMERCIAL COLLECTOR ROADWAY – URBAN
TWO WAY LEFT TURN LANE WITH
MONOLITHIC SIDEWALK & NO PARKING



MINIMUM ROAD STRUCTURE
 (NOT TO SCALE)



TITLE:

CROSS SECTION
 INDUSTRIAL / COMMERCIAL
 COLLECTOR ROADWAY – RURAL

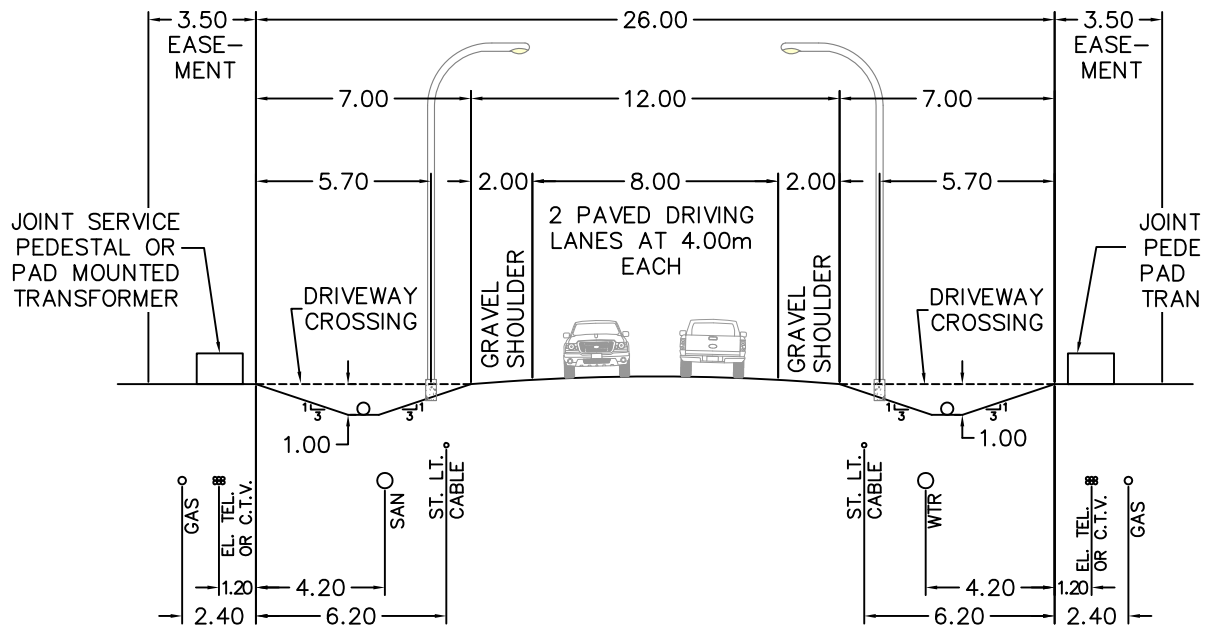
STANDARD DETAILS

SCALE: N.T.S.

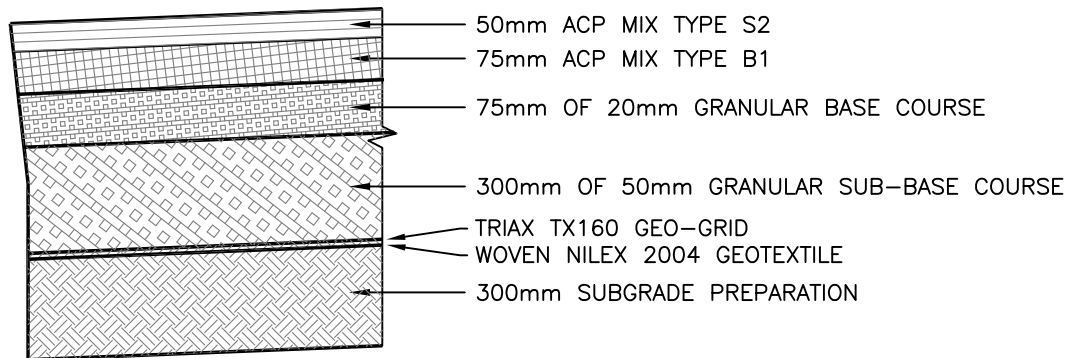
DATE: MAY 2014

STD. DWG NO.

D-108



INDUSTRIAL / COMMERCIAL COLLECTOR ROADWAY – RURAL



MINIMUM ROAD STRUCTURE (NOT TO SCALE)



TITLE:

CROSS SECTION
LOW IMPACT DEVELOPMENT
INDUSTRIAL / COMMERCIAL
COLLECTOR ROADWAY – RURAL

STANDARD DETAILS

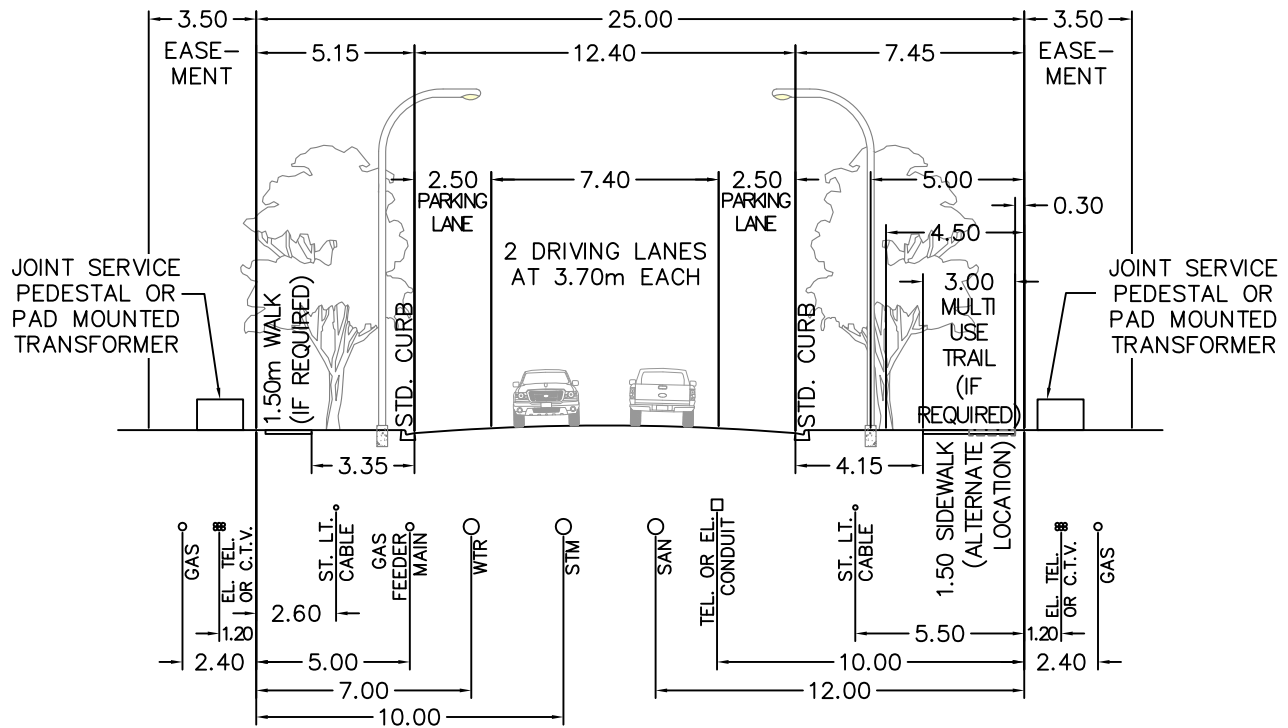
SCALE: N.T.S.

DATE: MAY 2014

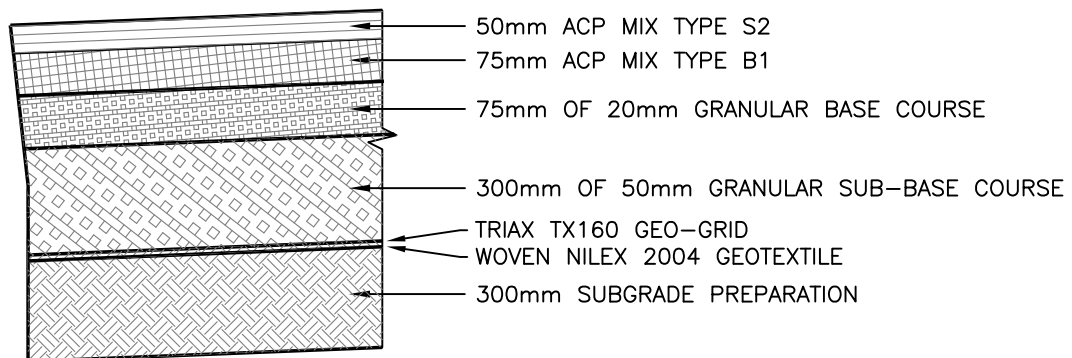
STD. DWG NO.

D-109

*WHERE MULTI USE TRAIL
IS PROVIDED VEHICLE
ACCESS TO R-1 AND R-2
LOTS IS PROHIBITED



RESIDENTIAL COLLECTOR ROADWAY – URBAN



MINIMUM ROAD STRUCTURE (NOT TO SCALE)



TITLE:
CROSS SECTION
RESIDENTIAL COLLECTOR ROADWAY
– URBAN
WITH SIDEWALK AND TRAIL OPTIONS

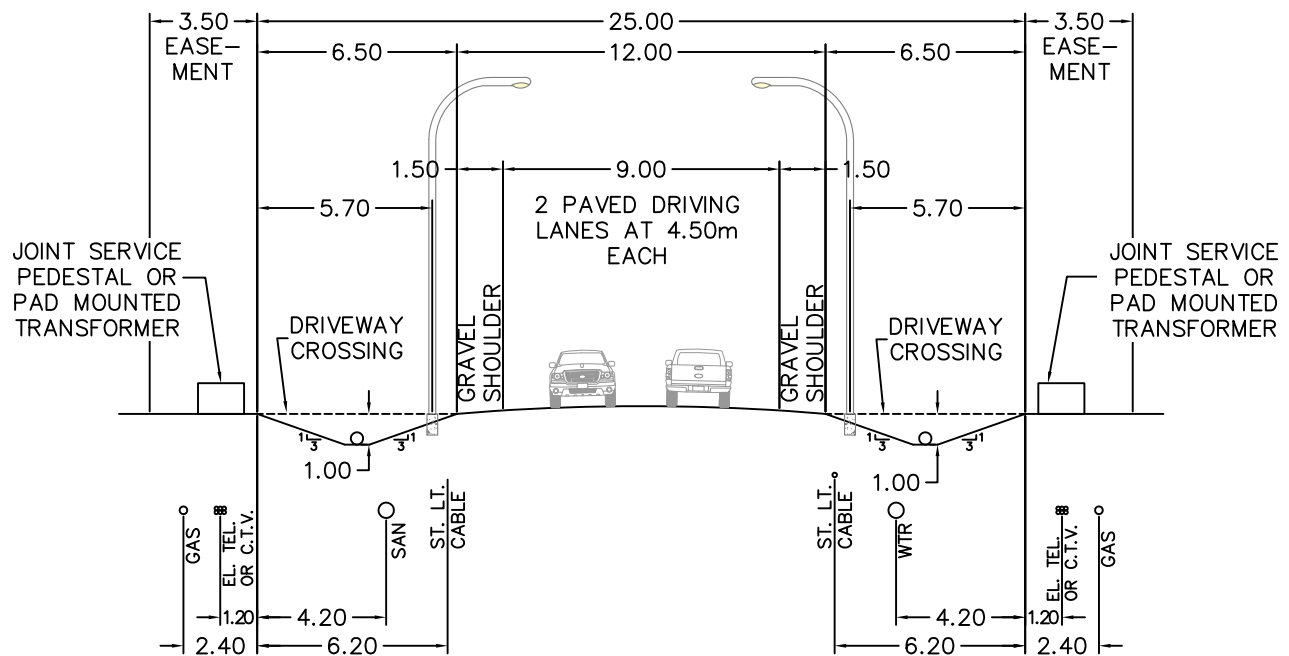
STANDARD DETAILS

SCALE: N.T.S.

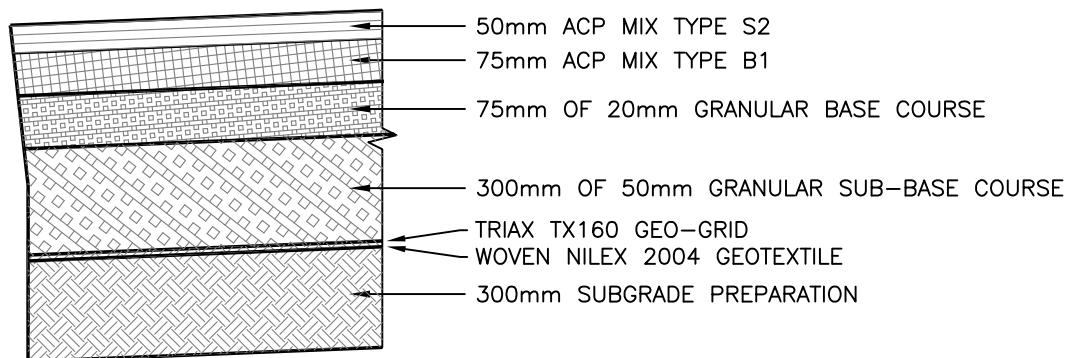
DATE: MAY 2014

STD. DWG NO.

D-110



RESIDENTIAL COLLECTOR ROADWAY – RURAL



MINIMUM ROAD STRUCTURE (NOT TO SCALE)



TITLE:

CROSS SECTION
RESIDENTIAL COLLECTOR
ROADWAY – RURAL

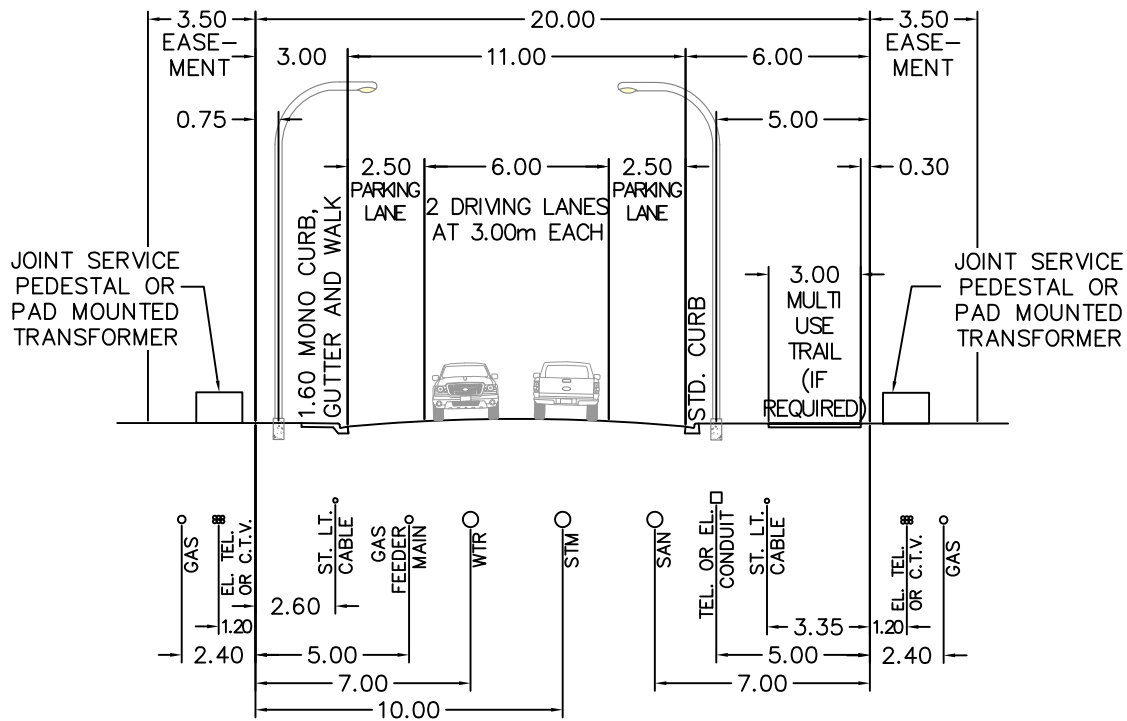
STANDARD DETAILS

SCALE: N.T.S.

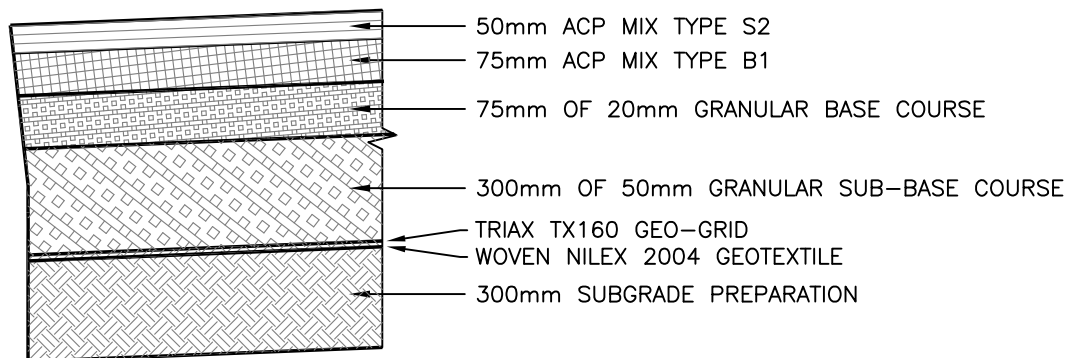
DATE: MAY 2014

STD. DWG NO.

D-111



LOCAL INDUSTRIAL / COMMERCIAL ROADWAY – URBAN



MINIMUM ROAD STRUCTURE (NOT TO SCALE)



TITLE:

CROSS SECTION
LOCAL INDUSTRIAL / COMMERCIAL
ROADWAY – URBAN

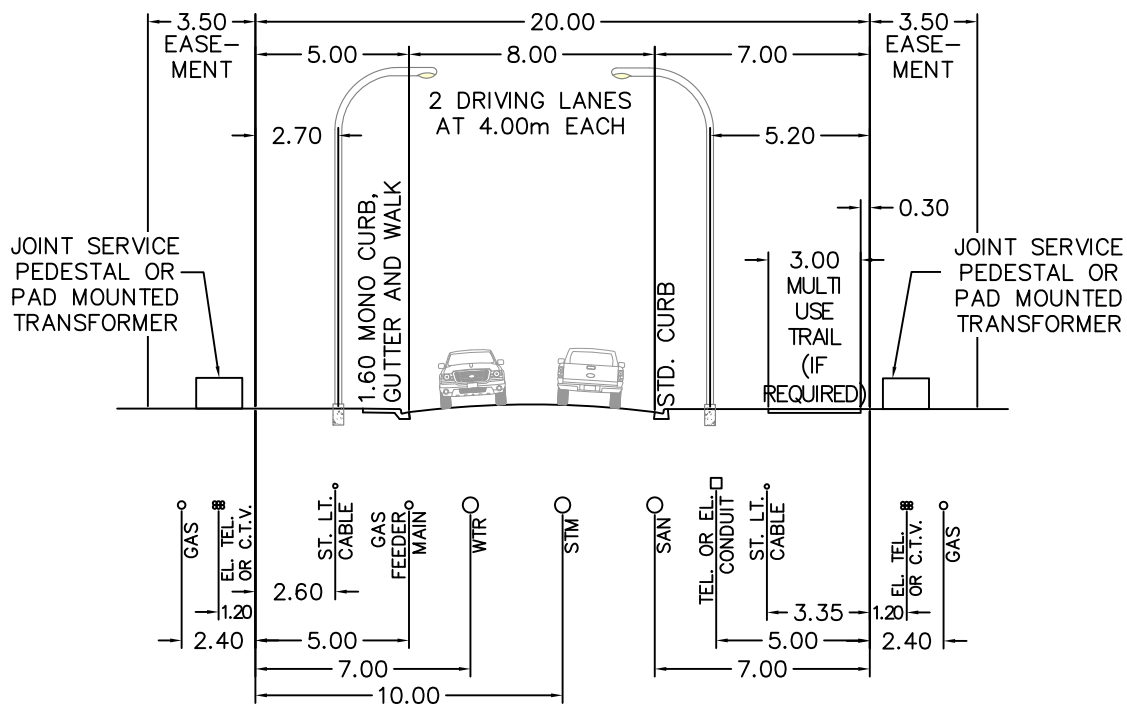
STANDARD DETAILS

SCALE: N.T.S.

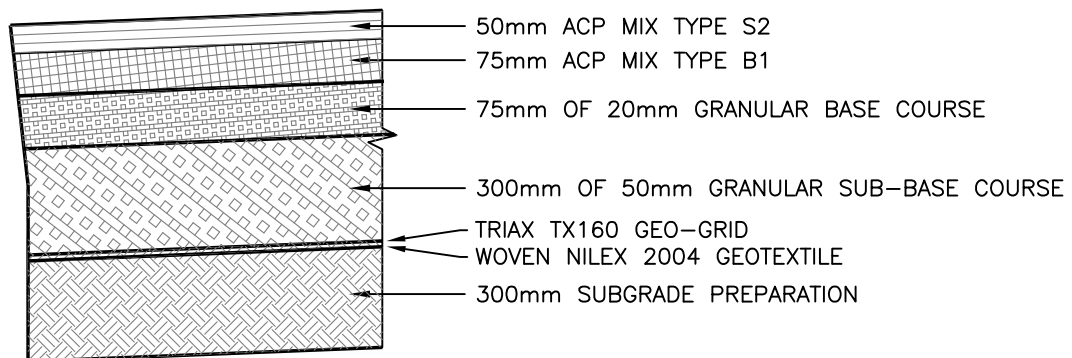
DATE: MAY 2014

STD. DWG NO.

D-112



LOCAL INDUSTRIAL / COMMERCIAL ROADWAY LOW IMPACT DEVELOPMENT



MINIMUM ROAD STRUCTURE (NOT TO SCALE)



TITLE:

CROSS SECTION
LOCAL INDUSTRIAL / COMMERCIAL
ROADWAY – URBAN LOW IMPACT

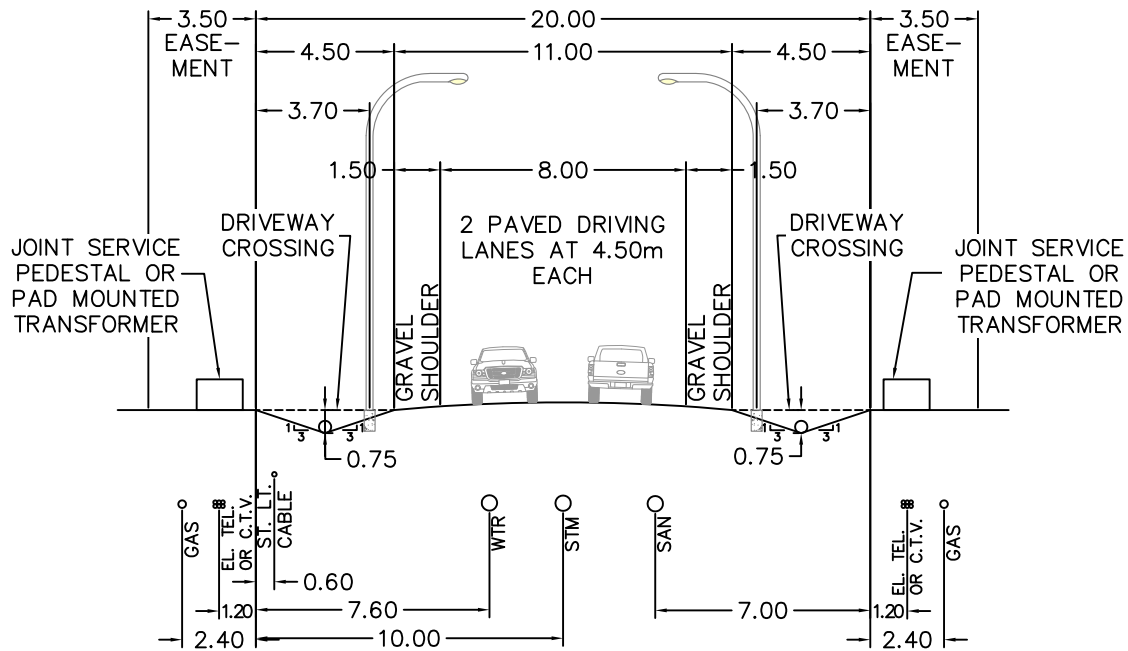
STANDARD DETAILS

SCALE: N.T.S.

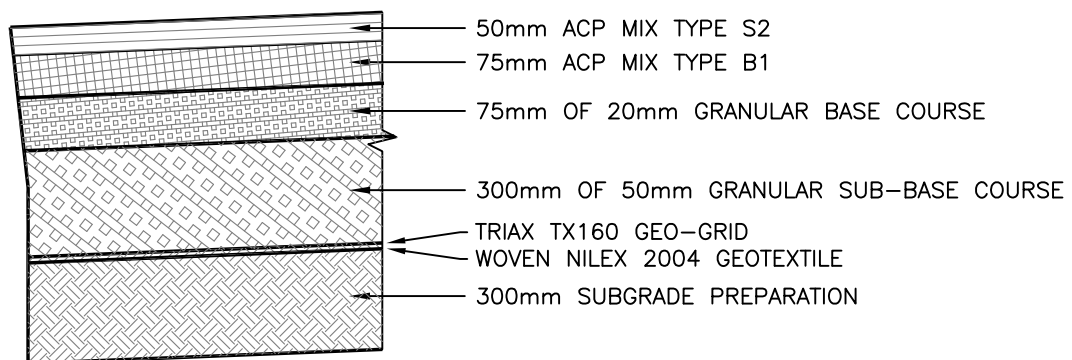
DATE: MAY 2014

STD. DWG NO.

D-113



LOCAL INDUSTRIAL / COMMERCIAL ROADWAY – RURAL



MINIMUM ROAD STRUCTURE (NOT TO SCALE)



TITLE:

CROSS SECTION
LOCAL INDUSTRIAL / COMMERCIAL
ROADWAY – RURAL

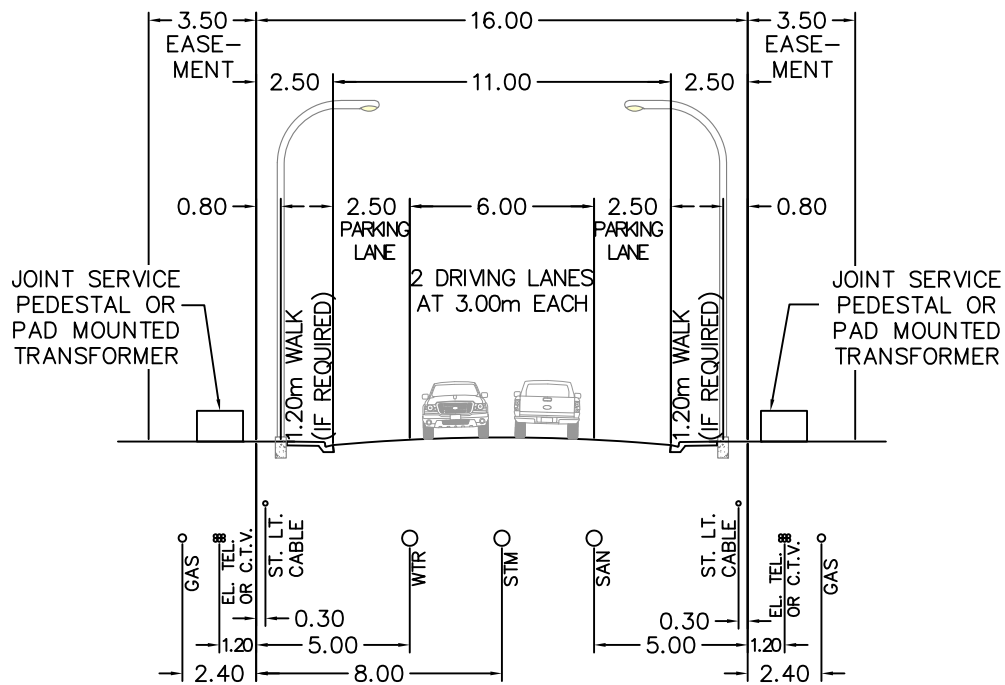
STANDARD DETAILS

SCALE: N.T.S.

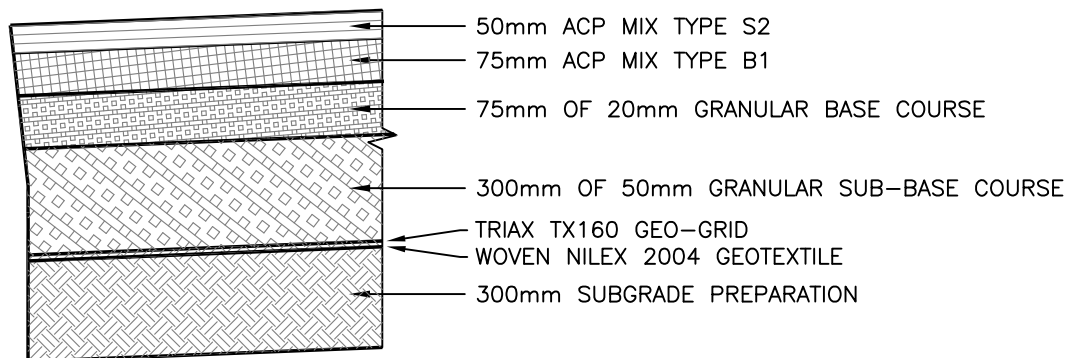
DATE: MAY 2014

STD. DWG NO.

D-114



LOCAL RESIDENTIAL ROADWAY MONOLITHIC SIDEWALK



MINIMUM ROAD STRUCTURE (NOT TO SCALE)



TITLE:

CROSS SECTION
LOCAL RESIDENTIAL ROADWAY
MONOLITHIC SIDEWALK

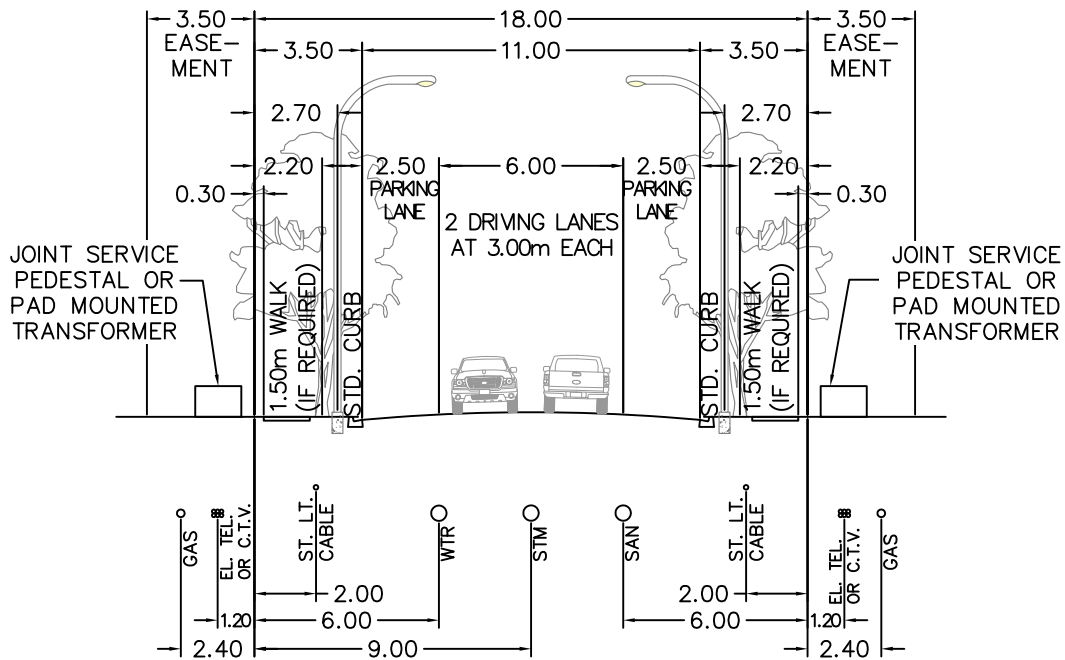
STANDARD DETAILS

SCALE: N.T.S.

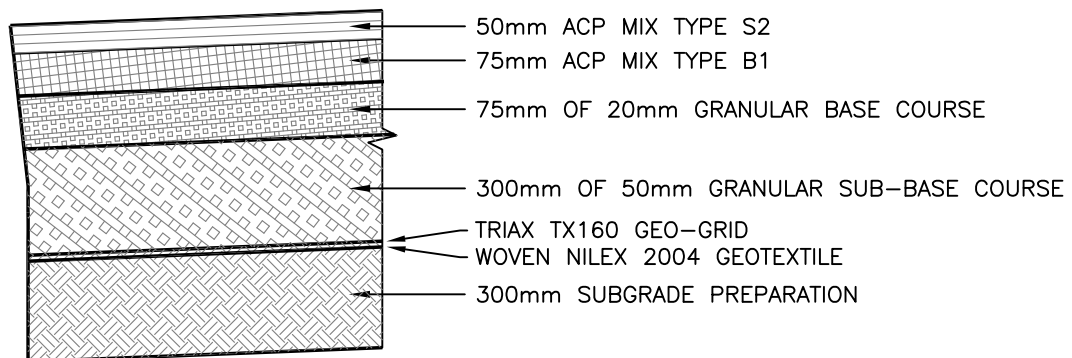
DATE: MAY 2014

STD. DWG NO.

D-115



LOCAL RESIDENTIAL ROADWAY – SEPARATE SIDEWALKS



MINIMUM ROAD STRUCTURE (NOT TO SCALE)



TITLE:

CROSS SECTION
LOCAL RESIDENTIAL ROADWAY
SEPARATE SIDEWALK

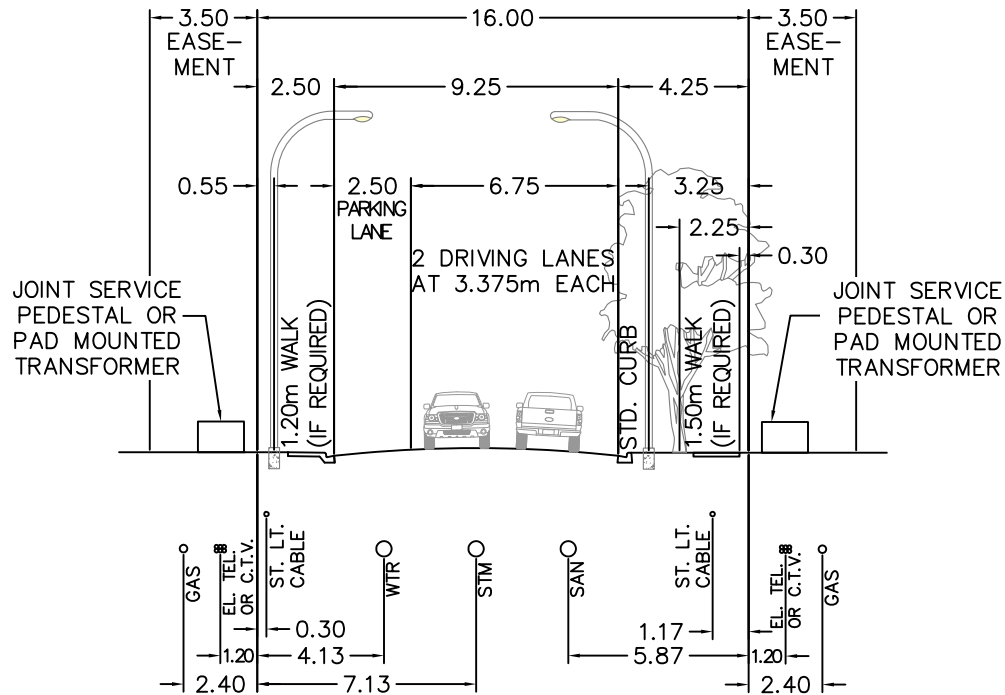
STANDARD DETAILS

SCALE: N.T.S.

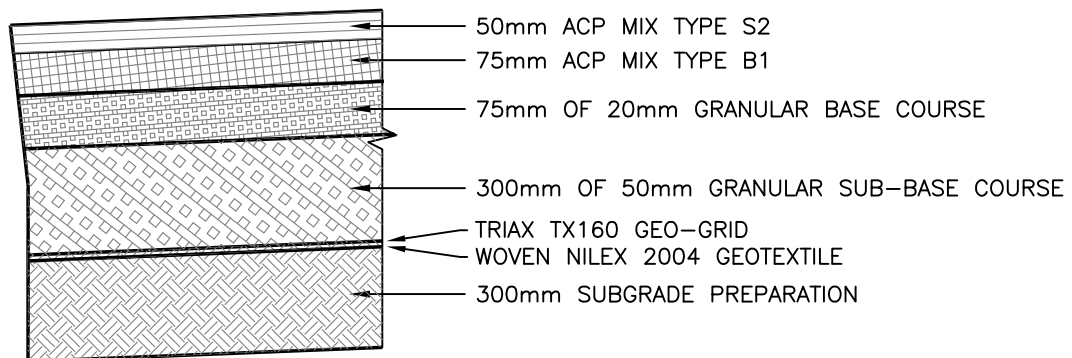
DATE: MAY 2014

STD. DWG NO.

D-116



LOCAL RESIDENTIAL ROADWAY – ON STREET PARKING ONE SIDE



MINIMUM ROAD STRUCTURE (NOT TO SCALE)



TITLE:

CROSS SECTION
LOCAL RESIDENTIAL ROADWAY
PARKING ONE SIDE

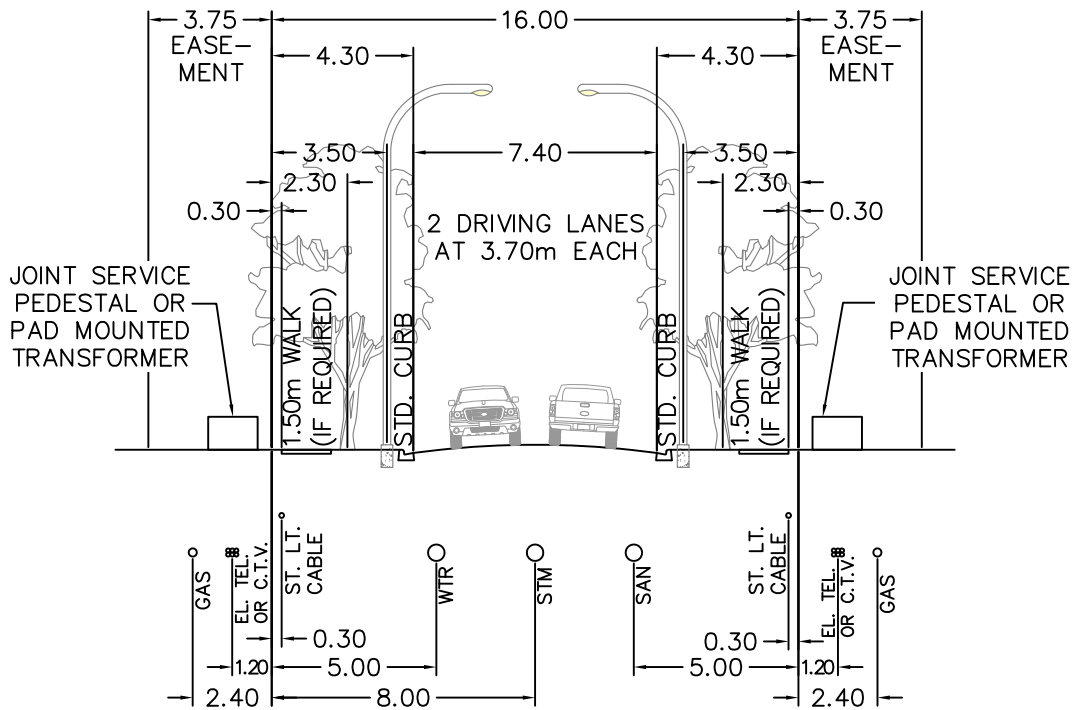
STANDARD DETAILS

SCALE: N.T.S.

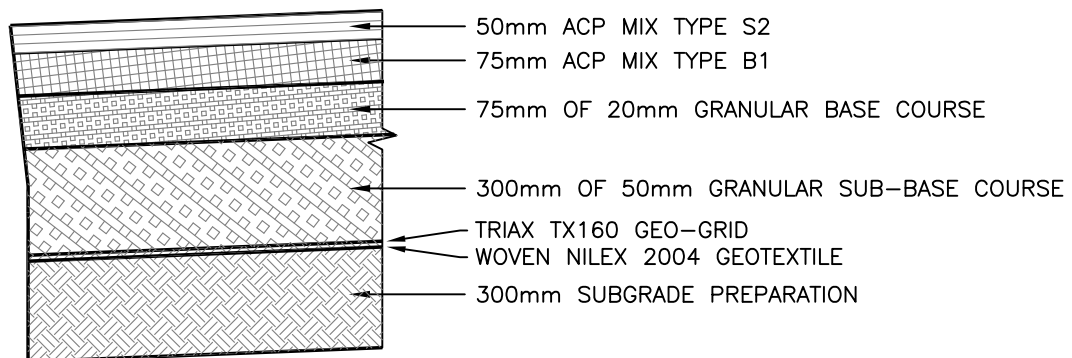
DATE: MAY 2014

STD. DWG NO.

D-117



LOCAL RESIDENTIAL ROADWAY – NO ON STREET PARKING LOW IMPACT DEVELOPMENT



MINIMUM ROAD STRUCTURE (NOT TO SCALE)



TITLE:

CROSS SECTION
LOCAL RESIDENTIAL ROADWAY
LOW IMPACT DEVELOPMENT

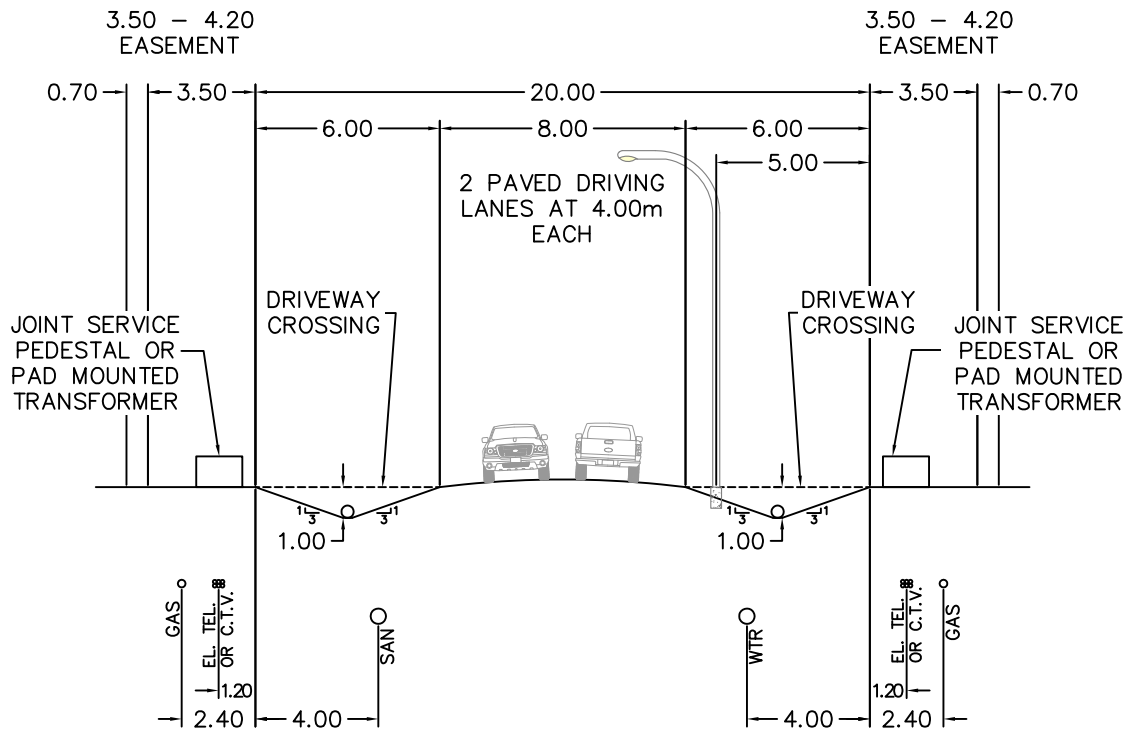
STANDARD DETAILS

SCALE: N.T.S.

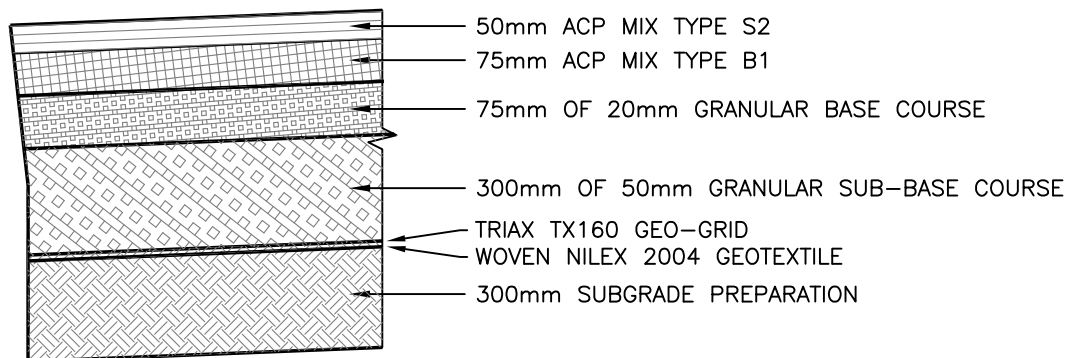
DATE: MAY 2014

STD. DWG NO.

D-118



LOCAL RESIDENTIAL ROADWAY — RURAL



MINIMUM ROAD STRUCTURE (NOT TO SCALE)



TITLE:

CROSS SECTION
LOCAL RESIDENTIAL ROADWAY
RURAL

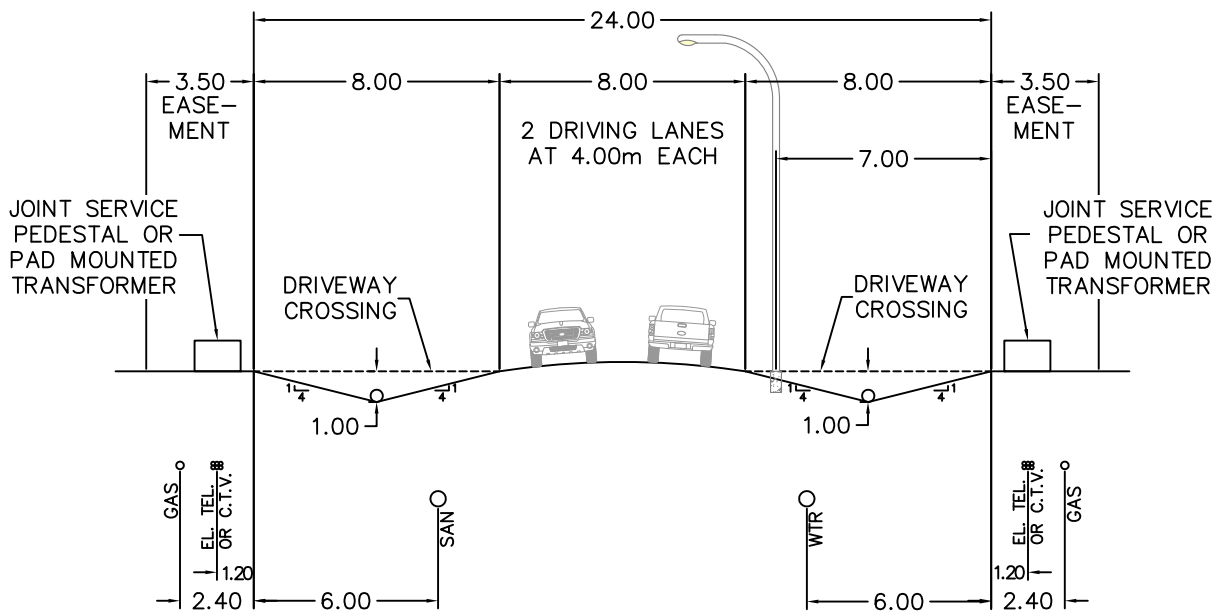
STANDARD DETAILS

SCALE: N.T.S.

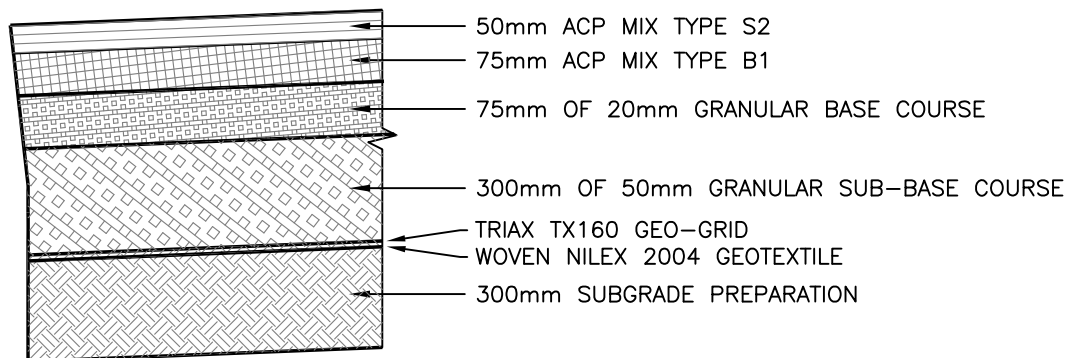
DATE: MAY 2014

STD. DWG NO.

D-119



LOCAL RESIDENTIAL ROADWAY – RURAL
1m DITCH DEPTH



MINIMUM ROAD STRUCTURE
(NOT TO SCALE)



TITLE:

CROSS SECTION
LOCAL RESIDENTIAL ROADWAY
RURAL WITH EXPANDED DITCHES

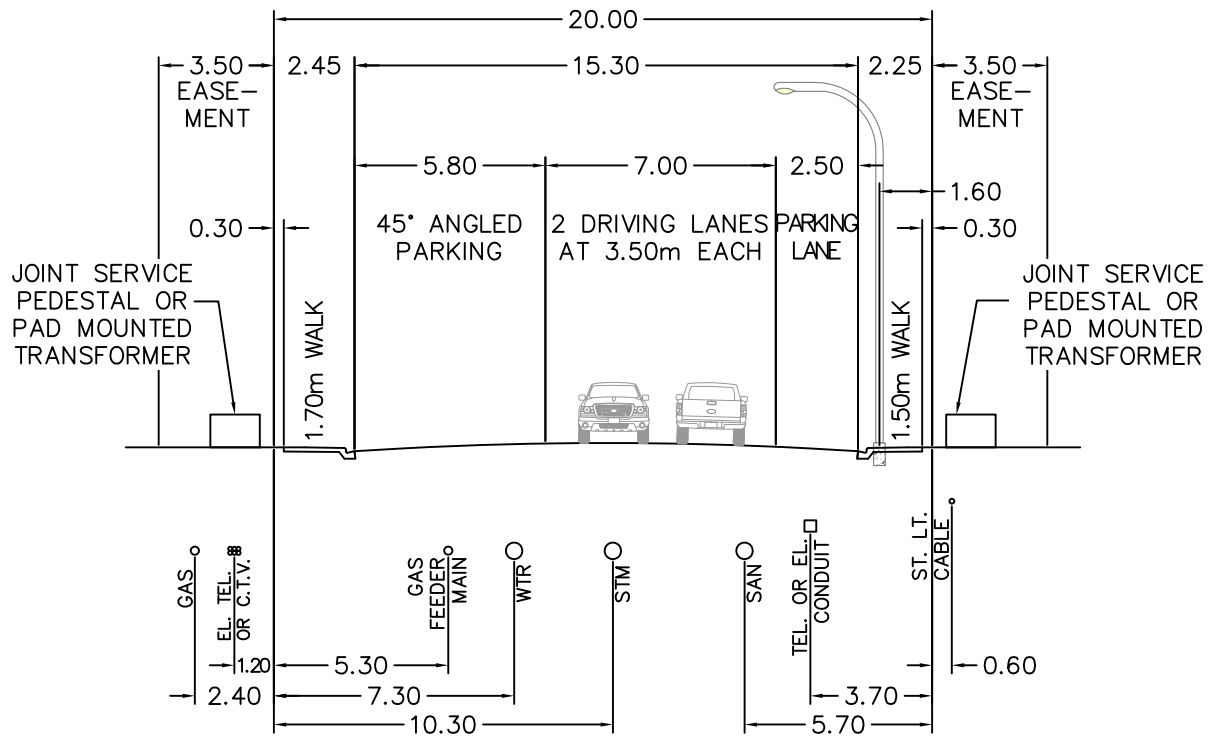
STANDARD DETAILS

SCALE: N.T.S.

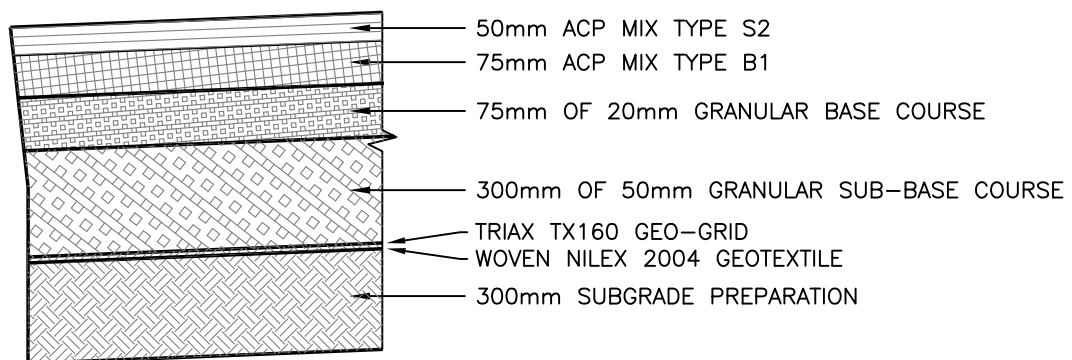
DATE: MAY 2014

STD. DWG NO.

D-120



LOCAL DOWNTOWN COMMERCIAL ROADWAY



MINIMUM ROAD STRUCTURE (NOT TO SCALE)



TITLE:

CROSS SECTION
LOCAL RESIDENTIAL ROADWAY
DOWNTOWN SECTION

STANDARD DETAILS

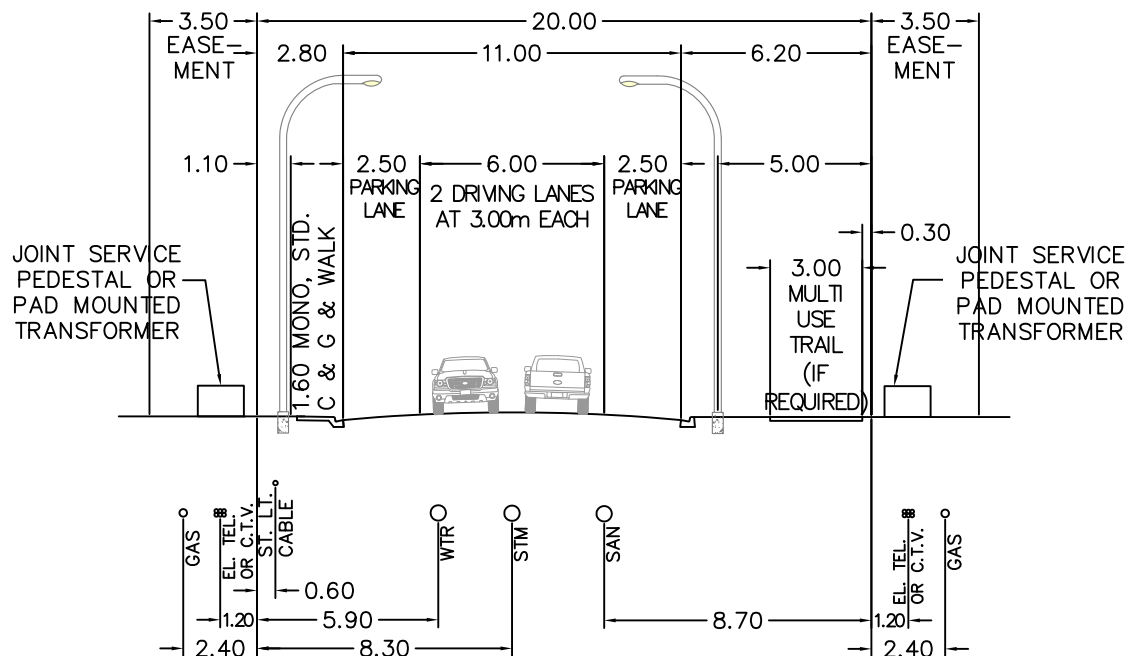
SCALE: N.T.S.

DATE: MAY 2014

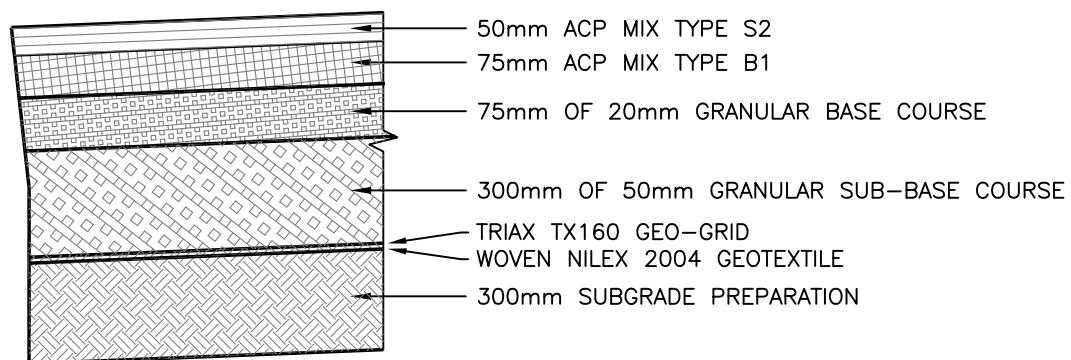
STD. DWG NO.

D-121

*WHERE MULTI USE TRAIL
IS PROVIDED VEHICLE
ACCESS TO R-1 AND R-2
LOTS IS PROHIBITED



LOCAL PUBLIC SERVICE ROADWAY – URBAN



MINIMUM ROAD STRUCTURE (NOT TO SCALE)



TITLE:

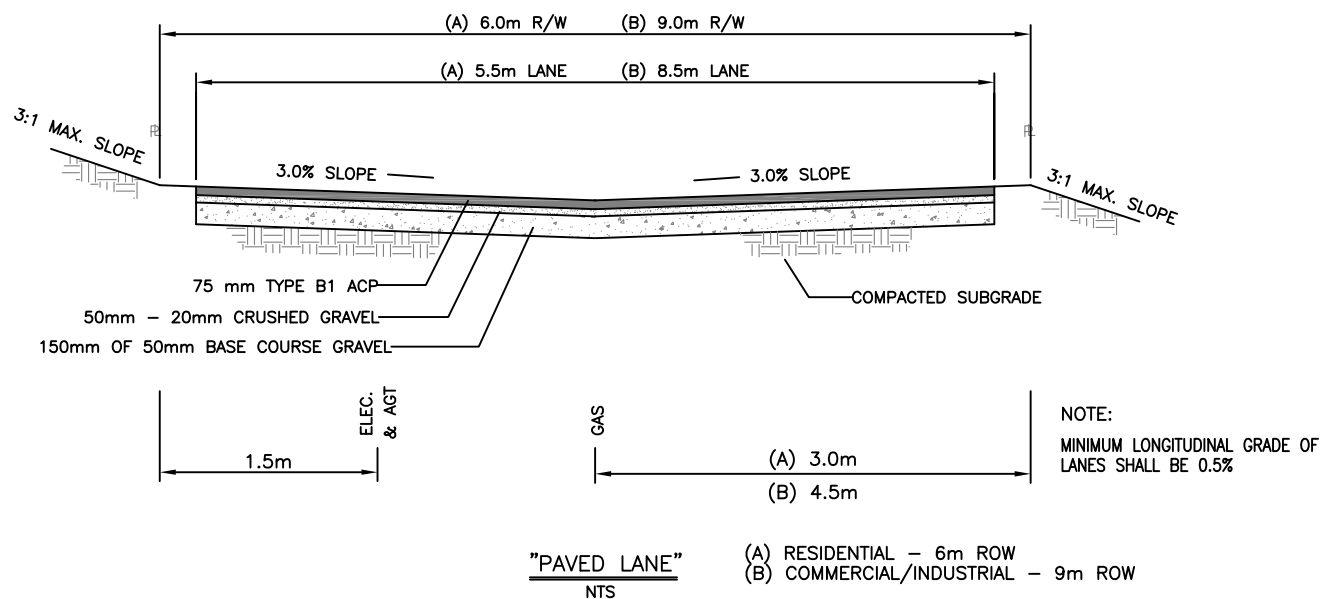
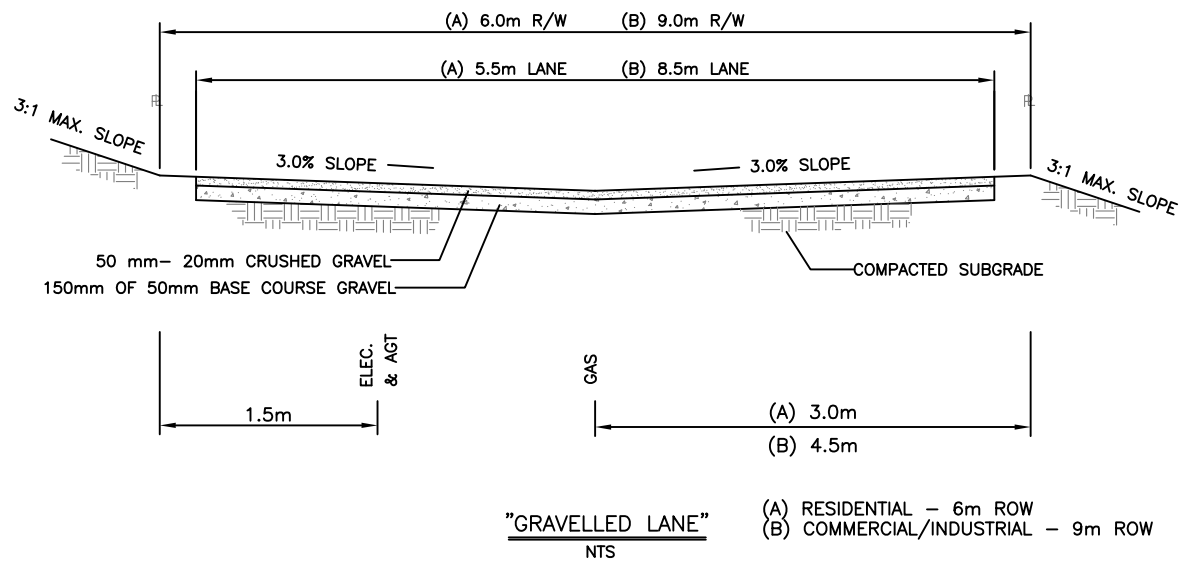
CROSS SECTION
LOCAL RESIDENTIAL ROADWAY
PUBLIC SERVICE

STANDARD DETAILS

SCALE: N.T.S.

DATE: MAY 2014

STD. DWG NO. D-122



TITLE:

TYPICAL LANE CROSS-SECTIONS

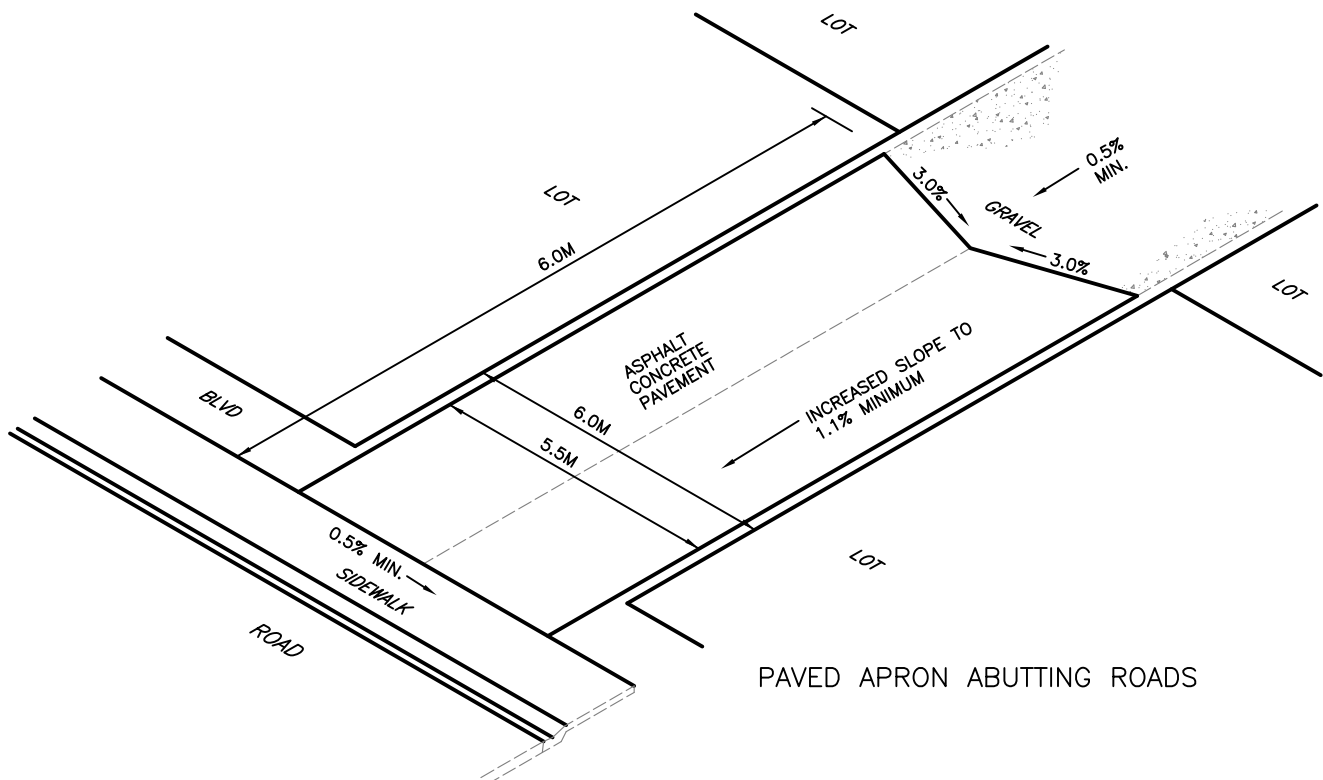
STANDARD DETAILS

SCALE: N.T.S.

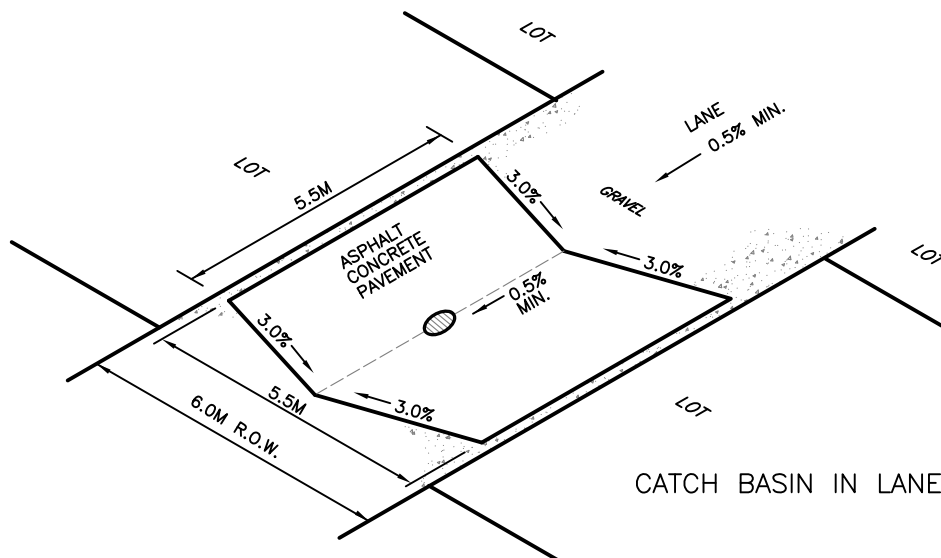
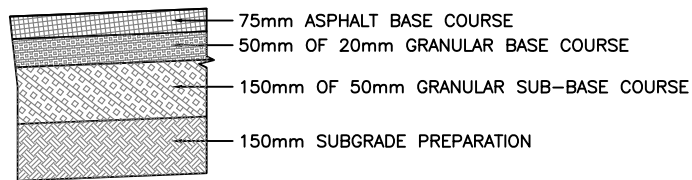
DATE: MAY 2014

STD. DWG NO.

D-123



MINIMUM PAVE APRON STRUCTURE



TITLE:

LANE PAVING DETAILS

STANDARD DETAILS

SCALE: N.T.S.

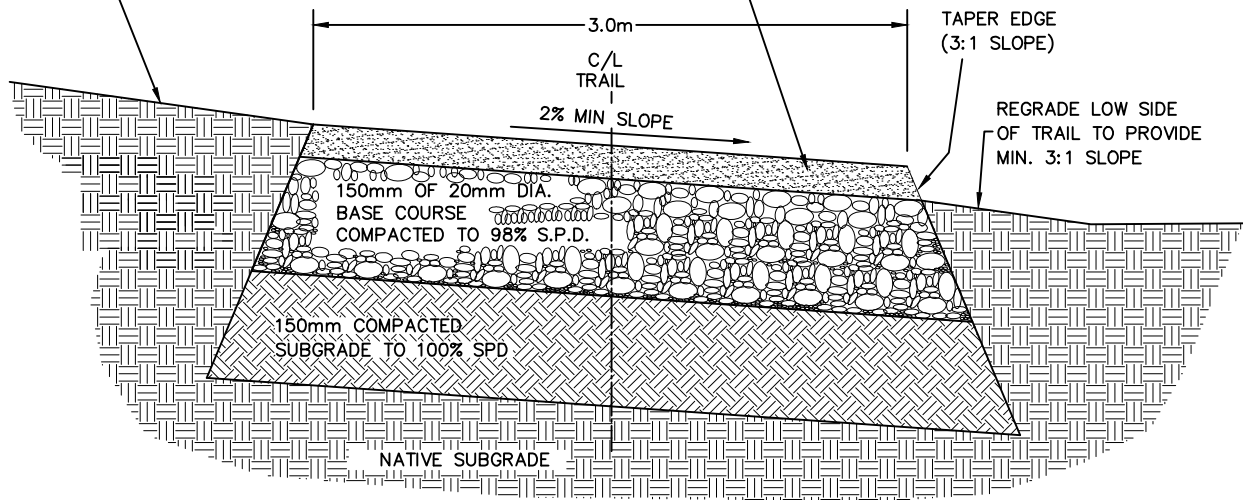
DATE: MAY 2014

STD. DWG NO.

D-124

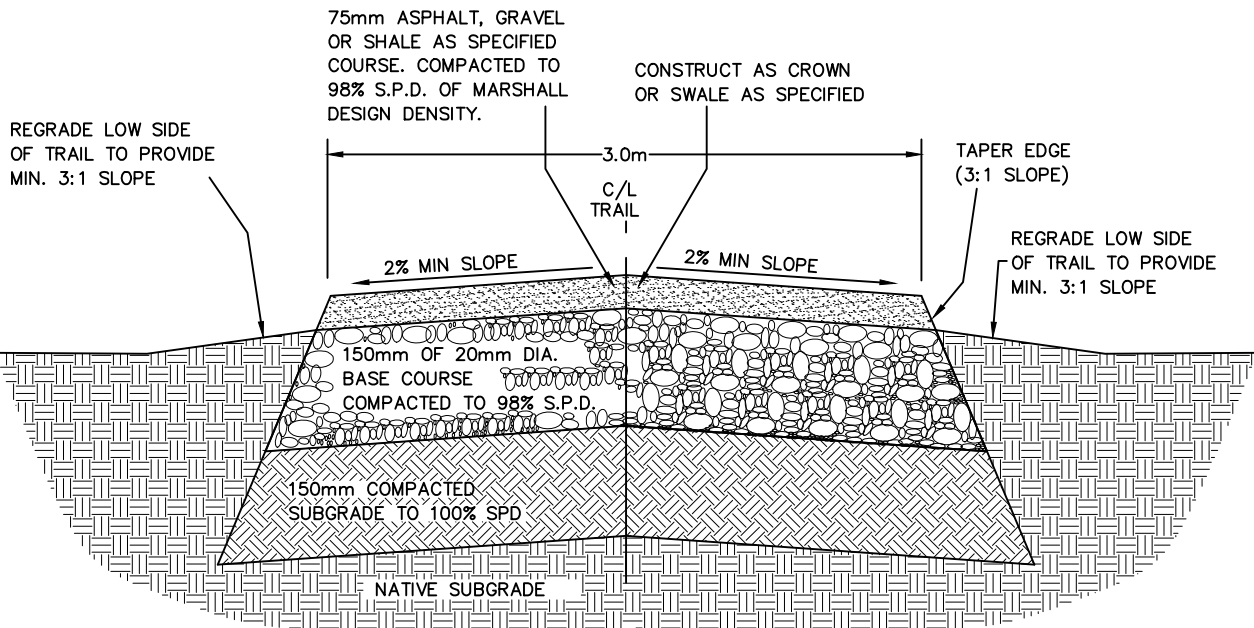
REGRADE HIGH SIDE OF TRAIL
TO PROVIDE MIN. 3:1 SLOPE
(GRADE TO MATCH TOP OF
TRAIL TO ENSURE DRAINAGE)

75mm ASPHALT GRAVEL
OR SHALE AS SPECIFIED
COURSE. COMPACTED TO
98% S.P.D. OF MARSHALL
DESIGN DENSITY.



TYPICAL TRAIL SECTION – CROSSFALL

NTS



TYPICAL TRAIL SECTION – CROWN OR SWALE

NTS

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES
2. MAKE ALL JOINTS WITH EXISTING VEGETATION
SMOOTH AND CONTINUOUS, WHERE NECESSARY
TRIM BACK ROOTS AND CLEAR DEBRIS



TITLE:

TYPICAL TRAIL CROSS-SECTIONS

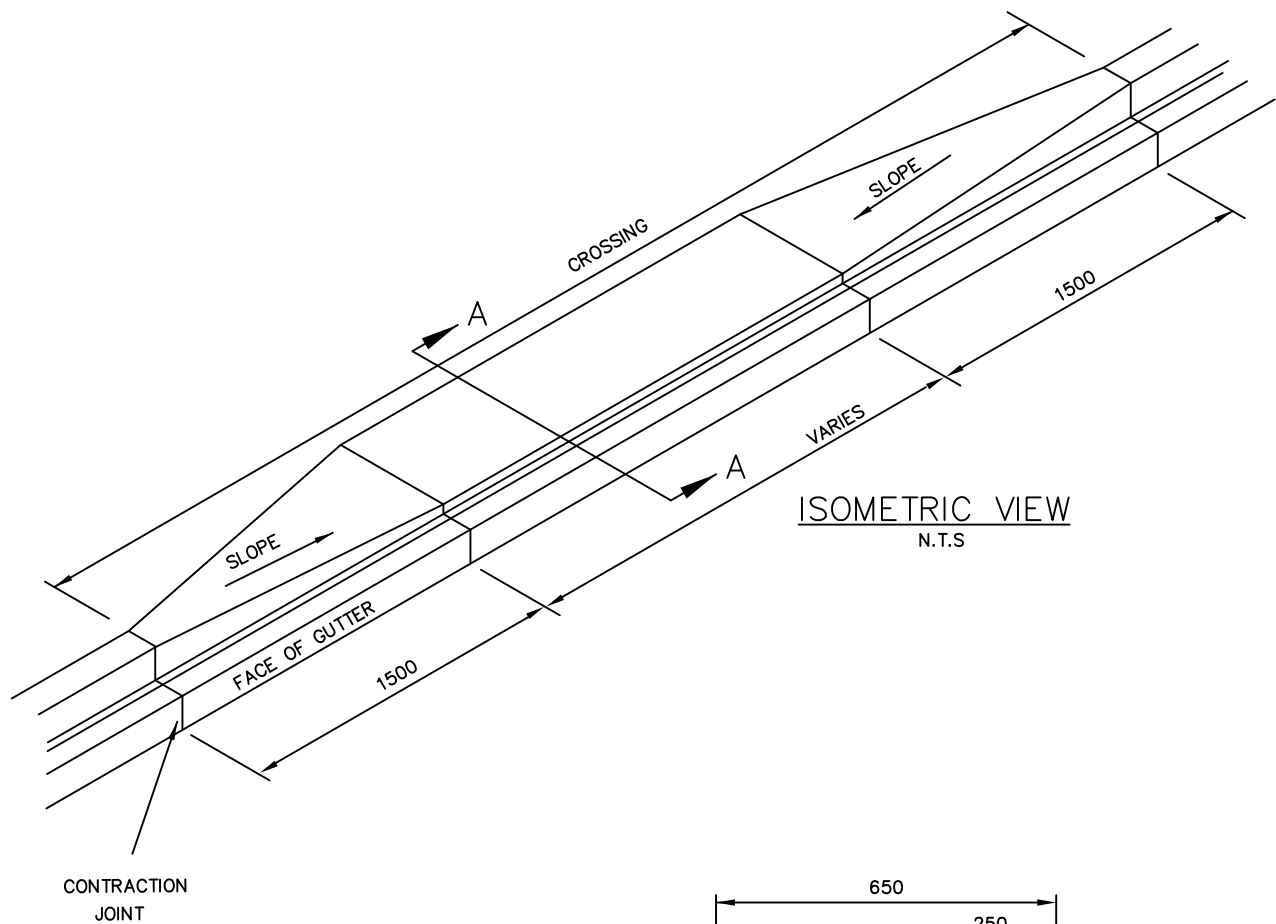
STANDARD DETAILS

SCALE: N.T.S.

DATE: MAY 2014

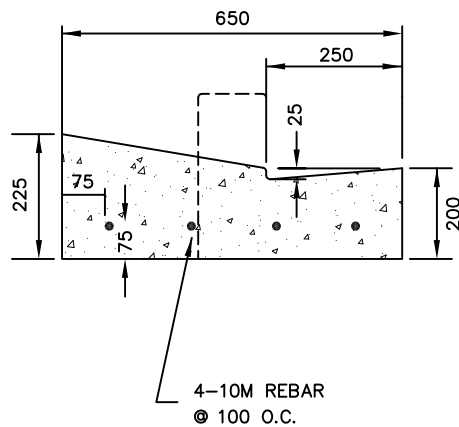
STD. DWG NO.

D-125



NOTES:

1. MAINTAIN THICKENED DEPTH THROUGHOUT.
2. ALL DIMENSIONS ARE IN MILLIMETRES



SECTION A - A



TITLE:

INDUSTRIAL / COMMERCIAL
CURB & GUTTER CROSSING

STANDARD DETAILS

SCALE: N.T.S.

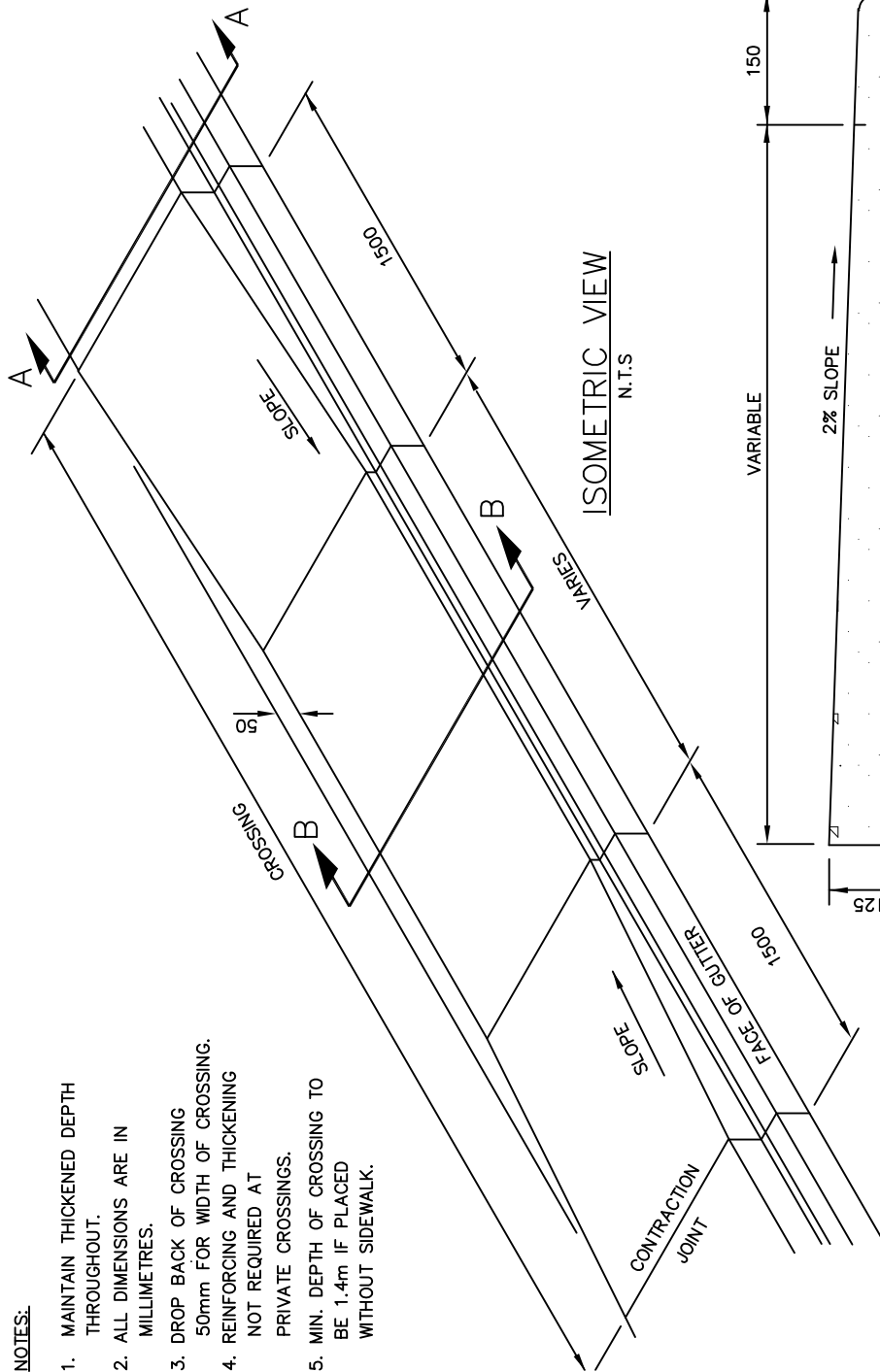
DATE: MAY 2014

STD. DWG NO.

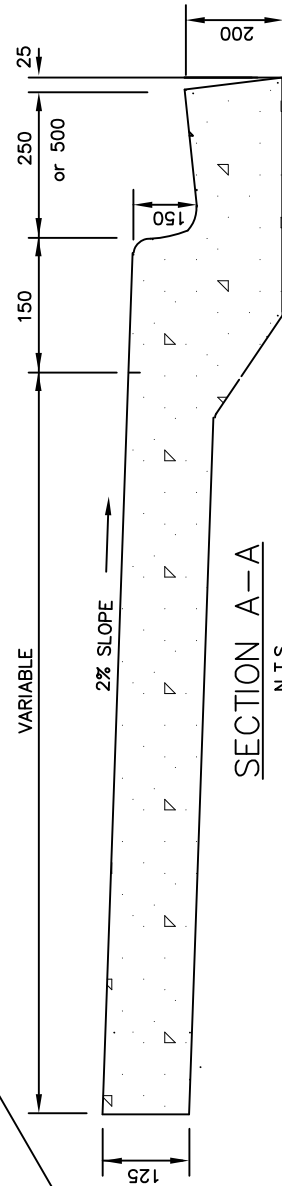
D-126

NOTES:

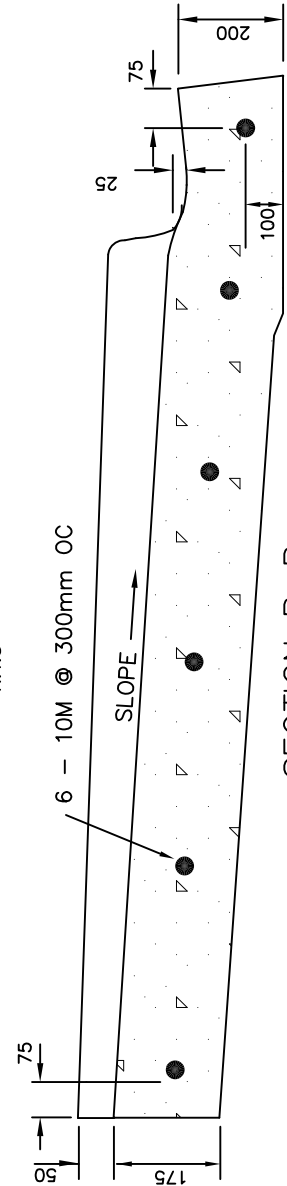
1. MAINTAIN THICKENED DEPTH THROUGHOUT.
2. ALL DIMENSIONS ARE IN MILLIMETRES.
3. DROP BACK OF CROSSING 50mm FOR WIDTH OF CROSSING.
4. REINFORCING AND THICKENING NOT REQUIRED AT PRIVATE CROSSINGS.
5. MIN. DEPTH OF CROSSING TO BE 1.4m IF PLACED WITHOUT SIDEWALK.



ISOMETRIC VIEW
N.T.S.



SECTION A-A
N.T.S.



SECTION B-B
N.T.S.



TITLE:

TYPICAL MONOLITHIC LANE AND DRIVEWAY CROSSING

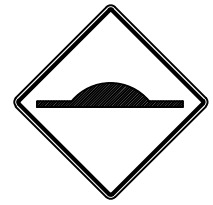
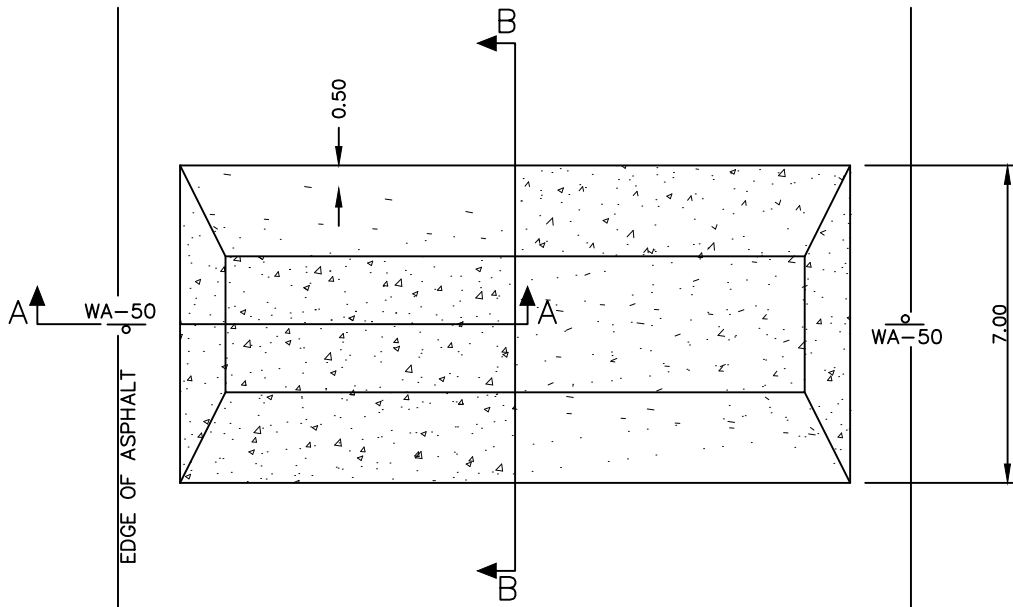
STANDARD DETAILS

SCALE: N.T.S.

DATE: MAY 2014

STD. DWG NO.

D-127

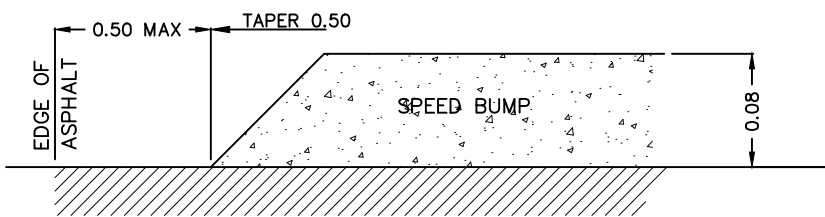


WA-50
450mm X 450mm
SPEED BUMP

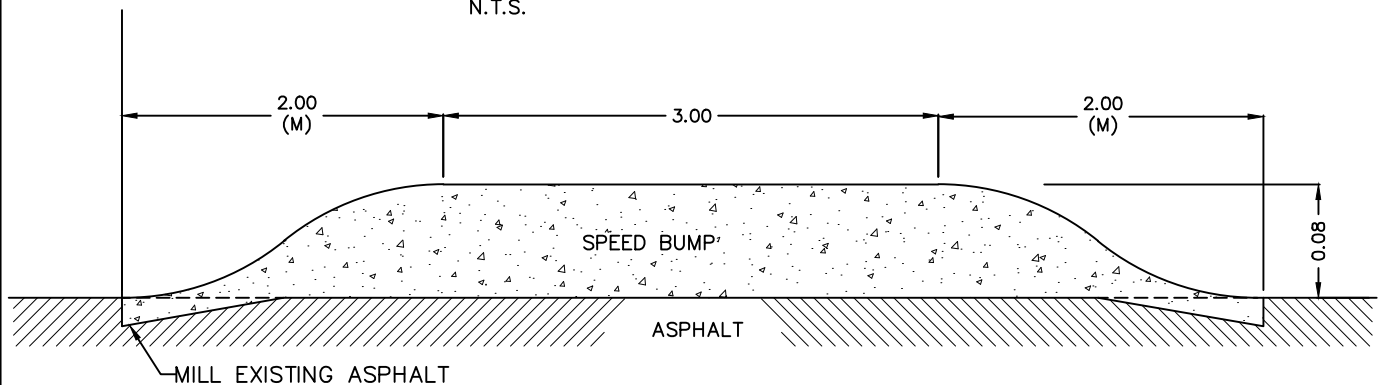
TWO WAY STREET/LANE
N.T.S.

NOTES:

1. PAINT 1.0 m WIDE YELLOW LINE ACROSS BOTH FACES OF BUMP.
2. PAINT 0.6 m WIDE CHEVRON PATTERN ON ENTIRE SURFACE.



SECTION A - A
N.T.S.



SECTION B - B
N.T.S.

SINUSOIDAL SPEED BUMP DEVELOPMENT:

DISTANCE (M)	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875	1.000	1.125	1.250	1.375	1.500	1.625	1.750	1.875	2.000
FINISHED HEIGHT(mm)	0	1	3	7	12	18	26	32	40	48	55	62	68	73	77	79	80



TITLE:

ASPHALT
SPEED BUMP

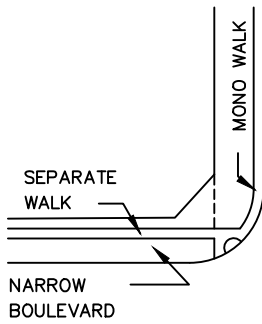
STANDARD DETAILS

SCALE: N.T.S.

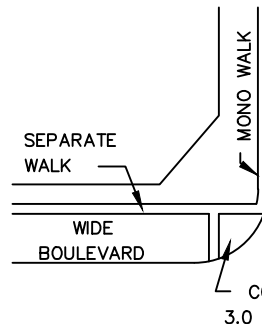
DATE: MAY 2014

STD. DWG NO.

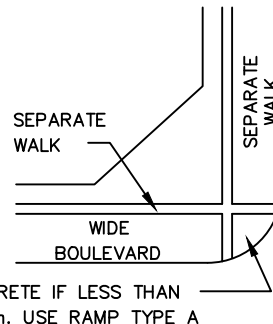
D-128



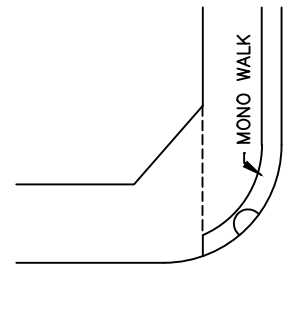
RAMP TYPE A



RAMP TYPE B

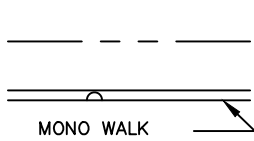


RAMP TYPE B



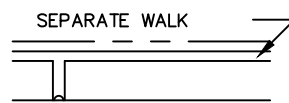
RAMP TYPE A

CORNER LAYOUT



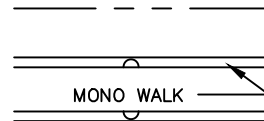
LOCATE RAMPS DIRECTLY ACROSS FROM CORNER RAMPS

RAMP TYPE C

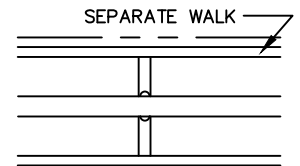


LOCATE RAMPS DIRECTLY ACROSS FROM CORNER RAMPS

RAMP TYPE D

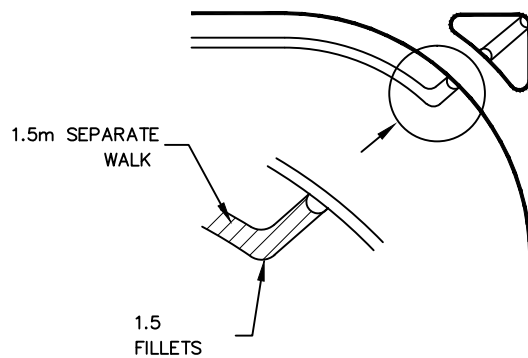


RAMP TYPE C

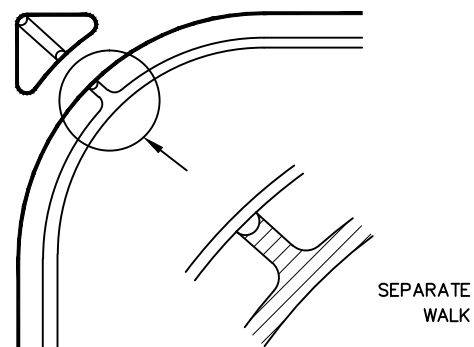


RAMP TYPE D

TANGENT LAYOUT



RAMP TYPE D



INTERSECTION LAYOUT

N.T.S.



TITLE:

WHEELCHAIR / BIKE
RAMP LOCATIONS

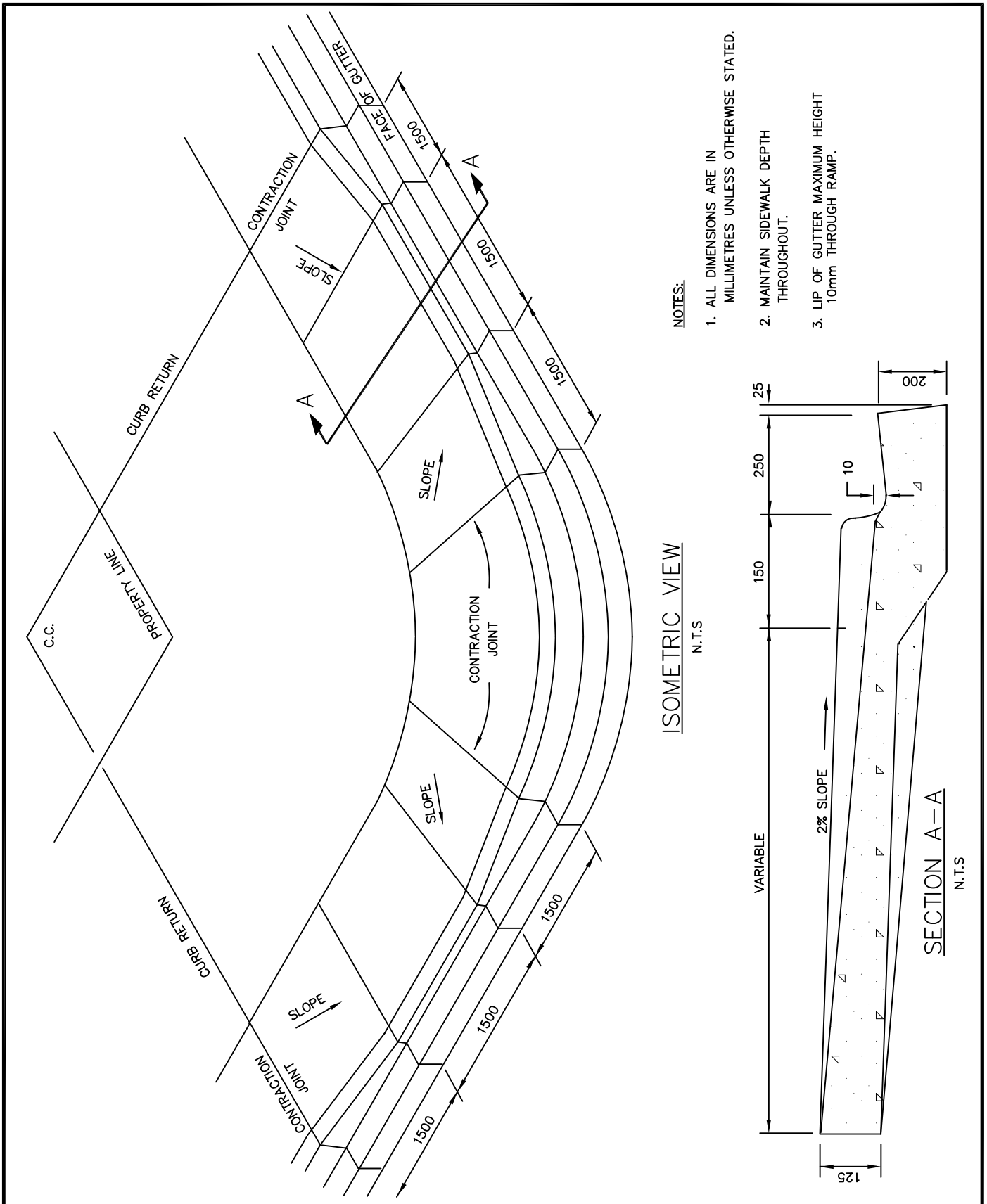
STANDARD DETAILS

SCALE: N.T.S.

DATE: MAY 2014

STD. DWG NO.

D-129



TITLE:

PARAPLEGIC RAMP DETAILS AT BOTH CURB RETURNS

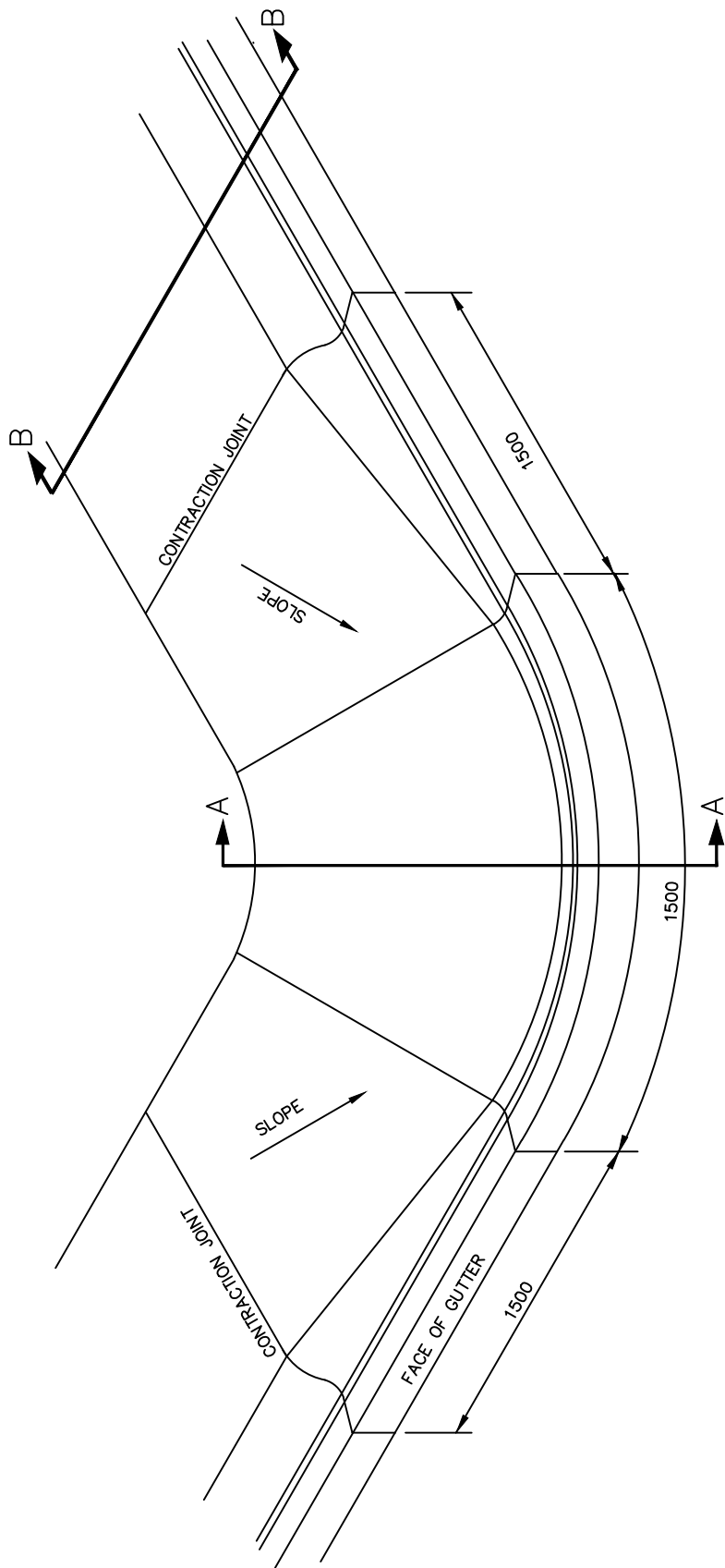
STANDARD DETAILS

SCALE: N.T.S.

DATE: MAY 2014

STD. DWG NO.

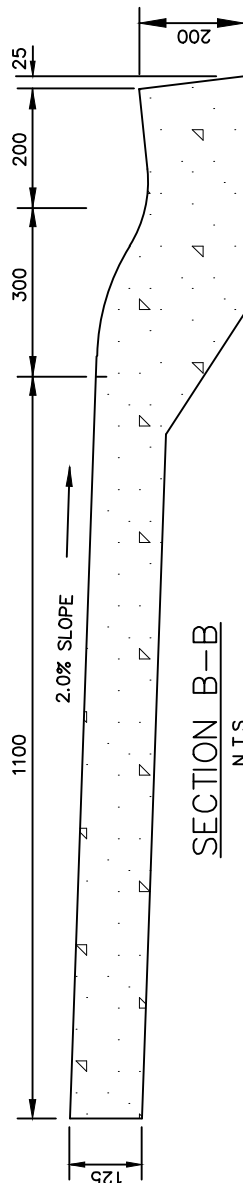
D-131



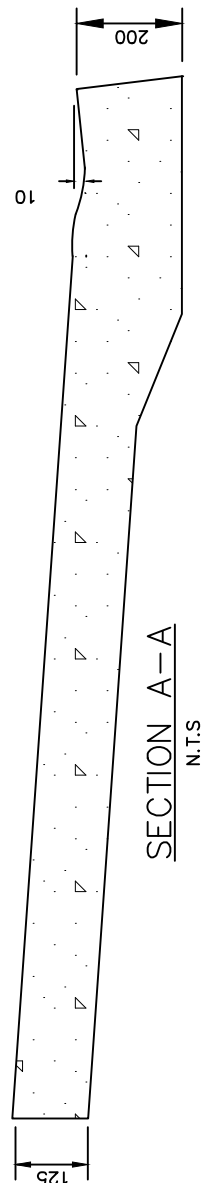
ISOMETRIC VIEW
N.T.S

NOTES:

1. MAINTAIN SIDEWALK DEPTH THROUGHOUT.
2. ALL DIMENSIONS ARE IN MILLIMETRES.
3. LIP OF GUTTER MAXIMUM HEIGHT 10mm THROUGH LIP.



SECTION B-B
N.T.S



SECTION A-A
N.T.S



TITLE:

PARAPLEGIC RAMP
DETAILS AT CENTRE
OF CURB RETURN
(ROLLED CURB)

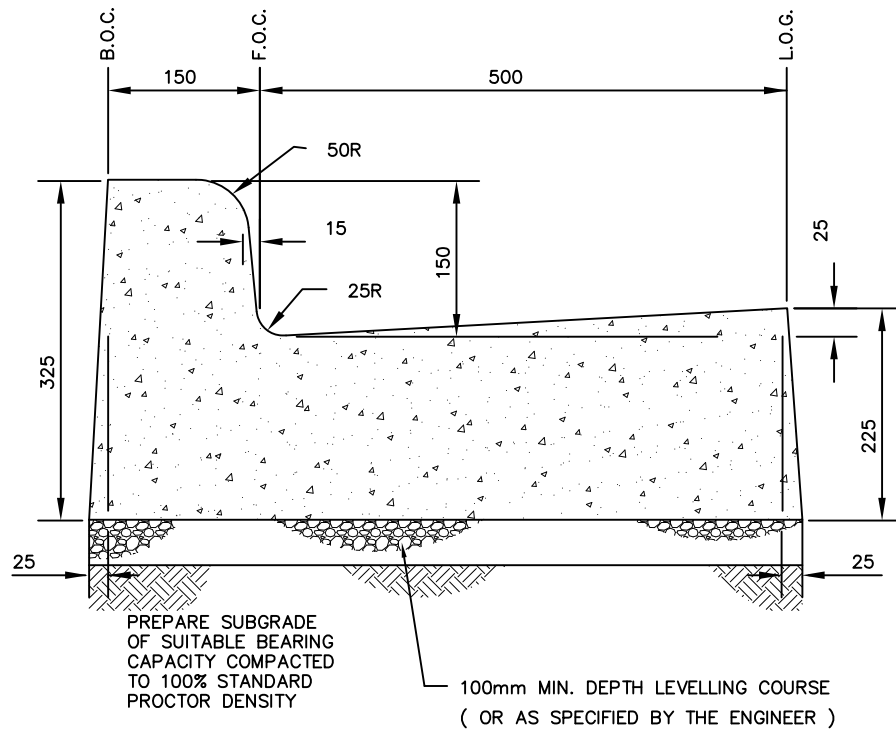
STANDARD DETAILS

SCALE: N.T.S.

DATE: MAY 2014

STD. DWG NO.

D-132



NOTES:

1. 25 mm BATTER NOT REQUIRED FOR HANDFORMED.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.



TITLE:

500mm STANDARD
CURB & GUTTER

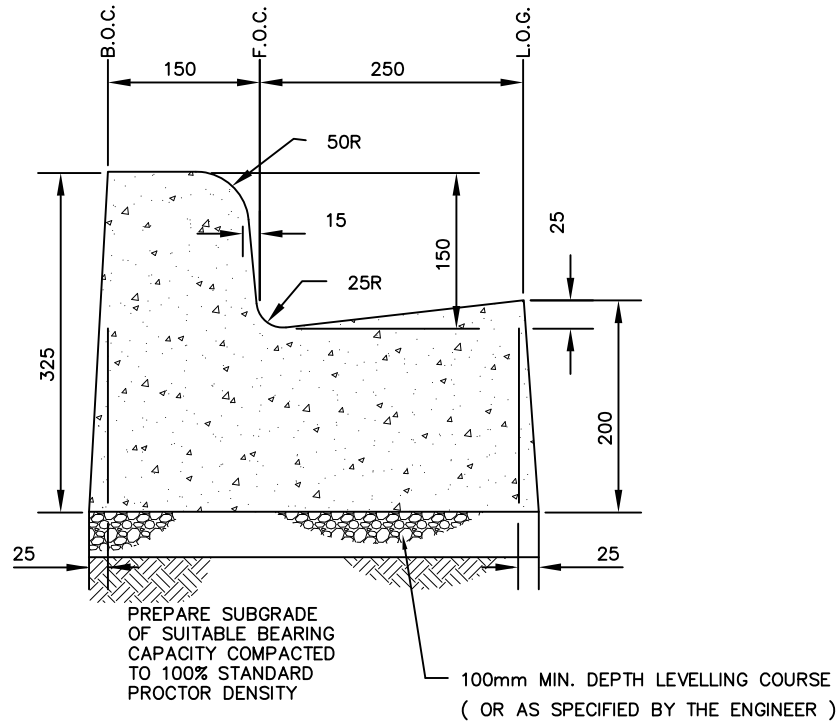
STANDARD DETAILS

SCALE: N.T.S.

DATE: MAY 2014

STD. DWG NO.

D-133



NOTES:

1. 25 mm BATTER NOT REQUIRED FOR HANDFORMED.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.



TITLE:

250mm STANDARD CURB & GUTTER

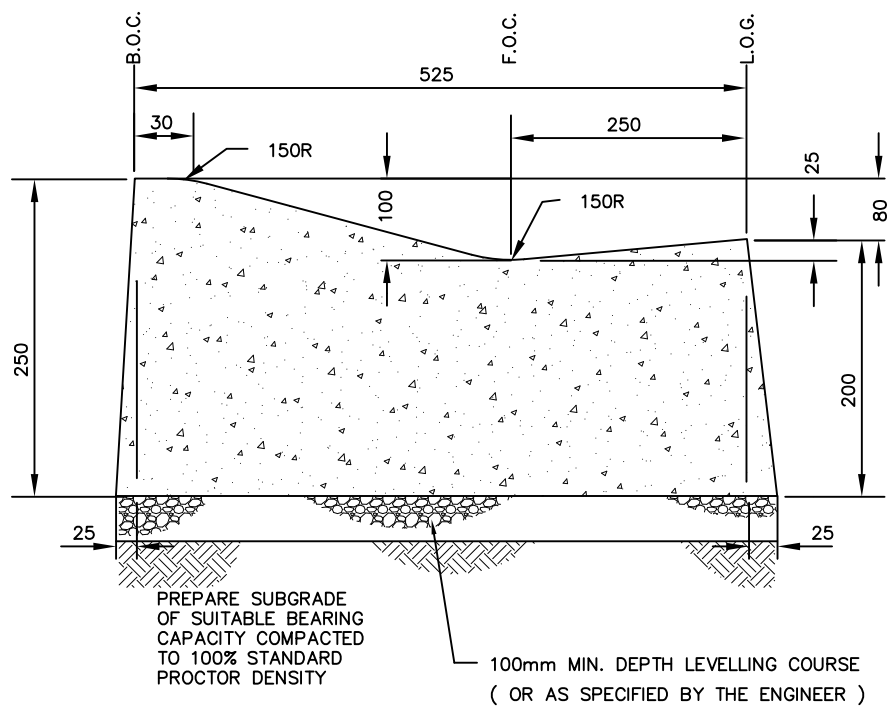
STANDARD DETAILS

SCALE: N.T.S.

DATE: MAY 2014

STD. DWG NO.

D-134



NOTES:

1. 25 mm BATTER NOT REQUIRED FOR HANDFORMED.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.



TITLE:

250mm LOW PROFILE ROLLED
CURB AND GUTTER

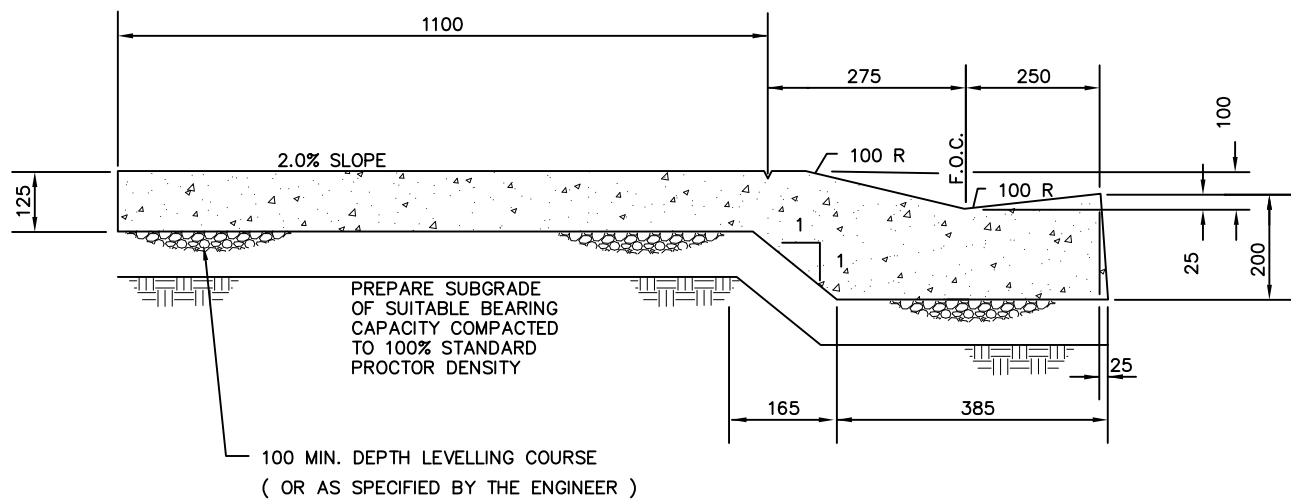
STANDARD DETAILS

SCALE: N.T.S.

DATE: MAY 2014

STD. DWG NO.

D-135



NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.



TITLE:

LOW PROFILE ROLLED
MONOLITHIC SIDEWALK

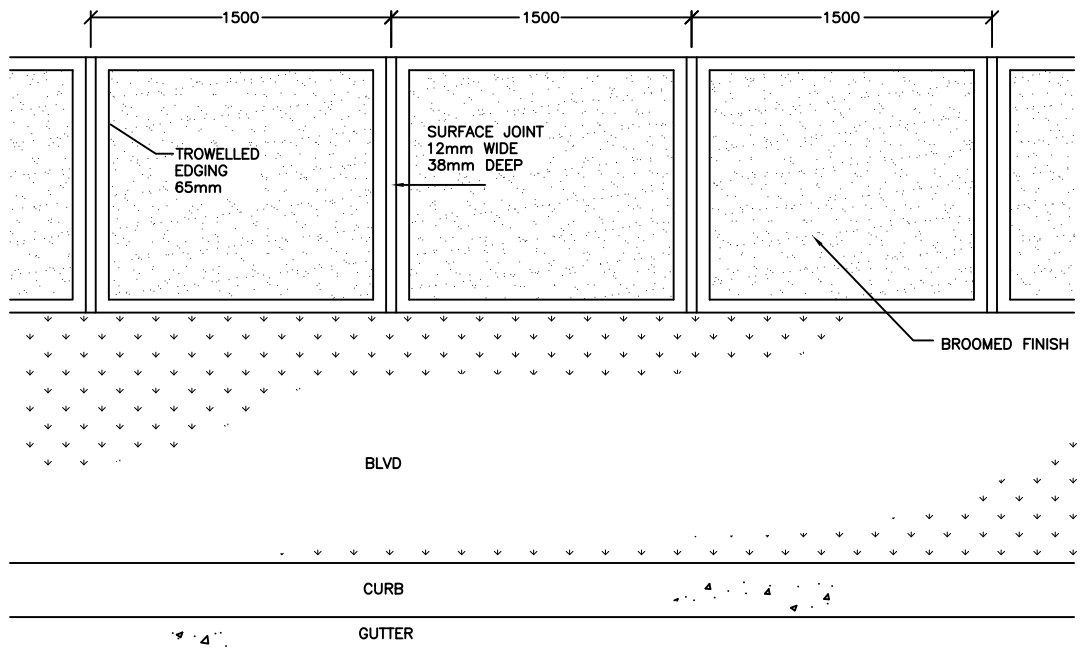
STANDARD DETAILS

SCALE: N.T.S.

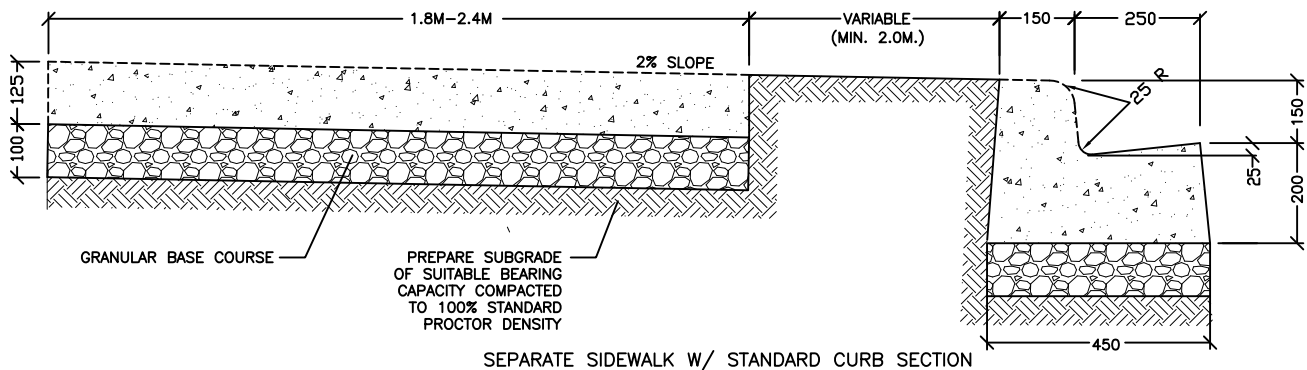
DATE: MAY 2014

STD. DWG NO.

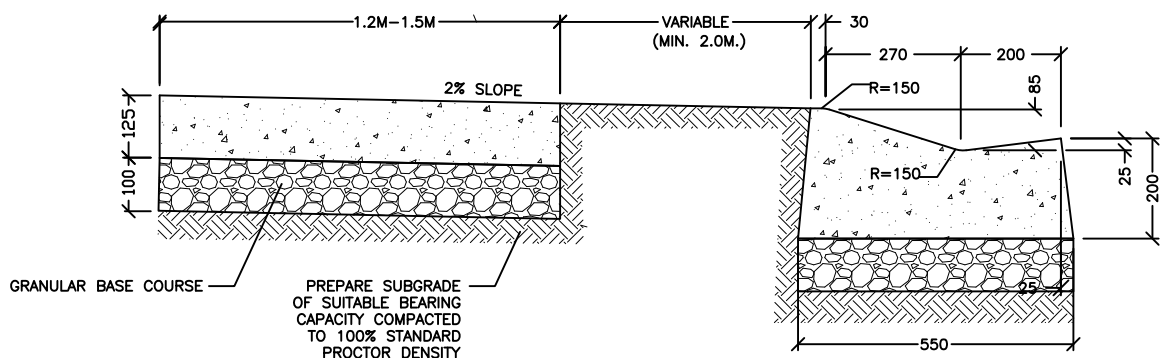
D-136



PLAN VIEW



SEPARATE SIDEWALK W/ STANDARD CURB SECTION



SEPARATE SIDEWALK W/ ROLLED CURB SECTION

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES.



TITLE:

SEPARATE SIDEWALK

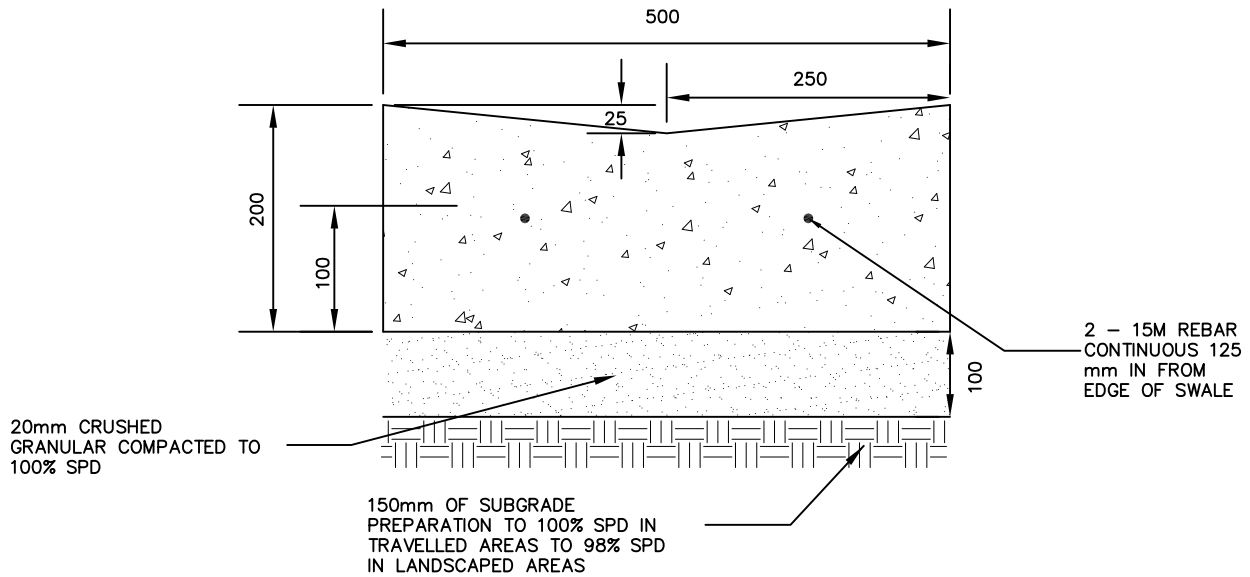
STANDARD DETAILS

SCALE: N.T.S.

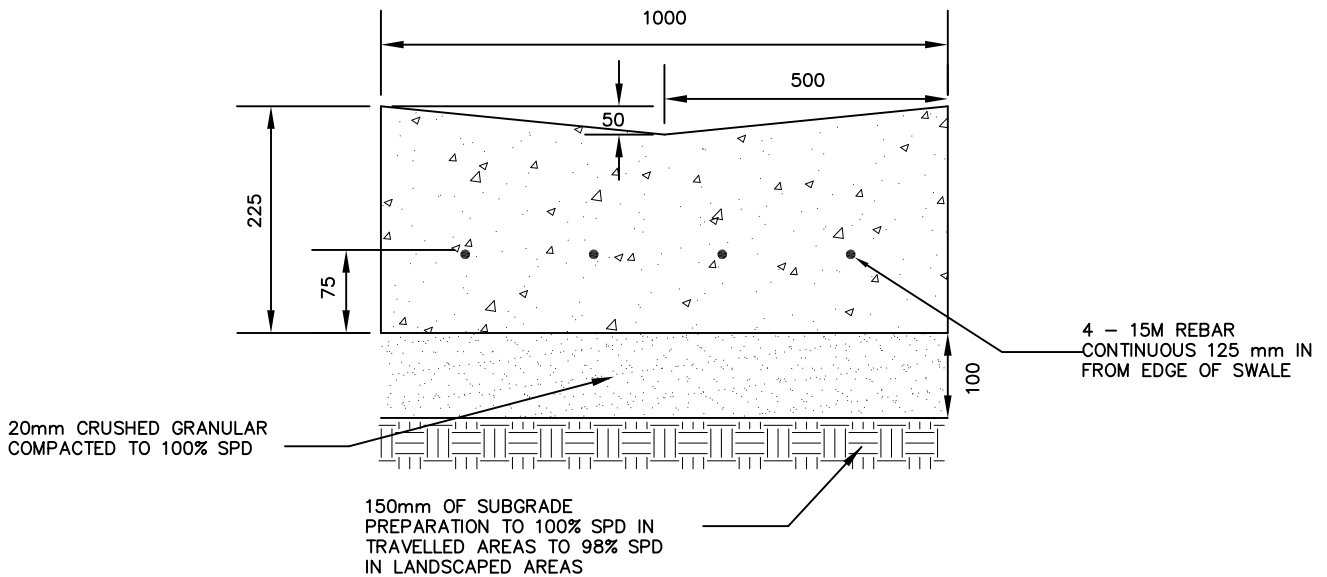
DATE: MAY 2014

STD. DWG NO.

D-137



500mm CONCRETE SWALE



1000mm CONCRETE SWALE

NOTE:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.



TITLE:

CONCRETE DRAINAGE SWALES

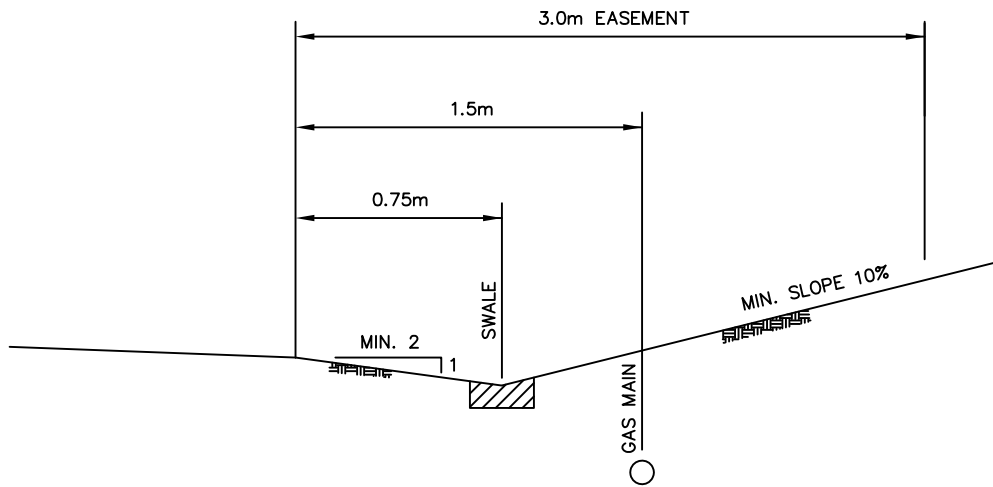
STANDARD DETAILS

SCALE: N.T.S.

DATE: MAY 2014

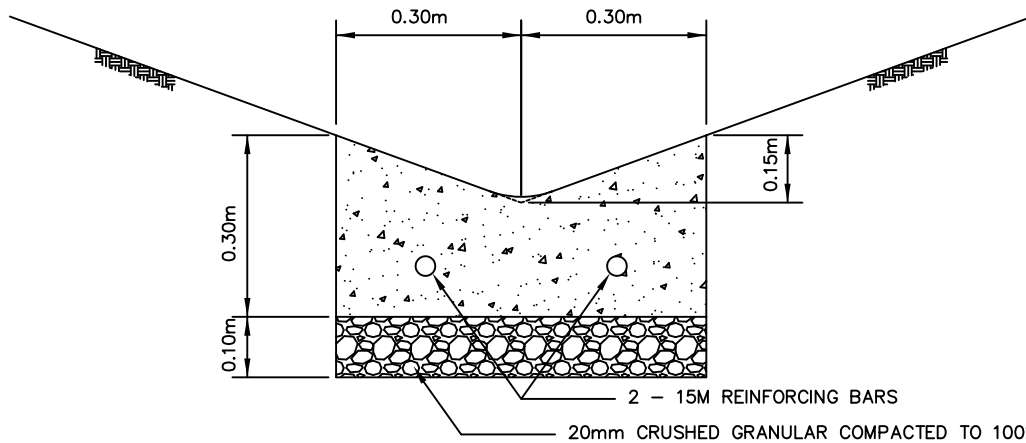
STD. DWG NO.

D-138



SWALE LOCATION
N.T.S.

SWALE DETAIL
N.T.S.



NOTES:

1. CONCRETE STRENGTH TO BE 25 MPa IN 28 DAYS.
2. REINFORCING BARS TO BE INTERMEDIATE GRADE
STEEL OF $f_s = 140\text{MPa}$



TITLE:

TYPICAL CONCRETE SWALE
BETWEEN ADJOINING PROPERTIES

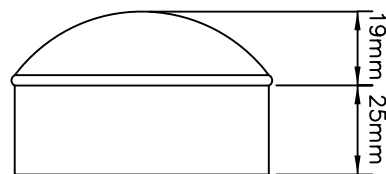
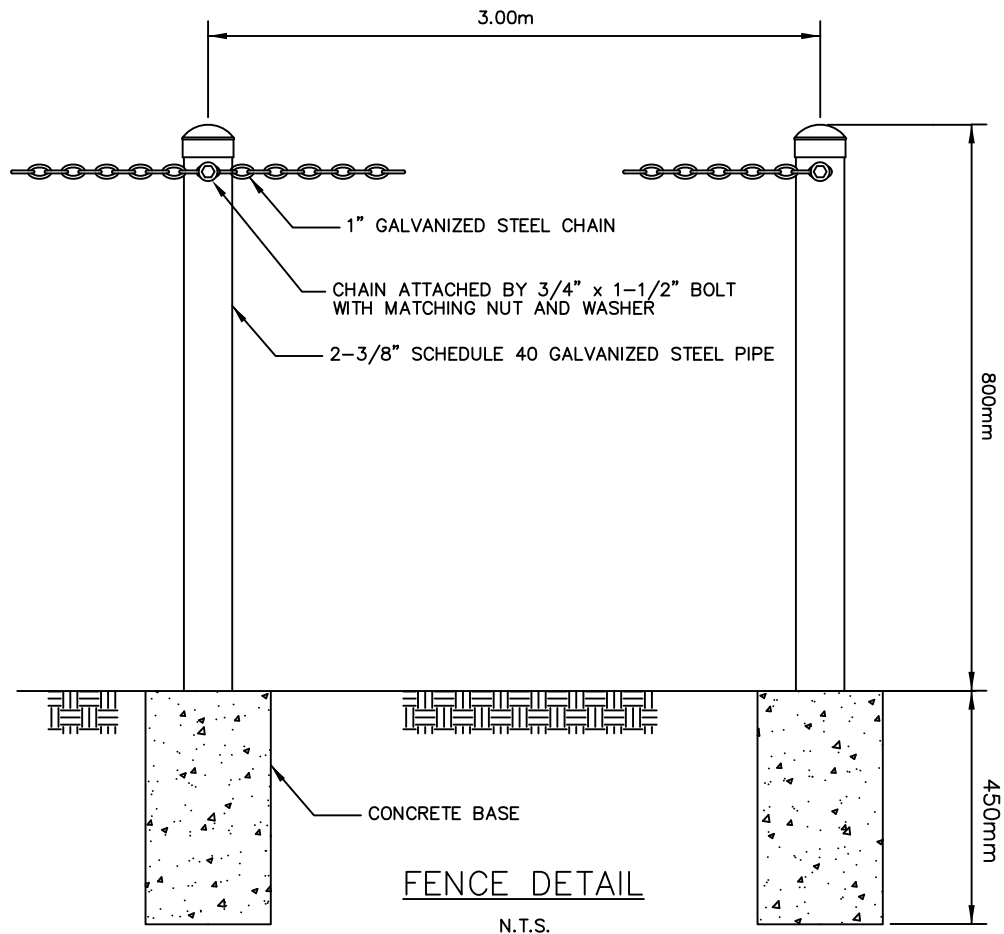
STANDARD DETAILS

SCALE: N.T.S.

DATE: MAY 2014

STD. DWG NO.

D-139



POST CAP DETAIL

N.T.S.



TITLE:

POST AND CHAIN FENCE

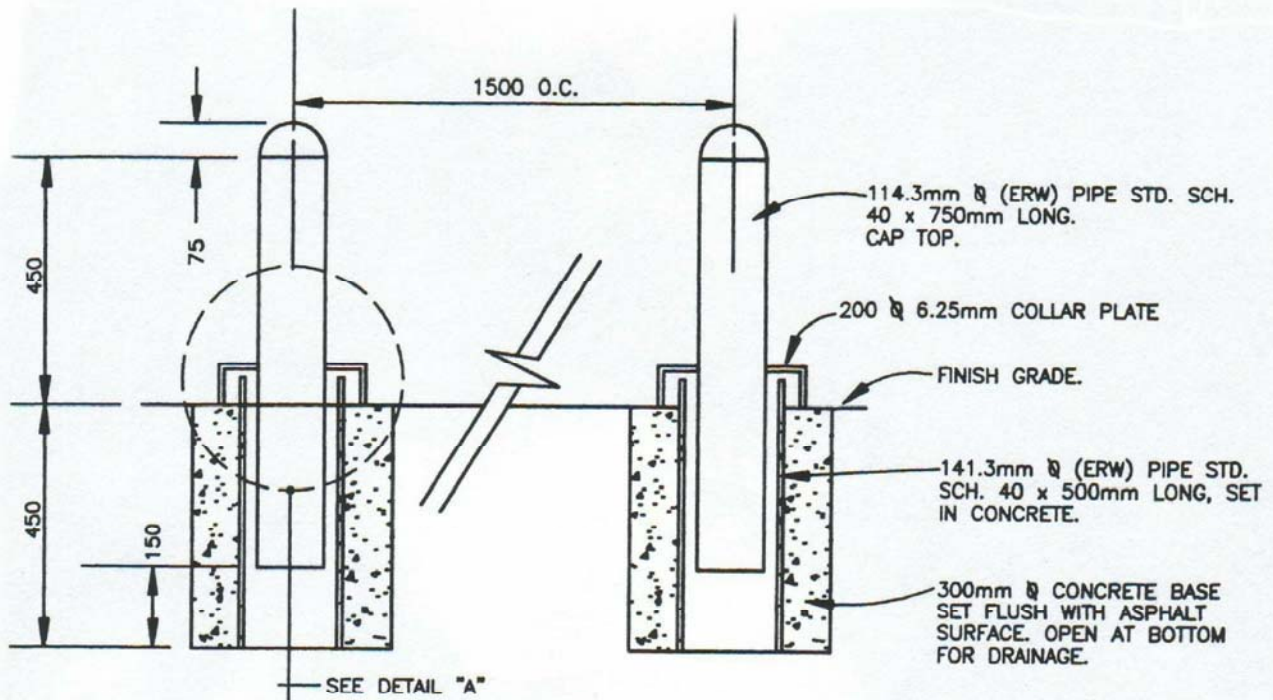
STANDARD DETAILS

SCALE: N.T.S.

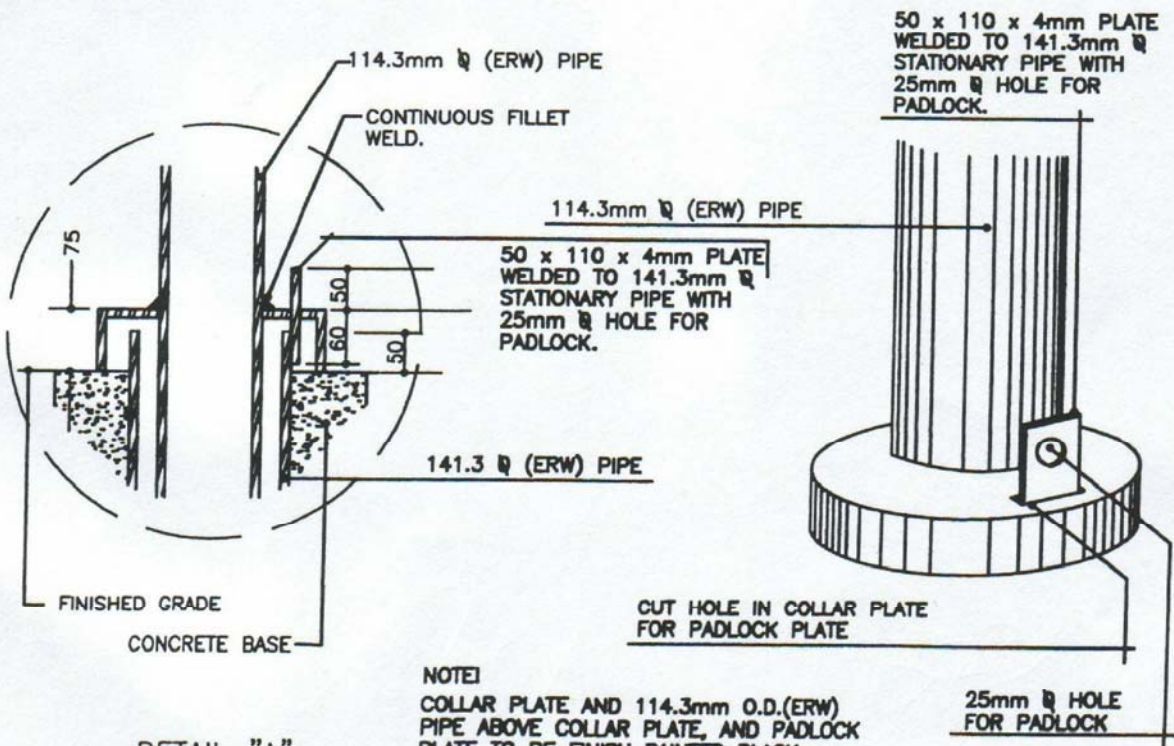
DATE: MAY 2014

STD. DWG NO.

D-140



SECTION



DETAIL "A"

NOTE:
COLLAR PLATE AND 114.3mm O.D.(ERW) PIPE ABOVE COLLAR PLATE, AND PADLOCK PLATE TO BE FINISH PAINTED BLACK. (EQUIVALENT TO RUSTOLEUM ENAMEL)
APRIL, 2002
NO SHARP EDGES.



TITLE:

REMOVABLE STEEL BOLLARD DETAIL

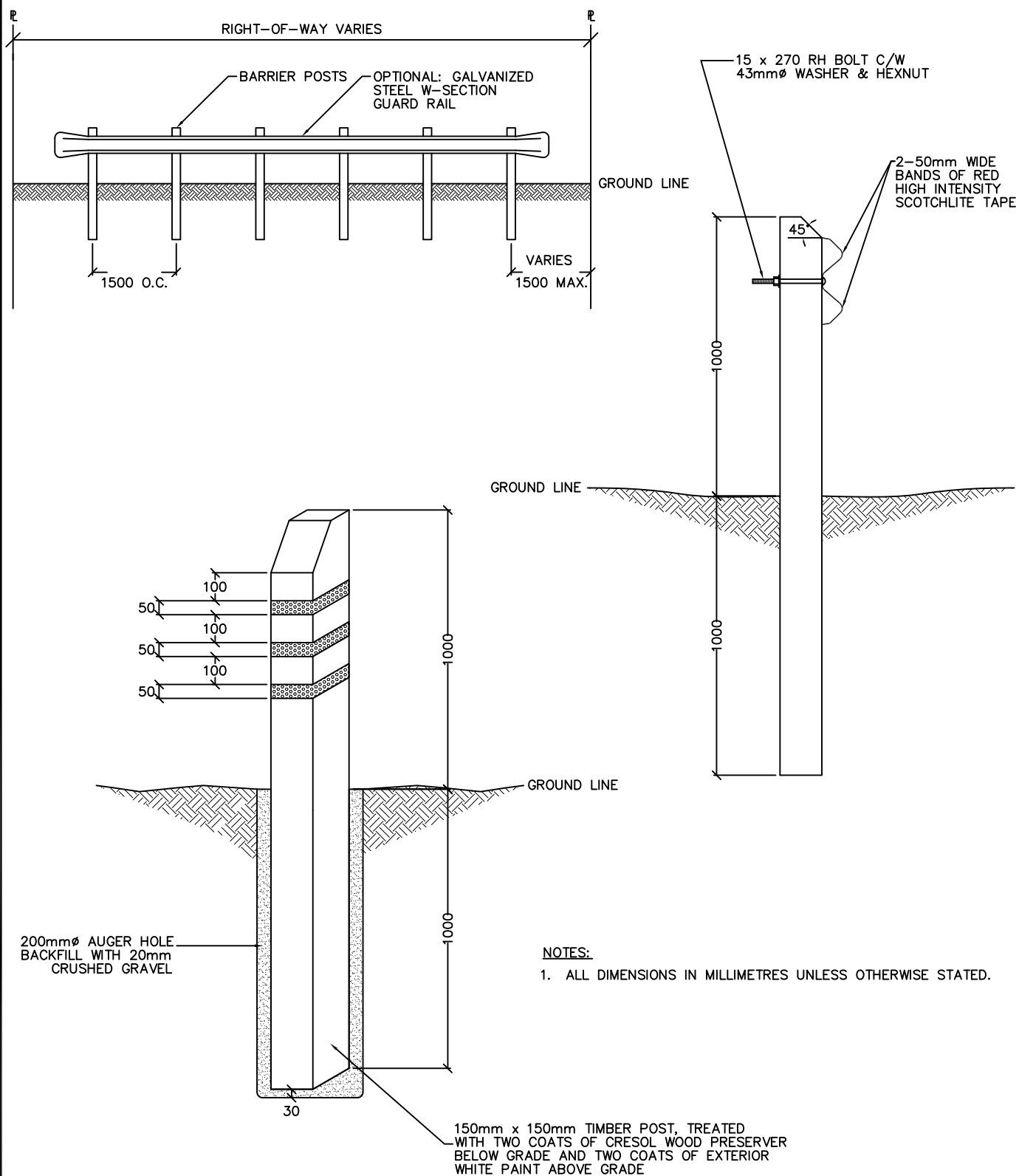
STANDARD DETAILS

SCALE: N.T.S.

DATE: MAY 2014

STD. DWG NO.

D-141



TITLE:

BARRIER POSTS

STANDARD DETAILS

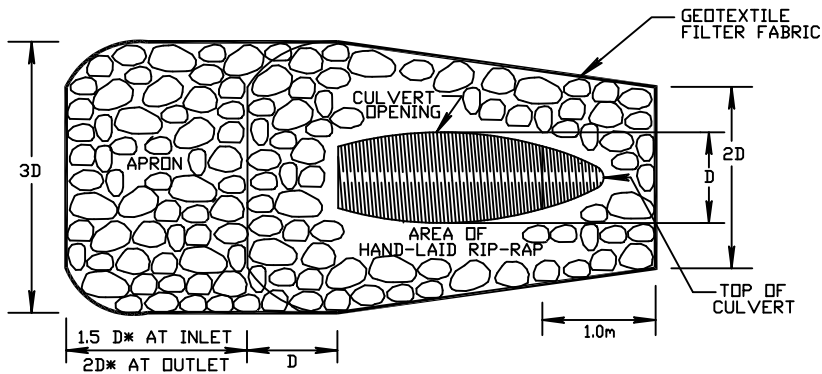
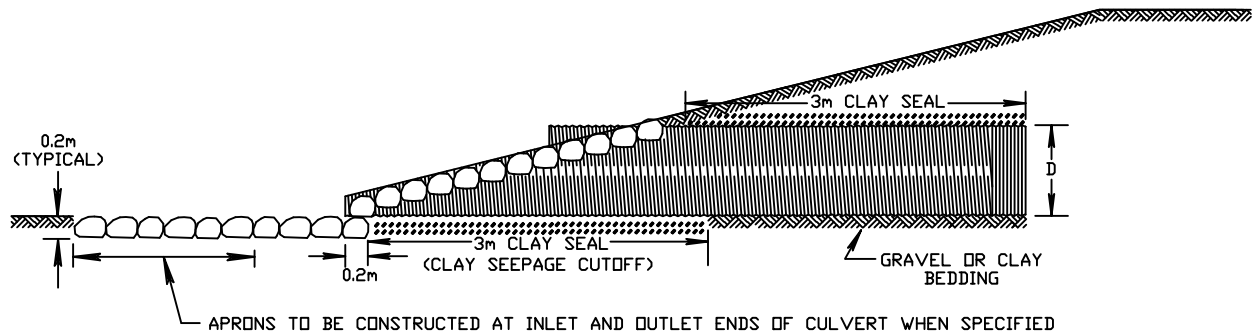
SCALE: N.T.S.

DATE: MAY 2014

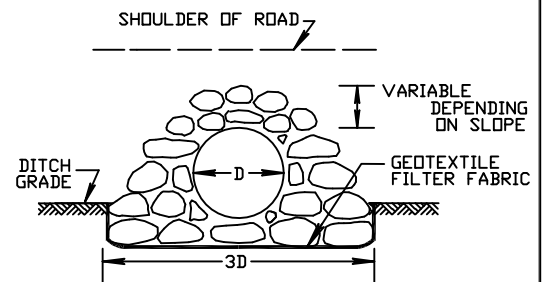
STD. DWG NO.

D-142

SECTION



* THESE ARE TYPICAL MINIMUM DIMENSIONS.



ELEVATION

PLAN VIEW

ESTIMATED RIPRAP SURFACE AREAS*

PIPE DIAMETER (mm)	AREA OF ONE END EXCLUDING APRON (m ²)	AREA OF ONE END INCLUDING INLET APRON (m ²)	AREA OF ONE END INCLUDING OUTLET APRON (m ²)
500	2	3	4
600	3	5	6
700	4	6	7
800	5	8	9
900	6	10	11
1000	7	12	13
1100	9	14	16
1200	10	16	19
1400	13	22	25

* THE ESTIMATED RIPRAP SURFACE AREAS SHOWN IN THIS TABLE ARE BASED ON A 4:1 SIDESLOPE.

NOTE:

THIS DRAWING SUPPLEMENTS SPECIFICATION 2.5 RIPRAP AND APPLIES TO CULVERTS LESS THAN 1500mm EQUIVALENT DIAMETER.



TITLE:

CULVERT / RIP-RAP DETAIL

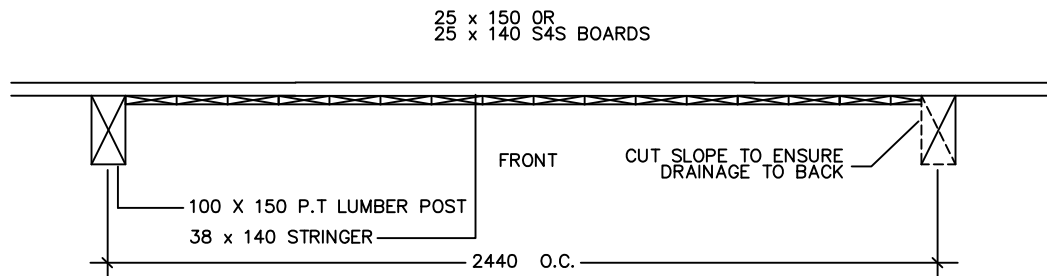
STANDARD DETAILS

SCALE: N.T.S.

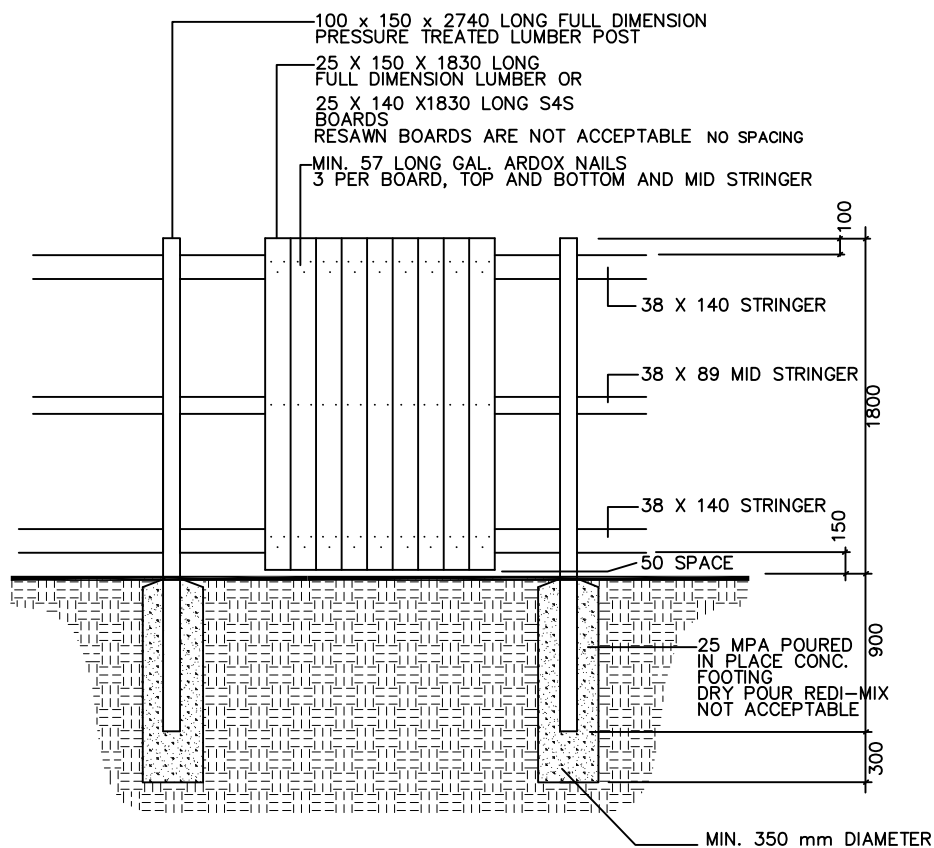
DATE: MAY 2014

STD. DWG NO.

D-143



FENCE PLAN



FENCE SECTION



TITLE:

WOOD SCREEN FENCE

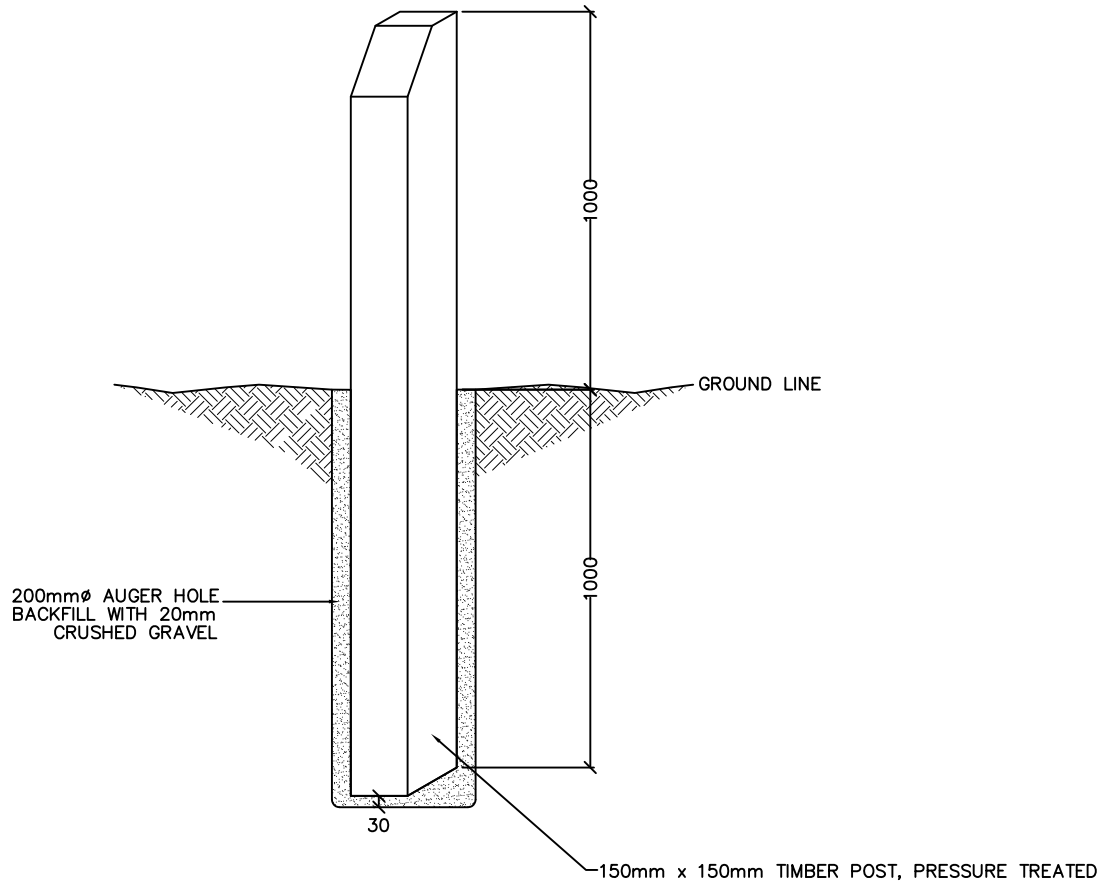
STANDARD DETAILS

SCALE: N.T.S.

DATE: MAY 2014

STD. DWG NO.

D-144



NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.
2. POSTS TO BE SPACED AT 1500 ON CENTER STARTING AND ENDING 1500 MAX. FROM PROPERTY LINE.



TITLE:

WOODEN BARRIER POSTS

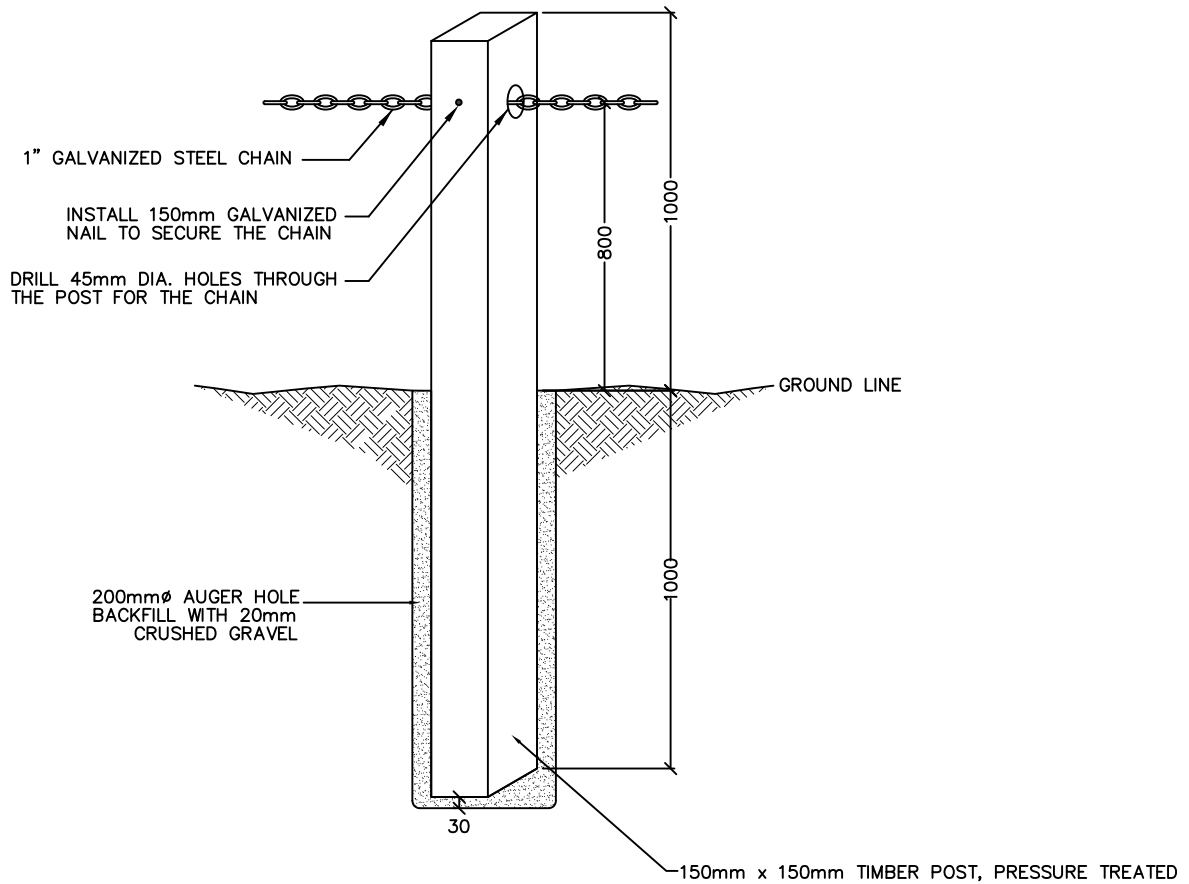
STANDARD DETAILS

SCALE: N.T.S.

DATE: MAY 2014

STD. DWG NO.

D-145



NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.
2. POSTS TO BE SPACED AT 3000 ON CENTER STARTING AND ENDING 1500 MAX. FROM PROPERTY LINE.



TITLE:

WOOD BOLLARD AND CHAIN FENCE

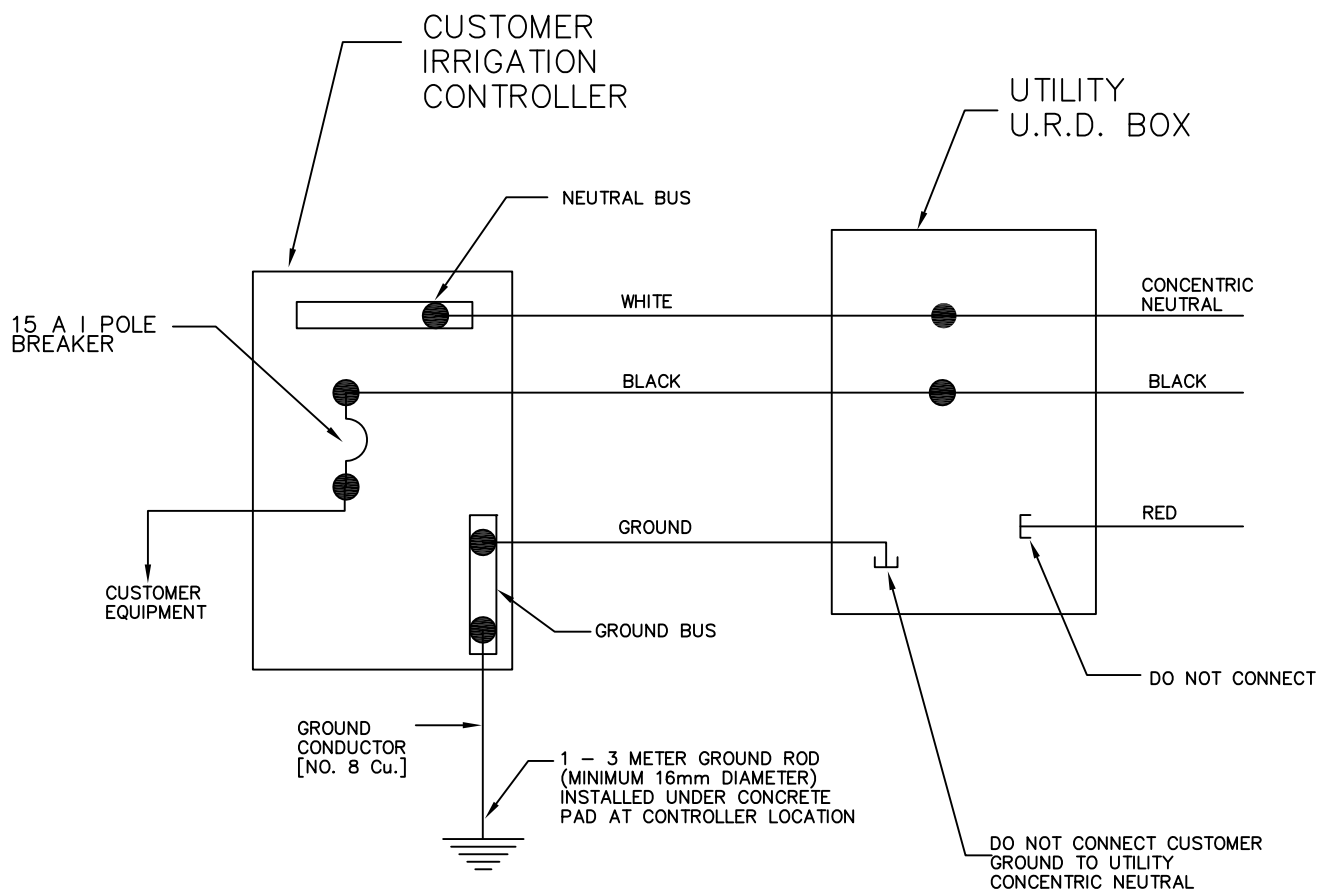
STANDARD DETAILS

SCALE: N.T.S.

DATE: MAY 2014

STD. DWG NO.

D-146



NOTES:

1. TYPICAL CUSTOMER CONDUCTOR IS No. 10 COPPER NMWU
2. NEUTRAL BUS AND GROUND BUS ARE BONDED VIA CONTROLLER CABINET



TITLE:

UNMETERED 120 VOLT CONNECTION
FOR IRRIGATION CONTROLLER

STANDARD DETAILS

SCALE: N.T.S.

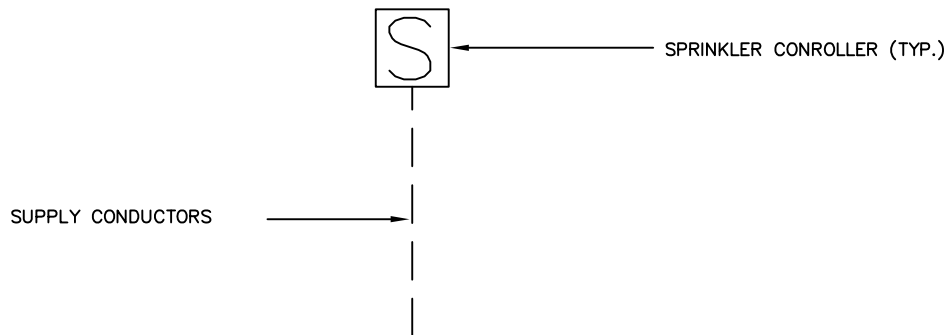
DATE: JUNE 2004

STD. DWG NO.

E-001

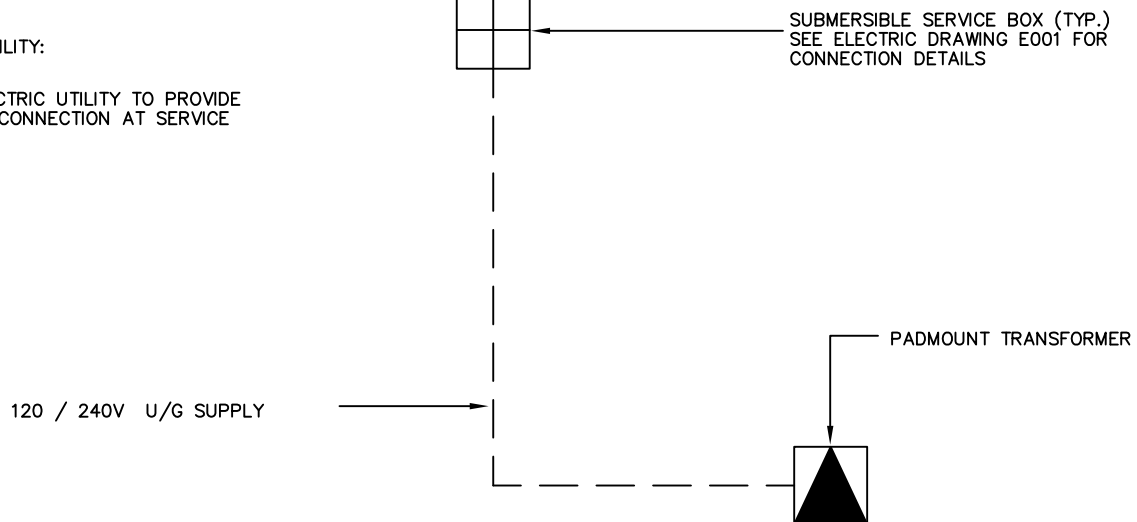
BY CONTRACTOR:

1. CONTRACTOR IS RESPONSIBLE FOR TRENCHING, INSTALLATION OF MAIN SERVICE EQUIPMENT, ELECTRIC SERVICE CABLE, AND CONNECTIONS AT CONTROLLER
2. CONTRACTOR TO CO-ORDINATE INSTALLATIONS AND FINAL CONNECTION AT SERVICE BOX WITH THE ELECTRIC UTILITY
3. SUPPLY CONDUCTORS FROM UTILITY SERVICE BOX TO IRRIGATION CONTROLLER TO BE BURIED 1.0 METER BELOW FINAL GRADE
CONDUCTORS CAN BE DIRECT BURIED IF USING NMW CABLE, OR OTHER TYPE OF CABLE SUITABLE FOR DIRECT BURIAL.



BY UTILITY:

1. ELECTRIC UTILITY TO PROVIDE FINAL CONNECTION AT SERVICE BOX.



TITLE:

UNMETERED U/G ELECTRIC SERVICE
FOR IRRIGATION CONTROLLER (TYP.)

STANDARD DETAILS

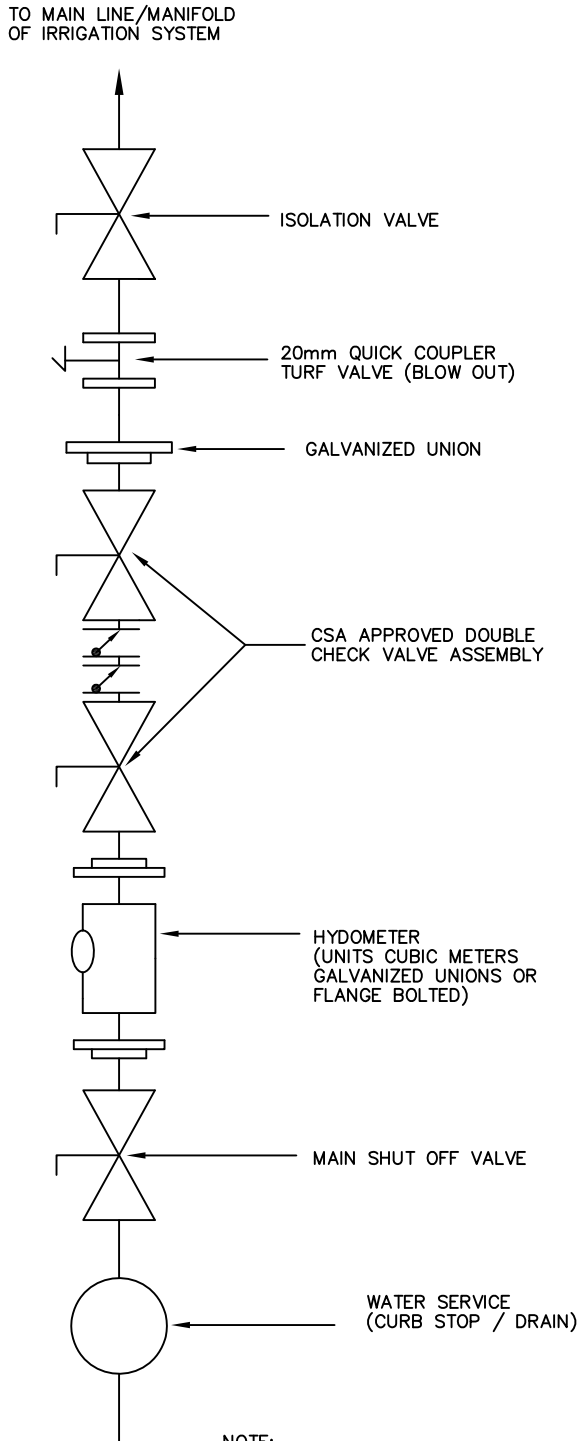
SCALE: N.T.S.

DATE: JUNE 2004

STD. DWG NO.

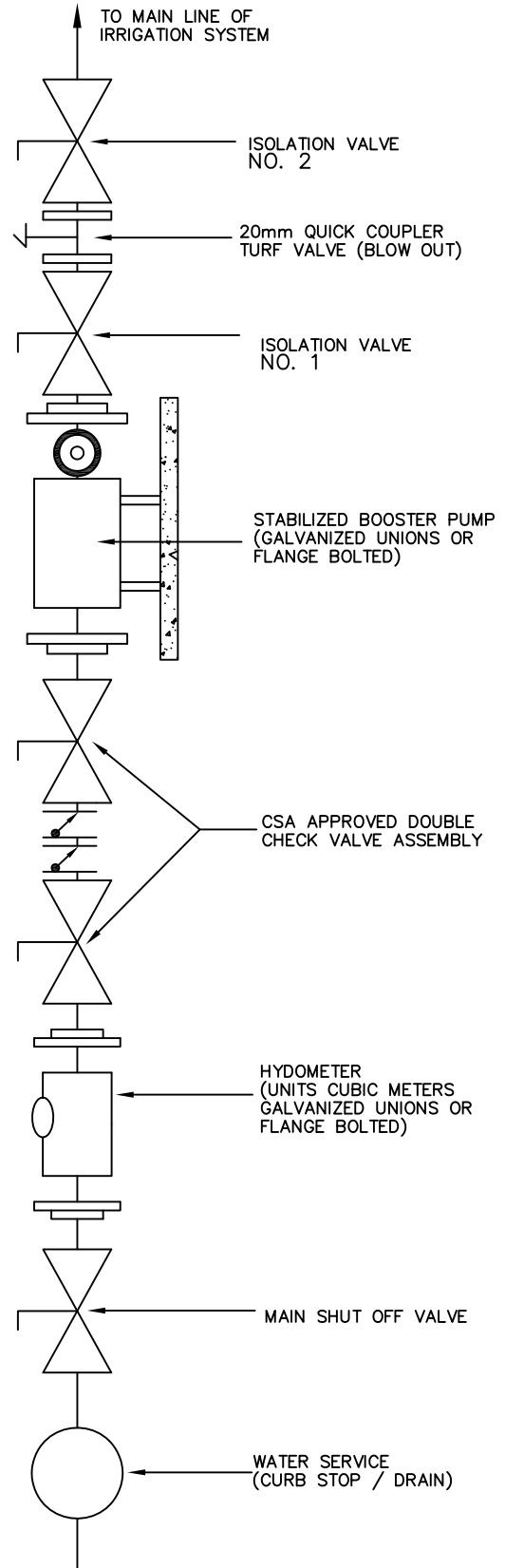
E-002

ALIGNMENT WITHOUT BOOSTER PUMP



NOTE:
THE PIPING AND FITTINGS AT THE
POINT OF CONNECTION AT THE
WATER SERVICE TO THE EXIT
POINT SHALL BE GALVANIZED

ALIGNMENT WITH BOOSTER PUMP



TITLE:

IRRIGATION WATER SERVICE
HARDWARE MATERIAL ALIGNMENT

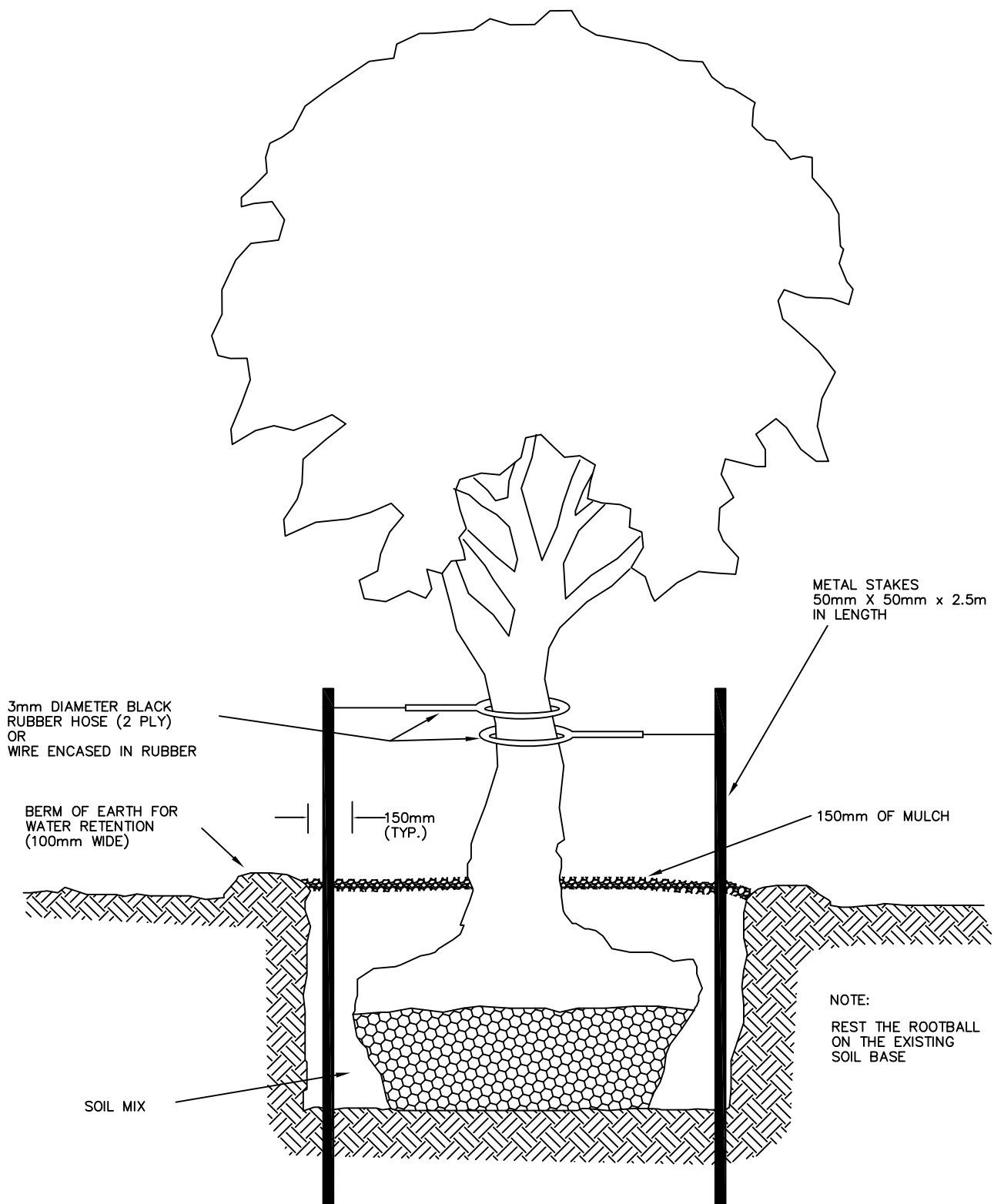
STANDARD DETAILS

SCALE: N.T.S.

DATE: JUNE 2004

STD. DWG NO.

E-003



TITLE:

TREE SUPPORT METHOD USING TREE STAKES C/W MULCH

STANDARD DETAILS

SCALE: N.T.S.

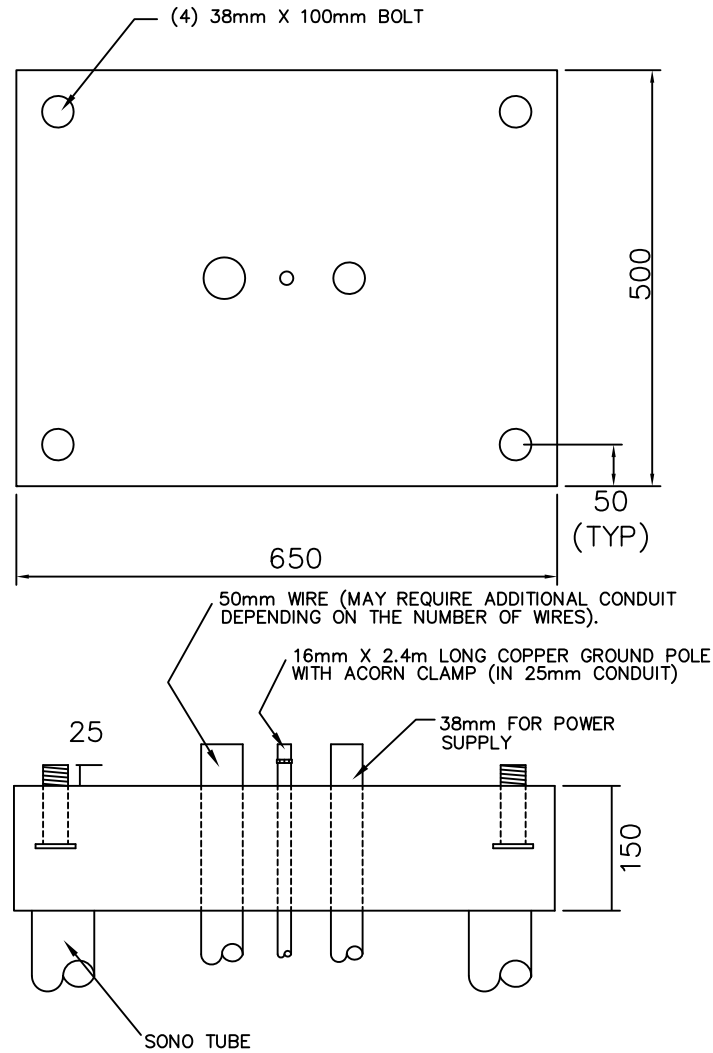
DATE: JUNE 2004

STD. DWG NO.

E-004

NOTES:

1. SIZE OF CABINET
WIDTH - 450mm
HEIGHT - 600mm
DEPTH - 300mm
2. CONSTRUCT WITH 2 - 150mm DIA. SONO TUBES
600mm IN DEPTH
3. CONCRETE BASE WITH WIRE MESH OR REBAR IN
CONCRETE. USE "L" SHAPED REBAR TO TIE BASE
AND SONO TUBES.
4. CABINET TO BE CUT AROUND THE CONDUIT.
5. ALL MEASUREMENTS ARE IN MILLIMETERS.



TITLE:

CONCRETE PAD FOR STANDARD
IRRIGATION CONTROLLER CABINET

STANDARD DETAILS

SCALE: N.T.S.

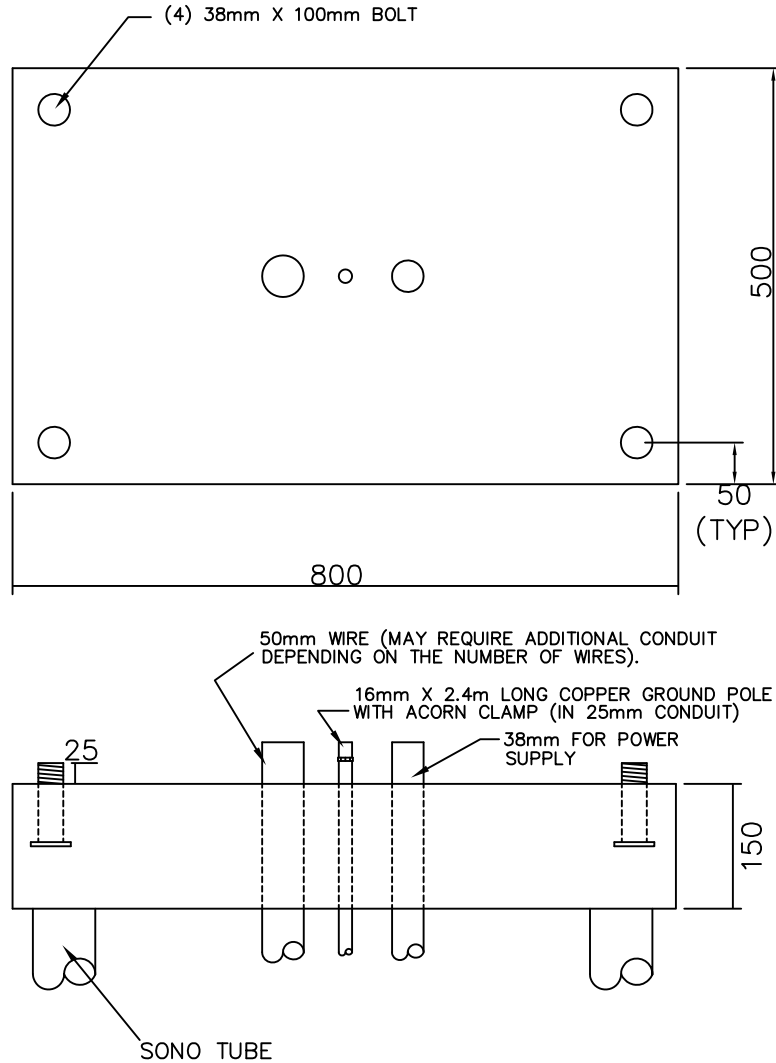
DATE: JUNE 2004

STD. DWG NO.

E-005

NOTES:

1. SIZE OF CABINET
WIDTH – 600mm
HEIGHT – 600mm
DEPTH – 300mm
2. CONSTRUCT WITH 2 – 150mm DIA. SONO TUBES
900mm IN DEPTH
3. CONCRETE BASE WITH WIRE MESH OR REBAR IN
CONCRETE. USE "L" SHAPED REBAR TO TIE BASE
AND SONO TUBES.
4. CABINET TO BE CUT AROUND THE CONDUIT.
5. ALL MEASUREMENTS ARE IN MILLIMETERS.



TITLE:

CONCRETE PAD FOR DOUBLE SCORPIO
IRRIGATION CONTROLLER CABINET

STANDARD DETAILS

SCALE: N.T.S.

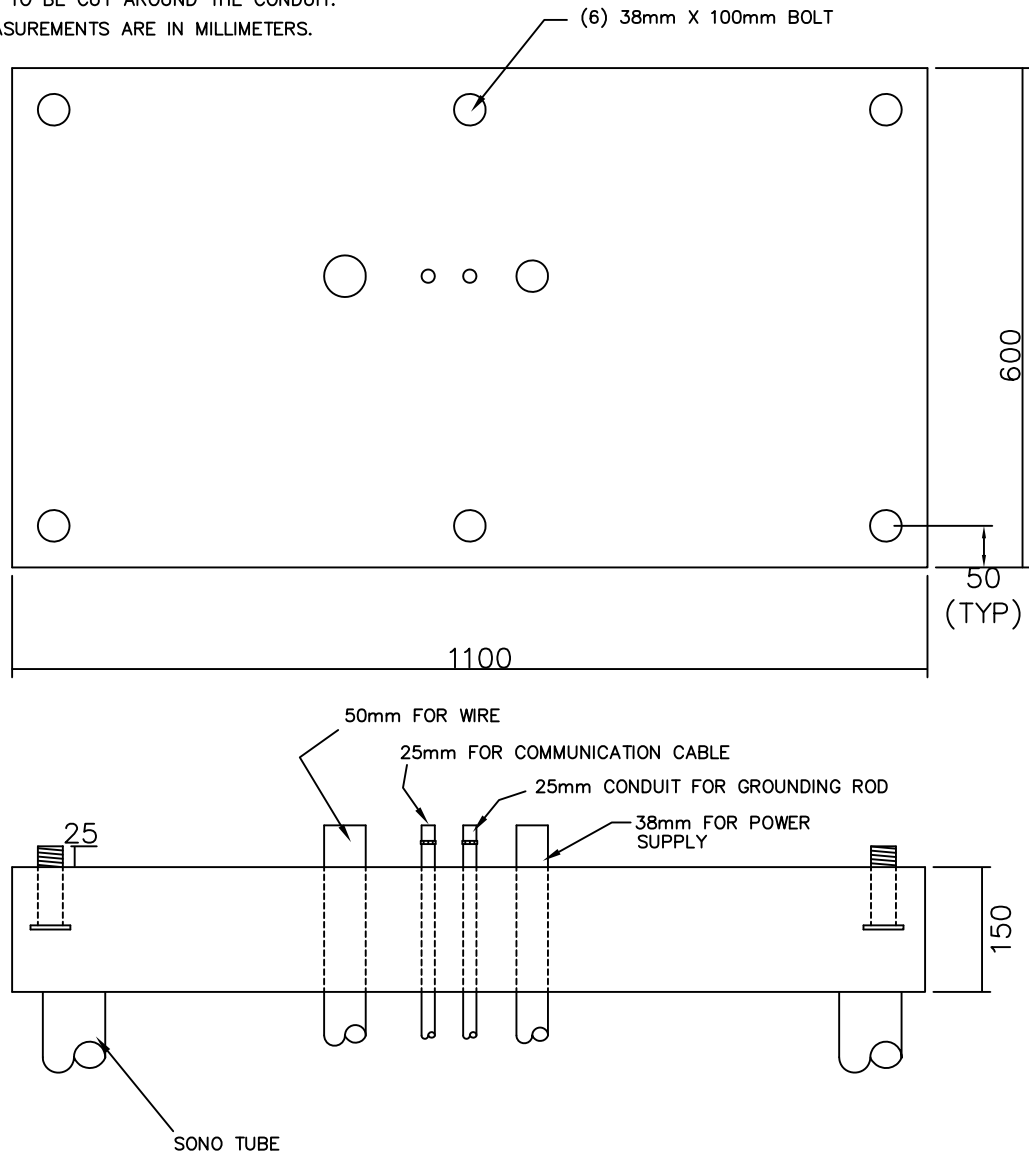
DATE: JUNE 2004

STD. DWG NO.

E-006

NOTES:

1. SIZE OF CABINET
WIDTH – 900mm
HEIGHT – 1100mm
DEPTH – 400mm
2. ALL BASES HAVE 100mm OVERHANG
3. CONSTRUCT WITH 2 – 200mm DIA. SONO TUBES
900mm IN DEPTH
4. CONCRETE BASE WITH WIRE MESH OR REBAR IN
CONCRETE. USE "L" SHAPED REBAR TO TIE BASE
AND SONO TUBES.
5. CABINET TO BE CUT AROUND THE CONDUIT.
6. ALL MEASUREMENTS ARE IN MILLIMETERS.



TITLE:

CONCRETE PAD FOR IRRINET
IRRIGATION CONTROLLER CABINET

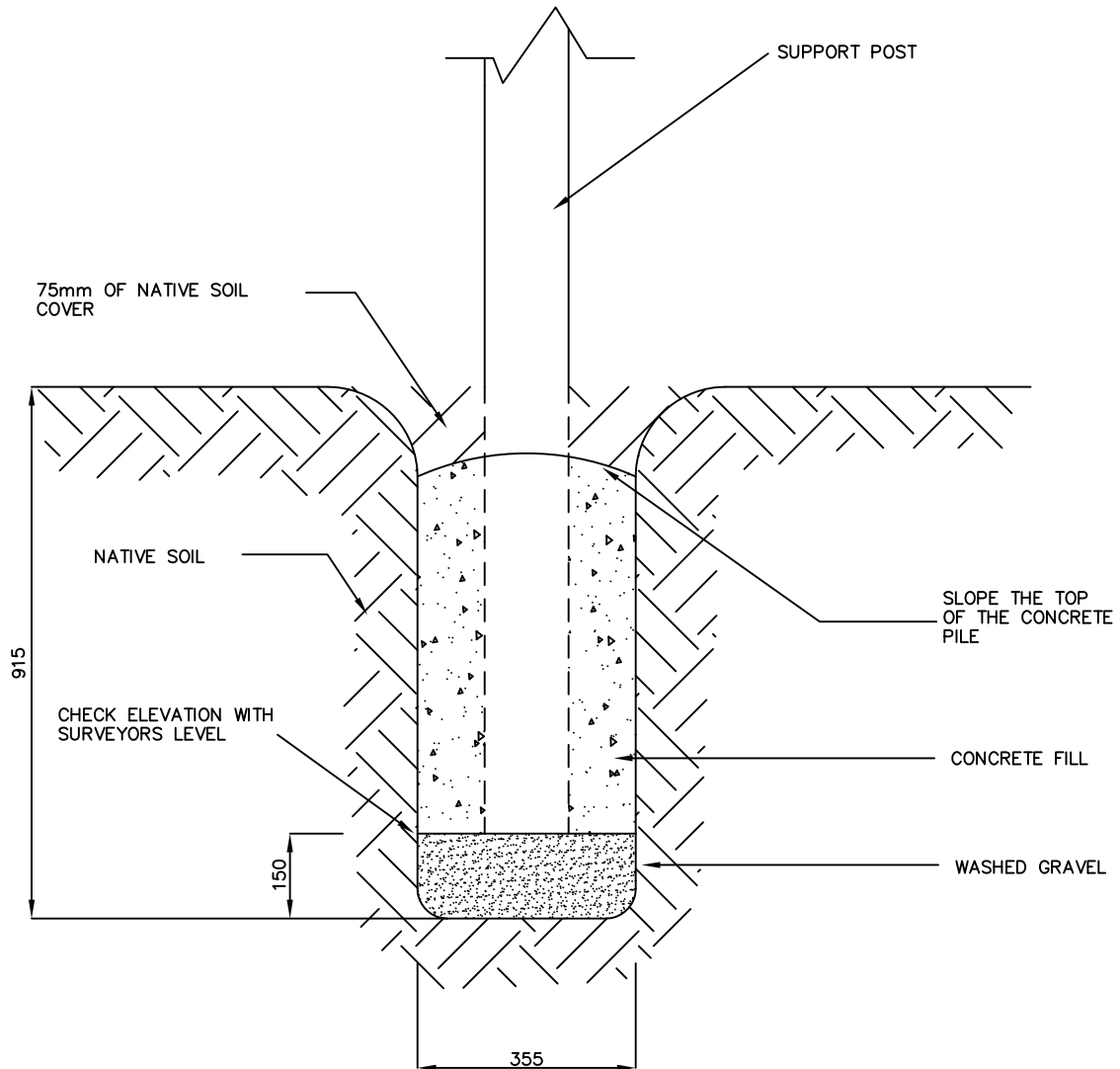
STANDARD DETAILS

SCALE: N.T.S.

DATE: JUNE 2004

STD. DWG NO.

E-007



NOTE: ALL MEASUREMENTS ARE IN MILLIMETERS



TITLE:

CONCRETE ENCASED SUPPORT POST
(MINIMUM INSTALLATION GUIDELINES)

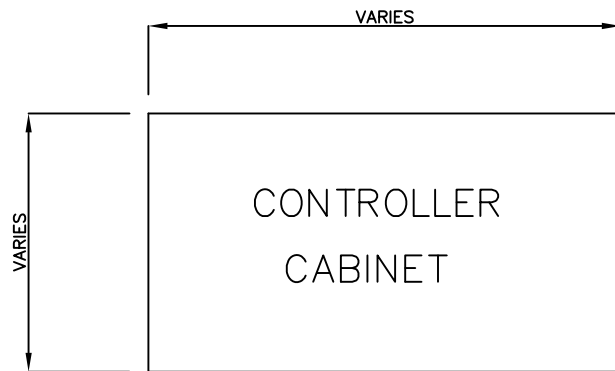
STANDARD DETAILS

SCALE: N.T.S.

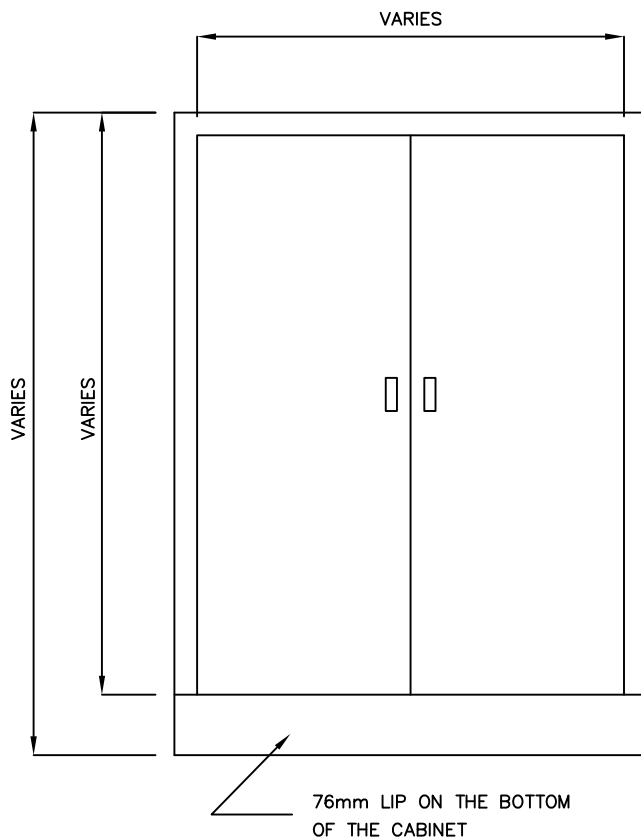
DATE: JUNE 2004

STD. DWG NO.

E-008



TOP VIEW



FRONT VIEW

NOTES

1. EXTERIOR INSTALLATIONS:
16 GAUGE STAINLESS STEEL
2. CABINET SHALL BE FITTED
WITH DOUBLE DOORS MOUNTED
ON STAINLESS STEEL PIANO
HINGES
3. MECHANISM MOUNTED WITH RIVETS
ON BOTH DOORS, CAPABLE OF
SECURING EACH DOOR INDIVIDUALLY
IN THE CLOSED POSITION
4. CABINET TO BE WEATHERPROOF
AND LOCKABLE
5. CLOSURE BRACKETS, HINGE ATTACHMENTS
AND PLYWOOD MOUNTS ARE TO BE
WELDED FROM THE INSIDE
6. EXTERIOR OF CABINET SHALL BE
SMOOTH AND ROUNDED WITH NO
PROTRUSIONS OR SHARP EDGES
EVIDENT
7. ANY POINT OF ENTRY INTO CABINET
WALL SHALL BE SEALED WITH A
WATERPROOF SEALER
8. ALL MEASUREMENTS ARE IN MILLIMETERS

THREE CABINET SIZES

(1) IRRINET

900 WIDE
1100 HIGH
400 DEEP

(2) DOUBLE SCORPIO

600 WIDE
600 HIGH
300 DEEP

(3) SINGLE SCORPIO OR STANDARD

450 WIDE
600 HIGH
300 DEEP



TITLE:

IRRIGATION CONTROLLER CABINET

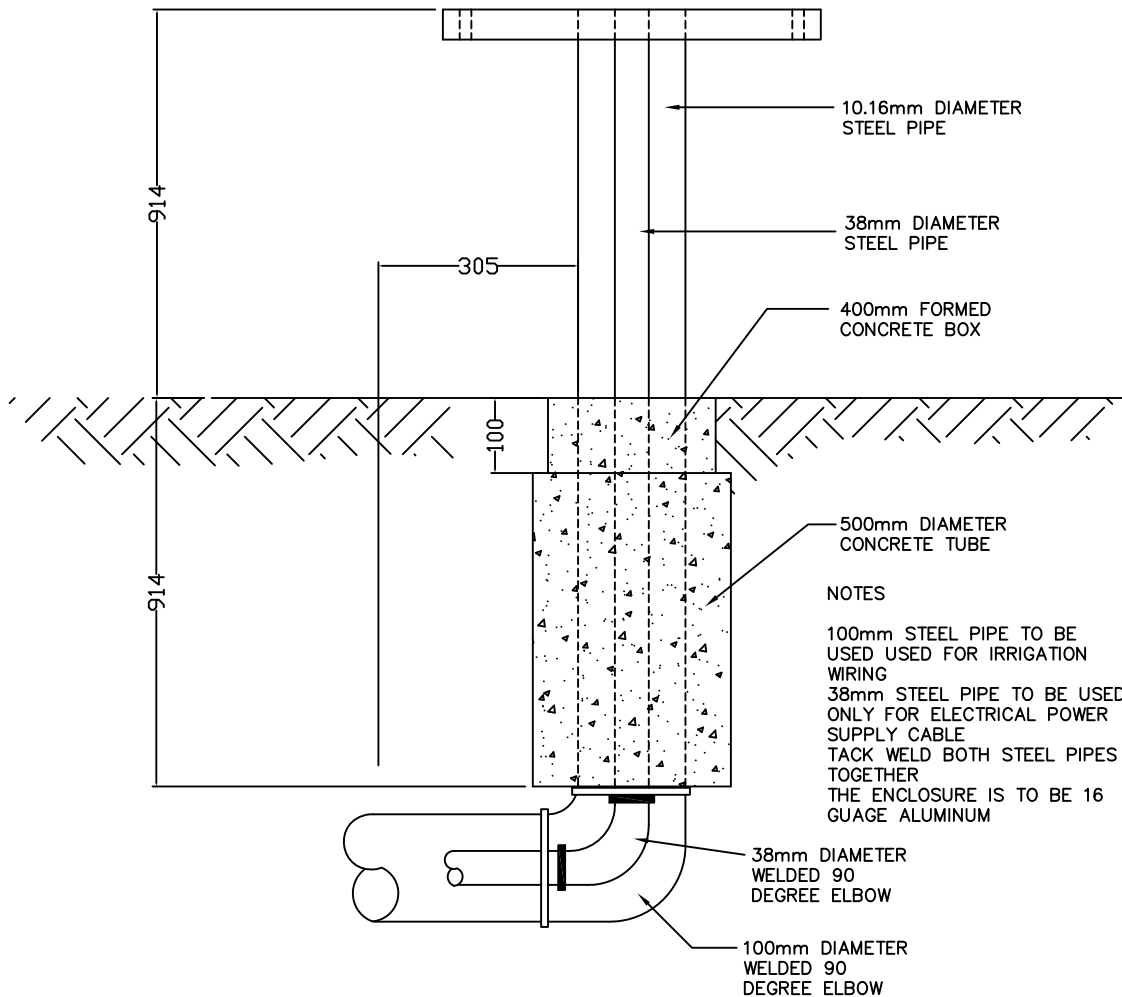
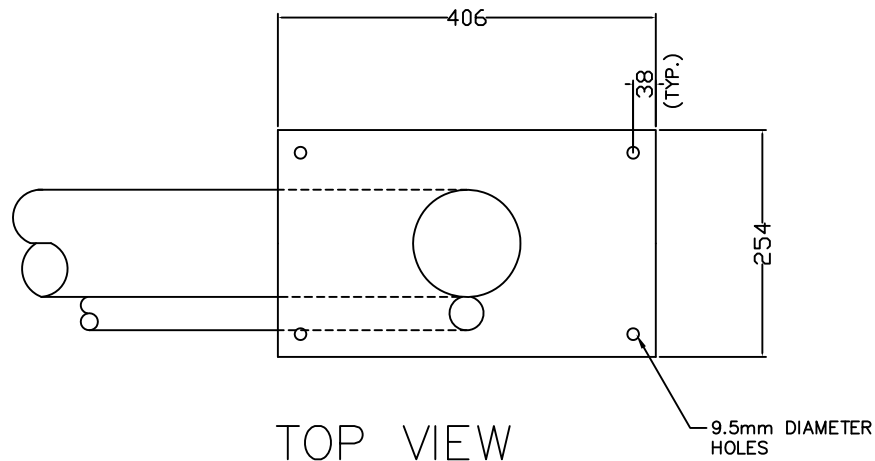
STANDARD DETAILS

SCALE: N.T.S.

DATE: JUNE 2004

STD. DWG NO.

E-009



TITLE:

SCORPIO CABINET PEDESTAL

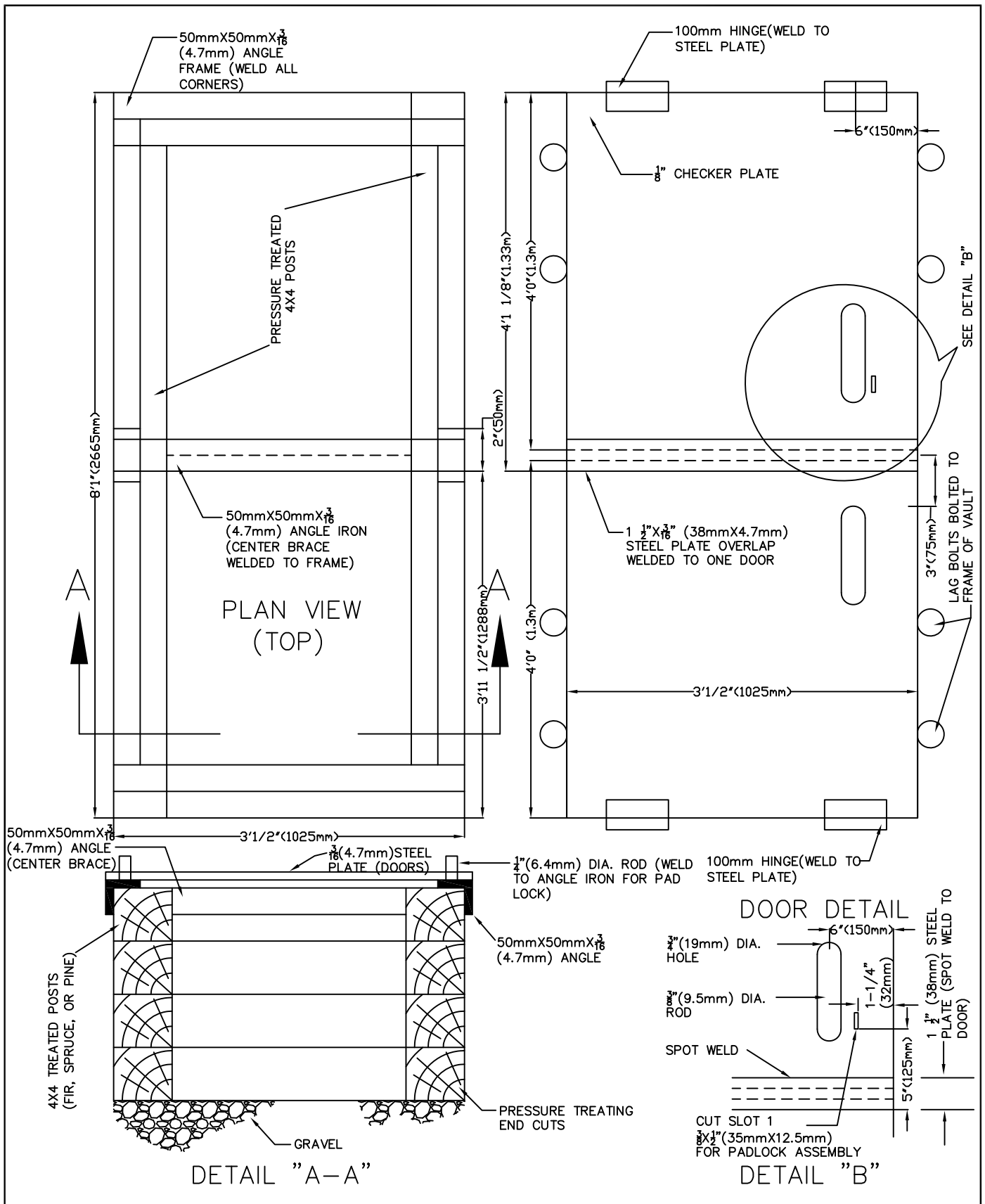
STANDARD DETAILS

SCALE: N.T.S.

DATE: JUNE 2004

STD. DWG NO.

E-010



TITLE:

VAULT DETAIL FOR IRRIGATION VALVE SYSTEM

STANDARD DETAILS

SCALE: N.T.S.

DATE: JUNE 2004

STD. DWG NO.

E-011