# CHAPTER 6

# WATER, RE-USE AND SEWER TRENCH

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# WATER, RE-USE AND SEWER TRENCH

# CONSTRUCTION SPECIFICATIONS

## INDEX

## 6.1 TRENCH EXCAVATION

A) General. Excavation for water main, re-use main, and sanitary sewer pipelines, fittings and appurtenances shall be by open trench to the depth and alignment shown on the accepted construction drawings. Where depth of trench and conditions allow, tunneling, boring, or jacking may be permitted when tunneling, boring, or jacking methods of construction are submitted to and accepted by the Director of Public Works. When jacking is permitted, only persons experienced in that work, using suitable equipment, shall perform the jacking operation.

B) Limit of Excavation. Except by written permission of the Director of Public Works, the maximum length of trench permitted to be open at any one time shall be 400 feet, or the distance necessary to accommodate the amount of pipe installed in a single day, whichever is smaller. This distance shall be the collective length at any location, including open excavation, pipe laying and appurtenances, construction and backfill which has not been temporarily resurfaced. No trench shall be left open at any time that the Contractor is not on the job site engaged in construction operations.

C) Trench Width. The width of trenches shall be only that necessary for the proper laying of the pipe. There shall be a minimum clearance of 8 inches between the trench wall and the wall of the pipe.

D) All unauthorized excavation below the established depth made without the written authorization of the Director of Public Works, shall be refilled with compacted approved granular material or with concrete by and at the expense of the contractor.

6.1.1 Trench Side Walls. When the trench side walls are sloped or benched, the sloping or benching shall terminate at a depth not less than one foot above the top of the pipe barrel, and from the point down the trench wall shall be vertical.

A) In the event that the maximum trench widths

previously specified are exceeded either through accident or otherwise, and if the Director of Public Works or Town Engineer determines that the design loadings of the pipe will be exceeded, the Contractor shall be required to either use a higher class bedding or use a pipe of stronger class. Cost of such remedial measures shall be at Contractor's expense.

B) Bracing Excavations. All excavations shall be properly sloped or supported in the manner as required by OSHA Federal Register Volume 37, No. 243, Sub-Part P, Section 1926.652, as amended, or as required by COSHA laws as may be necessary to protect life, property and the work. Shoring shall be, designed by a qualified professional. Sharing design shall be submitted to the Director for acceptance.

C) Trench Bottom Excavation. The trench bottom shall be excavated to a depth as specified in the Bedding Materials section and the associated drawings of these standards unless otherwise specified by the Consultant and accepted by Director of Public Works. Before the pipe is laid, the trench bottom shall be graded by backfilling with bedding material to provide uniform bearing and support for the entire length of pipe. A continuous trough shall be excavated to receive the bottom quadrant of the pipe barrel and bell holes shall be provided at each joint to permit the jointing to be performed properly and to permit the pipe to be uniformly supported.

D) Unsuitable Trench Bottoms. Where unsuitable foundation bedding material is encountered in the trench bottom, such material shall be removed to a depth acceptable to the Director of Public works. The unsuitable material shall be replaced with bedding material and compacted as specified in the Bedding Materials section to provide a suitable foundation for the pipe.

E) Over-Excavating for Rock. When rock or hard clay is encountered in the trench bottom, the trench shall be over-excavated to a depth of 6-inches below the bottom of the pipe. The over-excavated material shall be replaced with an acceptable bedding material and compacted as specified the bedding Materials section.

F) Over-Excavating for Unstable Trench Conditions. When unstable conditions are encountered in the trench bottom, the trench shall be over-excavating to a depth of 6-inches below the bottom of the pipe. The over-excavated material shall be replaced with trench stabilizing material as specified in the Bedding Materials section.

6.1.2 Dewatering.

A) The contractor shall provide and maintain at all times during construction, ample means and devices with which to divert surface water and to promptly and properly dispose of all water entering the trench or water and sewer utility structure excavation. Pipe trenches or structure excavation shall be kept free from water during excavation, construction, pipe laying and jointing. The method of dewatering shall maintain a water surface below the bedding material.

B) Dewatering shall be accomplished by the use of sump pumps and/or rock or gravel drains placed below subgrade foundations or subsurface pipe drains.

C) The Contractor shall dispose of the water in a suitable manner without damage to adjacent property or without being a menace to public health or without causing a public inconvenience or nuisance. The water shall not be drained into work completed or under construction. Trench water shall not be allowed to enter any sewer lines either by gravity or by pumping. All manholes under construction shall be sealed tightly to prevent water from excavation, or

groundwater, from entering the sanitary sewer system.

D) The dewatering operation shall continue until such time that it is safe to allow the water table to rise in the excavation. Pipe trenches shall contain enough backfill to prevent pipe floatation.

6.1.3 Grading and Stockpiling.

A) The contractor shall control stockpiling and grading of trench excavation material in a manner that shall not endanger the work and that shall avoid obstructing sidewalks, driveways and fire hydrants. Grading and stockpiling shall prevent water from running into excavations. Satisfactory provisions shall be made for street drainage at all times.

B) Pipe clearance in Rocks. Ledge rock, boulders and stones larger than 12-inches in their greatest dimension, shall be removed from the trench to provide a clearance of at least 6-inches between the bottom or side of the pipe and/or appurtenances and the rock.

6.1.4 Rock Excavation. Rock excavation shall consist of igneous, metamorphic and sedimentary rock which cannot be excavated without blasting or the use of rippers, and all boulders or other detached stones each having a volume of 2 cubic yards or more. Where rock, hardpan or other unyeilding material is encountered, it shall be removed below the designed grade for a depth of 6-inches. This extra depth excavation shall be backfilled with compacted granular bedding material.

6.1.5 Blasting. Excavation blasting will be permitted for portions of the work which may be expedited thereby, provided that a written permit is given by the Director of Public Works, and a permit is granted by the municipal authority having jurisdiction. The Director of Public Works shall have the right to limit the use of explosives or to order the discontinuance of

any blasting methods which in his opinion, endanger any part of any public or private property, the safety of inhabitants of the area, or the traveling public.

The contractor shall enlist the services of a professional Explosives Engineer. All blasting shall be in accordance with the Explosive Statutes of Colorado.

Blasting shall be performed in such a manner that no damage will result to any building, structure, pipeline, or facility on or off the site of the work, or above or below ground line. Any damage suffered as a result of blasting shall be repaired to the satisfaction of the Director of Public Works, at the Contractor's expense.

Blasting shall be done in such a manner that the rock is not loosened nor disturbed below the pipe foundation.

Blasting in a trench shall not proceed until the trench walls have been shored or braced in a manner satisfactory to the Director of Public Works.

6.1.6 Pavement Removal. Excavation in paved streets shall meet the minimum trench width requirements. The street pavement shall first be cut using a saw or wheel cutter. The use of mechanical impact or air impact cutter shall not be permitted unless the contractor is given prior written permission by the Director of Public Works. The pavement cut shall follow a line parallel to the pipe centerline and twelve (12) inches beyond the trench wall. In the event pavement beyond the original pavement cut is undermined or damaged during construction, additional pavement shall be removed after trench backfilling. The additional pavement shall consist of a cut parallel to the pipe centerline with transitions to the original cut on each side. Any paving that is damaged by the Contractor outside the above stated limits shall be replaced at the Contractor's expense.

All excavated paving and concrete shall be stockpiled separately and disposed of by the Contractor off the site of the work at his expense and shall not be used as trench backfill material.

6.1.7 Preparation for Pipe Laying. When the excavation is in firm earth, care shall be taken to avoid excavation below the established grade plus the required specified overdepth to accommodate the granular bedding. Over excavation shall be replaced using stabilization materials.

6.1.8 Unstable Trench Conditions. When soft or otherwise unstable foundation material is encountered in the bottom of the trench, it shall be removed; and replaced with stabilization materials or a concrete cradle. A trench bottom that is wet will not be considered evidence that the trench bottom is unstable.

A) Stabilization Material. Shall be uniformly graded washed rock conforming to the following sieve analysis. A minimum of six (6) inches of granular bedding material shall be placed over the stabilization material as required in these Specifications.

| Sieve Size | Percent Passing |
|---|---|
| 2" | 95-100 |
| 1" | 35-70 |
| ½" | 10-30 |
| #4 | 0-5 |

6.2 PIPE BEDDING

6.2.1 General. The pipe shall be carefully bedded as shown in the bedding details. The minimum support for the pipe except for PVC sanitary sewer pipe shall be Class "C" Bedding unless otherwise required by the Director of Public Works. PVC sanitary sewer pipe shall be a minimum of Class "B" Bedding.

6.2.2 Granular Bedding Material. Granular bedding

material shall be a well graded gravelly material, meeting the following requirements (sand shall not be used):

| Sieve Size | Total passing by Sizes (% by weight) |
|---|---|
| 3/8" | 100 |
| No. 4 | 70 - 100 |
| No. 8 | 35 - 95 |
| No. 16 | 20 - 85 |
| No. 30 | 10 - 65 |
| No. 50 | 5 - 30 |
| No. 100 | 5 - 15 |
| No. 200 | 0 - 10 |

6.2.3 Compacting Granular Bedding Material. Granular bedding material shall be deposited in layers and compacted by surface or internal vibrators, or hand or power tampers. The material shall be compacted to a minimum of 95% of maximum dry density as determined by AASHTO T180 or 70% relative density as determined per ASTM D-2049, whichever is greater.

6.2.4 Compaction of Ordinary Backfill Material within the Bedding Section. Compaction of ordinary backfill material within the bedding section shall mean that A1 to A5 soils shall be compacted to 95% of the maximum dry density determined by AASHTO T180 and A6 and A7 soils shall be compacted to 95% of the maximum dry density determined by AASHTO T99.

6.2.5 Compaction Testing. Compaction testing shall be in accordance with paragraph 6.3.5 of these Specifications.

6.2.6 Classes of Bedding.

A) Class A Bedding: (Concrete Cradle) Class A bedding shall be defined as that method of bedding in which the lower half of the pipe is set in reinforced concrete. The minimum thickness of concrete under the lowest part of the conduit shall be ¼ of the outside pipe diameter, but not less than 6-inches. The concrete shall extend upward around the pipe to the spring line of the pipe barrel. The concrete cradle shall be a minimum of

6-inches thick in all places. Reinforcement shall be #4 deformed bars 12-inches laterally on centers. Backfill materials shall be hand compacted to a minimum depth of one foot above the pipe.

B) Class B Bedding: (Granular II) Class B bedding shall be defined as that method of bedding in which the pipe is set on compacted granular bedding material. The trench shall be excavated to a depth below the established grade equal to ¼ of the outside diameter, but not less than 4-inches. In rock excavation, the minimum depth shall be 6 inches. Granular bedding material shall be placed and compacted under the pipe and around the sides of the pipe to springline. The granular bedding material shall be, consolidated and compacted by hand operated mechanical vibrators. This type of bedding shall be considered equivalent to AWWA Standard C150, Laying Condition Type 5.

C) Class B Bedding Alternate: The same requirements shall apply as in Class B bedding except granular material shall be placed to a depth of 1 foot above the pipe. This may be used at the Contractor's option or shall be required by the Inspector if the Contractor fails the compaction test on the backfill material to 1 foot above the pipe. This bedding condition shall be used when soils, that have a plasticity index of 20 or greater, are encountered.

D) Class C Bedding: (Granular I) Class C bedding shall be defined as that method of bedding in which the pipe is set on compacted granular bedding material supporting the lower quadrant of the pipe barrel. The trench shall be excavated to a depth below the established grade equal to 1/8 of the outside pipe diameter, but not less than 4-inches. Compacted granular material shall be placed under the pipe and around the sides of the pipe to a minimum of 1/6 of the outside pipe diameter from the

bottom of the pipe barrel. The granular bedding material shall be consolidated and compacted by an approved compaction device. Backfill material shall be hand compacted to 1-foot above the pipe. This type of bedding shall be considered equivalent to AWWA Standard C150, Laying Condition Type 4.

E) Class D Bedding: (Flat Bottom) Class D bedding shall be defined as that method of bedding in which the pipe is placed on a flat bottom trench which support the pipe barrel throughout its length. Bell Holes shall in all cases be provided and the bells shall be kept free of foreign material. Backfill material shall be hand compacted under the haunches of the pipe and to a minimum depth of 1-foot above the pipe. This type of bedding shall only be used for ductile iron pipe water main construction and shall be considered equivalent to AWWA Standard C150, Laying Condition Type 3.

## 6.3 BACKFILLING AND COMPACTION

6.3.1 General. Backfilling shall be performed as soon as practicable, but only when authorized by the Director Of Public Works or his Inspector. The amount of open trench or uncompacted backfill or sum of both shall not be more than 200 feet at any time. Jetting or ponding shall not be allowed. Backfill material, which is above the optimum moisture content, shall be removed from the site and disposed of by the Contractor at his expense. Soil with the proper moisture content shall then be installed. Unless specified otherwise, all excess backfill shall be, disposed of off the rights-of-way and public property by the Contractor at his expense. Special care shall be taken to insure proper compaction around valve boxes and manholes.

In general, the backfill material shall consist of material, which has been excavated from the trench except for rubbish, frozen material, broken pavement, other debris, stones greater than 3-inches in diameter, organic muck, or

other materials considered deleterious by the Director of Public Works. When in the opinion of the Engineer or Director of Public Works the excavated material is not satisfactory for use as backfill, or whenever there is a shortage of satisfactory backfill material from whatever cause, the Contractor shall furnish all necessary suitable backfill material and shall dispose of the condemned excavated material at the Contractor's expense.

6.3.2 Ordinary Backfill Material. Ordinary backfill material shall be that material excavated from pipelines on the site that is free from frozen materials, large amount of organic or other objectionable materials. Clay and similar material with a plasticity index in excess of 20 will not be considered suitable for backfilling within 1-foot of the pipe.

6.3.3 Select Backfill Material. Select Backfill shall be used under roadways whenever ground water is encountered within 3-feet of the surface. Select backfill shall be road base crushed or pit run gravel, all of which passes a 1-inch sieve and not more than 30 percent passes a No. 80 sieve.

6.3.4 Compacting Granular Backfill Material. Granular backfill material shall be deposited in layers and compacted by surface or internal vibrators, or hand or power tampers. The material shall be compacted to a minimum of 95% of maximum dry density as determined by AASHTO T180 or, 70% of relative density as determined by ASTM D-2409, whichever is greater. The backfill may be tested at any depth and shall be properly compacted at all depths. The time and depth of testing shall be at the discretion of the Inspector. Testing shall be in accordance with Section 7.06 of these specifications.

6.3.5 Compacting Ordinary Backfill. Ordinary backfill shall be placed form 1-foot above the pipe to the surface, compacted in lifts. Backfill shall be, placed to a minimum depth of 30-inches above the top of the pipe before vibratory

roller or compacting hammer is used over the pipe. Ordinary backfill in roadways shall be compacted as follows:

A) Within three (3) feet of subgrade elevation:

| Soil Type | Compaction | Moisture Content |
|---|---|---|
| A-1 thru A-5 | 95% max. dry density* | ± 3 pts. Optimum dry density O.M.C. |
| A-6 & A-7 | 95% max. dry density** | -1 to +3 points O.M.C. |

B) Below three (3) feet below subgrade elevation:

| Soil Type | Compaction | Moisture Content |
|---|---|---|
| A-1 thru A-5 | 90% max. dry density* | ± 3 pts. O.M.C. |
| A-6 & A-7 | 90% max. dry density** | -1 to +3 points O.M.C. |

* As determined by AASHTO T180
** As determined by AASHTO T99

The backfill may be tested at any depth and shall be properly compacted at all depths. The time and depth of testing shall be at the discretion of the Public Works Inspector. Testing shall be in accordance with paragraph 6.3.6 of these specifications.

6.3.6 Compaction Testing. The compaction of the bedding and the backfill shall be tested at a rate of at least one (1) test per 200 cu. yd. of fill material or portions thereof. The testing shall be at varying depths and locations. The Public Works Inspector may require more testing around manholes and valve boxes. Initial test results shall be submitted to the Inspector within 24 hours of the test or on the next Town working day. Final test results shall be certified by a registered professional engineer specializing in soils analysis to be correct and shall be submitted

to the Director of Public Works within one (1) week of the test. Compaction testing on private developments will be at the expense of the Contractor/Developer. Town of Bennett personnel will provide the testing on Town contracts only.

6.3.7 Maintenance of Backfill. All backfull shall be maintained to the satisfaction of the Director of Public Works at all times during construction. Accesses across trenches for driveways and streets shall be maintained free of hazards to traffic or pedestrians.

6.4 SURFACE RESTORATION

Pavement, curb, gutter, sidewalk, drainage culverts, headwalls, or other street improvements destroyed, removed, or damaged during construction shall be repaired or replaced to a condition equal to that prior to construction, to the same elevation and alignment, to the satisfaction of the Director of Public Works. The subgrade for all restored surfaces shall be thoroughly compacted by a method of compaction acceptable to the Director of Public Works. The cost of restoration work and removal of all debris form the site of the work shall be at the expense of the Contractor.

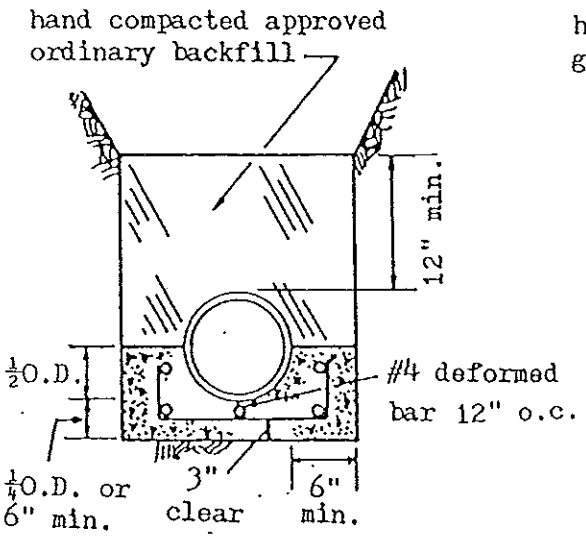
Natural or artificial groundcover destroyed, removed or damaged during construction shall be re-seeded and shall have erosion control provided to restore the groundcover to a condition equal to that prior to construction, to the same elevation and alignment to the satisfaction of the Director of Public Works.

6.5 WATER FOR CONSTRUCTION

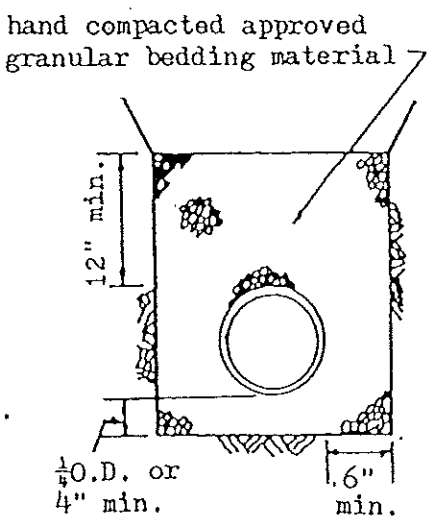
Water for construction purposes, testing and the flushing of new water mains and sanitary sewers is available from the Town Municipal Water Distribution System. The Contractor shall make arrangements with Director of Public Works before utilizing any water. All valves connected to fire hydrants shall be operated in accordance with the instructions of the Director. All water used for construction shall be, metered by a meter supplied by the Town. Water used for construction shall be, paid for by the Contractor.

## 6.6 GRADE STAKES

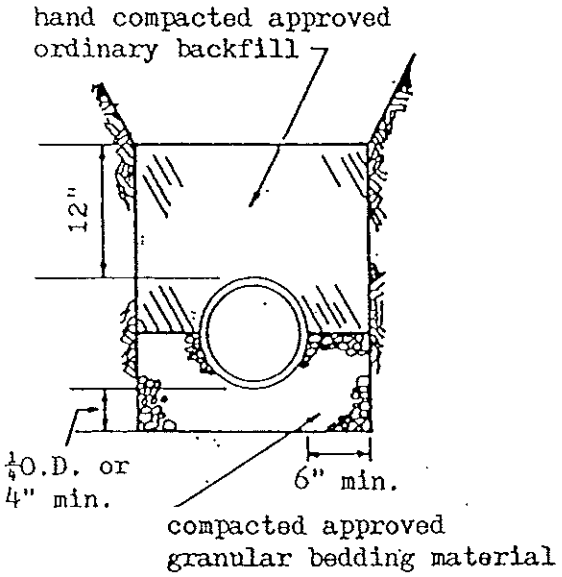
The Consultant shall provide grade stakes for all water main and sanitary sewer line installation. These stakes shall locate the respective water main or sanitary sewer alignment location and elevation. The maximum distance between stakes shall be 25 feet. All water main fittings, valves, and appurtenances shall be staked for location and elevation. All manholes shall be staked for centers, line and elevation.



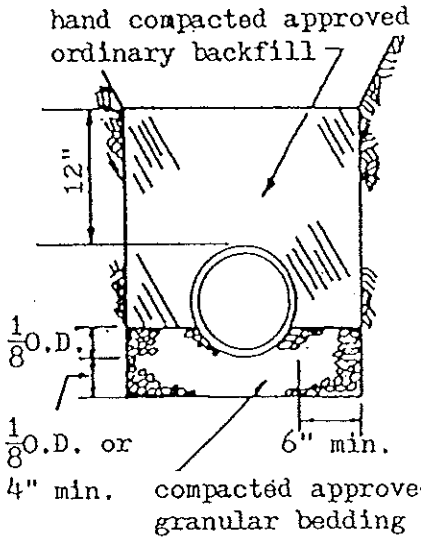

CLASS A
CONCRETE CRADLE




CLASS B ALTERNATIVE
COMPACTED GRANULAR
BEDDING

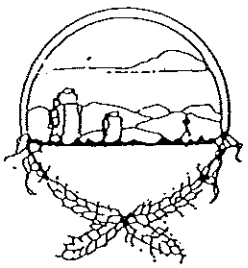



CLASS B
COMPACTED GRANULAR
BEDDING




CLASS C
COMPACTED GRANULAR
BEDDING

NOTE:
THERE SHALL BE A MINIMUM OF 30" OF BACKFILL OVER THE PIPE BEFORE OTHER THAN HAND COMPACTION EQUIPMENT IS USED IN THE TRENCH.



PIPE BEDDING CLASSES

Town of Bennett

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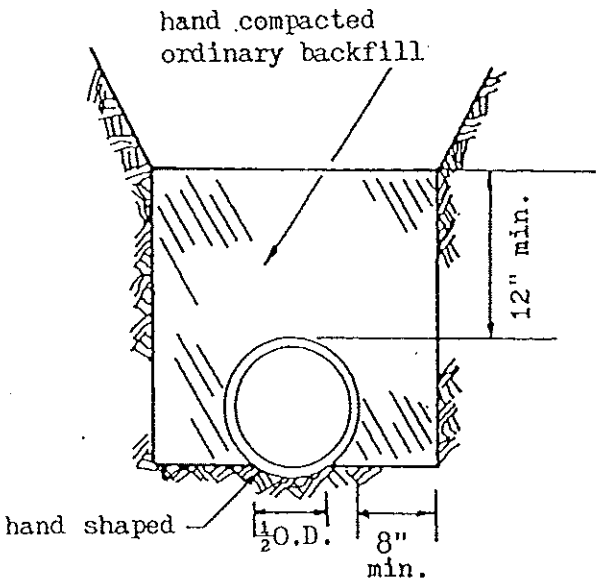
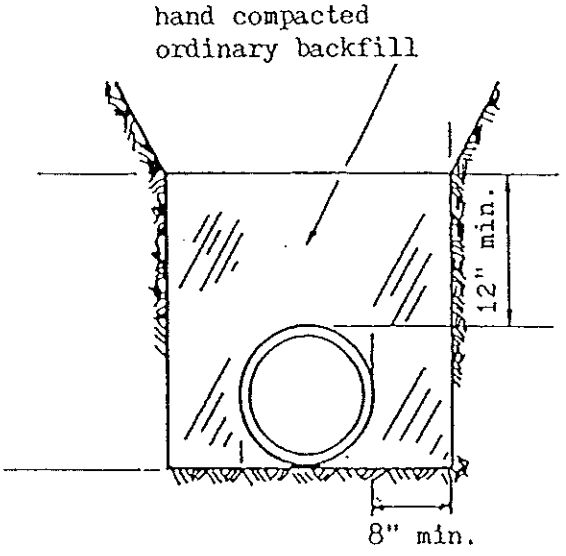
Revised: _____

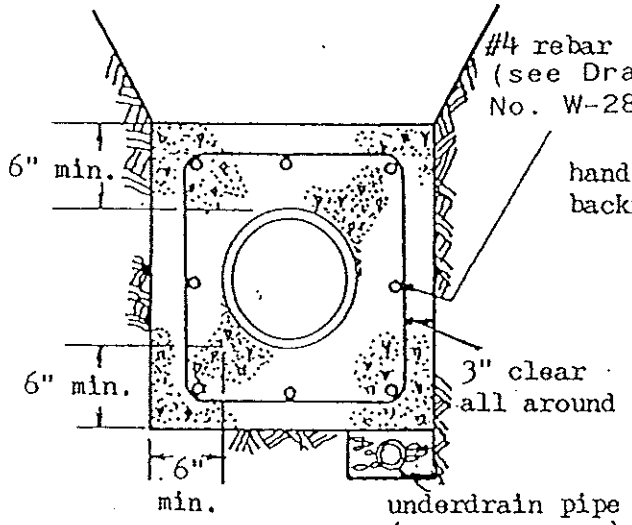
Drawing No.
T - 1



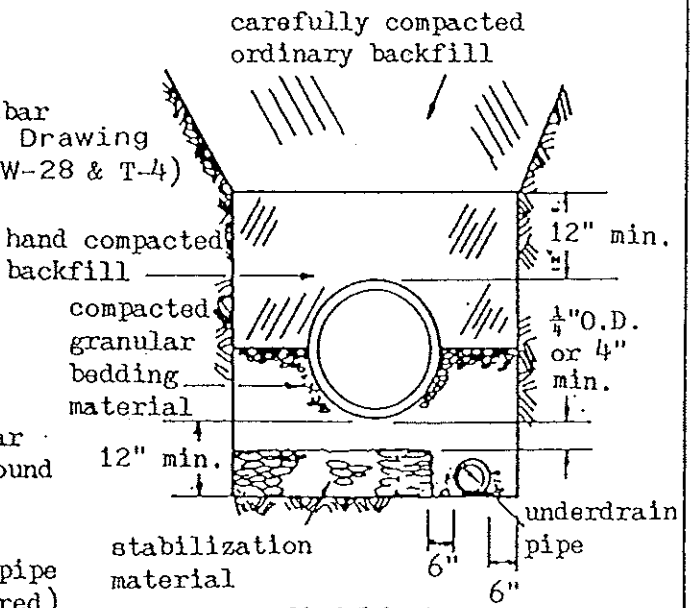

CLASS C
HAND SHAPED BOTTOM
(SPECIAL AUTHORIZATION REQUIRED)



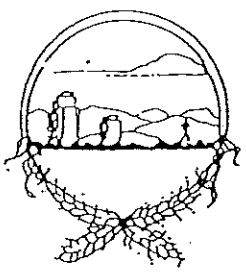

CLASS D
FLAT BOTTOM
(WATERLINE ONLY)




ENCASEMENT
TYPICAL AND UNDERDRAIN




CLASS B
TYPICAL UNDERDRAIN



PIPE BEDDING CLASSES

Town of Bennett

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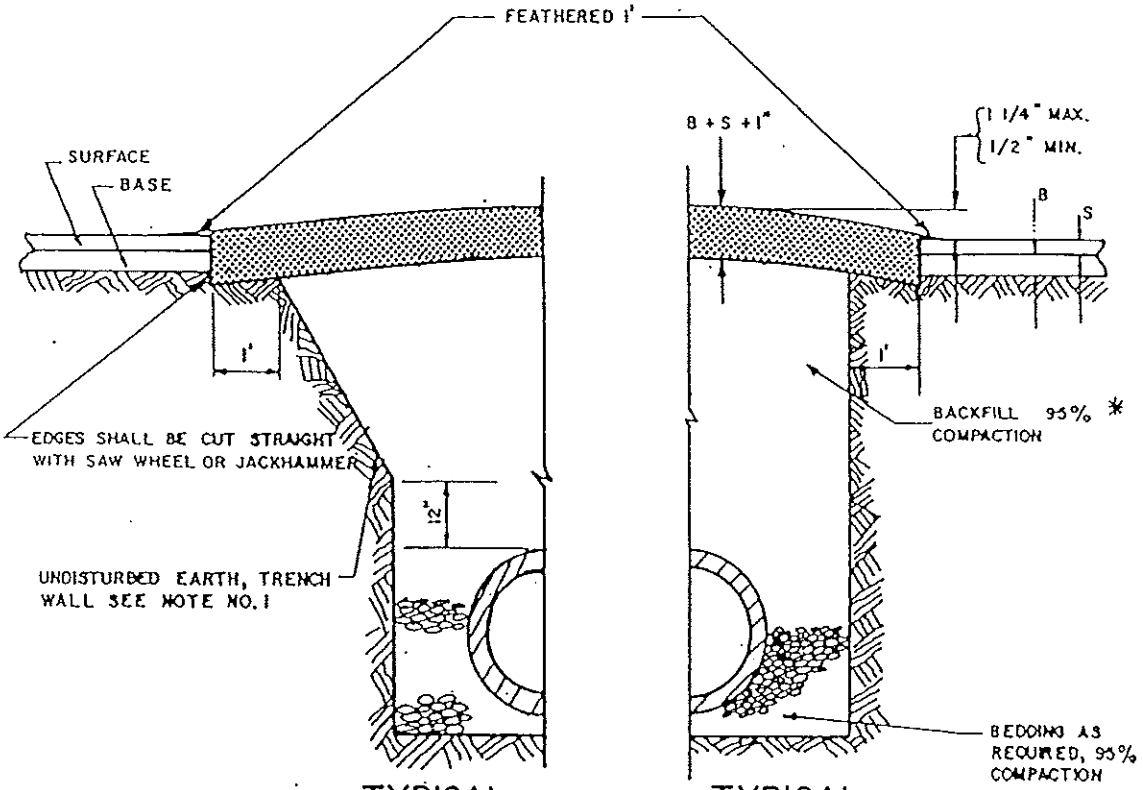
Drawing No.
T - 2




TYPICAL SLOPED TRENCH

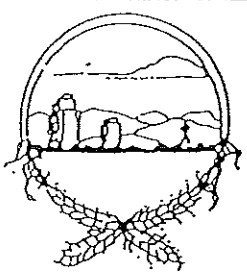
TYPICAL VERTICAL TRENCH

NOTES

1. TRENCH TO BE SLOPED OR BRACED AND SHEETED AS NECESSARY FOR THE SAFETY OF THE WOKMEN AND THE PROTECTION OF OTHER UTILITIES.
2. THE SURFACE COURSE SHALL BE FEATHERED 12" BEYOND THE EDGE OF THE REMOVED ASPHALT OR PAVEMENT.
3. THE PATCH SHALL BE FULL DEPTH ASPHALT OR CONCRETE.

*

| COMPACTION | SOIL (ASTM D 2487) |
|---|---|
| AASHTO T180 | ALL "G" & "S" SOILS |
| AASHTO T 99 | ML, CL, MH, CH |



# TRENCH PATCHING

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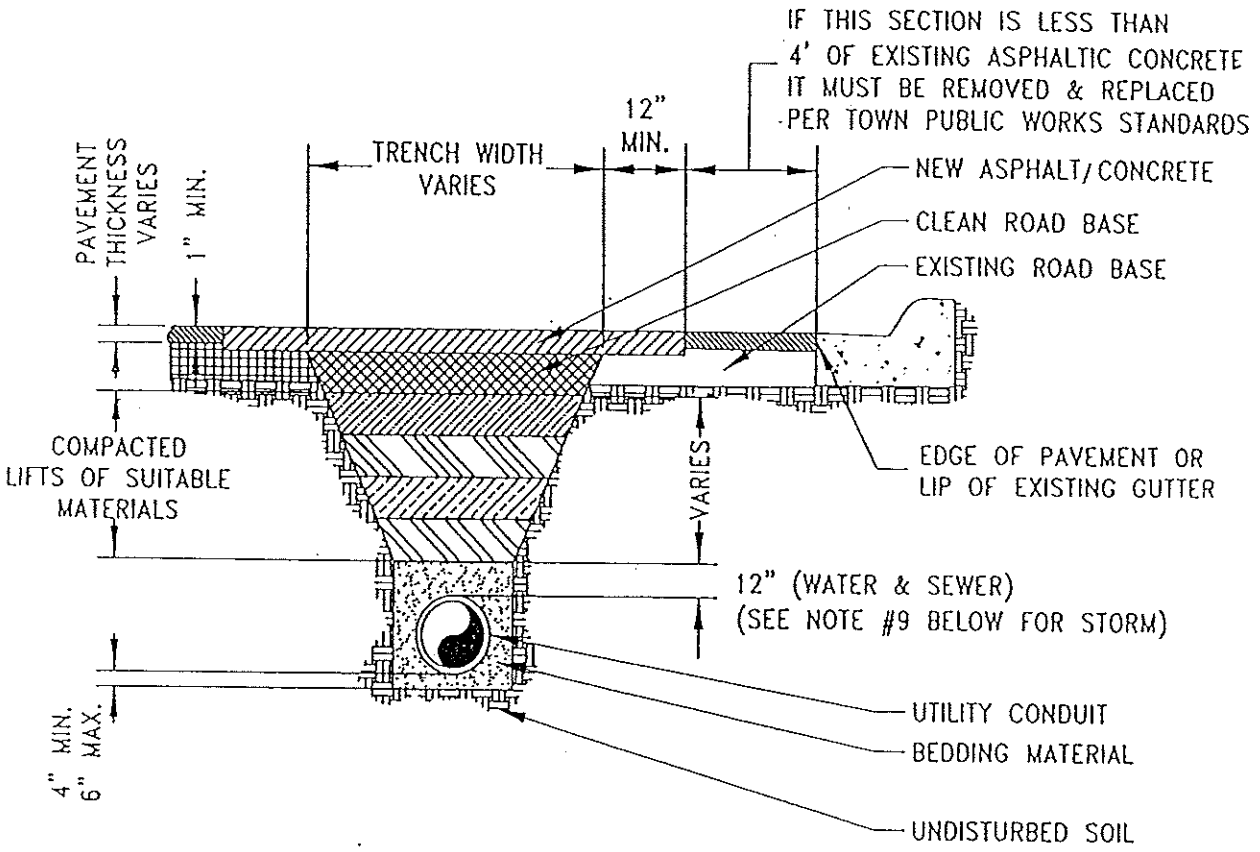
Revised: _____

Town of Bennett

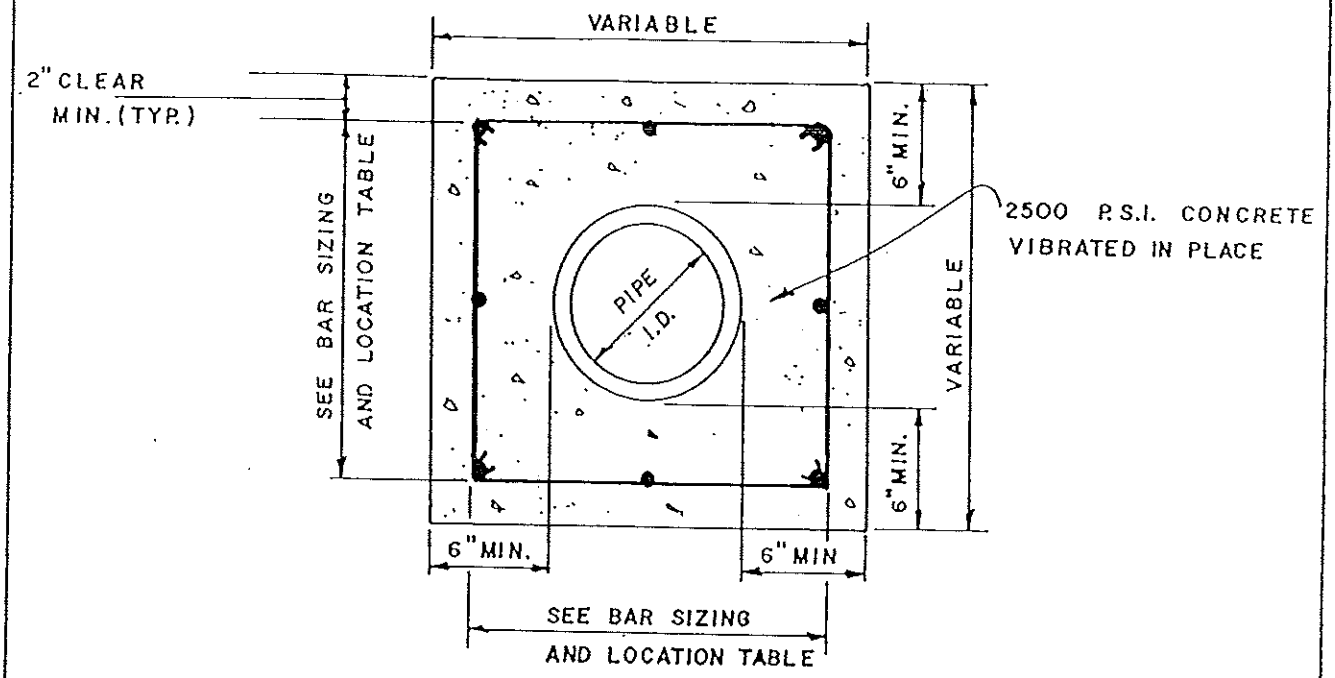
Drawing No. T - 3



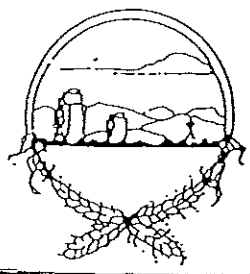

NOTES:

1. ALL TRENCHES SHALL BE BACKFILLED IN ACCORDANCE WITH THE ABOVE DETAIL UNLESS OTHERWISE SPECIFIED BY THE TOWN.
2. PRIOR TO PLACEMENT OF ASPHALT CONCRETE, PAVEMENT EDGE SHALL BE SAW CUT TO A CLEAN, VERTICAL & STRAIGHT EDGE.
3. 1-SAC SAND/CEMENT SLURRY MAY BE SUBSTITUTEED FOR BACKFILL MATERIAL.
4. TRENCH WIDTH SHALL NOT BE MORE THAN 16" NOR LESS THAN 12" WIDER THAN THE DIAMETER OF THE PIPE.
5. USE #4 REBAR AT 2' CENTERS ALONG THE PERIMETER OF CONCRETE REPLACEMENT SECTIONS.
6. 95% COMPACTION IS REQUIRED ON ALL TRENCHING ZONES, BOTH IMPROVED & UNIMPROVED AREAS.
7. IN UNIMPROVED AREAS, ALL DISTURBED AREAS SHALL BE REGRADED, SEEDED & MULCHED.
8. IN CONCRETE ROADWAYS, A MINIMUM OF 1/2 PANEL WIDTH OR 10' x 5' SECTION WILL BE ALLOWED TO REMAIN, OTHERWISE THE ENTIRE CONCRETE PANEL MUST BE REPLACED.
9. BEDDING MATERIAL DEPTH WHEN INSTALLING STORM SEWER SHALL BE UP TO SPRING LINE, EXCEPT IN AREAS OF UNSUITABLE BACKFILL, THEN BEDDING MATERIAL SHALL BE 12" ABOVE PIPE.

| | | |
|---|---|---|
| | TRENCH DETAIL | Issued: _____<br>Revised: _____ |
| | Town of Bennett | Drawing No.<br>T - 3a |




| PIPE I.D. | No. of LONGITUDINAL BARS AND LOCATION | | |
|---|---|---|---|
| 6 IN. | 4 — NO. 4 BARS | 1 EACH | CORNER |
| 8 IN. | 4 — NO. 4 BARS | 1 EACH | CORNER |
| 10 IN. | 8 — NO. 4 BARS | 3 EACH | SIDE |
| 12 IN. | 8 — NO. 4 BARS | 3 EACH | SIDE |
| 15 IN | 8 — NO. 4 BARS | 3 EACH | SIDE |
| 18 IN. | 8 — NO. 4 BARS | 3 EACH | SIDE |
| 21 IN. | 12 — NO. 4 BARS | 4 EACH | SIDE |
| 24 IN. | 12 — NO. 4 BARS | 4 EACH | SIDE |
| 27 IN. | 12 — NO. 4 BARS | 4 EACH | SIDE |
| 30 IN. | 12 — NO. 4 BARS | 4 EACH | SIDE |
| 33 IN. | 12 — NO. 4 BARS | 4 EACH | SIDE |
| 36 IN. | 16 — NO. 4 BARS | 5 EACH | SIDE |



# STANDARD DETAIL
# CONCRETE ENCASEMENT

Town of Bennett

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Revised: _____

Drawing No.
T - 4