

SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL CONTENTS

<u>SPECIFICATIONS AND INSTALLATION</u>	<u>SECTION NO.</u>
Scope	4.01
Testing	4.02
-Not Used-	4.03
Precutting Paved Surfaces	4.04
Site Preparation	4.05
Trench Alignment and Depth	4.06
Trench Excavation	4.07
Common Excavation	4.07A
Rock Excavation	4.07B
-Not Used-	4.08
Hand Excavation	4.09
Piling of Excavated Trench Material	4.10
Disposal of Excavated Material	4.11
Bracing and Sheeting	4.12
Dewatering	4.13
Trench Bottom Conditions	4.14
Augering	4.15
Casing Pipes	4.16
Bedding within Pipe Zone	4.17
Trench Dams	4.18
Backfill and Compaction	4.19
Imported Granular Fill	4.20
Concrete	4.21
Road Sub-Base Gravel Course	4.22
Road Base Gravel Course	4.22A
Approved Native Backfill	4.23
Controlled Density Fill	4.24
Variation in Specification Requirements for Traveled Surfaces	4.25
Fish Habitat Gravel	4.26
Surface Restoration	4.27
Pavement Restoration	4.28
Final Cutting Paved Surfaces	4.29
Trench Settlement during Guarantee Period	4.30
Private Utilities in City Rights-of-Way	4.31

<u>STANDARD DRAWINGS</u>	<u>DWG. NO.</u>
Trench Details	T-1
Sanitary and Storm Sewer in Common Trench	T-2
Controlled Density Fill in Paved Surface Area	T-3
Pavement Restoration – Type 1 (Asphalt Thickness <75mm)	T-4
Pavement Restoration – Type 2 (75mm Minimum Thickness)	T-4A
Pavement Restoration – Asphalt Cutting for a Manhole	T-4B
Concrete Encasement for Watermain/Sewer Separation	T-5
Pipe Protection With Concrete	T-6
Typical Location of Service Connection to Residential Vacant Lots	T-7
Trench Dams – Type 1 for all Utility Mains	T-8

SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL CONTENTS

Trench Dams – Type 2 Optional for Storm Sewer Mains	T-8A
Private Utilities - Underground Electrical Common Trench Detail	T-9
Private Utilities - Underground Electrical Typical Service Box Location	T-10
Detail of Support for Existing Utilities	T-11

SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL SPECIFICATIONS AND INSTALLATION

4.01 SCOPE

- .1 This specification refers to trench excavation, bedding, backfill and all work pertaining thereto.
- .2 Trenches shall be excavated only as far in advance of the pipe laying operation as safety, traffic, and weather conditions permit. Caution shall be exercised with respect to structures, piping, or other man-made obstacles that may exist within the working area and due consideration given to the protection and support of such properties and structures.
- .3 Only those products approved by the City Engineer or listed in the City of Nanaimo Approved Products List will be accepted for installation.

4.02 TESTING

- .1 The Engineer will arrange for a testing firm to carry out tests to determine whether the applicable standards and specifications have been met. Where initial testing indicates non-compliance with the specifications, additional testing shall be required at the Contractor's expense.
- .2 The Contractor, as directed by the Engineer, shall supply specimens or samples for testing.
- .3 The types of tests listed below are the minimum testing requirements. The Engineer shall determine if additional testing is required.
 - (a) Regular sieve analysis of aggregate gradation on materials to be incorporated in the works.
 - (b) Determination of optimum moisture content and Modified Proctor Density (ASTM D1557) on all materials to be used for import bedding and backfill.
 - (c) Field density tests taken on the compacted backfill.
 - (d) Other tests as may be required.

4.03 -NOT USED-

4.04 PRECUTTING PAVED SURFACES

- .1 When trenching along or across a paved surface, pavement shall first be sawn or cut by methods approved by the Engineer in straight lines parallel to the trench centreline. The total cut width of pavement shall not be greater than the specified maximum trench width at the ground surface shown on the drawings. Concrete curbs and sidewalks shall be sawn at existing joints.
- .2 Where, in the opinion of the Engineer, existing pavement is in poor condition, pavement may be cut by hand, mechanical means, or trenching equipment.
- .3 When asphalt cutting around a manhole is required to repair the manhole frame and cover, it shall be done in accordance with Standard Drawing No. T-4B.
- .4 Pavement that has been cut and removed to permit trenching shall be disposed of as waste material and shall not be placed in the trench backfill. Pavement that has been removed by grinding may be re-used as backfill if approved by the Engineer.

SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL SPECIFICATIONS AND INSTALLATION

- .5 Pavement Restoration shall be done in accordance with Section 4.28 - Pavement Restoration.

4.05 SITE PREPARATION

- .1 Remove all brush, weeds, grasses and accumulated debris from the trench width and working area.
- .2 Where directed by the Engineer for trenchwork in existing lawns, carefully cut and remove sod prior to excavation.
- .3 For trenchwork in landscaped statutory rights-of-way, carefully remove fences, shrubs, small trees and other items for replacement after backfilling is completed. If, in the opinion of the Engineer, removed trees are too large to be replaced, the contractor shall not be responsible for their replacement unless otherwise noted on the construction drawings.
- .4 For trenchwork in landscaped boulevards, the Contractor shall provide 14 days notice to all property owners for the removal of all fences, shrubs, small trees or other structures or plantings within the road rights-of-way that the property owner wishes to retain. Plantings and structures listed above, not removed by the property owner upon expiration of the 14 day notice, shall be removed and disposed of by the Contractor.
- .5 Remove all top soil within the trench width and where required in the working area, and stockpile for replacement at locations approved by the Engineer. Stumps, boulders and other deleterious material shall be removed from the top soil and disposed of as specified in Section 4.11 – Disposal of Excavated Material. Do not handle top soil while it is wet or frozen.
- .6 Cut pavement, sidewalks and curbs in accordance with Section 4.04 – Precutting Paved Surfaces.
- .7 Provide temporary drainage control to protect construction area and adjacent properties. Provide siltation controls to protect natural watercourse or existing storm drainage systems.

4.06 TRENCH ALIGNMENT AND DEPTH

- .1 The trench shall be excavated so that pipe can be laid to the established alignment and depth with allowance made for specified trench wall clearances and bedding as required.
- .2 Prior to, or at the commencement of construction, the contractor shall check existing mains for line and elevation at the point of connection. If they are different than what is shown on the construction drawings, the contractor shall immediately report the difference to the Engineer and cease construction pending direction from the Engineer.

SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL SPECIFICATIONS AND INSTALLATION

4.07 TRENCH EXCAVATION

- .1 Trench excavation shall be classified as common or rock excavation.
- .2 Trenches shall be excavated to the section and dimensions as shown on the drawings. Trench stability and safety procedures shall conform to WorkSafeBC Regulations.
- .3 Ledge rock, boulders, and large stones shall be removed to provide a clearance of at least 150mm around all sides of pipe, fittings and appurtenances.
- .4 In road rights-of-way, the trench width shall be kept to a minimum and the trench width be such that at least one-way traffic can be maintained at all times unless otherwise approved by the City Engineer.
- .5 To prevent damage to existing utilities, excavate the last 300mm above the utility by hand.
- .6 If, in the opinion of the Engineer, trench width exceeds the maximum allowable for pipe support, the contractor may be required to provide a higher class of bedding, a pipe with a higher strength class or concrete encasement at no extra cost to the owner.
- .7 Excavation for manholes shall be to dimensions which will permit assembly of the sections in accordance with these specifications. **(REVISED NOVEMBER 2016)**
- .8 Excavate trenches only as far in advance of pipe laying operation as safety, traffic and weather conditions permit. In no case shall open trenches exceed 30 metres.
- .9 All excavations left unattended shall be adequately protected with approved fencing and barricades and with flashing lights where required.

4.07A COMMON EXCAVATION

- .1 Common excavation is the excavation and removal of all material encountered which is not classified as rock.

4.07B ROCK EXCAVATION

- .1 Rock excavation is:
 - (a) The removal of detached masses of rock including single boulders, and pieces of concrete or masonry having individual volumes in excess of 1 cubic metre, or solid rock which requires drilling and blasting or breaking with a power-operated tool for its removal.
 - (b) Removal of soft or disintegrated rock which can be removed with a hand pick or power-operated excavator or shovel, or previously blasted or broken stone in rock fills or elsewhere with individual volumes less than one cubic metre, or boulders or pieces of fractured rock which do not occur naturally within the excavated volume but fall into the excavation from the adjacent area, shall not be classified as rock excavation. Hardpan (glacial till) shall not be classified as rock excavation.

SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL SPECIFICATIONS AND INSTALLATION

- (c) Overbreak, is that portion of solid rock which is excavated, displaced or loosened outside the limits used to calculate the volume of rock excavation and will be classified as unauthorized overexcavation.
- (d) Authorized overexcavation is that excavation required by the Engineer as a result of unsuitable foundation conditions not resulting from the Contractor's operation.
- (e) Unauthorized overexcavation is that excavation required as a result of the Contractor's operation as determined by the Engineer. Replacement of unauthorized overexcavation shall be at no additional cost to the Owner.

.2 Rock excavation for trenches:

- (a) Where rock is encountered in the trench or pit, the method of removal shall be agreed with the Engineer before its removal.
- (b) When blasting is required during excavation, the Contractor shall exercise extreme care and shall limit the use of explosives to such charges that shall not cause damage to existing pipelines, other utilities or private property. Blasting shall be done by experienced persons, qualified for the work. The compliance with regulations regarding the use and storage of explosives shall be the responsibility of the Contractor and he shall be responsible for any accidents or injury, loss and/or damage which might occur as a result of his blasting.
- (c) Overbreak shall be removed as directed by the Engineer and replaced with imported granular fill, placed and compacted as specified herein at no additional cost to the Owner.

4.08 -NOT USED-

4.09 HAND EXCAVATION

- .1 Mechanical trenching and backfilling equipment shall be used except where by so doing, damage to trees, buildings, sidewalks, curbs, piping, or other existing structures or man-made obstacles above or below ground cannot be avoided. Trenches shall be hand excavated and backfilled where such obstacles prevent the use of mechanical equipment.
- .2 Authorized hand excavation shall be restricted to trench excavation in statutory rights-of-way and only in those locations which, in the opinion of the Engineer, necessitate hand excavation methods.
- .3 The following and similar circumstances shall not be considered as authorized hand excavation:
 - (a) Crossing of existing structures and utility works;
 - (b) Where lighter or smaller mechanical equipment could be used;
 - (c) Where, by the use of close sheeting, timber support, equipment pads, or other facilities, mechanical equipment could be used; or
 - (d) Where the presence of timbering, sheeting, well pointing equipment, or other Contractor placed obstacles restrict the use of mechanical equipment.

SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL SPECIFICATIONS AND INSTALLATION

4.10 PILING OF EXCAVATED TRENCH MATERIAL

- .1 Common excavation approved by the Engineer as approved native backfill, may be piled along the trench in accordance with WorkSafeBC regulations and provided the working space is adequate for this purpose and provided that by so doing the backfill material does not spill onto private properties adjacent to the line of the trench thereby disturbing fences, buildings, shrubs, lawns, or other items of value.
- .2 Piling of excavated material along the trench shall not unduly restrict cross traffic at road intersections. Material shall be cleared from road intersections and provision made for use of the cross road by traffic as soon as possible after excavation has taken place. Pedestrian traffic to individual properties shall be maintained at all times and timber bridges shall be provided where it is necessary to cross open trenches. Roadways, driveways, and drainage facilities shall not be blocked unnecessarily. The spoil pile shall be located such that hindrance to local traffic is minimal.
- .3 In order that excavated material may be piled along the trench, roads may be temporarily closed to traffic with the permission of the City of Nanaimo and providing that adequate detour traffic routes can be established to move traffic around the construction area, and providing also that street entrances to driveways are not blocked from vehicular traffic for periods in excess of one day. One lane shall be kept open at all times for emergency vehicles unless otherwise approved by the City Engineer.
- .4 Where excavated material cannot be piled along the trench in compliance with the above restrictions, it shall be trucked to locations where backfilling is taking place or trucked to stockpile for return to the trench at the time of backfilling. Alternatively, subject to approval of the Engineer, excavated material may be wasted and replaced with approved material at the time of backfilling.
- .5 The contractor shall retain sufficient approved native backfill material for the backfilling of the trench. Surplus approved native backfill material shall be taken to and used at other locations within the project site suitable for material placement.
- .6 The contractor shall take all measures required to protect approved native backfill from contamination, segregation and weather.

4.11 DISPOSAL OF EXCAVATED MATERIAL

- .1 Surplus or waste excavated material shall be removed from the trench area during the excavation or backfilling operations and shall not be left along the trench following the completion of backfilling the trench.
- .2 Surplus excavated material which is not required for the works, as shown on the drawings or specified elsewhere herein, shall be disposed of at sites obtained by the Contractor. Waste material shall not be dumped on private property without the written permission of the owner of the property and a fill permit obtained from the City of Nanaimo.
- .3 The Contractor shall exercise particular care to avoid spillage on paved roadways over which excavated material is hauled, and any such spillage shall be cleaned up promptly by sweeping.

SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL SPECIFICATIONS AND INSTALLATION

- .4 Failure to immediately begin cleanup of spillage from roadways when required by the City of Nanaimo will result in the Contractor being charged all costs accrued by the City of Nanaimo to do the cleanup work.
- .5 Care shall also be exercised to avoid spreading the excavated material over a wide area and rutting or otherwise damaging unnecessarily adjacent property when side casting of excavated material is permitted.

4.12 BRACING AND SHEETING

- .1 Trenches shall be excavated, sheeted and braced in accordance with WorkSafeBC regulations or as may be necessary to protect life, property, and structures adjacent to the work, the work itself, or to maintain trench widths within the specified limits. Trench sheeting and bracing shall be located no closer than 150mm to the widest section of any installed pipe.
- .2 Whenever possible, vertical trench timber or sheeting shall be placed so that it does not extend below the springline of the pipe being installed. When it is necessary to place sheeting or timber below the pipe springline, as in the case of overexcavation for trench bottom stabilization, sheeting shall be raised in 600mm lifts and all backfill placed below the level of the pipe springline shall be thoroughly compacted on each lift to fill the void left by the raised sheeting.
- .3 Trench sheeting and bracing shall be removed, except in situations where the removal of trench sheeting and bracing will result in damage to adjacent structures. When sheeting and bracing is left in place, it shall be cut off above springline.
- .4 Where sheeting or timber is removed from a trench in which backfill is to be compacted, it shall be removed in a manner which permits compaction of the backfill in the manner specified.
- .5 WorkSafeBC approved cages may also be used in place of sheeting.

4.13 DEWATERING

- .1 During construction, ground and surface water shall be controlled to the extent that excavation and pipe installation can proceed in the specified manner and such that the trench bottom is not disturbed to the detriment of the pipe installation. Trench water shall not be permitted to enter the pipe being installed unless approval is received from the Engineer.
- .2 Pumps, well points, or other equipment shall be employed to keep excavations free of water. Caution shall be exercised to make sure that foundation problems with existing structures and works under construction do not result from the selected method of dewatering excavations.
- .3 Discharge from pumps, well points, or other dewatering equipment shall be located and controlled such that loss, damage, nuisance, or injury does not result.

SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL SPECIFICATIONS AND INSTALLATION

- .4 The contractor shall be responsible for any claims or actions resulting from the dewatering operation.

4.14 TRENCH BOTTOM CONDITIONS

- .1 Trenches shall be maintained such that pipe can be installed without allowing water, muck, silt, gravel, or other foreign material into the pipe. Material remaining in the trench bottom on completion of machine excavating which has been disturbed or softened by workmen or trench water shall be removed before bedding material is placed. The trench bottom shall be firm and capable of supporting the pipe to be installed.
- .2 When, in the opinion of the Engineer, the material in the trench bottom is found to be unstable or otherwise unsuitable for pipe support or the support of appurtenant structures, the Engineer shall direct the contractor to utilize the most suitable of the following stabilization methods:
 - (a) Overexcavate to suitable subgrade and backfill with base gravel and compact to 95% Modified Proctor Density (ASTM D1557). Use of import granular fill, subbase gravel, drainrock or bedding material shall be at the discretion of the Engineer.
 - (b) Use of concrete bedding as directed by the Engineer.
 - (c) Other methods as proposed by the Engineer and approved by the City Engineer.

4.15 AUGERING

- .1 Augering shall be performed with hand- or power-operating equipment, subject to the approval of the Engineer.
- .2 Auger holes shall terminate in open trench.
- .3 Augering shall be performed such that undermining or displacement of the roadway structure does not result and the completed auger hole is not more than 50mm larger in diameter than the maximum outside diameter of the casing pipe or pipe to be augered.
- .4 The augered hole shall be to the correct line and grade. If an obstruction is encountered that will cause deviation from the correct line and grade, a new hole shall be augered.

4.16 CASING PIPES

- .1 Casing pipes shall be as shown in the construction drawings and shall be laid to the grade and alignment shown.
- .2 The same bedding and backfill criteria shall be used for casing pipe as required for main piping.
- .3 All pipe joints within the pipe casing shall be fully restrained with approved mechanical restrainers and shall be approved by the Engineer.

SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL SPECIFICATIONS AND INSTALLATION

4.17 BEDDING WITHIN PIPE ZONE

- .1 Bedding materials shall be granular in nature, free of organic material, silt or clay, and shall conform to the following gradation limits when tested in accordance with ASTM C136:

Gradation Limits (Percent by Weight Passing)		
<u>Sieve Designation</u>	<u>Type 1</u>	<u>Type 2</u>
19.0 mm	100	90 - 100
12.5 mm		65 - 85
9.5 mm	85 - 100	50 - 75
4.750 mm	70 - 100	25 - 50
2.36 mm		10 - 35
1.18 mm	20 - 65	
0.850 mm		5 - 20
0.6 mm	0 - 45	
0.425 mm		0 - 15
0.180 mm		0 - 8
0.15 mm	0 - 10	
0.075 mm	0 - 5	0 - 5

- .2 Type 1 is the standard acceptable bedding material. Type 2 shall be used where specified by the Engineer.
- .3 Other acceptable bedding materials, for use only where shown on the construction drawings or as approved by the Engineer, are drainrock or native material.
- .4 The bedding material shall cover the full width of the trench bottom and have a minimum depth of 100mm on completion of compaction. In rock excavation the minimum depth of bedding below the pipe shall be 150mm after completion of compaction.
- .5 Bedding material shall be compacted in maximum 150mm lifts to 95% of Modified Proctor Density (ASTM D1557).
- .6 Bedding material shall be placed in such a manner that the pipe is evenly supported throughout its length by the pipe bedding material.
- .7 Placement and compaction of the bedding material shall not damage or displace the pipe.
- .8 Bedding material shall be leveled across the full width of the trench to an elevation of 300mm above the crown of the pipe.

SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL SPECIFICATIONS AND INSTALLATION

4.18 TRENCH DAMS

- .1 Trench dams shall be constructed on all utility main lines where grades are ten percent (10%) or greater, or when indicated on the construction drawings. **(REVISED NOVEMBER 2016)**
- .2 All trench dams on utility mains shall be constructed in accordance with Standard Drawing No. T-8. Trench dams on storm sewer gravity mains as per Standard Drawing No. T-8A requires approval by the City Engineer.
- .3 All trench dam drain pipes shall be capped at the highest end of the run.
- .4 Trench dam spacing shall be as follows:

SANITARY AND STORM GRAVITY SEWERS		WATERMANS AND FORCEMANS	
SLOPE	MAX. SPACING	SLOPE	MAX. SPACING
10% - 15%	30m	10% - 29%	10m (upon approval of City Engineer)
15% - 20%	25m	30% - Over	See Section 4.18.5
20% - 35%	20m		
35% - 50%	15m		
50% - Over	10m		

(REVISED NOVEMBER 2016)

- .5 Where the slope of the watermain is 30% or greater, a geotechnical study shall be submitted to assess slope stability. Geotechnical studies shall be completed in accordance with the "Guidelines for Legislated Landslide Assessments for Proposed Residential Development in British Columbia" published by APEGBC. Additionally, the City Engineer may request a geotechnical study regardless of the pipe grade if the stability of the adjacent slope is in question. **(REVISED NOVEMBER 2016)**
- .6 If approved by the Engineer, concrete trench dams may be constructed of wetted sandbag sacks filled with wet pre-mixed concrete for areas inaccessible by construction equipment. Sacked concrete shall be laid in courses such that joints in succeeding courses are staggered. Courses shall be a minimum of nine (9) per vertical metre and shall be placed around the pipe and keyed into the trench walls to form a water tight dam.
- .7 Relief drains shall be installed on all trench dams to an acceptable watercourse or storm sewer system.

SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL SPECIFICATIONS AND INSTALLATION

4.19 BACKFILL AND COMPACTION

- .1 Backfill material shall be:
 - (a) Imported granular fill (Section 4.20 – Imported Granular Fill)
 - (b) Approved native material (Section 4.23 – Approved Native Backfill)
 - (c) Controlled density fill (Section 4.24 – Controlled Density Fill)
- .2 General:
 - (a) Placement and compaction of backfill material shall not damage or displace the pipe.
 - (b) Remove shoring or cages in such a manner as to allow proper compaction and to prevent trench walls from collapsing.
 - (c) Place backfill in lifts suitable to the soil type and compaction equipment being used as determined by the Engineer.
 - (d) Import granular fill shall be used for backfill unless native soils are suitable and approved by the Engineer, and are specified on the construction drawings.
 - (e) Deficiencies in the quantities of approved native backfill material which are the result of the Contractor's operation shall be replaced with imported granular fill at no additional cost to the Owner.
 - (f) Trenches shall be backfilled to a depth to allow for surface restoration in accordance with Section 4.27 – Surface Restoration.
- .3 Traveled Surfaces:
 - (a) Traveled surfaces are roadways, lanes, driveways, road shoulders, sidewalks, walkways or other surfaces on which vehicular or pedestrian traffic normally travels. The ultimate extent of the traveled surface must be considered.
 - (b) Under no circumstances shall a trench in a traveled area be left in a hazardous condition.
 - (c) Trenches in traveled surfaces shall be backfilled with imported granular fill in accordance with Section 4.20. Approved native backfill shall be used when directed by the Engineer in accordance with Section 4.23. Trenches located in existing arterial, collector or commercial/industrial roads shall be backfilled with controlled density backfill in accordance with Section 4.24.
 - (d) Approved native backfill shall be compacted to 95% Modified Proctor Density (ASTM D1557).
- .4 Untraveled Surfaces:
 - (a) Untraveled surfaces are all other surfaces not classified as traveled surfaces.
 - (b) Untraveled surfaces shall be backfilled with approved native backfill and compacted to 90% Modified Proctor Density (ASTM D1577).

SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL SPECIFICATIONS AND INSTALLATION

4.20 IMPORTED GRANULAR FILL

- .1 The Contractor shall import granular fill for trench backfill, unless the material excavated from the trench is suitable and approved by the Engineer.
- .2 All imported granular fill for trench backfill shall consist of well graded granular material, with not more than 8% passing the 0.075 mm sieve, which contains no stones larger than 150mm in diameter and contains no stumps, roots, organic or other deleterious material.
- .3 All imported granular fill shall require approval by the Engineer prior to placement.
 - (a) A wet sieve analysis (ASTM C117) may be required by the Engineer to confirm the fines content of the imported granular fill material.
- .4 The use of quarried or blast rock as import granular fill for trenches requires specific approval by the City Engineer unless listed in the City of Nanaimo Approved Product List. Quarried or blast rock shall be hard and durable, well graded, with not more than 8% passing the 0.075 mm sieve, which contains no stones larger than 150 mm in diameter and no stumps, roots, organic or other deleterious material.

4.21 CONCRETE

- .1 Concrete for pipe base, encasement or backfill shall have a minimum compressive strength of 20MPa at twenty-eight (28) days and be in accordance with Section 11.31 – Concrete.
- .2 Backfill material shall not be placed over the concrete until the concrete has obtained its initial set but in no case shall time be less than one hour.

4.22 ROAD SUB-BASE GRAVEL COURSE

- .1 The road sub-base gravel shall be in accordance with Section 9.29 - Road Sub-Base Gravel Course.

4.22A ROAD BASE GRAVEL COURSE

- .1 The road base course gravel shall be in accordance with Section 9.30 - Road Base Gravel Course.

4.23 APPROVED NATIVE BACKFILL

- .1 Approved native backfill shall be soils native to the excavation and suitable for backfilling to the required compaction densities as determined by the Engineer.
- .2 The maximum size rock in approved native backfill shall be 200mm in any dimension.
- .3 Approved native backfill material placed within 600mm of the finished surface shall have a maximum rock size of 75mm measured in any dimension.

SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL SPECIFICATIONS AND INSTALLATION

- .4 Unsuitable native materials, i.e. rock, clay or silt may be mixed with granular material for use as approved native backfill if approved by the Engineer. In no case shall the silt and clay content exceed 30% by volume.

4.24 CONTROLLED DENSITY FILL

- .1 All materials and methods shall conform to CAN/CSA A23.1 and A23.2.
- .2 Materials:
 - (a) Portland cement: Type 10 to CAN/CSA A3000, for winter conditions Type 30 may be used. **(REVISED NOVEMBER 2016)**
 - (b) Fly Ash: Type F to CAN/CSA A23.5.
 - (c) Water: To CAN/CSA A23.1.
 - (d) Aggregate: To CAN/CSA A23.1.
 - (e) Air entraining admixture: To CAN3 - A266.2. **(REVISED NOVEMBER 2016)**
 - (f) Chemical admixtures: To CAN3 - A266.2. Use of admixtures to accelerate or retard curing as directed by the Engineer. **(REVISED NOVEMBER 2016)**
- .3 Mix Design:
 - (a) Compressive strength: 0.5MPa at twenty-eight (28) days.
 - (b) Cement content: 25kg per m³.
 - (c) Slump: 150 - 200mm
 - (d) Air entrainment: 4 - 6%
- .4 Formwork:
 - (a) Formwork, if required, shall conform to CSA S269.3.
- .5 Placement:
 - (a) Provide the Engineer with twenty-four (24) hours notice prior to placing controlled density backfill.
 - (b) Segregation of the material during placement shall not be permitted. Pumping of controlled density fill is permitted if approved by the Engineer.
 - (c) Internal vibrators or other methods of consolidation may be used to ensure undercut areas of pavement are fully supported.
 - (d) When using controlled density fill to bed and surround the pipe, material shall be placed so as not to damage or displace the pipe.
 - (e) Begin placement of controlled density fill at the high end of sloping trenches.
 - (f) Do not place load on the controlled density backfill until authorized by the Engineer.
 - (g) Steel road plates or other approved means of supporting traffic shall be used until surface restoration can proceed.

4.25 VARIATION IN SPECIFICATION REQUIREMENTS FOR TRAVELED SURFACES

- .1 Requirements under Section 4.19 - Backfill and Compaction, Section 4.27 - Surface Restoration and Section 4.28 - Pavement Restoration may be modified or deleted as determined and authorized by the Engineer depending on soil conditions, the condition of

SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL SPECIFICATIONS AND INSTALLATION

the existing pavement and road structure, traffic control, future planned construction or other reasons, that affect work outlined under the aforementioned specification sections.

4.26 FISH HABITAT GRAVEL

- .1 Gravel shall be composed of inert, non-fractured smooth washed aggregate.
- .2 Gradation:

GRADATION LIMITS (Percent by Volume & Percent by Weight Passing)		
US STANDARD SIEVE SIZE	GRADATION LIMITS (PERCENT BY WEIGHT PASSING)	PERCENT BY VOLUME
100 mm	100	0
75 mm	95	5
50 mm	80	15
37.5 mm	60	20
19 mm	25-30	30-35
9.5 mm	10-15	10-20
6.3 mm	0 - 15	0 - 15
4.75 mm	0 - 5	0 - 5

4.27 SURFACE RESTORATION

- .1 General:
 - (a) Surface restoration shall be completed immediately following the backfilling operation.
 - (b) Restore all disturbed surfaces to a condition equal to or better than the condition that existed prior to construction to the satisfaction of the Engineer unless otherwise specified.
 - (c) Repair any damage to adjacent lands or improvements.
 - (d) Damage to paved surfaces shall be seal coated, patched or replaced in an approved manner to the satisfaction of the Engineer.
 - (e) Damage to graveled surfaces shall be restored by scarifying, regrading and compacting the surface, or if required, regravelling the surface with base gravel or approved equivalent to the satisfaction of the Engineer.

SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL SPECIFICATIONS AND INSTALLATION

.2 Traveled Surfaces:

- (a) Restoration of traveled surfaces shall conform to the following minimum requirements, or to the existing road structure, whichever is greater, unless otherwise noted on the construction drawings.

LOCATION	SUB-BASE	BASE	SURFACE TREATMENT
Gravel Roads	300mm	50mm	-
Gravel Shoulders	300mm	50mm	-
Asphalt Roads (Existing)	250mm	100mm	50mm Asphalt
Asphalt Roads (With CDF)	CDF	100mm	50mm Asphalt
Gravel Driveways	-	100mm	-
Asphalt Driveways	-	100mm	50mm Asphalt
Concrete Driveways*	-	100mm	100mm Concrete
Asphalt Sidewalks	250mm	100mm	50mm Asphalt
Concrete Sidewalks	250mm	100mm	100mm Concrete
Asphalt Walkways	150mm	50mm	50mm Asphalt

- * Concrete driveways within the road rights-of-way shall be restored in accordance with the asphalt driveway requirements where the abutting street is not constructed with concrete curb and gutter or where future road widening will be required.

- (b) Place and compact sub-base, and base to 95% Modified proctor Density (ASTM D1557).
 (c) Restore asphalt road surfaces in accordance with Section 4.28 – Pavement Restoration.
 (d) If approved by the Engineer, excavated road gravel may be reused for the sub-base course.
 (e) Concrete shall be in accordance with Section 8 – Curbs, Sidewalks and Walkways.

.3 Ditches:

- (a) Reshape ditches to the original lines, grades and sections as existed prior to construction unless otherwise shown on the construction drawings.
 (b) Restore ditch with a minimum of 300mm of import granular fill, or other material specified by the Engineer where stability of ditch slopes and bottom cannot be maintained.
 (c) Compact to 95% Modified Proctor Density (ASTM D1557).

.4 Boulevards, Statutory Rights-of-way and Private Property:

- (a) Surface restoration in untraveled boulevard areas shall be limited to the replacement of topsoil, grass, gravel, rock chips or bark mulch (subject to drainage conditions) unless otherwise stated in the construction drawings or contract documents.
 (b) Surface restoration shall be a minimum depth of 100mm, or to meet pre-construction conditions, whichever is greater, unless otherwise noted on the construction drawings.

SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL SPECIFICATIONS AND INSTALLATION

- (c) Restore unimproved areas with materials equivalent to the surface conditions prior to construction.
- (d) Restore gardens with materials approved by the Engineer including top soil, bark mulch, rock chips or other materials required to match pre-construction conditions.
- (e) Restore lawns with sod removed prior to construction, otherwise restore lawn with top soil approved by the Engineer and seed or sod to match existing lawn.
- (f) Restore gravel surfaces with equivalent granular materials.
- (g) Restore driveways in accordance with Section 4.27.2.
- (h) Restore landscaped areas in accordance with Section 4.27.5.
- (i) Surface restoration in statutory rights-of-way shall also be in accordance with the rights-of-way condition sheet.
- (j) Prior to acceptance of the work, the contractor shall obtain and submit, in duplicate to the Engineer, a written release from each owner of property, where works were constructed or damaged, certifying that the owner is satisfied with the completed works.

.5 Landscaped Areas:

- (a) Top soil, shrubs, small trees, fences and other items removed prior to, or during construction shall be replaced to the satisfaction of the property owner.
- (b) Replacement shrubs, trees and plants shall be planted at a suitable time of the year in accordance with good horticultural practice to provide a maximum assurance of survival.
- (c) During the maintenance period, any trees, shrubs or plants which show signs of dying as a result of the Contractor's operation shall be replaced with new plantings of a similar variety, age and size at no extra cost to the owner.

4.28 PAVEMENT RESTORATION

- .1 All pavement restorations with a minimum 75mm asphalt thickness shall be constructed in accordance with Standard Drawing No. T-4A or as directed by the Engineer. All pavement restorations with less than 75mm asphalt thickness shall be constructed in accordance with Standard Drawings No. T-4 or as directed by the Engineer.
- .2 All pavement restorations where asphalt cutting around a manhole is required, shall be done in accordance with Standard Drawing No. T-4B.
- .3 All excavations in traveled paved areas shall be patched on the same day as the excavation with a temporary or permanent patch, or with approved steel plates, unless otherwise directed by the Engineer.
- .4 Temporary Pavement Patching:
 - (a) All temporary patching and steel road plates shall be installed and maintained to ensure safe and smooth conditions.
 - (b) Temporary patching shall consist of cold or hot mix asphaltic concrete as approved by the Engineer and placed to a minimum compacted thickness of 50mm.
 - (c) Use of steel road plates shall require approval from the Engineer and shall only be used where the specifications or drawings require the trench to be left open. (i.e. to allow curing of concrete or controlled density fill.) Steel plates shall be rated to meet traffic loading requirements.

SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL SPECIFICATIONS AND INSTALLATION

.5 Permanent Asphaltic Concrete Pavement Patching:

- (a) Install permanent pavement patch within 15 days of the excavation unless otherwise approved by the Engineer.
- (b) Remove and dispose of all broken, cracked, damaged or temporary pavement as well as paved areas showing settlement.
- (c) All pavement outside the allowable trench width, as shown on Standard Drawing No. T-1, that is damaged as a result of the contractor's operation shall be removed; all backfill beneath the damaged pavement recompact; and the pavement reinstated in accordance with these specifications at no additional cost to the Owner.
- (d) If required, re-cut existing pavement so that the location and alignment of the patch is in accordance with Section 4.29 – Final Cutting Paved Surfaces, and so that the pavement edge is a minimum of 300mm from the trench wall.
- (e) Excavate patch, as required, to ensure placement of the specified thickness of road base. Road base material and placement shall be in accordance with Section 9 - Streets, Traffic Signs and Markings.
- (f) Pavement edges shall be thoroughly cleaned. Tack coat, in accordance with Section 12.27, shall be applied to completely cover all pavement edges. **(REVISED NOVEMBER 2016)**
- (g) Minimum compacted pavement thickness shall be equal to the existing pavement thickness or 50mm, whichever is greater.
- (h) Material and placement of pavement shall be in accordance with Section 12 - Asphaltic Concrete Paving.
- (i) Finished permanent pavement patch shall be smooth and match adjacent pavement grades and be free of humps, depressions or ridges and within 6mm of the existing pavement grades when measured with a 3.0m straightedge, but not uniformly high or low.
- (j) The contractor shall maintain all pavement patches in complete repair during the warranty period. Should a dangerous situation arise, the pavement patch shall be repaired immediately upon notification by the Engineer, unless otherwise directed by the Engineer.

.6 Temporary RAP Patching: **(REVISED NOVEMBER 2016)**

- (a) The RAP specifications shall be in accordance with Section 12.23.3(a) – Recycled Asphalt Pavement. **(REVISED NOVEMBER 2016)**
- (b) Minimum compacted RAP thickness shall be 50mm or as specified in the contract documents. **(REVISED NOVEMBER 2016)**
- (c) RAP patches shall be compacted to 95% modified proctor, (ASTM D1557) in one lift so the finished grade is at or above the existing pavement surface. **(REVISED NOVEMBER 2016)**
- (d) If the finished grade is below the existing pavement surface, the RAP shall be scarified, additional RAP material added, and recompact so the finished grade is at or above the existing pavement surface. **(REVISED NOVEMBER 2016)**
- (e) If the finished grade is above the existing pavement surface, it shall be trimmed flush with the existing pavement surface. **(REVISED NOVEMBER 2016)**
- (f) Temporary RAP patches are to be used only on low volume roads unless directed otherwise by the City Engineer. **(REVISED NOVEMBER 2016)**

SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL SPECIFICATIONS AND INSTALLATION

4.29 FINAL CUTTING PAVED SURFACES

- .1 All final pavement cuts shall be sawn in accordance with Section 4.28 – Pavement Restoration.
- .2 All final cuts shall be a minimum of 300mm from the trench wall.
- .3 All longitudinal pavement cuts in streets shall lie outside a vehicle wheel path, unless otherwise directed by the Engineer.

4.30 TRENCH SETTLEMENT DURING GUARANTEE PERIOD

- .1 The Contractor shall replace materials and rectify all failures that occur as a result of settlement of trench backfill or collapse of trench walls during the guarantee period. ~~as specified in Section 2.03 – Materials and Workmanship, Article 29.~~ ***(REVISED NOVEMBER 2019)***
- .2 Trenches in which backfill settles shall be refilled with the specified backfill material, and paved surfaces that are adjacent to trenches or on trench backfill, which fail during this period, shall be replaced or repaired in an approved manner.

Formatted: Font: Bold, Italic

4.31 PRIVATE UTILITIES IN CITY RIGHTS-OF-WAY

- .1 Private utilities within City of Nanaimo road rights-of-way generally shall follow the alignments shown on Standard Drawings No. T-9 and T-10.
- .2 All private utilities shall be traceable electronically.
- .3 Installation of private utilities shall require prior approval by the City Engineer.