DRAFT
STANDARDS FOR THE CONSTRUCTION OF STREETS AND DRIVEWAYS

FRANKLIN, NEW HAMPSHIRE

JANUARY 2007

TABLE OF CONTENTS

TECHNICAL SPECIFCATIONS

SECTION 01010

DRAINAGE SYSTEM DESIGN

PART 1 GENERAL

1.01 DESIGN GUIDELINES

A. These general design criteria are established for the design of the drainage system in the City of Franklin. This portion of the document shall be utilized concurrently with the applicable sections of the City's Construction Standards and Technical Specifications. Design drawings and technical specifications for proposed new or modified publicly or privately owned drainage systems (surface, underdrain, roof, foundation, basement, etc.) shall be submitted to the Department for approval in accordance with these rules.

B. All design and construction drawings for the drainage system shall comply with these standards, the City's Construction Standards, Technical Specifications and applicable section of the NHDOT Standard Specifications and Standard Details.

C. Certificates of Compliance shall be submitted by the Contractor for each material to the Municipal Services Department for review and approval.

D. All drainage calculations and designs shall be completed in accordance with the requirements outlined in the City of Franklin's Subdivision Regulations and shall be performed using the following storm frequency criteria:

   a. Catch basins, driveway culverts, and street drainage pipes, minor streams, culverts, and stormwater basins – 25-year design storm event;
   b. Bridges and culverts associated with major streams and any rivers – 50 year design storm event;
   c. The Municipal Services Director or his designee reserves the right to request that critical bridges and culverts (as determined by the City) be designed to pass the 100 year design storm**.**

E. Minimum pipe culvert sizes are as follows: Roadways – 18"; Driveways – 15".

F. Pipe materials must be Reinforced Concrete Pipe (RCP), Class IV or High Density Polyethylene Pipe (HDPE) with a smooth interior wall suitable for H-20 live load requirements. All cross culverts 24" diameter and larger must be RCP. No corrugated metal pipe or aluminum pipe is permitted.

G. All piping, catch basins, and inlet structures shall be designed in accordance with the Standards for the Construction of Streets and Driveways.

H. Minimum cover for culverts, measured between the pipe crown and finished grade, shall be as follows:

   a. Under Roads and commercial Driveways– 3 feet for all types of pipe material;
   b. Under grassed areas – 2 feet for all types of pipe material;
   c. Under Residential driveways – 1 foot for all types of pipe material.

I. All pipe ends, not connected to a drainage structure will have a flared end section designed for the type of pipe material or a concrete (or stone) headwall.

J. All outlet points shall be designed with the proper and adequate stabilization and energy dissipation devices.

K. The minimum grade of culverts shall be 0.5% or as required to maintain a minimum velocity of 3 feet per second (fps) while flowing one-third (1/3) full.

1.02 LOCATION OF DRAINAGE PIPES AND MANHOLES

A. In general, catch basins, drain manholes and pipes shall be located within legally established public streets or right-of-way wherever possible. If drainage systems cannot be located in right-of-way or public streets, then access easements to all catch basins, manholes, discharge structures, stormwater management devices and pipes shall be provided.

B. The easement width shall be a minimum of 20 feet. If the drain pipe or structure is over 12 feet in depth, then the minimum easement width shall be 30 feet

.

C. A plan and profile of the drainage system is required. The deflection angle from the inflow pipe to the outflow pipe at any junction shall not be less than 90 degrees unless approved by the Director of Municipal Services.

D. Manholes for access to drainage pipes shall be provided at:

   1. All points of change in alignment;
   2. All points of change in grade.
   3. All points where a lateral pipe is connected to the system
   4. At intervals not exceeding 300 feet on all sewers.

E. Maximum drain pipe depth is not to exceed 20 feet without prior approval by the Municipal Services Department.

F. Drain pies shall be installed to avoid crossing other utilities at highly acute angles (the smallest angle measure between utilities should be between 45 and 90 degrees).

G. All drainage pipes shall have a horizontal clearance of at least five (5) feet from any other utility (water, sewer, gas, cable, fiber optic, telephone, etc.).

1.03 DRAINAGE STRUCTURES

A. Drainage structures (catch basins and manholes) will be of precast concrete construction. Precast concrete barrel sections and precast manhole bases shall conform to ASTM Designation C478. The wall thickness shall not be less than 5 inches for 48 inch inside diameter structures, or 6-inches for 60-inch and 7-inches for 72-inch inside diameter barrel sections. Lift holes and other openings are to be sealed with Portland cement mortar flush to the outside structure wall prior to backfilling.

B. Manholes and catch basins shall not be less than four feet inside diameter. The minimum distance between pipe openings in the manhole or catch basin wall will be 12 inches. If the minimum clearance between pipes can not be accomplished with a four foot diameter manhole or catch basin a larger structure is required.

C. Manhole frames and cover shall have a minimum clear opening of 30”. All manholes greater than 60 inch diameter and 14 feet deep shall have a clear opening of 36”.

D. High capacity grates (cascade) shall be used in all areas where the gutter line grade exceeds 6%.

E. Maximum distance between structures shall be 300 feet

F. Minimum invert slope across manhole shall be 0.1 ft/ft.

1.04 UNDERDRAINS

A. Underdrains will be installed at the locations shown on the approved plans and in accordance with the City’s Construction Standards. If site conditions warrant additional underdrain installations, as determined by the Municipal Services Director or his designee, they will be added by the Contractor at no cost to the City.

B. All underdrains systems shall be designed such that underdrain pipes discharge to catch basins, manholes or headwalls.

SECTION 02300

EARTHWORK – ROADWAY AND DRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes furnishing all plant, labor, equipment and materials and performing all operations in connection with excavations, excavation support systems, dewatering, blasting, backfilling, filling, grading, constructing embankments, compaction and appurtenant work, complete in place, in accordance with the Drawings, City's Construction Standards and Technical Specifications and as directed by the Municipal Services Director or his designee.

1.2 RELATED DOCUMENTS

A. Drawings, City's Construction Standards and Technical Specifications.

B. The State of New Hampshire Department of Transportation (NHDOT) Standard Specifications for Road and Bridge Construction (hereinafter referred to as NHDOT Standard Specifications) and NHDOT Standard Plans for Road and Bridge Construction (hereinafter referred to as NHDOT Standard Plans), latest edition.

1.3 SUBMITTALS

A. Backfill Materials: The Contractor shall submit a grain size analysis and curve performed in accordance with ASTM D422 and a moisture density curve indicating the maximum dry density and optimum moisture content in accordance with ASTM D1557, for each proposed source of backfill for review by the Municipal Services Director or his designee. The grain size analysis shall indicate that the backfill material conforms to the gradation requirements specified.

B. Filter Fabric: Submit the manufacturer's information on the filter fabric to the Municipal Services Director or his designee for review.

C. Submit the qualifications of the independent geotechnical testing laboratory performing soil testing and inspection services during earthwork operations. The geotechnical testing laboratory must demonstrate to the Municipal Services Director or his designee's satisfaction, based on evaluation of laboratory

submitted criteria conforming to ASTM D3740, that it has the experience and capability to conduct required field and laboratory geotechnical testing. Laboratory shall be supervised by a Registered Professional Engineer in the State of New Hampshire.

D. Excavation Support and Dewatering Plans:

1. Design Responsibility: The design of the excavation support and dewatering systems is the responsibility of the Contractor. The designs shall be prepared, sealed and signed by a registered Professional Engineer registered in the State of New Hampshire with a minimum of five years experience designing excavation support systems and dewatering systems.

2. Excavation Support Plan:

a. Design excavation support systems in accordance with the Drawings and the Specifications.

b. Design internal bracing support members for the maximum forces during excavation or removal stages.

c. Design excavation support systems in a manner permitting safe and expeditious construction of permanent structures, minimizing movement or settlement of the ground, and preventing damage to adjacent facilities.

d. For support systems in which bracing is installed between opposite sides of the excavation, design and construct support of both sides to obtain comparable rigidity.

e. Choose location of excavation support to allow for expected deviations from line during installation without encroaching on future permanent structures or right-of-way limits.

f. Tiebacks are not permitted.

g. Excavation support systems shall be located within the right-of-way or easements.

h. Submit drawings for the record, for contractor-designed excavation support systems.

i. Submit design calculations for the record, including theoretical deflections of all excavation support members, and anticipated surface

settlement versus horizontal distance from excavation support members. The design calculations shall be prepared, sealed and signed by the Registered Professional Engineer, Registered in the State of New Hampshire responsible for the design.

j. Proceed with caution in areas of utility facilities. Expose utility facilities by hand excavation or by other methods acceptable to the utility owner and the Municipal Services Director or his designee.

k. If existing utility facilities interfere with the proposed method of support, modify or relocate such facilities as required. Written permission shall be obtained from the Municipal Services Director or his designee prior to any modification or relocation of any existing facility.

3. Dewatering Plan:

a. Design Criteria: The Contractor is responsible for the adequacy of the groundwater control systems, and for designing groundwater control systems, to:

1) Provide a substantially dry and stable subgrade for the prosecution of the subsequent operations.

2) Not result in damage to adjacent properties, buildings, structures, utilities, other work, work of adjacent contracts, and other facilities.

3) Prevent soil particles and debris from entering the discharge by providing trash racks and sedimentation basins as required.

4) Assure that after 12 hours of initial pumping, no soil particles will be present in discharge.

5) The groundwater level shall be maintained at least 3 feet below the pipe invert during excavation, construction and backfilling.

6) Collection and disposal of groundwater discharge shall be in accordance with all Federal, State and local codes, rules and regulations. The Contractor shall obtain all necessary permits.

b. Prior to installation of the groundwater control system, submit working drawings and design data for the record, showing the following:

1) The proposed type of groundwater control system.

2) Arrangement and location of groundwater control system components. Description of equipment and other components to be used, with installation, operation, maintenance, and sediment disposal procedures.

3) Types and sizes of sedimentation basins and filters.

4) Design calculations demonstrating adequacy of the purposes groundwater control system and equipment.

5) Within one week, resubmit revised working drawings as necessary to reflect changes required by field conditions.

6) Obtain and submit to the Municipal Services Director or his designee, required agency permits for discharge of effluent. Submit two copies of all required permits at least one week prior to system installation.

1.4 EXCAVATION

A. The Contractor shall perform all excavations of every description and of whatever substances encountered, in a manner as required to allow for placing of temporary earth support, forms, installation of pipe and other work, and to permit access to the Municipal Services Director or his designee for the purpose of observing the work. Bottoms of trenches and excavations shall be protected from frost and shall be firm, dry and in an acceptable condition to receive the work; work shall not be placed on frozen surfaces nor shall work be placed on wet or unstable surfaces.

B. All excavations made in open cut will be controlled by the conditions existing at the various locations and shall always be confined to the limits as designated by the Municipal Services Director or his designee. In no case shall earth be excavated or disturbed by machinery so near to the finished subgrade for structures and pipelines as to result in the disturbance of the earth below the subgrade. The final excavation to subgrade should be accomplished with a smooth faced bucket or by hand if directed by the Municipal Services Director or his designee.

C. All open excavations shall be adequately safeguarded by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons, and damage to property.

D. Contractor shall provide suitable and safe means for completely covering all

open excavations and for accommodating travel when work is not in progress.

1.5 TEMPORARY EARTH SUPPORT

A. The Contractor shall furnish, place and maintain such sheeting, shoring, and bracing at locations necessary to support the sides of excavations and to prevent danger to persons or damage to pavements, facilities, utilities, or structures, and to prevent injurious caving or erosion or the loss of ground, and to maintain pedestrian and vehicular traffic as directed and required.

B. In all sheeting, shoring and bracing operations, care shall be taken to prevent injury to persons or damage to structures, facilities, utilities and services. Any injuries to persons shall be the responsibility of the Contractor; and any damage to the work occurring as a result of settlement, water or earth pressure, or other causes due to inadequate bracing or other construction operations of the Contractor shall be satisfactorily repaired or made good by the Contractor, at no additional expense to the City.

C. Where sheeting is to be used, it shall be driven ahead of excavation operations to the extent practicable so as to avoid the loss of material from behind the sheeting; where voids occur outside of the sheeting, they shall be filled immediately with selected fill, thoroughly compacted.

D. All sheeting will be removed upon completion of the construction unless otherwise ordered. If directed by the Municipal Services Director or his designee, the Contractor shall leave in place all sheeting and bracing at the locations and within the limits ordered. The Contractor shall cut off the sheeting at elevations to be determined by the Municipal Services Director or his designee.

E. The Contractor shall comply with all federal, state, and local safety regulations, and requirements.

1.6 GROUNDWATER CONTROL

A. The Contractor shall provide, at his own expense, adequate pumping and drainage facilities to maintain the excavated area sufficiently dry from groundwater and/or surface runoff so as not to adversely affect construction procedures nor cause excessive disturbance of underlying natural ground. The drainage of all water resulting from pumping shall be managed so as not to cause damage to adjacent property.

B. Any damage resulting from the failure of the dewatering operations of the Contractor, and any damage resulting from the failure of the Contractor to

maintain all the areas of work in a suitable dry condition, shall be repaired by the Contractor, as directed by the Municipal Services Director or his designee, at no additional expense to the City. The Contractor's pumping and dewatering operations shall be carried out in such a manner as to prevent damage to the Contract work and so that no loss of ground will result from these operations. Precautions shall be taken to protect new work from flooding during storms or from other causes. Pumping shall be continuous where directed by the Municipal Services Director or his designee to protect the work and/or to maintain satisfactory progress.

C. All pipelines or structures not stable against uplift during construction or prior to completion shall be thoroughly braced or otherwise protected. Water from the trenches, excavations and drainage operations shall be disposed of in such a manner as to avoid public nuisance, injury to public health or the environment, damage to public or private property, or damage to the work completed or in progress.

D. The Contractor shall control the grading in the areas surrounding all excavations so that the surface of the ground will be properly sloped to prevent water from running into the excavated area. Where required, temporary ditches shall be provided for drainage. Upon completion of the work and when directed, all areas shall be restored by the Contractor in a satisfactory manner and as directed.

1.7 BLASTING

A. Blasting shall be not be permitted without written consent of the Municipal Services Director or his designee.

B. Blasting shall be completed in accordance with applicable sections of New Hampshire Revised Statutes Amendments (RSA) and State Laws.

1.8 VIBRATION MONITORING

A. Conduct a pre-construction survey of the interior and exterior of all buildings located within 75 feet of the work area. Survey shall include videotape and still photographs to document pre-construction conditions.

B. Perform continuous monitoring of construction operations and periodic monitoring of structures adjacent to work area to ensure structures are not affected by construction operations. Establish a temporary benchmark elevation on adjacent structures and monitor structures for potential settlement.

C. If evidence of disturbance or damage to utilities, equipment, buildings, or

structures is observed or reported, discontinue operations and immediately notify the Municipal Services Director or his designee. Consult with Municipal Services Director or his designee regarding revised procedures.

D. Restore or replace utilities, equipment, buildings, or structures damaged by Contractor operations at no cost to the City.

1.9 QUALITY ASSURANCE

A. Testing: Employ a certified, independent testing laboratory acceptable to City and Municipal Services Director or his designee to perform field and laboratory material evaluation tests. Materials and installed work may require testing and retesting at any time during progress of work. Tests, including retesting of rejected materials for installed work, shall be done at Contractor's expense.

PART 2 - PRODUCTS

2.1 BACKFILL MATERIALS

A. Common Fill: Common fill shall be soil containing no stone greater than 2/3 loose lift thickness. The materials shall be free of trash, ice, snow, tree stumps, roots and other organic and deleterious materials. Common fill shall not contain more than 35 percent by weight of silt and clay. It shall be of such a nature and character that it can be compacted to the specified densities in a reasonable length of time. Topsoil and subsoil shall not be considered common fill.

B. Structural Fill: Structural fill shall consist of gravel and sand consisting of hard durable particles, and free from trash, ice and snow, tree stumps, roots and other organic and deleterious or organic matter. Structural fill shall conform to the following gradation requirements:

Sieve Size	Percent Passing by Weight
8-inch	100 (a)
3-inch	70-100
1-inch	45-90
No. 4	20-70
No. 10	15-60
No. 40	10-40

Sieve Size	Percent Passing by Weight
No. 200	0-10
(a) Four-inch maximum particle size within 12 inches of slab, footing or pavement grade.	

C. Stone Fill, Class B: Class B stone fill shall be irregular in shape with approximately 50 percent of the mass having a minimum volume of 3 cubic feet, approximately 40 percent of the mass ranging between 1 and 3 cubic feet, and the remainder of the mass composed of spalls.

D. Stone Fill, Class C: Class C stone fill shall consist of clean, durable fragments of ledge rock of uniform quality, reasonably free from thin or elongated pieces. The stone shall be made from rock which is free from topsoil and other organic material. The stone shall meet the following requirements and shall meet NHDOT Standard Specifications, Section 585.

Sieve Size	Percent Passing by Weight
12-inch	100
4-inch	50-90
1 ½ -inch	0-30
¾-inch	0-10

E. Crushed Ledge: Crushed ledge shall consist of durable crushed ledge, free from ice, and snow, sand, clay, loam or other deleterious or organic material. Crushed ledge shall conform to the following gradation requirements:

Sieve Size	Percent Passing by Weight
1-inch	90-100
½ -inch	60-80
No. 4	30-50
No. 200(a)	0-10
(a) Fraction passing the No. 4 Sieve.	

F. Crushed Stone: Crushed stone shall consist of durable crushed rock or durable crushed gravel stone, free from ice and snow, sand, clay, loam, or other

deleterious or organic material. The crushed stone shall be uniformly blended and shall conform to the following requirements and shall meet NHDOT Standard Specifications, Section 520, Standard Stone Size No. 67 and 89.

Sieve Size	**Percent Passing by Weight**	
	3/4-inch Stone (No. 67)	**1/2-inch Stone (No. 89)**
1-inch	100	---
3/4-inch	90-100	---
1/2-inch	---	100
3/8-inch	20-55	90-100
No. 4	0-10	20-55
No. 8	0-5	5-30
No. 16	---	0-10
No. 50	---	0-5

G. Crushed Gravel: Crushed gravel shall consist of durable gravel and shall be free from ice and snow, sand, clay, loam, or other deleterious or organic material. Crushed gravel shall meet the following requirements and shall meet NHDOT Standard Specifications, Section 304.

Sieve Size	**Percent Passing by Weight**
3-inch	100
2-inch	95-100
1-inch	55-85
No. 4	27-52
No. 200(a)	0-12
(a) Fraction passing the No. 4 Sieve.	

H. Gravel: Gravel shall consist of durable gravel and shall be free from ice and snow, rots, sod, rubbish, sand, clay, loam, or other deleterious or organic material. Gravel shall meet the following requirements and shall meet NHDOT Standard Specifications, Section 304.

Sieve Size	Percent Passing by Weight
6-inch	100
No. 4	20-75
No. 200(a)	0-12
(a) Fraction passing the No. 4 Sieve.	

I. Sand: Sand shall consist of clean inert, hard, durable grains of quartz or other hard durable rock, free from clay, organic, surface coatings or other deleterious material. Sand shall conform to the following gradation requirements meeting NHDOT Standard Specification Section 304.

Sieve Size	Percent Passing by Weight
6-inch	100
No. 4	70-100
No. 200 (a)	0-12
(a) Fraction passing the No. 4 Sieve.	

J. Controlled Density Fill: Controlled Density Fill (CDF) shall be self compacting, excavatable, cement-based backfill material. It shall consist of cement, fine aggregate, fly ash and water; air-entraining mixtures may also be added. The 28 day compressive strength shall be less than 100 psi, in place density shall be 90 to 100 psf. Air entrainment shall be 25% to 30%.

K. Asphalt Stabilized Base: The material shall consist of the existing pavement blended with the underlying sand and gravel sub-base as required to meet these specifications. Reclaimed stabilized base shall have a minimum bitumen content between 3 and 5 percent and conform to the following gradation:

Sieve Size	Percent Passing by Weight
3"	100
1"-1½"	80-100
3/4"	55-90
No. 4	40-70
No. 200	3-10

2.2 FILTER FRABIC

A. Filter Fabric: Filter Fabric used as a drainage medium shall consist of a nonwoven fabric made from polypropylene or polyethylene filaments or yarns. The fabric shall be inert to organic chemicals commonly encountered in the soil. The fabric shall conform to the following recommended property tests:

Property	Unit	Test Method	Minimum Value
Weight	oz/sy	ASTM D-3776-84	4.5
Grab Strength	lbs	ASTM D-4632-86	120
Grab Elongation	percent	ASTM D-4632-86	55
Trapezoid Tear Strength	lbs	ASTM D-4533-85	50
Mullen Burst Strength	psi	ASTM D-3786-80	210
Puncture Strength	lbs	ASTM D-4833-88	70

PART 3 - EXECUTION

3.1 FILLING AND BACKFILLING

A. Subgrade Preparation: After the subgrade has been shaped to line, grade, and cross-section, it shall be thoroughly compacted. This operation shall include any required reshaping and wetting to obtain proper compaction. All soft or otherwise unsuitable material shall be removed and replaced with suitable material from excavation or borrow. The resulting area, and all other low sections, holes, or depressions shall be brought to the required grade with accepted material and the entire subgrade shaped to line, grade and cross-section and thoroughly compacted.

B. Backfill Material Selection:

1. Unless otherwise specified or directed, material used for filling and backfilling shall meet the requirements as herein specified.

2. In general, the material used for backfilling utility trench excavations shall be material removed from the excavations provided that the reuse of these materials result in the required trench compaction and meets the requirements specified for common fill.

3. All backfill placed within building limits shall be structural fill unless otherwise specified.

4. In areas where the bottom of the excavation is in fine sand and silt and is below the groundwater table, the first lift of backfill shall be 12 inches of compacted crushed stone, unless otherwise indicated on the Drawings, to provide a working mat and drainage layer.

5. Maintain backfill material with a uniform moisture content, with no visible wet or dry streaking, between plus 2 percent and minus 3 percent of optimum moisture content. The final filled soil mass shall be as uniform as possible in lift thickness, moisture content, and effort required to compact soil mass.

C. Trench Backfill:

1. The trenches shall be backfilled as soon as practicable with suitable material. All trench backfilling shall be done with special care, in the following manner and as directed by the Municipal Services Director or his designee.

2. Backfill material for pipe bedding shall be deposited in the trench, uniformly on both sides of the pipe, for the entire width of the trench to the springline of the pipe. The selected backfill material shall be placed by hand shovels, in layers not more than 4 inches thick in loose depth, and each

layer shall be thoroughly and evenly compacted by tamping on each side of the pipe to provide uniform support around the pipe, free from voids.

3. The balance of backfill shall be spread in layers not exceeding 12 inches in loose depth. Each layer shall be thoroughly compacted by mechanical methods and shall contain no rock, stones or boulders larger than 4 inches in their greatest dimension.

4. All trench backfilling shall be done with special care and must be carefully placed so as not to disturb the work at any time; if necessary, a timber grillage or other suitable method shall be used to break the fall of material.

5. The moisture content of the backfill material shall be such that proper compaction will be obtained. Puddling of backfill with water will not be permitted.

6. Backfill within areas to receive topsoil or pavement construction shall be made to grades required to establish the proper subgrade for the placement of topsoil or pavement base courses.

7. In backfilling trenches, each layer of backfill material shall be moistened and compacted to a density at least equal to that of the surrounding undisturbed earth, and in such a manner as to permit the rolling and compaction of the filled trench or excavation with the adjoining earth to provide the required bearing value, so that paving of the excavated and disturbed areas, where required, can proceed immediately after backfilling is completed.

8. Any trenches or excavations improperly backfilled or where settlement occurs shall be reopened, to the depth required for proper compaction, then refilled and compacted with the surface restored to the required grade and condition, at no additional expense to the City.

9. During filling and backfilling operations, pipelines will be checked by the Municipal Services Director or his designee to determine whether any displacement of the pipe has occurred. If the observation of the pipelines shows poor alignment, displaced pipe or any other defects, they shall be remedied in a manner satisfactory to the Municipal Services Director or his designee at no additional cost to the City.

10. The top 18 inches of backfill in unpaved roads shall be constructed with 6 inches of crushed gravel on top of 12 inches of gravel. The material shall be placed in three 6-inch lifts, each lift proof rolled and compacted with rollers before placing subsequent lifts.

D. Backfilling Against Structures:

1. Backfilling against masonry or concrete shall not be done until permitted by the Municipal Services Director or his designee. The Contractor shall not place backfill against or on structures until they have attained sufficient strength to support the loads (including construction loads) to which they will be subjected, without distortion, cracking or other damage. As soon as practicable after the structures are structurally adequate and other necessary work has been satisfactorily completed, special leakage tests of the structures shall be made by the Contractor, as required by the Municipal Services Director or his designee. After the satisfactory completion of leakage tests and the satisfactory completion of any other required work in connection with the structures, the backfilling around the structures shall proceed using suitable and approved excavation material. The best of the backfill material shall be used for backfilling within 2 feet of the structure. Just prior to placing backfill, the areas shall be cleaned of all excess construction material and debris and the bottom of excavations shall be in a thoroughly compacted condition.

2. Symmetrical backfill loading shall be maintained. Special care shall be taken to prevent any wedging action or eccentric loading upon or against the structures. During backfilling operations, care shall be exercised that the equipment used will not overload the structures in passing over and compacting these fills. Except as otherwise specified or directed, backfill shall be placed in layers not more than 12 inches in loose depth and each layer of backfill shall be compacted thoroughly and evenly using approved types of mechanical equipment. Each pass of the equipment shall cover the entire area of each layer of backfill.

3. In compacting and other operations, the Contractor shall conduct his operations in a manner to prevent damage to structures due to passage of heavy equipment over, or adjacent to, structures, and any damage thereto shall be made good by the Contractor at no additional expense to the City.

E. After backfilling trenches and excavations, the Contractor shall maintain the surfaces of backfill areas in good condition so as to present a smooth surface at all times level with adjacent surfaces. Any subsequent settling over backfilled areas shall be repaired by the Contractor immediately, in a manner satisfactory to the Municipal Services Director or his designee, and such maintenance shall be provided by the Contractor for the life of this Contract, at no additional expense to the City.

F. The finished subgrade of the fills and filled excavations upon which topsoil is

to be placed, or pavements are to be constructed, shall not be disturbed by traffic of other operations and shall be maintained in a satisfactory condition until the finished courses are placed. The storage or stockpiling of materials on finished subgrade will not be permitted.

G. Uniformly smooth grading of all areas to be graded, as indicated and as directed, including excavated and filled sections, embankments and adjacent transition areas, and all areas disturbed as a result of the Contractor's operations, shall be accomplished. The finished surfaces shall be reasonably smooth, compacted and free from surface irregularities.

3.2 COMPACTION

A. Compaction Requirements: The degree of compaction is expressed as a percentage of the maximum dry density at optimum moisture content as determined by ASTM Test D1557, Method C unless otherwise noted. The compaction requirements are as follows:

Area	**ASTM Density Degree of Compaction**
Below footings	95%
Below slabs	95%
Wearing and base course pavement	95% *
Aggregate and reclaim base course below pavement	95% *
Subgrade below aggregate/reclaim base course	92%
Trench backfill - below pavements - below landscaped areas - below structures	95% 90% 95%
Other areas	90%

* The criteria for degree of compaction and density testing methodology shall be as specified in NHDOT Standard Specifications.

B. Moisture Control:

1. Fill that is too wet for proper compaction shall be disced, harrowed, or

otherwise dried to a proper moisture content to allow compaction to the required density. If fill cannot be dried within 24 hours of placement, it shall be removed and replaced with drier fill.

2. Fill that is too dry for proper compaction shall receive water uniformly applied over the surface of the loose layer. Sufficient water shall be added to allow compaction to the required density.

C. Unfavorable Conditions:

1. In no case shall fill be placed over material that is frozen. No fill material shall be placed, spread or rolled during unfavorable weather conditions. When work is interrupted by heavy rains, fill operations shall not be resumed until the moisture content and the density of the previously placed fill are as specified.

2. In freezing weather, a layer of fill shall not be left in an uncompacted state at the close of the day's operations. Prior to terminating work for the day, the final layer of compacted fill shall be rolled with a smooth wheeled roller to eliminate ridges of soil left by compaction equipment.

D. Compaction Control:

1. In-place density tests shall be made in accordance with ASTM D1556, D2922, D2167 or NHDOT Standard Specifications (roadway construction only) as the work progresses, to determine the degree of compaction being attained by the Contractor. Any corrective work required as a result of such tests shall be performed by the Contractor at no additional expense to the City. In-place density tests shall be made a Contractor’s expense by a testing laboratory experienced and certified to complete required testing.

2. The Municipal Services Director or his designee's duties do not include supervision or direction of the actual work by the Contractor, his employees or agents. Neither the presence of the Municipal Services Director or his designee nor any observation and testing performed by Municipal Services Director or his designee shall excuse the Contractor from defects discovered in his work at that time or subsequent to the testing.

3. In-place density tests shall be performed as a minimum according to the following or as directed by the Municipal Services Director or his designee:

a. Two tests per lift under spread footings and slabs.

b. A minimum of every 10 cubic yards of backfill in trenches or around

structures.

c. In accordance with NHDOT Standard Specifications for roadway construction.

3.3 FINE GRADING

A. Before placement of surface treatment or base course material, the subgrade shall be shaped to a true surface conforming to the Drawings. All depressions and high spots shall be filled with suitable material or removed and such areas again compacted until the surface is smooth and properly compacted. A tolerance of 1/2-inch above or below the finished subgrade will be allowed provided that this 1/2-inch above or below grade is not maintained for a distance longer than 50 feet and that the required crown is maintained in the subgrade. Any portion which is not accessible to a roller shall be thoroughly compacted by other mechanical methods.

3.4 TEMPORARY EARTH SUPPORT

A. Install, maintain, and remove the excavation support system in accordance with the record drawings, and in such a manner as to prevent movement, settlement, or loss of ground, removal of fines from the adjacent ground, and damage to or movement of adjacent structures.

B. Perform field welding by certified welders in accordance with American Welding Society Standard AWS D 1.1, "Structural Welding Code."

C. The distance from ground surface to the uppermost brace level or tieback shall not exceed 5 feet. The vertical distance between brace levels shall not exceed 12 feet. The maximum distance between the lowermost brace level to the excavation bottom shall not exceed 10 feet.

D. Soldier Piles and Lagging:

1. Use only in areas where the groundwater table outside of the excavation support system is lower than the bottom of excavation.

2. Prebore holes for soldier poles to a diameter at least 4 inches larger than the maximum diagonal dimension of the pile sections. Extend holes to the full design depth of the soldier pile.

3. Carry bottom of soldier pile design below the main excavation adequate to prevent lateral and vertical movement. In areas where additional excavation is required below the main excavation subgrade after the soldier poles have

been installed, make provisions to prevent movement of main excavation supports.

4. After seating soldier piles in pre-excavated holes, encase piles with structural concrete by tremie methods up to the lowest point of the excavation adjacent to the pile location. Immediately fill remainder of the hole with lean concrete or sand by tremie methods, completely encasing the pile.

5. After concrete filled soldier piles have attained 25% of concrete design strength, excavation may proceed. As excavation proceeds, remove lean concrete or sand from pile as long as excavation progresses sufficient to place lagging. Follow the excavation closely with placement of lagging.

6. Use timber lagging, precast reinforced concrete lagging, or steel sheeting secured in place to soldier piles, or installed behind flanges. Use precast reinforced concrete members or steel sheeting secured in place to soldier piles when excavation support system is to be left in place.

7. Carefully perform excavation for the installation of lagging to minimize the formation of voids.

8. If unstable material is encountered during excavation, take suitable measures to stabilize it and prevent ground displacement.

9. Maintain a sufficient quantity of material on hand for lagging, bracing, and other operations for protection of the work and for use in case of an accident or an emergency.

10. Fill voids behind lagging with sand bags or other material acceptable to the Municipal Services Director or his designee.

11. The hole bottom shall be cleaned free of all loose soil using methods acceptable to the Municipal Services Director or his designee.

E. Sheet Piling:

1. Install sheet piling to the depth below the bottom of excavation to prevent movement of the supported soil, to cut off groundwater, and prevent heaving or piping of the bottom of the excavation.

2. Grout may be used by the Contractor, or the Contractor may be directed by the Municipal Services Director or his designee to use grout to increase the stability and strength of soil, to minimize soil loss, or to control seepage

through interlocks.

F. Internal Bracing for Support System:

1. Use wales, struts, and rakers as necessary to provide internal excavation support. Continuous wales shall be used for either sheet piles, or soldier piles and lagging.

2. When wales are used, obtain tight bearing between wales and wall, and ample bearing area with wedges and packing for load transfer. Connections between struts, wales, and the wall system shall be capable of resisting the design compressive loads as well as a tensile load equal to ten percent of the strut compressive design load.

3. Provide struts with intermediate bracing as needed to enable the struts to carry the maximum load without distortion or buckling. The slenderness ratio of the struts shall be less than 120.

4. Provide diagonal bracing as needed for stability of the system.

5. Include web stiffeners, plates, or angles as needed to prevent rotation, crippling, or buckling of connections and points of bearing between structural steel members. Allow for eccentricities caused by field fabrication and assembly.

6. Install and maintain internal bracing support members in tight contact with each other and with the surface being supported.

7. Preload internal bracing members, including struts, shores and similar members to 50 percent of the design load.

   a. Use procedures that produce uniform loading members without inducing harmful eccentricities, over-stressing, or distortion.

   b. Make provisions for permanently fixing each member with steel shims or wedges welded into place.

   c. Accomplish preloading by jacking supports in place against soldier piles or wales. Do not use wooden wedges to preload bracing members.

   d. Include in the preloading system the means to determine, within five percent, the amount of preload induced into bracing members.

8. Excavate no more than 2 feet below the bottom of strut about to be placed.

Install strut, and preload immediately after installation and before continuing excavation.

9. Do not remove internal bracing and transfer loads to the permanent structure except as provided in the accepted design. When removing struts, increased vertical spacing will not be allowed.

G. Removal of Excavation Support:

1. Remove all portions of the excavation support system. When removing the excavation support system, do not disturb or damage adjacent buildings, structures, waterproofing material, or utilities. Fill voids immediately with lean concrete.

2. Remove non-salvageable material of the excavation support system from the site immediately.

3. The Contractor shall be responsible for any damage to adjacent buildings, structures, waterproofing material, or utilities due to the removal of the excavation support system. All damage to existing buildings, structures, waterproofing materials, or utilities shall be repaired immediately by the Contractor to the satisfaction of the City, Utility Owner, and the Municipal Services Director or his designee, at no additional cost to the City or the Utility Authority.

END OF SECTION

SECTION 02370

EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes furnishing all labor, equipment, and materials and performing all operations in connection with the construction, maintenance and removal of erosion and sedimentation checks and controls, stabilization of slopes and disturbed areas, protection of resource areas, and disposal of sediment and surface water, in accordance with the Drawings, City's Construction Standards and Technical Specifications and as directed by the Municipal Services Director or his designee.

1.2 RELATED DOCUMENTS

Q. Drawings, City's Construction Standards and Technical Specifications.

R. The State of New Hampshire Department of Transportation (NHDOT) Standard Specifications for Road and Bridge Construction (hereinafter referred to as NHDOT Standard Specifications) and NHDOT Standard Plans for Road and Bridge Construction (hereinafter referred to as NHDOT Standard Plans), latest edition.

1.3 SUBMITTALS

A. Submit manufacturer's literature and catalog data, or both, showing that the materials provided meet the requirements of this Specification.

B. Submit manufacturer's certificates of compliance that the silt fence and matting/blankets meet the Specifications.

C. Submit samples of silt fence and matting/blanket materials.

D. Submit erosion and sedimentation control plan as directed by the Municipal Services Director or his designee.

PART 2 - PRODUCTS

2.1 HAY BALES

A. Hay bales shall consist of hay from acceptable grasses and legumes, free from weeds, reeds, twigs, chaff, debris, other objectionable material or excessive amounts of seeds and grain. It shall be free from rot or mold and the moisture content shall not exceed fifteen (15) percent by weight at the time of weighing.

B. The hay shall be securely baled with twine of adequate size to permit rehandling when the bale is in a saturated condition.

C. Individual bales shall be of a longitudinal shape not exceeding one hundred (100) pounds when weighed.

2.2 SILT FENCE

A. Filter fabric for silt fence shall consist of pervious sheets of woven propylene, nylon, polyester, or ethylene yarn. Material shall meet the following requirements:

Requirement	Property	Test Method
Tensile Strength	ASTM D 1682 Grab Test	100 lbs. min.
Grab Elongation	ASTM D 1682 Grab Test	30 % +/- 10%
Equivalent Opening Size	100 sieve min. 40 sieve max.	Corps of Engineers CW 02215
Bursting Strength	ASTM D 751 Diaphragm	175 psi min. Bursting Tester

B. Filter fabric shall contain a stabilizer and/or inhibitors to make the filaments resistant to deterioration resulting from exposure to sunlight or heat to provide a minimum of 6 month of expected usable construction life at a temperature range of 0 degrees to 120 degrees F. The fabric filter shall be a minimum of 36 inches wide, cut from a continuous roll to finish fence length to avoid the use of seams. Splice filter fabric together only when absolutely necessary and only at a support post, with a minimum 6 inch overlap and securely sealed. The filter fabric shall be free of defects or flaws which significantly affect its physical and/or filtering properties.

C. Wire fence reinforcement for fabric silt fences shall be a minimum of 30 inches in height, a minimum of 14 gauge and shall have a maximum mesh spacing of 6 inches. The wire fence reinforcement shall be used with all filter fabrics except those approved for use without a wire fence reinforcement by the manufacturer.

D. Posts shall be of wood or steel and a minimum of 4 feet long. Wood posts shall be at least nominal 2 x 2 inches. Steel posts shall be round or U, T or C shaped with a minimum weight of 1.3 pounds per foot and have projections for fastening the wire to the fence.

E. Wire staples for attaching filter fabric to wooden posts shall be No. 9 gauge and shall be at least one inch long.

2.3 MATTING/BLANKETS

A. Jute Matting: Undyed and unbleached jute yarn woven into a uniform open, plain weave mesh, furnished in rolled strips conforming to the following physical requirements:

Property	Requirement
Width	48", plus or minus 1" 78 warp ends per width of cloth. 41 weft ends per yard
Weight	1.22 - 1.80 lbs/sq.yd., plus or minus 5%

B. Excelsior Matting: Uniform web of interlocking wood excelsior fibers with a backing of mulch net fabric on one side only. The mulch net shall be of either twisted paper chord or cotton cord. Excelsior matting shall be furnished in rolled strips and shall conform to the following physical requirements.

Property	Requirement
Width	36", plus or minus 1"
Weight	0.80 lbs/sq.yd., plus or minus 5%

C. Erosion control matting and mulching blankets will be permitted if approved by the Municipal Services Director or his designee and comply with the requirements of the NHDES publication "Stormwater Management and Erosion and Sediment Control for Urban and Developing Areas in N.H."

PART 3 - EXECUTION

3.1 GENERAL

A. Erosion and sedimentation control measures shall be installed in accordance

with manufacturer's recommendations, as indicated on the Drawings and as directed by the Municipal Services Director or his designee.

B. Erosion and sedimentation control measures shall be installed following clearing and prior to grubbing operations. No removal of stumps, boulders, topsoil or preparation of excavation shall be performed until Municipal Services Director or his designee has approved the installation of erosion and sedimentation control measures.

C. Contractor shall comply with all permits and conditions of permits issued for the project. Compliance shall be Contractor's responsibility whether or not the Contractor obtained the permit.

D. Contractor shall comply with all local, federal and state regulations.

E. Erosion and sedimentation control measures shall remain in place and be maintained by the Contractor until permanent measures have been established, unless otherwise directed by the Municipal Services Director or his designee. Maintenance of control measures shall be performed by the Contractor at no additional cost to the City.

3.2 WORK IN RESOURCE AREAS

A. Resource Areas: Resource areas are those areas, conditions or features which, when disturbed by construction activities, create an adverse environmental impact. Such areas include, but are not necessarily limited to densely wooded areas, steep slopes, wetland areas, streams, brooks, rivers and other water bodies.

B. A sedimentation barrier consisting of a continuous row of staked hay bales and/or silt fence shall be placed between all resource areas and the work area to prevent soil materials from entering the resource area. This sedimentation barrier shall be inspected and maintained on a daily basis.

C. The following activities shall not be permitted within 50 feet of designated resource areas:

1. Stockpiling and storage of equipment or materials.

2. Refueling of equipment.

3. Maintenance and repair of vehicles and equipment.

D. Should the City deem that the Contractor's activities are unnecessarily

detrimental to resource areas, then the City reserves the right to order the Contractor to immediately cease all activities on-site until the situation is resolved to the satisfaction of the City.

3.3 MITIGATION

A. All operations, particularly those associated with excavation and backfilling, shall be planned and executed in such a manner as to minimize the amount of excavated and exposed fill or other foreign material that is washed or otherwise carried into waterways or wetlands. The water quality of waterways or wetlands shall not be degraded due to construction operations.

B. It is the intent of these Specifications to prevent the unnecessary occurrence of sedimentation or siltation of the adjacent waterways, wetlands, and their various impoundments. In the event that sedimentation or siltation prevention measures used by the Contractor prove to be inadequate, as determined by the Municipal Services Director or his designee, the Contractor shall be required to adjust his operations to the extent necessary to prevent any such sedimentation or siltation from occurring.

C. Contractor shall keep streams, wetlands, and other water crossings clear of mud, silt, debris, and other objectionable materials resulting from Contractor's construction operations.

D. Contractor shall protect existing drainage structures from siltation. Contractor shall remove accumulated silt from drainage structures at no additional cost to the City.

E. Contractor shall maintain the flow capacity of river and stream channels to prevent unnatural flooding due to Contractor's operations.

F. Contractor shall preserve existing natural drainage patterns and vegetative cover.

G. Contractor shall use temporary vegetation, soil stabilization matting and mulching to protect areas exposed during construction. Contractor shall minimize the amount of bare earth exposed at any one time during construction, and he shall also minimize the length of time bare earth is exposed.

H. Baled hay shall be placed to form temporary water stops, dams, diversions, dikes, berms and for other uses connected with water pollution control. Bales that become to clogged to be effective shall be removed from the site and new bales provided as directed by the Municipal Services Director or his designee. Bales shall be replaced as often as necessary to provide effective sedimentation

control.

I. On sloping terrain, hay bales may be used to trap sediment until vegetation has become established.

J. Install hay bale or gravel check dams at 50-foot intervals along the centerline of drainage ditches as shown on the Drawings and as directed by the Municipal Services Director or his designee until permanent surface treatments are installed and fully stabilized.

K. Hay bales or other materials necessary for sedimentation and erosion control shall be placed and maintained along wetland and waterway boundaries and along street drains in roadways if sediment is to be left overnight or if there is rain during construction activities. All soil left overnight along roadways adjacent to waterways and wetlands shall be covered.

L. Sediment-laden water that is being pumped from the trenches or excavations shall not be pumped directly into watercourses or wetlands. Sedimentation basins of hay bales, check dams, silt fence or other means acceptable to the Municipal Services Director or his designee shall be used for this purpose.

M. Spoil resulting from trench excavation or grading shall be leveled or removed to permit free entry of water from adjacent land surfaces without excessive erosion or harmful ponding.

N. No volume of fill additional to preconstruction conditions shall be left in areas subject to flooding.

O. A stockpile of haybales and silt fence will be maintained at the project for use as needed for repair or reinforcement of the sedimentation controls until the area is stabilized.

P. Silt fence and sedimentation barriers shall be maintained at no additional cost to the City as follows:

1. Inspect silt fences and sedimentation barriers immediately after each rainfall and at least daily during prolonged rainfall. Provide any required repairs immediately. Should the fabric on a fabric silt fence decompose or become ineffective prior to the end of the expected useful life, and the barrier still be necessary, replace the fabric promptly.

2. Remove sediment deposits after each storm event as directed by the City. As a minimum, remove sediment when deposits reach approximately one-half the height of the barrier.

3. Dispose of sediment deposits off-site, placed upland in a manner which will prevent its later erosion into the resource protection area, or in manner approved by the City.

4. Maintain the fabric silt fence until all upslope soils are permanently stabilized by vegetation.

Q. Periodically inspect earthwork to detect any evidence of erosion and sedimentation and promptly apply corrective measures.

R. Erosion and sedimentation control measures shall be disposed of in accordance with all local, state and federal regulations following the completion of construction activities in a particular area.

END OF SECTION

SECTION 02630

STORM DRAINAGE SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes furnishing all labor, equipment, and materials and performing all operations in connection with the construction of drain pipe, drain manholes, catch basins, and headwalls in accordance with the Drawings, City's Construction Standards and Technical Specifications and as directed by the Municipal Services Director or his designee.

1.2 RELATED DOCUMENTS

A. Drawings, City's Construction Standards and Technical Specifications.

B. The State of New Hampshire Department of Transportation (NHDOT) Standard Specifications for Road and Bridge Construction (hereinafter referred to as NHDOT Standard Specifications) and NHDOT Standard Plans for Road and Bridge Construction (hereinafter referred to as NHDOT Standard Plans), latest edition.

1.3 SUBMITTALS

A. Submit manufacturer's technical product data and installation instructions for materials and products.

B. Submit shop drawings, descriptive literature and manufacturer's data showing pipe dimensions and joint system for each type and class of pipe.

C. Submit manufacturer's certificates of compliance with these Specifications on all products and materials.

1.4 QUALITY ASSURANCE

A. The quality of all new materials, the process of manufacture, and the finished product shall be subject to the review of the Municipal Services Director or his designee. Such review may be made at the place of manufacturer, or on the site after delivery, or at both places and the pipe shall be subject to rejection at any time on account of failure to meet any of the specification requirements even though sample product may have been accepted as satisfactory. The Municipal

Services Director reserves the right to apply such tests as he may from time to time deem necessary to check on compliance with the Specifications.

PART 2 - PRODUCTS

2.1 CULVERTS AND STORM DRAINS

B. Reinforced Concrete Pipe:

1. Reinforced concrete pipe shall be manufactured by an established manufacturer of good reputation in the industry. Manufacturer shall have a minimum of 5 years experience.

2. Reinforced concrete pipe shall be manufactured in a permanent plant adapted to meet all the design requirements of the pipe.

3. Reinforced concrete pipe shall have an interior surface that is smooth and even, free from roughness, projections, indentations, offsets, or irregularities of any kind.

4. Reinforced concrete pipe shall be Class IV unless structural loading requirements require Class V.

5. Reinforced concrete pipe shall be as specified in NHDOT Standard Specifications, Section 603.

C. High Density Polyethylene (HDPE) Pipe:

1. HDPE pipe shall be manufactured by an established manufacturer of good reputation in the industry. Manufacturer shall have a minimum of 5 years experience.

2. HDPE pipe shall be manufactured in a permanent plant adapted to meet all the design requirements of the pipe.

3. HDPE pipe shall have corrugated exterior surface and an interior surface that is smooth and even, free from roughness, projections, indentations, offsets, or irregularities of any kind.

4. HDPE pipe shall be HI-Q Sure-Lok ST pipe as manufactured by Hancor or approved equal. Pipe shall meet the requirements of AASHTO M294 Type S.

5. Fittings shall be suitable for the intended application and match the pipe

materials. Fittings shall meet the requirements of AASHTO M294.

6. Pipe and fittings shall meet ASTM D3350 Cell Classification 324420C.

2.2 UNDERDRAINS

A. Underdrain pipe shall be HDPE corrugated exterior surface and an interior surface that is smooth and even, free from roughness, projections, indentations, offsets, or irregularities of any kind or PVC (SDR 35 or 26). Coiled slotted house underdrain pipe corrugated metal pipe will not be permitted.

2.3 CATCH BASINS AND DRAIN MANHOLES

A. Drainage structures (catch basins and manholes) will be of precast concrete construction. Precast concrete barrel sections and precast manhole bases shall conform to ASTM Designation C478. The wall thickness shall not be less than 5 inches for 48 inch inside diameter structures, or 6-inches for 60-inch and 7-inches for 72-inch inside diameter barrel sections. Lift holes and other openings are to be sealed with Portland cement mortar flush to the outside structure wall prior to backfilling.

B. Any structure less than 6’ deep (rim to invert) shall be a flat top H20 loading. All other manholes shall be provided with eccentric cone.

C. Manholes and catch basins shall not be less than four feet inside diameter. The minimum distance between pipe openings in the manhole or catch basin wall will be 12 inches. If the minimum clearance between pipes can not be accomplished with a four foot diameter manhole or catch basin a larger structure is required.

D. Precast concrete bases shall be manufactured to contain wall openings of the minimum size to receive the ends of the pipes. Openings shall be accurately set to conform to line and grade of the adjoining pipes. Subsequent cutting or tampering in the field, for the purpose of creating new openings or altering existing openings will not be permitted.

2.4 CASTINGS

A. Castings shall be cast iron of uniform quality, free from blowholes, shrinkage, distortion or other defects. They shall be smooth and well cleaned by shotblasting. All castings shall be manufactured true to pattern; component parts shall fit together in satisfactory manner. Castings shall have continuously machined bearing surfaces to prevent rocking and rattling. Covers and grates shall be machined to fit securely and evenly on the frame. Covers shall have a

diamond surface design.

B. Castings shall be Class 30 minimum and shall conform to ASTM A48 for Gray Iron Castings.

C. Covers for all drain manholes shall have the word "DRAIN" cast into the top surface in 3” letters.

D. Standard drain manhole frames and covers shall be Pamrex frames and covers as manufactured by CertainTeed, or approved equal.

E. Manhole frames and cover shall have a minimum clear opening of 30”. All manholes greater than 60 inch diameter and 14 feet deep shall have a clear opening of 36”.

F. Catch basin frames and grates shall be Rexus castings as manufactured by CertainTeed, or approved equal for roadway slopes less than or equal to 4%. For roadway slopes greater than 4% NHDOT Type F (Bicycle safe) frames and grates shall be used. Double grates will be used when hydraulic conditions as determined by the Municipal Services Director or his designee. All castings must be American made.

G. Catch basins grates and frames shall be standard grates and frames by type as specified in NHDOT Standard Specifications, Section 604.

2.5 BRICK AND MORTAR

A. Brick and mortar for inverts, tables, and raising castings to grade shall be as specified in NHDOT Standard Specifications, Section 604.

2.6 HEADWALL

A. Refer to Drawings, Construction Details and Technical Specifications for headwall type, size and configuration. Materials shall be as specified in NHDOT Standard Plans and Specifications.

2.7 FLARED ENDS

A. Flared ends will be provided and installed for HDPE or RCP pipe in accordance with the manufacturer’s recommendations, in accordance with NHDOT Standard Plans and Specifications and to the satisfaction of the Municipal Services Director or his designee.

2.8 BEDDING, BACKFILL AND FILTER FABRIC

A. Refer to Drawings, Construction Details and Technical Specifications for bedding, backfill and filter fabric requirements. Materials shall be as specified in Section 02300.

PART 3 - EXECUTION

3.1 GENERAL

A. Excavation and backfill shall conform to the provisions of Section 02300

3.2 RECONSTRUCTION

A. The Contractor shall reconstruct existing drainage structures, ditches and swales in close conformity with the existing lines, grades, slopes, dimensions and materials unless otherwise indicated on the Drawings or directed by the Municipal Services Director or his designee.

B. The Contractor shall reuse the existing material if, in the opinion of the Municipal Services Director or his designee, the material is suitable. If, in the opinion of the Municipal Services Director or his designee, and if, due to the Contractor's operations, the material is not suitable, the Contractor shall replace existing structures with new structures of the same material at no additional cost to the City.

C. Upon excavation, if it is determined that the existing drainage pipe or structures are inadequate; the Municipal Services Director or his designee may direct the Contractor to remove and replace such materials.

3.3 PIPE INSTALLATION

A. Pipe, fittings and accessories shall be handled and stored in accordance with manufacturer’s instructions and in a manner to ensure pipe, fittings and accessories are installed in a sound and undamaged condition.

B. Contractor shall furnish slings, straps and/or other approved devices to provide satisfactory support of the pipe when lifted. Transportation from delivery areas to the trench shall be restricted to operations which cause no damage to the pipe units.

C. Contractor shall take care not to damage pipe by impact, bending, compression or abrasion during handling and installation. Pipe shall not be dropped from trucks onto the ground or into trench.

D. Upon delivery and prior to and after installation, all pipe and fittings shall be inspected for cracks and defects and any other evidence of unsuitability. Pipe which has been damaged or which does not meet the requirements of these Specifications shall be rejected and shall be immediately removed from the site at the Contractor's expense. No pipe or fitting which is found to be defective shall be installed. If any pipe is discovered to be defective after it has been laid, it shall be removed and replaced with a non-defective pipe at the Contractor's expense. The Contractor shall furnish such labor and assistance as may be required for inspection purposes.

E. Pipe, fittings and excavation shall be to the line and grade as indicated on the Drawings and as specified herein.

F. Pipe shall be laid in the dry and at no time shall water in the trench be permitted to flow into the pipe. Provide temporary diversion of water as required to permit the installation of pipe in the dry.

G. Except where a concrete cradle or envelope is required, the pipe shall be installed as indicated on the Construction Standards. The pipe shall be in contact with the shaped bedding throughout its full length. In trenches, no blocking or supporting of the pipe by concrete, stones, bricks, wooden wedges, or method of other than bedding the pipe as indicated on the Construction Standards will be permitted. Each length of pipe shall be shoved home against the pipe previously laid and held securely in position. Joints shall not be "pulled" or "cramped". Pipe shall be jointed in accordance with manufacturer's instructions.

H. Jointing:

1. Joints for reinforced concrete pipe will be in accordance with the manufacturer's recommendations.

2. High Density Polyethylene Pipe: Pipe shall be joined with the Sure-Lok (bell and spigot) joint and shall provide a minimum pull apart strength of 400 pounds. The bell shall be an integral part of the pipe. The joint shall use a gasket to form a silt-tight connection. Gaskets shall be installed in the bell by the pipe manufacturer. Joints shall remain silt-tight when subject to a 1.5 degree axial misalignment.

A. Allow time for observation of the work by the Municipal Services Director or his designee before any backfill is placed. Relay any pipe out of alignment and remove any pipe that is damaged.

B. When work is not in progress, the end of pipe shall be suitably closed to prevent entry of animals, material, debris, etc.

C. Existing utilities damaged or broken during construction shall be repaired immediately by the Contractor. All repairs shall be made prior to the continuation of work. The Municipal Services Director or his designee and utility authority shall be immediately notified of any breaks or unanticipated disruptions of service.

D. At the end of each work day or at intervals determined by the Municipal Services Director or his designee, with the Contractor, will review the pipe for alignment. Unsatisfactory work shall be reinstalled to the satisfaction of the Municipal Services Director or his designee at no additional cost to the City.

E. During construction, Contractor shall provide all reasonable and necessary materials and labor for laying out the pipe, setting stakes and making measurements including the furnishing of a licensed land surveyor. Contractor shall not proceed until he has made timely request of the Municipal Services Director or his designee for and has received from him, such controls and instructions as may be necessary for the work to progress. The work shall then he done in strict conformity with such controls and instructions.

F. Contractor shall carefully preserve benchmarks, reference points and stakes, and in case of destruction by his own operations shall be responsible for re-establishing benchmarks, reference points and stakes. Any mistakes or delays caused by the disturbance or loss of benchmarks, reference points and stakes shall be the responsibility of the Contractor.

G. Refer to NHDOT Standard Specifications, Section 603 and Section 605 for additional requirements.

3.4 CATCH BASINS, DRAIN MANHOLES AND CASTINGS

A. Catch basins, drain manholes and castings shall be reconstructed and installed in accordance with NHDOT Standard Specifications, Section 604, except as herein modified:

1. Precast concrete bases shall be supported on a compacted level foundation of crushed stone. The depth of the compacted stone shall be the greater of 8-inch or as indicated on the Drawings.

2. Invert channels shall be formed of brick and mortar placed on the base. The inverts shall conform accurately to the size of the adjoining pipes. Side inverts shall be curved and main inverts (where direction changes) shall be laid out in smooth curves of the longest possible radius which is tangent to the centerlines of adjoining pipes.

3. Brickwork to be laid with close joints shall not to exceed ¼-inch for face work, all joints well broken and bonded and each seventh course to be headers.

    a. Each brick is to be thoroughly wet just before laying and is to be completely embedded in mortar under its bottom, its side and its end at one operation. Care is to be taken to have every joint full of mortar and the outside is to be fully filled and the inside pointed.

    b. The hardest, regular shaped brick are to be used for the tables and inverts of manholes, the Contractor culling the brick for this purpose. Great care is to be taken in building and shaping sewer inverts and only competent masons are to be employed in this work.

    c. No brick work is to be laid in water and no water is to be allowed to rise on the work until it has set at least 24 hours. No drainage shall be affected through manholes or sewers or drains.

    d. Do not plaster or mortar over brickwork inside the manholes.

B. Upon completion of the work, Contractor shall clean all catch basins and drain manholes of silt and other debris.

3.5 DRAINAGE SWALES

A. Refer to Construction Standards and Technical Specifications.

3.6 HEADWALL

A. Refer to Construction Standard and NHDOT Standard Specifications.

END OF SECTION

SECTION 02700

BASES AND PAVEMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes furnishing all labor, equipment, and materials, and performing all operations in connection with constructing base courses and pavements for roadways, drives, curbs and waterways and installing pavement markings, complete in place, in accordance with the Drawings and Specifications and as directed by the Municipal Services Director or his designee.

1.2 RELATED DOCUMENTS

A. Drawings, City's Construction Standards and Technical Specifications.

B. The State of New Hampshire Department of Transportation (NHDOT) Standard Specifications for Road and Bridge Construction (hereinafter referred to as NHDOT Standard Specifications) and NHDOT Standard Plans for Road and Bridge Construction (hereinafter referred to as NHDOT Standard Plans), latest edition.

1.3 SUBMITTALS

A. Submit a statement of qualifications for the paving contractor. The information shall include the name of the paving contractor, key personnel resumes, equipment lists and list of prior experience.

B. Submit certificates of compliance that the proposed materials to be used for the work comply with the Specifications.

C. No paving shall be placed until submittals have been reviewed by the Municipal Services Director or his designee.

1.4 QUALITY ASSURANCE

A. All work to be performed under this Contract is under the control of the City for all municipal roads and the NHDOT for all state roads.

B. All permits required by the City and NHDOT shall be obtained and paid for by

the Contractor.

C. The paving contractor completing the work shall have a minimum of 5 years experience in municipal and state roadway paving operations. The City reserves the right to reject paving contractors who, in the judgment of the Municipal Services Director or his designee, lacks the necessary experience or equipment to perform the work as specified, or who displays a lack of ability based on the actual performance of the work completed.

D. The paving plant used by the Contractor for the preparation of the bituminous concrete shall be acceptable to the Municipal Services Director or his designee. The Municipal Services Director or his designee reserves the right to inspect the plant and the making of the material.

PART 2 - PRODUCTS

2.1 PAVEMENT

A. Pavement shall meet the requirements of NHDOT Standard Specifications.

B. Job mix formula for bituminous pavement materials shall be as follows:

1. Temporary pavement material shall be base course gradation Type B as specified in NHDOT Standard Specifications, Section 401, Table 2E.

2. Permanent base course pavement material shall be base course gradation Type B as specified in NHDOT Standard Specifications, Section 401, Table 2E.

3. Leveling course material shall be as specified in NHDOT Standard Specifications, Section 411, Table 1.

4. Permanent wearing course pavement material shall be wearing course gradation Type D as specified in NHDOT Standard Specifications, Section 401, Table 2E.

5. Bituminous curb material shall be as specified in NHDOT Standard Specifications, Section 609.

6. Bituminous driveway material shall be wearing course gradation as specified in NHDOT Standard Specifications, Section 401, Table 2E.

7. Bituminous waterway material shall be wearing course gradation as

specified in NHDOT Standard Specifications, Section 401, Table 2E.

C. Reclaimed asphalt pavement shall be as specified in NHDOT Standard Specifications, Section 401.

2.2 BASE COURSES

A. Aggregate base course material shall be as specified in Section 02300.

B. Reclaimed stabilized base course material shall be as specified in NHDOT Standard Specifications, Section 306.

2.3 PAVEMENT MARKINGS

A. Permanent Pavement Markings: Paints for permanent pavement markings shall be as specified in NHDOT Standard Specifications, Section 708. Color shall be as follows::

1. Edge Strips: Reflectorized white conforming to NHDOT NH 4.11.

2. Roadway Centerline: Reflectorized yellow conforming to NHDOT NH 4.12.

B. Temporary Pavement Markings: Temporary pavement markings shall be raised plastic markings for centerline installation. Color shall be reflectorized yellow on two sides. Markings shall conform to NHDOT Standard Specifications.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall replace all pavement, markings, curbs, waterways and drives which have been removed or damaged during construction operations. Pavement replacement shall include satisfactory repair by the Contractor of roadways, curbs, sidewalks, driveways and any other surface disturbed by his operations by the same materials as removed or as specified herein. Care shall be taken to minimize trench widths in paved areas.

B. The Contractor shall place all bituminous pavement by machine method only unless otherwise permitted by the Municipal Services Director or his designee. The equipment for spreading and finishing shall be mechanical, self-powered pavers, capable of spreading and finishing the pavement true to the established line, grade, width and crown. The pavement shall be placed and compacted

only at such times as to permit the proper checking by the Municipal Services Director or his designee. Paving boxes shall be of proper size to allow paving the excavated trenches.

D. Hand methods of placing bituminous pavement will be permitted only for particular locations in the work where because of irregularity, inaccessibility or other unavoidable obstacles mechanical spreading and finishing cannot be performed.

3.2 BASE COURSES AND SUBGRADE

A. After the subgrade has been shaped to line, grade, and cross section, it shall be thoroughly compacted. This operation shall include any required reshaping and wetting to obtain proper compaction. All soft or otherwise unsuitable material shall be removed and replaced with suitable material from excavation or borrow. The resulting area, and all low sections, holes, or depressions shall be brought to the required grade with approved material and thoroughly compacted. Refer to Section 02300 for compaction requirements and additional requirements for fine grading.

B. Base courses shall be constructed to the depths and areas shown on the Drawings.

C. Aggregate base courses shall be constructed in accordance with NHDOT Standard Specifications, Section 304, except as herein modified:

1. Gravel and crushed gravel base courses shall be placed in 6-inch lifts and compacted to 95% maximum density unless otherwise directed by the Municipal Services Director or his designee. Refer to Section 02300 for additional compaction requirements.

2. Crushed gravel shall be fine graded with a power grader or other approved equipment. Tolerances shall be within 1/2” or less.

3. No pavement shall be placed until fine grading has been checked by the Municipal Services Director or his designee.

D. Reclaimed stabilized base courses shall be constructed in accordance with NHDOT Standard Specifications, Section 306, except as herein modified:

1. Excess reclaimed base course material from City streets shall become the property of the City unless otherwise directed by the Municipal Services Director or his designee. Contractor shall remove excess material from the work site and haul and stockpile material in a location to be determined by

the City. Excess material not salvaged by the City, as determined by the Municipal Services Director or his designee, shall become the property of the Contractor.

2. All cobbles, stones and boulders 6-inch in diameter or greater that are exposed under the existing pavement shall be removed from the work area.

3. No pavement shall be placed until fine grading has been checked by the Municipal Services Director or his designee.

E. The Contractor shall regrade and recompact the base course for installation of permanent base and wearing course pavement in areas which are disturbed during construction, and in areas as directed by the Municipal Services Director or his designee.

F. After the base course has been rolled to the required grade, any broken or irregular edges of the existing pavement shall be saw cut in straight lines leaving a sound vertical face 12-inches back from the edge of the trench or other excavations to accept placement of a 12-inch minimum overlap of bituminous base course pavement on undisturbed material.

G. The edges of the existing pavement shall receive an application of a cut-back asphalt so that the new pavement material may be properly bonded to the existing.

3.3 BITUMINOUS PAVEMENT

A. Bituminous base course and wearing course pavement shall be constructed in accordance with NHDOT Standard Specifications, Section 401 except as herein modified:

1. Pavement shall only be placed when the underlying surface is dry, frost-free and the surface temperature is above 50 degrees F, unless otherwise directed by the Municipal Services Director or his designee.

2. Pavement shall only be placed during daylight hours.

3. All existing iron grates, covers and valve boxes within the limits of pavement shall be adjusted by the Contractor prior to placing the wearing course of pavement

4. All catch basins shall be covered with acceptable cover before paver passes over grate.

5. Manholes and other castings shall be sprayed with an approved product, to prevent adhesion between the pavement and casting, before the paver passes over casting. The casting shall be clean of asphalt at the completion of the paving.

6. The Contractor shall do the required handwork around catch basins to provide a downward slope to catch basin grates.

7. Compaction shall be completed by and 8-ton minimum static steel wheel roller. A smaller roller shall be used to smooth-out edges.

B. Temporary Pavement

1. Temporary pavement shall be placed in areas where test pits or exploratory excavations occur in paved areas, where the road is to be reconstructed by others and as directed by the Municipal Services Director or his designee.

2. Contractor shall place temporary pavement the full width of the excavation within the same week of the trench being backfilled unless otherwise directed by the Municipal Services Director or his designee.

3. Temporary pavement shall be repaired as necessary to maintain the surface of the pavement until replaced by the permanent pavement. If points of settlement or holes appear in the temporary pavement, the Contractor shall repair the same within 24 hours of notification by the Municipal Services Director or his designee.

4. After the specified time period for trench settlement has elapsed and when so directed by the Municipal Services Director or his designee, the Contractor shall remove and dispose of the temporary pavement, cut the trench edges and regrade the base course for installation of the permanent pavement.

3.4 CURBS AND WATERWAYS

A. Curbs shall be replaced with the existing curbing if existing curbs have not been damaged, or with new curb sections of the same material, dimensions and alignment for those sections damaged during removal.

B. Bituminous curbs shall be replaced as required and installed as indicated on the Drawings and directed by the Municipal Services Director or his designee.

C. Bituminous curbs shall be constructed in accordance with NHDOT Standard Specifications, Section 609, except as herein modified:

1. The bituminous curb shall be placed on the permanent base course

pavement. The wearing course pavement shall be constructed after placement of the bituminous curbs.

2. Prior to placing the bituminous curb, the permanent base course pavement shall be cleaned and painted with a tack coat of bituminous material.

3. Bituminous curbs shall not be placed within 24 hours of last rainfall.

4. Bituminous curbs shall be placed by extruding curb paver and compacted to 95% maximum density.

D. Curbs shall conform to the grade of roadway and adjacent curb sections.

E. Areas behind curbs and sidewalks shall be graded smooth. Areas shall receive loam and seed or replacement of sidewalks as required.

F. The Contractor shall be responsible for damage to curbs until final completion.

G. Bituminous waterways shall be replaced as required and installed as indicated on the Drawings and directed by the Municipal Services Director or his designee. Waterways shall be placed in two 1-inch thick bituminous courses on a 12-inch compacted crushed gravel baseunless otherwise indicated on the Drawings. Material shall be compacted by tamping or rolling. The Contractor shall be responsible for damage to the waterway until final completion.

3.5 PAVEMENT MARKINGS

A. Pavement markings shall be placed in accordance with NHDOT Standard Specifications, Section 632.

B. Pavement markings shall be placed where required by City on municipal roads and by NHDOT on state roads.

C. The Contractor shall repaint traffic lines where lines have been damaged due to construction operations. All painting repairs shall meet with the approval of the City or NHDOT as required.

D. Painted crosswalks and parking lines disturbed during the work shall be repainted to match preconstruction conditions.

E. Temporary pavement markers shall be installed on all pavement that will be unmarked for a period exceeding 48 hours, unless otherwise directed by the Municipal Services Director or his designee.

3.6 INFRA-RED HEATER TRENCH REPAIRS

A. Infra-Red heater trench repairs shall be performed by an experienced infra-red operator in the following general manner:

B. Areas to be repaired shall be swept clean to remove all loose and foreign materials.

C. An approved infra-red heater shall be positioned over the area to be repaired for a period of time required to soften the existing pavement to a depth of two or more inches. Oxidation of the pavement, caused by improper heating techniques, must be avoided. Unsuitable material must be discarded, if this condition occurs.

D. The softened area shall be scarified and raked to a workable condition.

E. Any necessary additional bituminous concrete mix must be obtained from a suitable infra-red heated storage unit required to keep asphalt mix at near constant temperature throughout the working day. Under no circumstances shall any asphalt mix to be used that measures a temperature of less than 200□F.

F. After the paving mixture has been properly admixed and raked to grade, compaction shall be obtained by use of a steel wheeled roller of sufficient weight to establish a uniform density comparable to that of the adjacent surface within the working area. The finished patch shall be level with no depression retaining water on any of its surface.

G. Edges of the rolled area shall be sealed with suitable asphalt emulsion, and sand spread over the entire area that has been patched.

3.7 FIELD QUALITY CONTROL

A. Thickness and Surface Tolerances:

1. Bituminous pavement courses shall be tested in-place for compliance with compacted thickness and surface tolerance requirements.

2. Contractor shall repair or remove and replace unacceptable pavement and retest as directed by the Municipal Services Director or his designee, all at no additional cost to the City.

3. Testing, tolerances and replacement shall be as specified in NHDOT Standard Specifications, Section 401.

4. In-place density tests shall be completed at Contractor’s expense by a

testing laboratory experienced and certified to complete the testing required.

B. Compaction: Refer to Section 02300

C. Guarantee: During the guarantee period, the Contractor shall maintain the surfacing and shall promptly fill any depressions and holes that may occur so as to keep the surfacing in a safe and satisfactory condition for traffic. Fill material shall be in compliance with these Specifications. Contractor shall maintain surfacing at no additional cost to the City.

END OF SECTION

SECTION 02920

LAWNS AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes furnishing all labor, equipment, and materials and performing all operations in connection with the application of loam, fertilizer, lime, mulch, seed and sod, and maintenance and protection of lawns and grasses in accordance with the Drawings and Specifications and as directed by the Municipal Services Director or his designee.

1.2 RELATED DOCUMENTS

A. Drawings, general provisions of the Contract, General Conditions, Supplemental Conditions and Division 1 Specification Sections apply to this Section.

1.3 SUBMITTALS

A. Submit samples of all materials requested by the Municipal Services Director or his designee. Analyses shall be certified by the manufacturer, dealer or testing laboratory, whichever is appropriate.

1.4 QUALITY ASSURANCE

A. The Municipal Services Director or his designee reserves the right to test and reject any material not meeting these Specifications by utilizing tests in accordance with methods adopted by the Association of Official Agricultural Chemists. Costs for these tests shall be paid by the Contractor

B. For the duration of the guarantee period, the Contractor shall insure that the soil remains free from erosion and that the grass cover remains in good condition. In addition, for the duration of the guarantee period, the Contractor shall maintain the slopes and grass cover at the Contractor's own expense when notified by the Municipal Services Director or his designee to do so. All repair work shall be done to the satisfaction of the Municipal Services Director or his designee and City.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Loam:

1. Loam shall be fertile, natural soil, typical of the locality, free from large stones, roots, sticks, boards, clods, clay, hardpan, peat, weeds, sod, lime, cement, bricks, ash, cinders, slag, concrete, tar, toxic materials that harmful to plants, and other deleterious material. Loam shall be obtained from naturally well-drained areas.

2. Loam shall not be excessively acid or alkaline and shall have a pH value within the range of 6 to 7.

3. Loam shall not contain less than 4 percent or more than 20 percent decayed organic matter in that portion of the sample which passes a 1/4-inch sieve when determined by the wet combustion method on a sample dried at 105 degrees C.

4. One hundred percent of loam weight shall pass a 1-inch opening sieve and 97 to 100 percent shall pass a 1/4-inch sieve. In the latter material there shall be not less than 20 percent or more than 65 percent passing a 200 mesh sieve as determined by a wash test made in accordance with the standard test ASTM D1140.

5. Before any loam is delivered, the Contractor shall submit a sample of 1 cubic foot of product from each source of supply including on-site stockpiles for the Municipal Services Director or his designee's review and approval. Delivery may begin upon such approval. The approved sample shall be stored on the site until the supply from its source is exhausted or until no more loam is required.

6. Samples of loam from each source shall be provided and tested by a testing laboratory approved by the Municipal Services Director or his designee. Test analysis shall be accompanied by the laboratory's recommendations for amending the loam. Loam shall be tested in conformance with the Standards of the Association of Official Agricultural Chemists. All testing shall be done at the Contractor’s expense.

7. No loam shall be delivered in a frozen or muddy condition.

8. Topsoil stockpiled as a result of Contractor operations may be used when approved by the Municipal Services Director or his designee. Additional

topsoil furnished by the Contractor shall be subject to the Municipal Services Director or his designee's approval.

B. Commercial fertilizer shall be complete fertilizer and shall be a standard product complying with state and federal fertilizer laws. Fertilizer shall be delivered to the site in the original unopened containers which shall bear the manufacturer's name and guaranteed statement of analysis. At least 40 percent by weight of the nitrogen content of the fertilizer shall be derived from organic materials. Fertilizer for lawn areas shall contain not less than 8 percent nitrogen, 6 percent phosphorus and 4 percent potash by weight of ingredients or as otherwise indicated by loam test results.

C. Superphosphate shall be finely ground phosphate rock as commonly used for agricultural purposes and shall contain not less than 18 percent available phosphoric acid.

D. Ground limestone shall contain not less than 95 percent total carbonates and shall be ground to such fineness that 50 percent will pass through a 100 mesh sieve and 90 percent will pass through a 20 mesh sieve. Coarser material will be accepted provided the specified rates of application are increased proportionately on the basis of quantities passing the 100 mesh sieve.

E. Water shall be furnished by the Contractor and shall be suitable for irrigation and free from ingredients harmful to plant life. Hose and other watering equipment required for the work shall also be furnished by the Contractor.

F. Lawn seed mixture shall be a fresh, clean, Park Seed Type 15. Seed may be mixed by an approved method on the site or may be mixed by the dealer. If the seed is mixed on the site, each variety shall be delivered in the original containers bearing the dealer's guaranteed analysis. If the seed is mixed by the dealer, the Contractor shall furnish to the Municipal Services Director or his designee the dealer's guaranteed statement of the composition of the mixture and the percentage of purity and germination of each variety.

1. Lawn seed shall be purchased from a recognized distributor and shall be composed of the following varieties mixed in the percentages indicated. Seed shall test to minimum percentages of purity and germination specified.

2. Park Seed Type 15 shall normally be used on loam areas. This seed mixture shall conform to the following:

Kind of Seed	Minimum Purity (%)	Minimum Germination (%)	Kilograms/Hectare (Lbs / Acre)
Creeping Red Fescue	96	85	45 (40)
Perennial Ryegrass	98	90	55 (50)
Kentucky Bluegrass	97	85	30 (25)
Redtop	95	80	5 (5)

G. Fiber mulch shall be composed of wood cellulose fiber containing no germination or growth inhibiting factors. The fiber shall be colored green to allow visual metering during application, have the properties of even dispersal and suspension when agitated in water and, when uniformly sprayed on soil surface, form an absorbent cover allowing percolation of water to underlying soil.

H. All materials shall be delivered to the site in original unopened packages, showing weight, manufacturer's name and guaranteed analysis. Materials shall be stored in such a manner that their effectiveness and usability will not be diminished or destroyed and shall be uniform in composition, dry, unfrozen and free flowing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All work shall be performed by workmen experienced in lawn installation under the full-time supervision of a qualified foreman.

B. After acceptance of subgrade work, whatever additional grading is necessary shall be performed to bring the subgrade to a true, smooth slope parallel to and, except where otherwise indicated, to 6 inches below grade of all areas to receive loam. Furnish and install grade stakes sufficiently spaced to insure correct line and grade of subgrade and finished grade. Immediately before placing loam, loosen the surface of the subgrade. In areas that have been severely compacted, scarify to a depth of 12 inches by approved methods.

C. Place and spread loam to a depth sufficiently greater than the depth required for lawn areas so that after natural settlement and compaction, the complete work will conform to the lines, grades and elevations indicated. After loam has been spread, prepare it carefully by scarifying or harrowing and hand raking. Remove all large stiff clods, lumps, brush, roots, stumps, litter and other foreign

material and stones over 1-inch in diameter and dispose of legally off site.

D. Apply commercial fertilizer and work thoroughly into the loam in two applications. The first application shall be within one week before the seeding or sodding, at the rate of 35 lbs per thousand square feet, harrowed into the top 2-inches of loam. The second application shall be as determined by the test results.

E. Apply ground limestone at the rate recommended by the testing laboratory and after loam has been spread and graded.

F. Incorporate superphosphate into the loam with the first application of commercial fertilizer at the rate of 20 lbs per thousand square feet or at the rate determined from the test results.

G. The season for the seeding shall be from April 1 to May 31 and from August 15 to October 15. The actual planting of lawns shall be done, however, only during periods within this season which are normal for such work as determined by weather conditions and by accepted practice in the local area. At option of and on responsibility of the Contractor, planting of grass may be done under unseasonable conditions without additional compensation, subject to approval as to time of work and methods of operation.

H. Seeding shall consist of soil preparation, seeding, raking, rolling, weeding, watering and otherwise providing all labor and materials necessary to secure the establishment of acceptable turf.

I. Immediately before any seed is sown, the ground shall be scarified, harrowed, raked and broomed until the surface is smooth, friable and of uniformly fine texture. No seeding shall be done during windy weather. Seed shall be sown in two directions at right angles to each other. Sow the seed evenly by hand or with an approved seeding device in the proportions and at the rate of 5 lbs. per 1,000 square feet of area. The seed shall be covered with a thin layer of loam by light raking or other approved method, rolled in both directions with a hand roller weighing not more than 100 lbs per foot of width, and watered with a fine spray. Necessary precautions shall be taken to keep the area undisturbed until the grass comes up.

J. All slopes 3:1 or steeper shall be overseeded with Annual Ryegrass, 98 percent purity, 90 percent germination, at the rate of 1 lb per 1,000 square feet, in addition to the specified seed mix. This shall be a separate sowing executed after the sowing of the regular mixture and before the raking and rolling operations. All areas disturbed by the work of this contract and not required to be developed otherwise shall be seeded except as otherwise noted on the

Drawings.

K. Hydroseeding: At his option, the Contractor may accomplish seeding by use of approved hydroseeding equipment designed specifically for this work. Mix seed, fertilizer, wood cellulose fiber mulch and non asphaltic-fiber binder in required amount of water to produce a homogeneous slurry. Add fiber mulch after seed, water, and fertilizer have been thoroughly mixed and apply at the rate of 200 pounds per acre dry weight. The slurry shall be applied within 30 minutes of mixing to prevent burning of the seed by fertilizer. Immediately following the application of the slurry mix, make separate application of fiber mulch and fiber binder at the rate of 1,000 pounds, dry weight, per acre except where erosion control blanket is applied immediately. When hydraulically sprayed on the ground, material shall form a blotter like cover impregnated uniformly with grass seed. Cover shall allow rainfall or applied water to percolate to underlying soil.

3.2 MAINTENANCE

A. Maintenance shall begin immediately after each portion of lawn is planted and the Contractor shall be responsible for maintenance of the lawn including watering, weeding, fertilization, mowing and replanting as necessary to establish a uniform stand of the specified grasses and until final acceptance. Scattered bare spots, none of which are larger than 72 square inches, will be allowed in seeded areas up to a maximum of 2 percent of any lawn area. After the grass has started, all areas and parts of areas which fail to show a uniform stand of grass, for any reason whatsoever, shall be reseeded and such areas and parts of areas shall be reseeded repeatedly until all areas are covered with a satisfactory growth of grass. At time of first cutting, keep mower blades not less than 2-1/2 inches high. Contractor is responsible for lawn maintenance until final acceptance or two cuttings, whichever is longer.

B. Prior to acceptance, any damage resulting from erosion, gulleys, washouts or other causes shall be repaired by filling with loam, tamping, refertilizing and resodding or reseeding.

C. Lawn areas shall be protected against trespassing and damage as required to insure satisfactory growth acceptable to the Municipal Services Director or his designee. Any means of protection shall require the approval of the Municipal Services Director or his designee prior to its erection.

D. All maintenance shall be completed at no additional cost to the City.

3.3 CLEANUP

A. After completion of the work, the Contractor shall remove all debris, materials, rubbish, etc. from the site and shall dispose of same in a manner satisfactory to the Municipal Services Director or his designee. The premises shall be left clean.

3.4 ACCEPTANCE

A. Upon written request by the Contractor, the Municipal Services Director or his designee will inspect all lawn areas to determine completion of contract work. This request must be submitted at least 10 days prior to the anticipated date. The lawns will become acceptable if they show a uniform, thick well developed stand of grass that may be occupied by the City for their intended use. When acceptance is made in writing to the Contractor, the Contractor's responsibility for maintenance shall terminate as herein specified.

B. The Contractor shall furnish to the City complete written instructions for maintenance of all lawn areas at time of acceptance.

C. Acceptance of the lawn area shall not occur before acceptance of the entire Project.

END OF SECTION

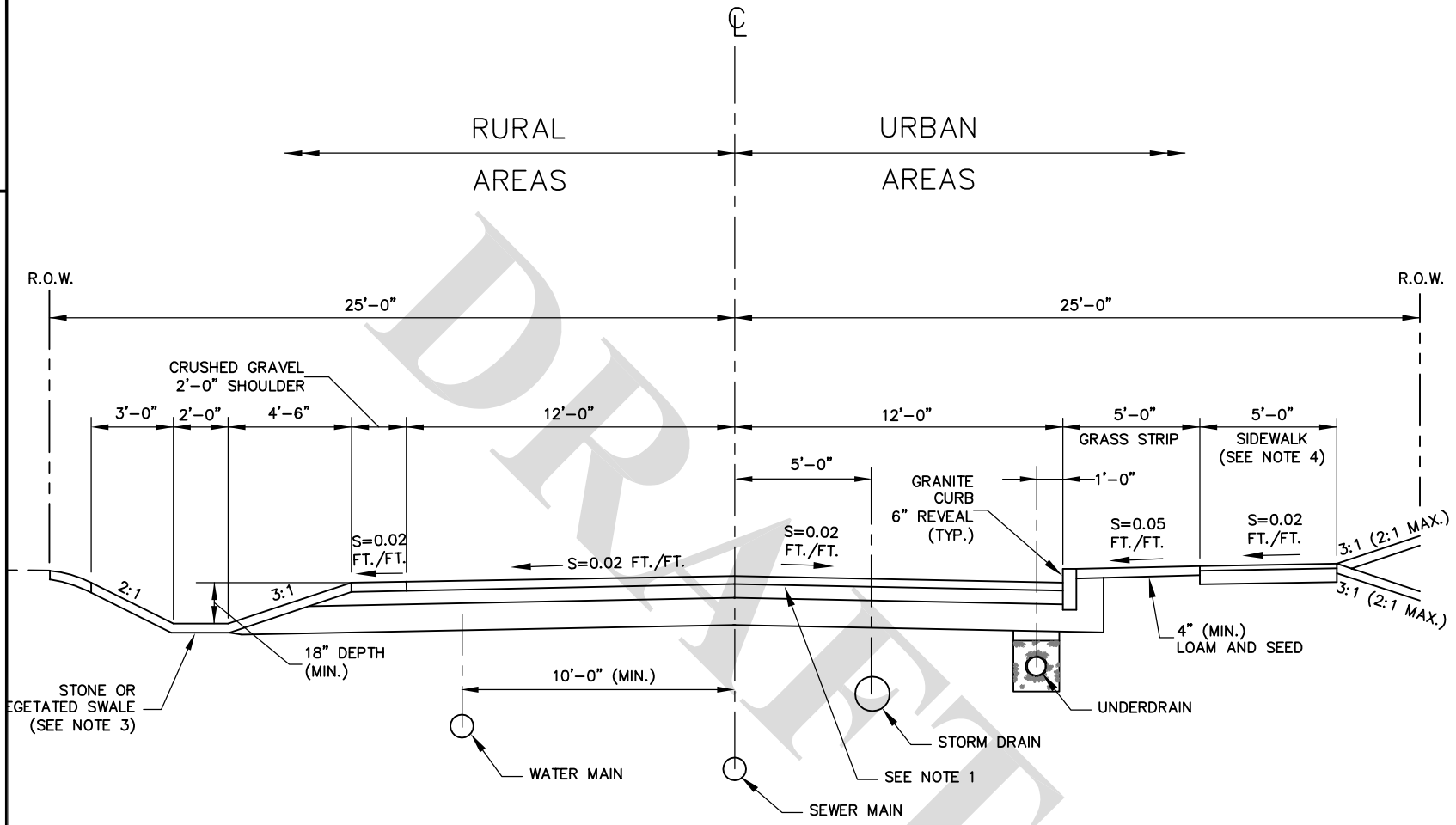
CONSTRUCTION DETAILS

CITY OF FRANKLIN, NH – CONSTRUCTION DETAILS

TYPICAL SECTIONS
LOCAL ROAD (50' RIGHT-OF-WAY)

D-1

JANUARY 2007



NOTES:

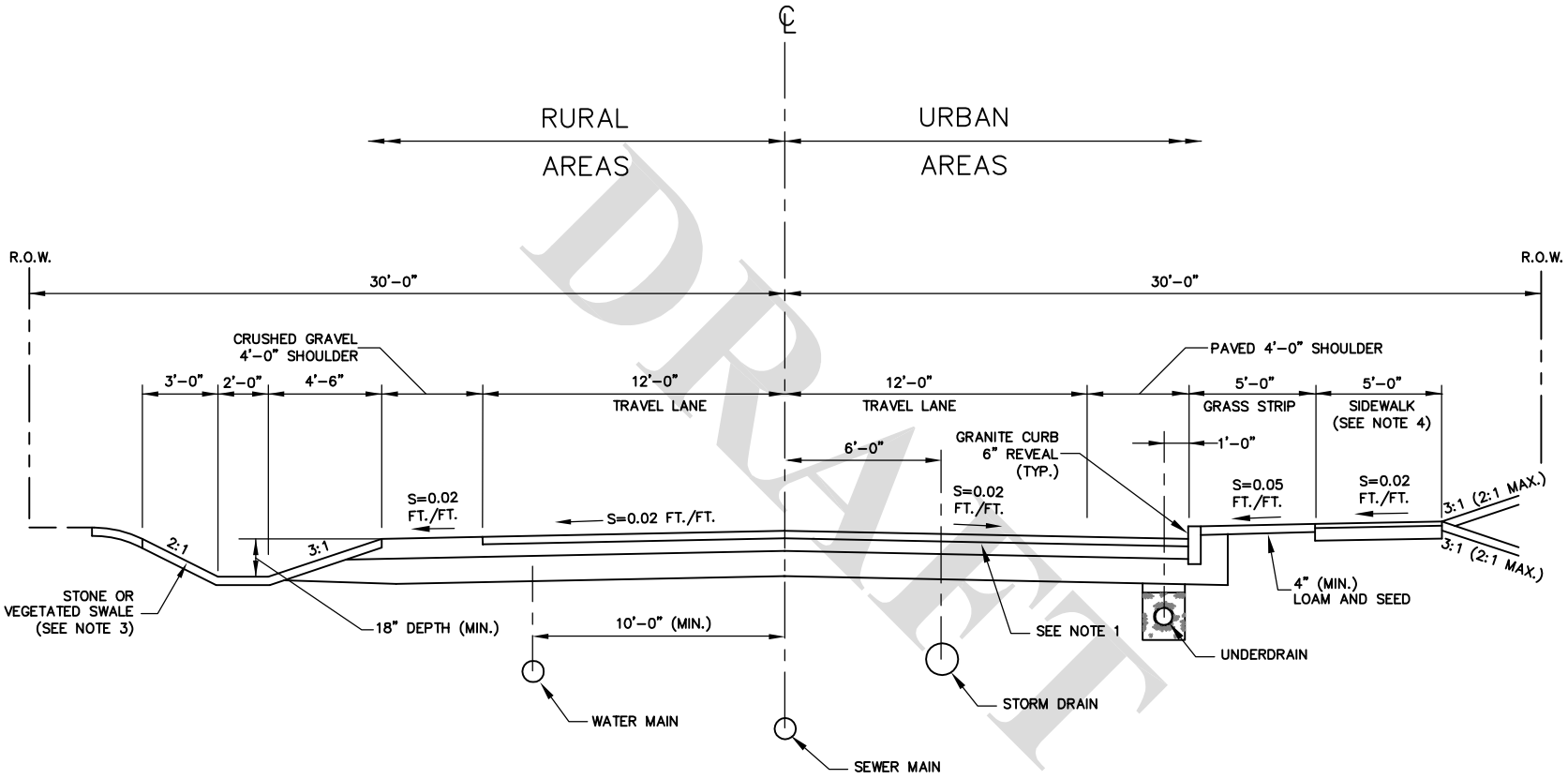
1. PAVEMENT STRUCTURE SHALL CONSIST OF 3.5" HOT BIT. PAVEMENT (1.5" SURFACE COURSE AND 2" BASE COURSE), 6" CRUSHED GRAVEL AND 12" GRAVEL (18" IN LEDGE AREAS).
2. RURAL AND URBAN AREAS AS DEFINED BY THE CITY OF FRANKLIN SUBDIVISION REGULATIONS OR PER THE PLANNING BOARD.
3. VEGETATED SWALES WILL BE USED WHEREVER POSSIBLE. STONE SWALES WILL BE USED ONLY IF APPROVED BY THE MUNICIPAL SERVICES DIRECTOR. SEE SWALE DETAILS FOR ADDITIONAL INFORMATION.
4. SIDEWALKS WILL BE INSTALLED IF REQUIRED BY THE PLANNING BOARD OR MUNICIPAL SERVICES DIRECTOR.

CITY OF FRANKLIN, NH – CONSTRUCTION DETAILS

TYPICAL SECTIONS
COLLECTOR ROAD (60' RIGHT-OF-WAY)

D-2

JANUARY 2007



NOTES:

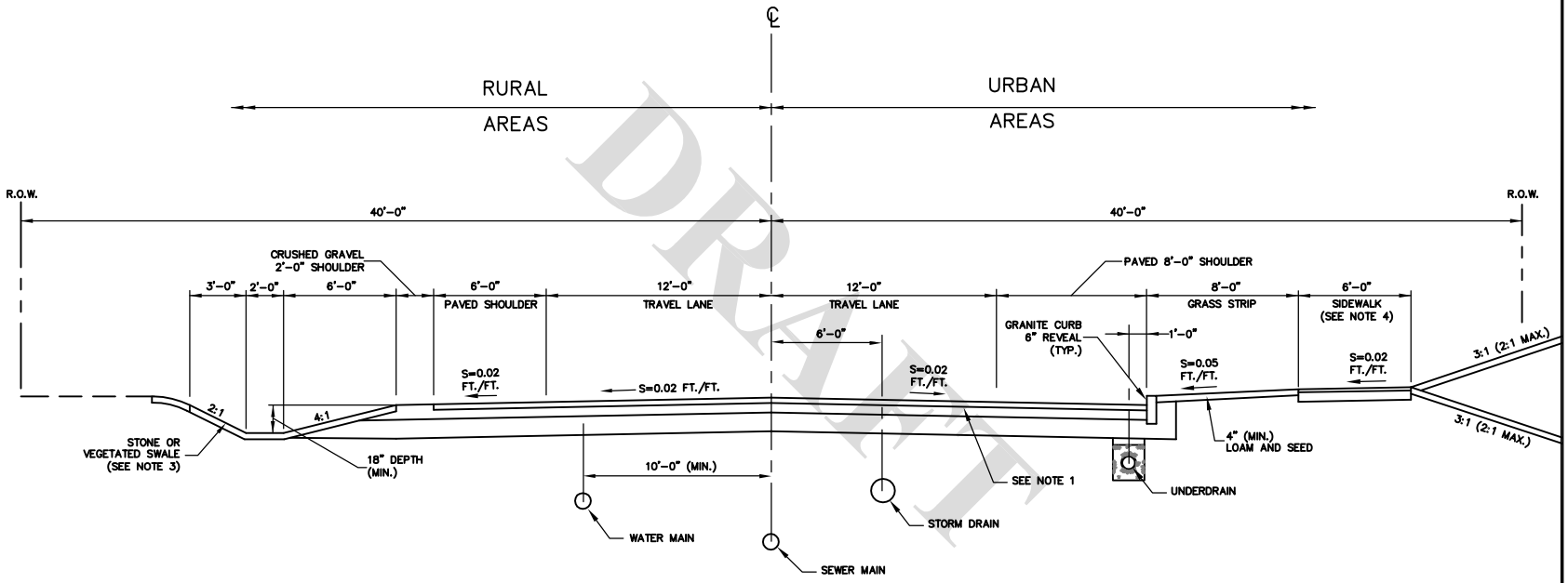
1. PAVEMENT STRUCTURE SHALL CONSIST OF 3.5" HOT BIT. PAVEMENT (1.5" SURFACE COURSE AND 2" BASE COURSE), 6" CRUSHED GRAVEL AND 12" GRAVEL (18" IN LEDGE AREAS).
2. RURAL AND URBAN AREAS AS DEFINED BY THE CITY OF FRANKLIN SUBDIVISION REGULATIONS OR PER THE PLANNING BOARD.
3. VEGETATED SWALES WILL BE USED WHEREVER POSSIBLE. STONE SWALES WILL BE USED ONLY IF APPROVED BY THE MUNICIPAL SERVICES DIRECTOR. SEE SWALE DETAILS FOR ADDITIONAL INFORMATION.
4. SIDEWALKS WILL BE INSTALLED IF REQUIRED BY THE PLANNING BOARD OR MUNICIPAL SERVICES DIRECTOR.

CITY OF FRANKLIN, NH – CONSTRUCTION DETAILS

TYPICAL SECTIONS
ARTERIAL (80' RIGHT-OF-WAY)

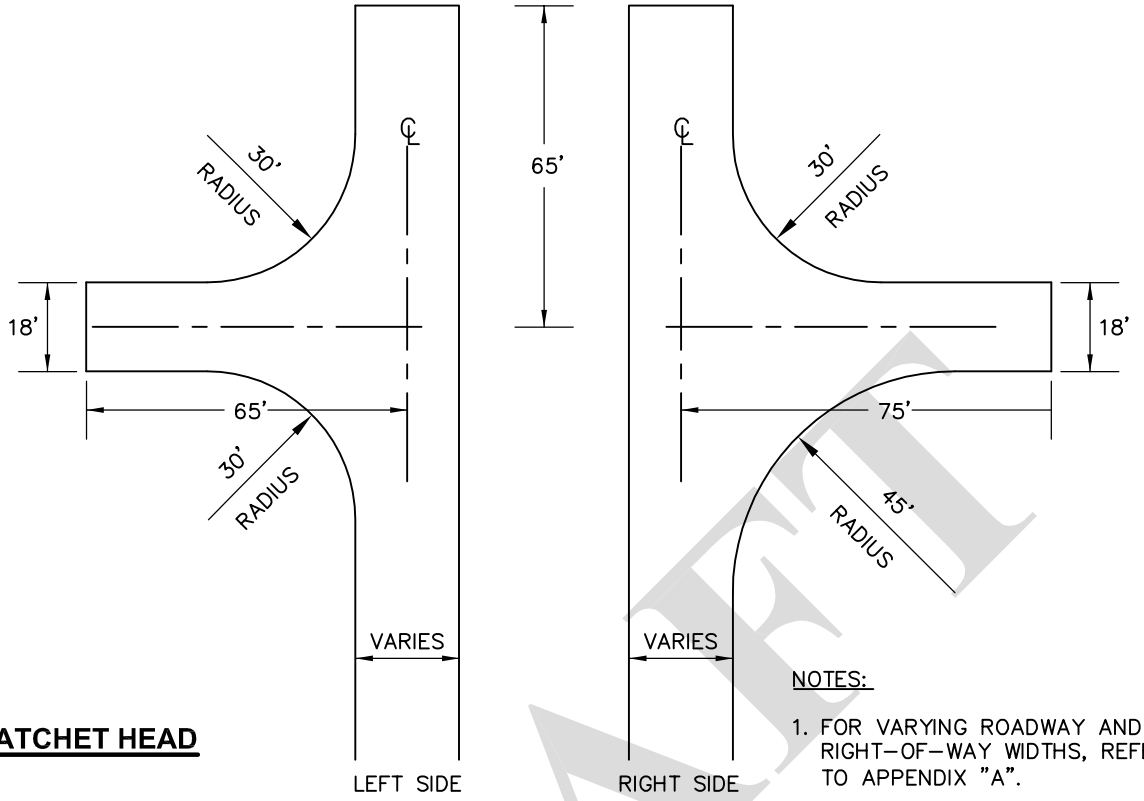
D-3

JANUARY 2007



NOTES:

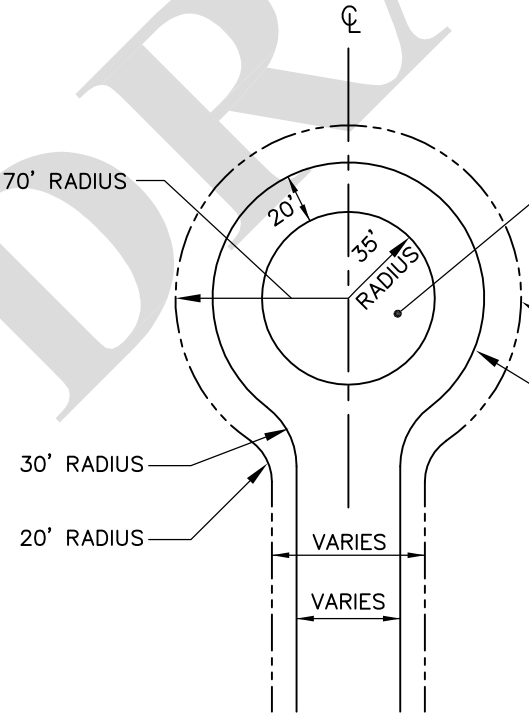
1. PAVEMENT STRUCTURE SHALL CONSIST OF 3.5" HOT BIT. PAVEMENT (1.5" SURFACE COURSE AND 2" BASE COURSE), 6" CRUSHED GRAVEL AND 12" GRAVEL (18" IN LEDGE AREAS).
2. RURAL AND URBAN AREAS AS DEFINED BY THE CITY OF FRANKLIN SUBDIVISION REGULATIONS OR PER THE PLANNING BOARD.
3. VEGETATED SWALES WILL BE USED WHEREVER POSSIBLE. STONE SWALES WILL BE USED ONLY IF APPROVED BY THE MUNICIPAL SERVICES DIRECTOR. SEE SWALE DETAILS FOR ADDITIONAL INFORMATION.
4. SIDEWALKS WILL BE INSTALLED IF REQUIRED BY THE PLANNING BOARD OR MUNICIPAL SERVICES DIRECTOR.
5. PAVEMENT STRUCTURE SHALL BE DESIGNED BASED ON UNDERLYING SOIL CONDITIONS, TRAFFIC VOLUMES, TRUCK PERCENTAGE AND OTHER CORRIDOR SPECIFIC DESIGN FACTORS IN ACCORDANCE WITH NHDOT STANDARD PAVEMENT DESIGN PROCEDURES.



HATCHET HEAD

NOTES:

1. FOR VARYING ROADWAY AND RIGHT-OF-WAY WIDTHS, REFER TO APPENDIX "A".



PROVIDE 4" LOAM AND SEED UNLESS OTHERWISE DIRECTED BY THE PLANNING POARD OR MUNICIPAL SERVICES DIRECTOR

RIGHT-OF-WAY

EDGE OF PAVEMENT

CUL-DE-SAC

NOTES:

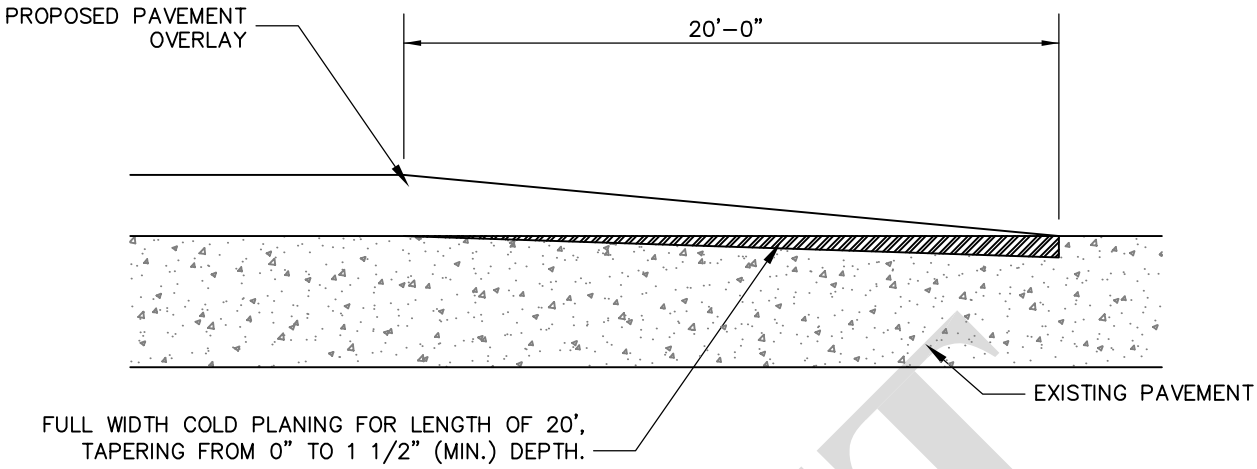
1. FOR VARYING ROADWAY AND RIGHT-OF-WAY WIDTHS, REFER TO APPENDIX "A".
2. CUL-DE-SAC DESIGN IN COMMERCIAL AREAS MAY BE MODIFIED TO PROVIDE ADEQAUTE ROADWAY WIDTH FOR LARGE VEHICLES ENTERING FROM DRIVEWAYS.

CITY OF FRANKLIN, NH - CONSTRUCTION DETAILS

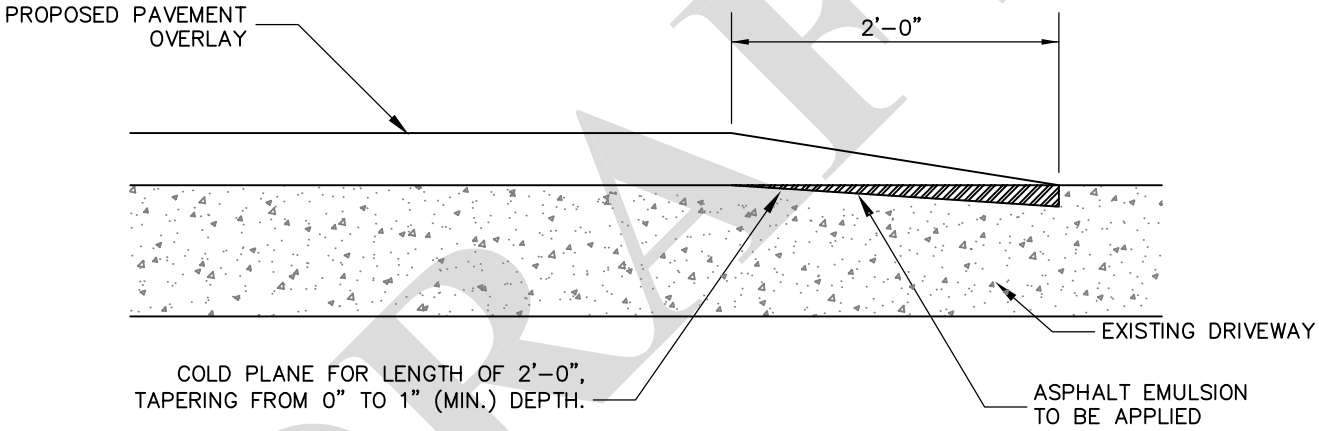
APPROVED TURN-AROUND DESIGNS (RESIDENTIAL AREAS)

D-4

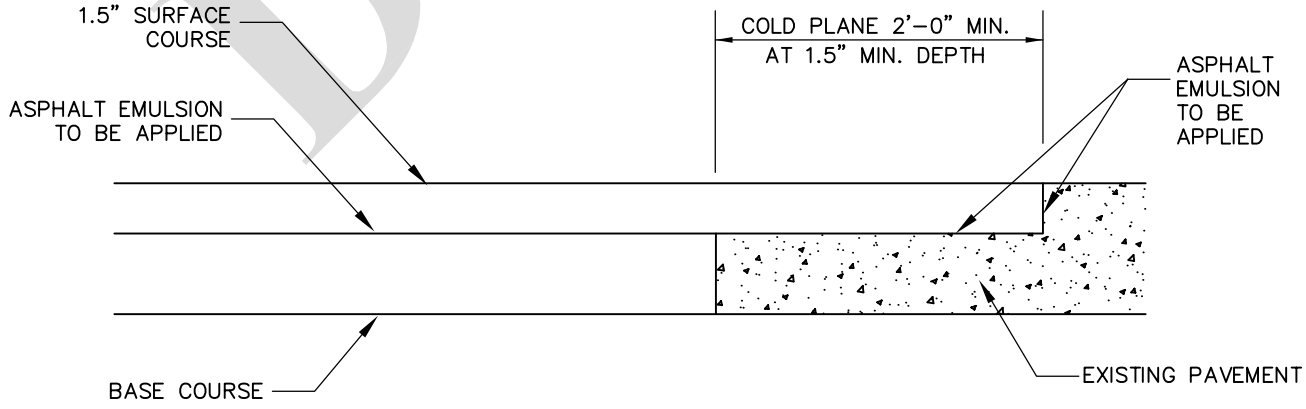
JANUARY 2007



PAVEMENT OVERLAY - CITY STREETS



PAVEMENT OVERLAY - DRIVEWAYS



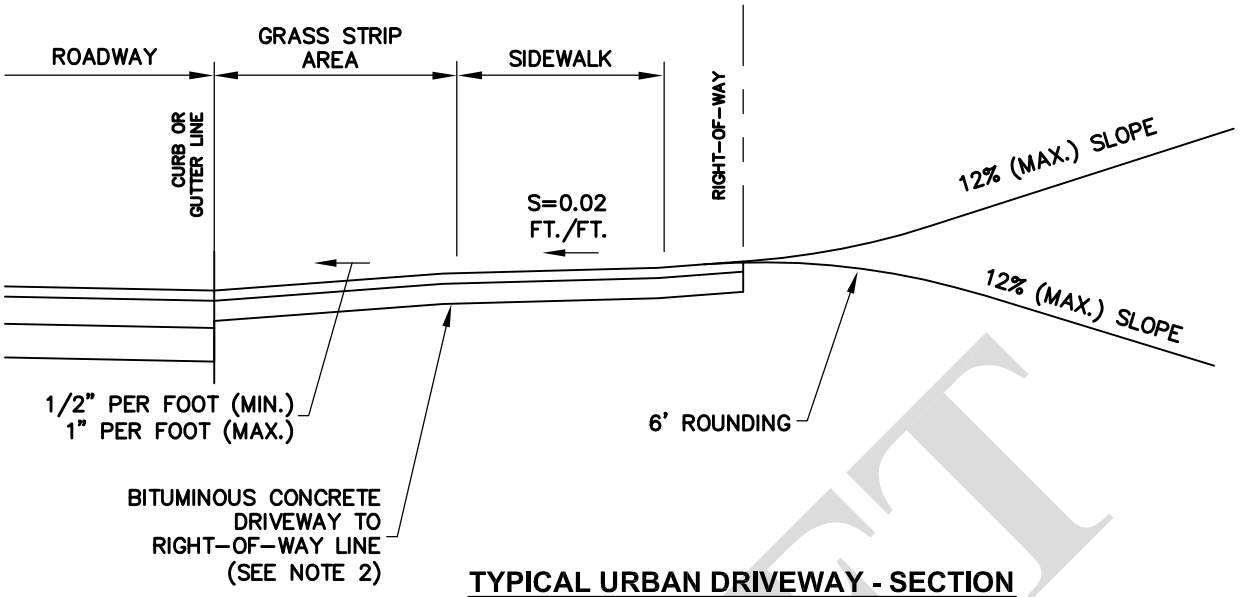
NEW PAVEMENT - CITY STREETS

CITY OF FRANKLIN, NH – CONSTRUCTION DETAILS

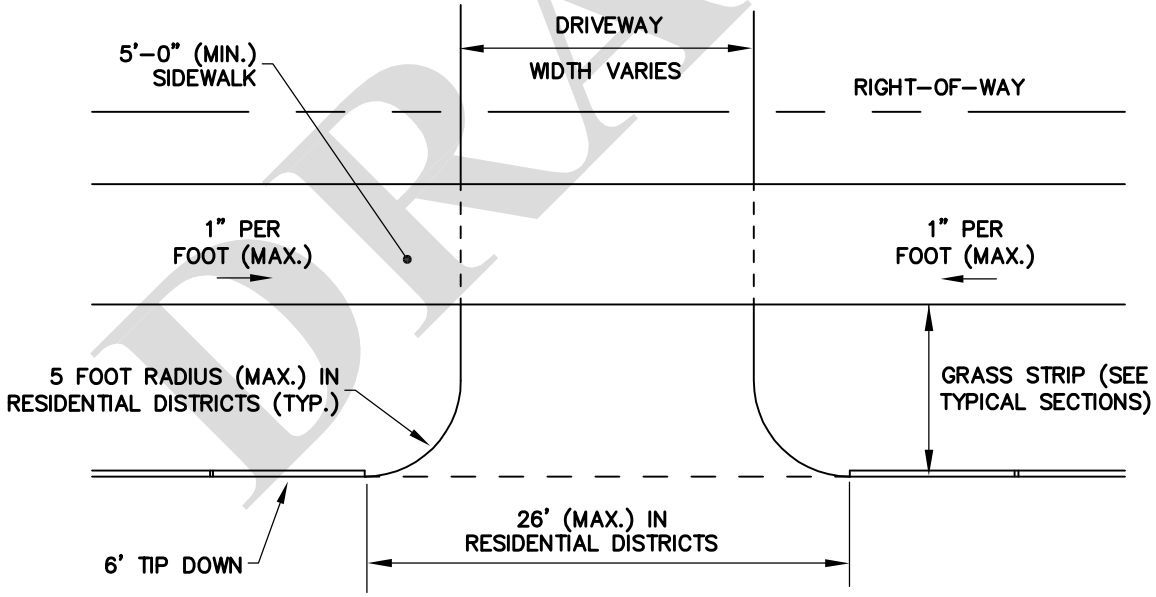
PAVEMENT JOINTS

D-5

JANUARY 2007



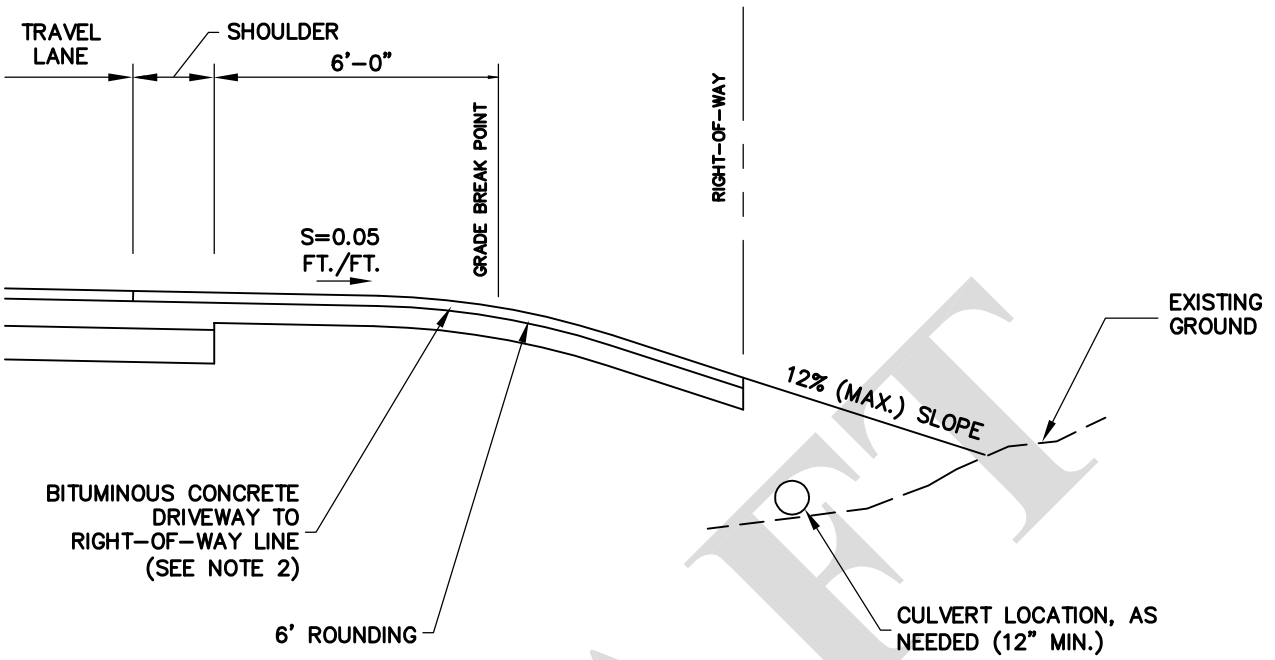
TYPICAL URBAN DRIVEWAY - SECTION



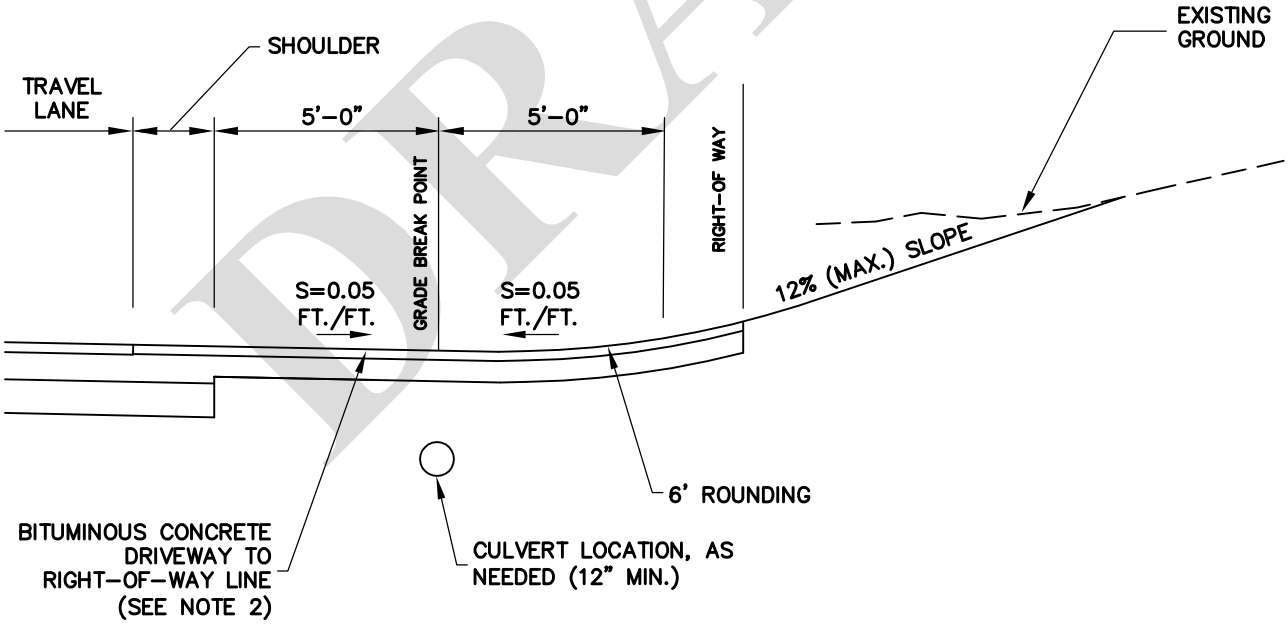
TYPICAL URBAN DRIVEWAY - PLAN

NOTES:

1. ALL DRIVEWAYS WILL HAVE A MINIMUM RADIUS OF 5 FEET FROM THE EDGE OF THE ROADWAY PAVEMENT TO THE DRIVEWAY PAVEMENT.
2. ALL RESIDENTIAL DRIVEWAYS WILL BE PAVED WITH BITUMINOUS CONCRETE FROM THE ROADWAY PAVEMENT TO THE RIGHT-OF-WAY LINE WITH MINIMUM OF 1" SURFACE COURSE, 2" BASE COURSE AND 6" OF CRUSHED GRAVEL. COMMERCIAL DRIVEWAYS WILL HAVE HEAVY DUTY PAVEMENT, IF REQUIRED, BY THE MUNICIPAL SERVICES DIRECTOR.



TYPICAL RURAL DRIVEWAY - FILL SECTION

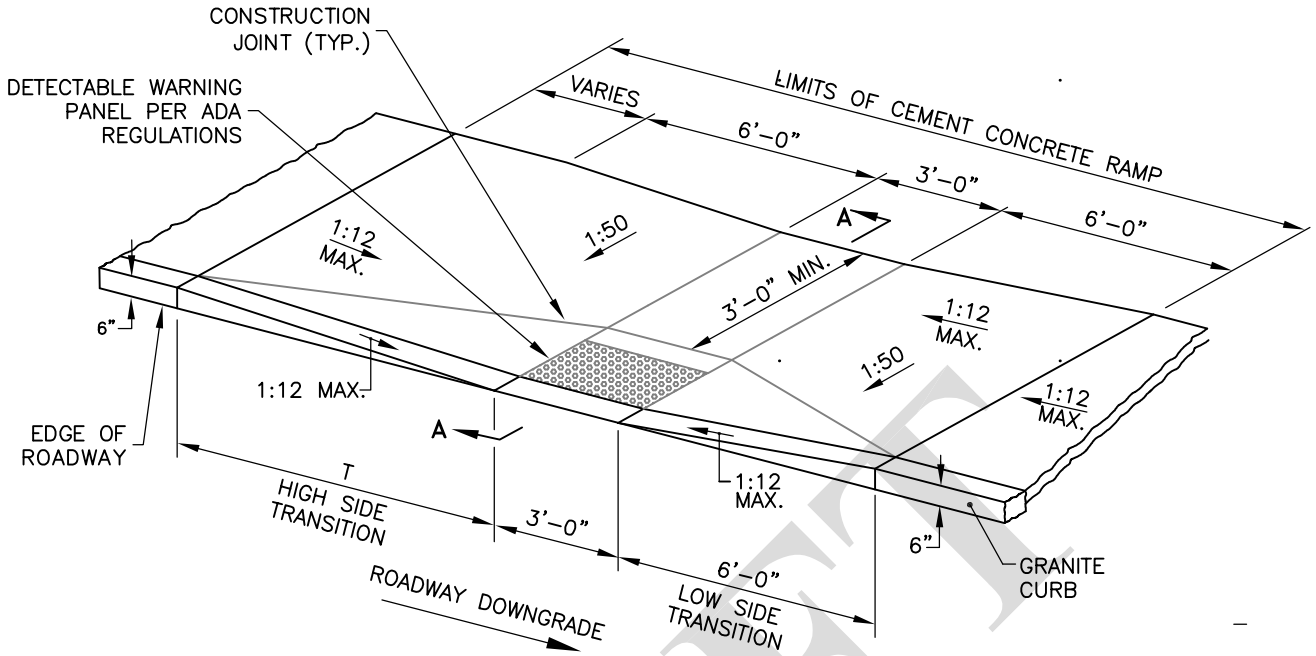


TYPICAL RURAL DRIVEWAY - CUT SECTION

NOTES:

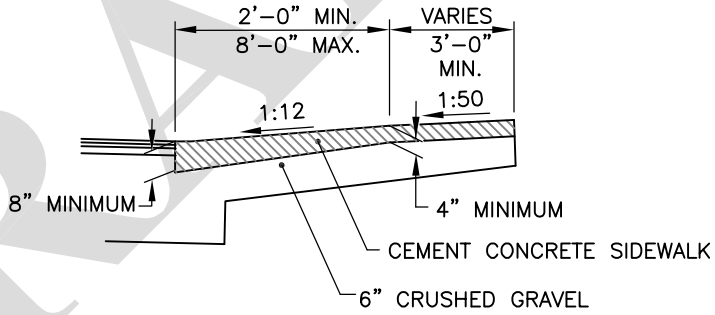
1. ALL DRIVEWAYS WILL HAVE A MINIMUM RADIUS OF 5 FEET FROM THE EDGE OF THE ROADWAY PAVEMENT TO THE DRIVEWAY PAVEMENT.
2. DRIVEWAYS WILL BE PAVED WITH BITUMINOUS CONCRETE FROM THE ROADWAY PAVEMENT TO THE RIGHT-OF-WAY LINE WITH A MINIMUM OF 1" SURFACE COURSE, 2" BASE COURSE AND 6" OF CRUSHED GRAVEL.

	CITY OF FRANKLIN, NH – CONSTRUCTION DETAILS	**D-7**
	RURAL DRIVEWAY	JANUARY 2007



ISOMETRIC VIEW

ROADWAY PROFILE GRADE	T (FT.)
0.00	6.0
0.01	7.0
0.02	8.0
0.03	9.5
0.04	11.5
0.05	15.0



SECTION A-A

NOTES:

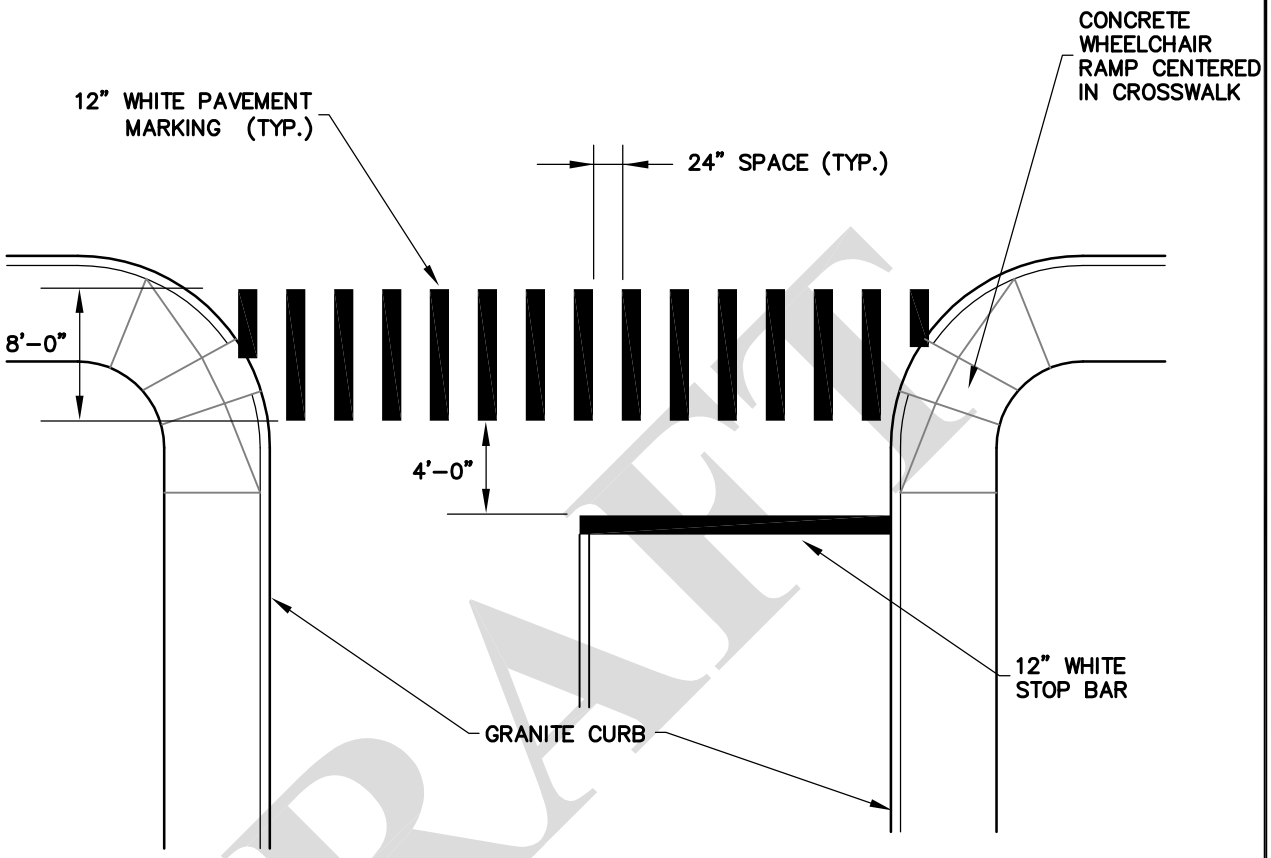
1. SIDEWALK CROSS SLOPES SHALL NOT EXCEED 2% (1:50). WHEELCHAIR RAMP GRADES MUST NOT EXCEED 8% (1:12).
2. FIXED OBJECTS, SUCH AS UTILITY POLES, HYDRANTS, AND SIGNS, SHALL NOT BE LOCATED ON ANY PART OF THE WHEELCHAIR RAMP.
3. CATCH BASINS LOCATED NEAR THE WHEELCHAIR RAMP SHALL BE LOCATED UPSTREAM OF THE RAMP OPENING.
4. THE ENTRANCE TO THE WHEELCHIR RAMP MUST BE FLUSH WITH THE ROADWAY.
5. ALL WHEELCHAIR RAMPS MUST BE CONSTRUCTED WITH CEMENT CONCRETE. BITUMINOUS CONCRETE WHEELCHAIR RAMPS WILL NOT BE ALLOWED.
6. THE WHEELCHAIR RAMP OPENING MUST BE LOCATED INSIDE A CROSSWALK AND AS CLOSE TO THE CENTER OF THE CROSSWALK AS POSSIBLE.

CITY OF FRANKLIN, NH – CONSTRUCTION DETAILS

CONCRETE WHEELCHAIR RAMP

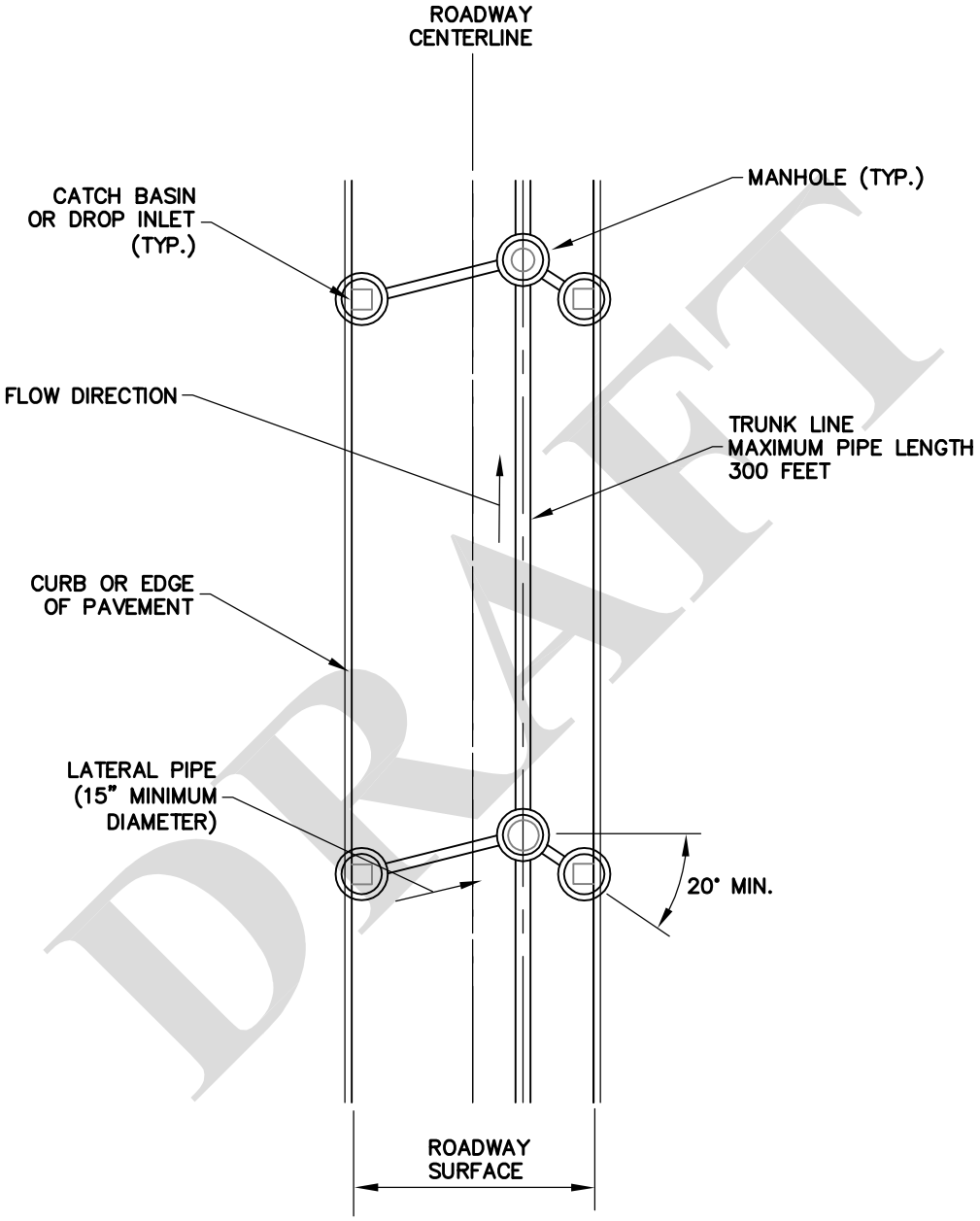
D-8

JANUARY 2007



NOTES:

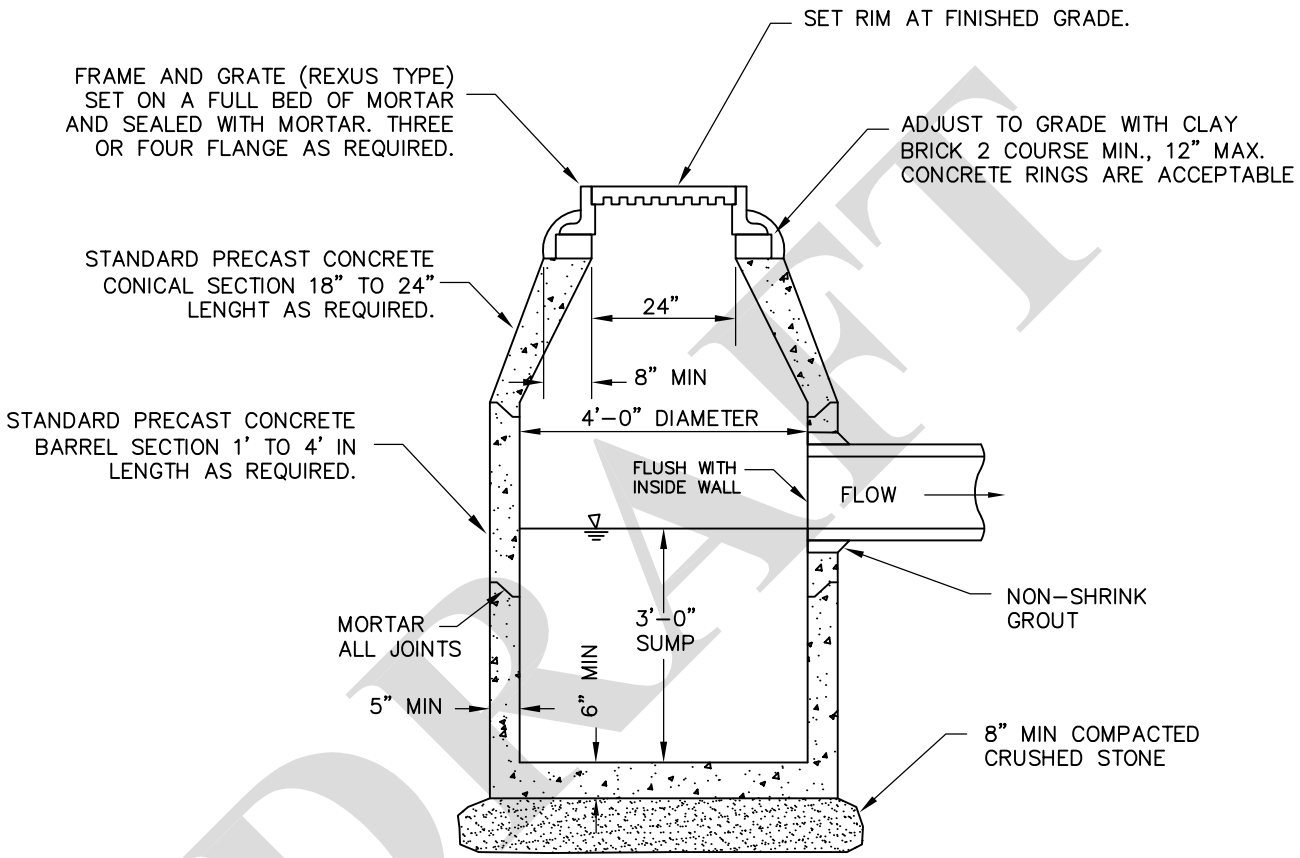
1. ALL PAVEMENT MARKINGS AND SIGNS SHALL CONFORM TO THE LATEST VERSION OF THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) INCLUDING ALL ADDENDA.
2. PAVMENT MARKINGS SHALL BE RETROREFLECTIVE PAINT IN ACCORDANCE WITH NHDOT STANDARDS UNLESS OTHERWISE DIRECTED BY THE PLANNING BOARD OR MUNICIPAL SERVICES DIRECTOR.
3. MID BLOCK CROSSWALK INSTALLTIONS SHALL INCLUDE SIGNS AS REQUIRED BY THE MUTCD.



NOTES:

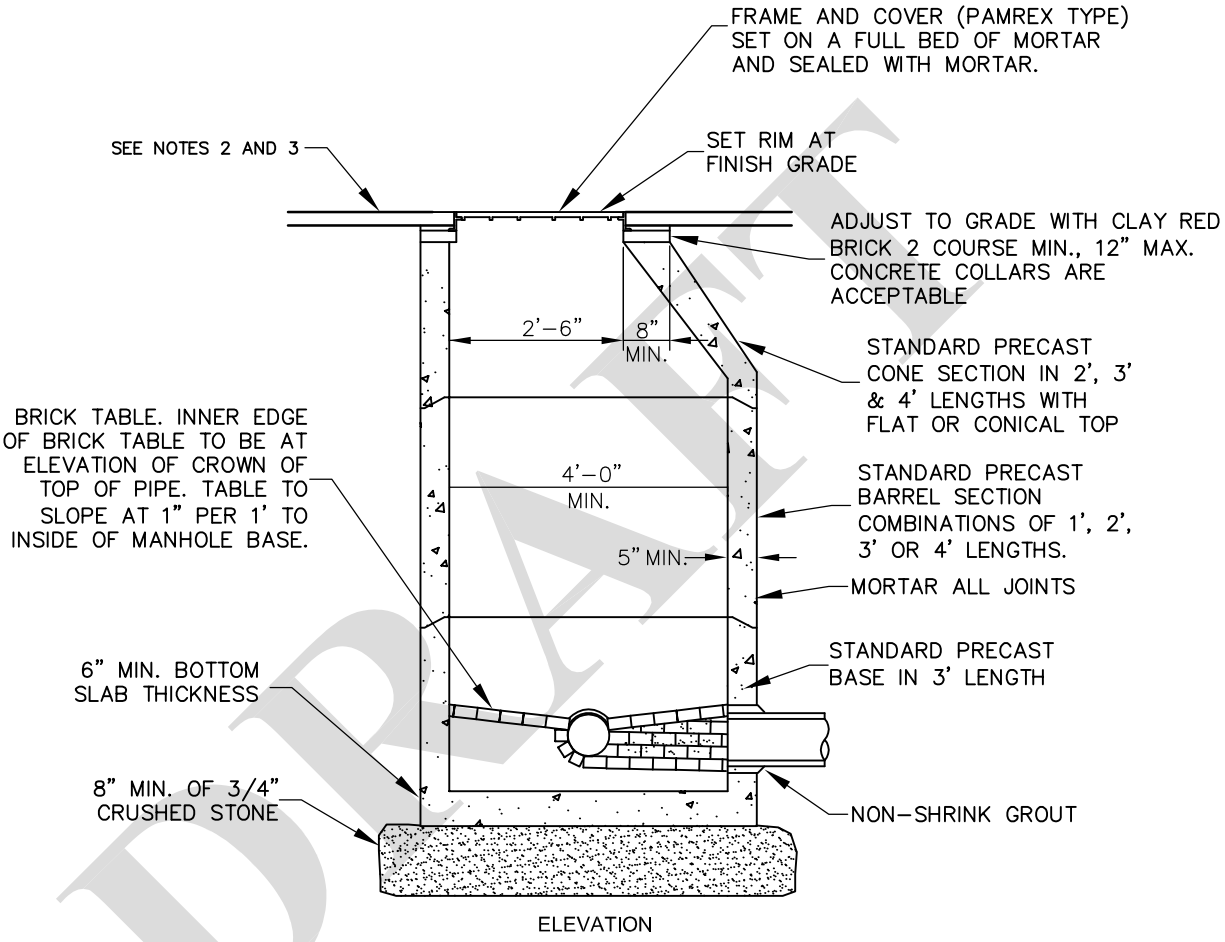
1. CATCH BASISN TO CATCH BASIN CONNECTIONS ARE NOT PERMITTED UNLESS APPROVED BY THE MUNICIPAL SERVIES DIRECTOR OR HIS DESIGNEE.

2. SEE TYPICAL ROADWAY SECTIONS, DRIAN MANHOLE, CATCH BASIN AND DROP INLET DETAILS.



NOTES:

1. PRECAST CONCRETE SECTION ASSEMBLIES SHALL WITHSTAND H–20 LOADING AND SHALL CONFORM TO ASTM C478.
2. PIPE OPENINGS SHALL BE LOCATED WITH A MINIMUM DISTANCE OF 12" BETWEEN OPENINGS AND A MINIMUM OF 6" TO SECTION JOINTS.



ELEVATION

NOTES:

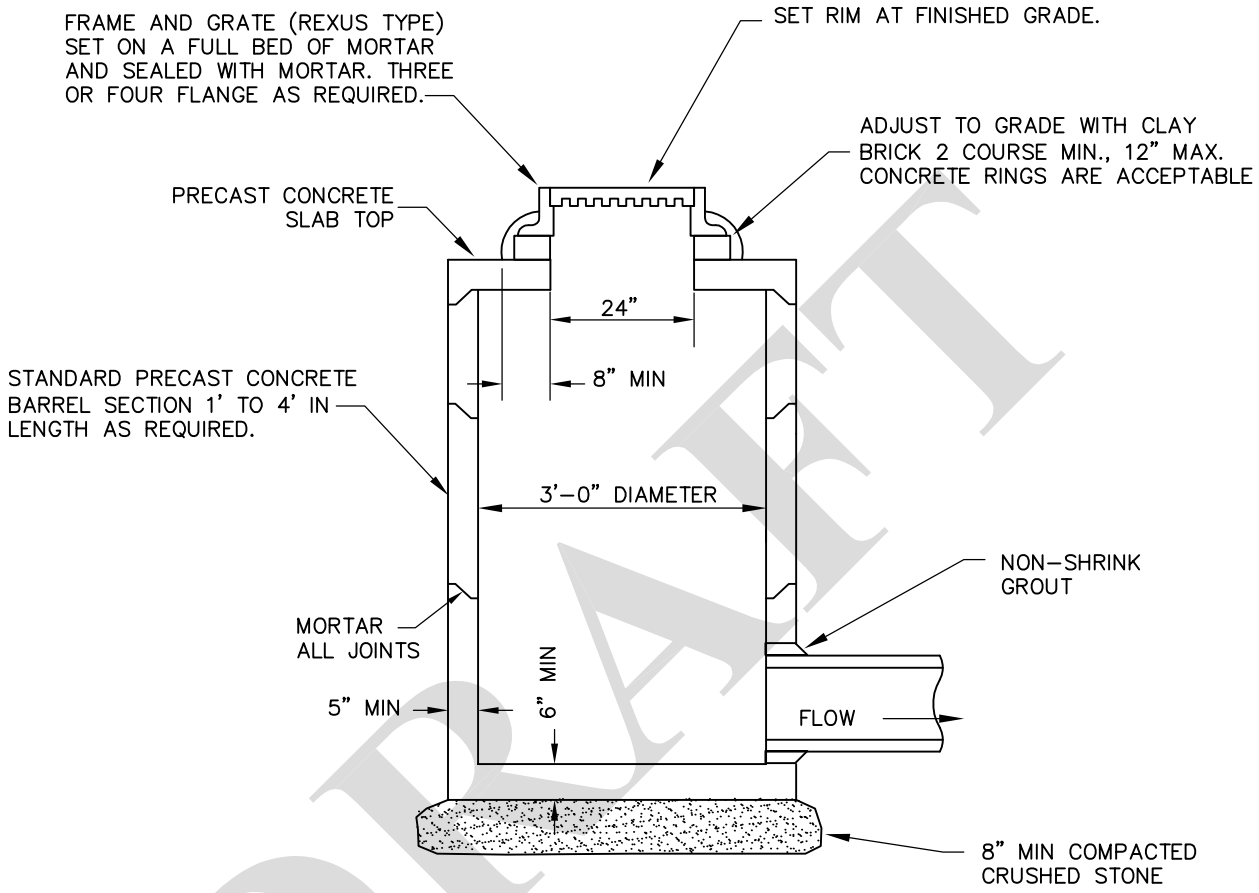
1. PRECAST MANHOLE SECTION ASSEMBLIES SHALL WITHSTAND H-20 LOADING AND SHALL CONFORM TO ASTM C478.
2. WHERE GRASS OCCURS, LOAM AND SEED ALL DISTURBED AREAS TO A MINIMUM DEPTH OF 4 INCHES UNLESS OTHERWISE NOTED. WHERE NO GRASS OCCURS, MATCH EXISTING MATERIALS AND DEPTHS OR PLACE A MINIMUM OF 6 INCHES OF GRAVEL, WHICHEVER IS GREATER.
3. PIPE OPENINGS SHALL BE LOCATED WITH A MINIMUM DISTANCE OF 12" BETWEEN OPENINGS AND A MINIMUM OF 6" TO SECTION JOINTS.

CITY OF FRANKLIN, NH - CONSTRUCTION DETAILS

DRAINAGE MANHOLE

D-12

JANUARY 2007



NOTES:

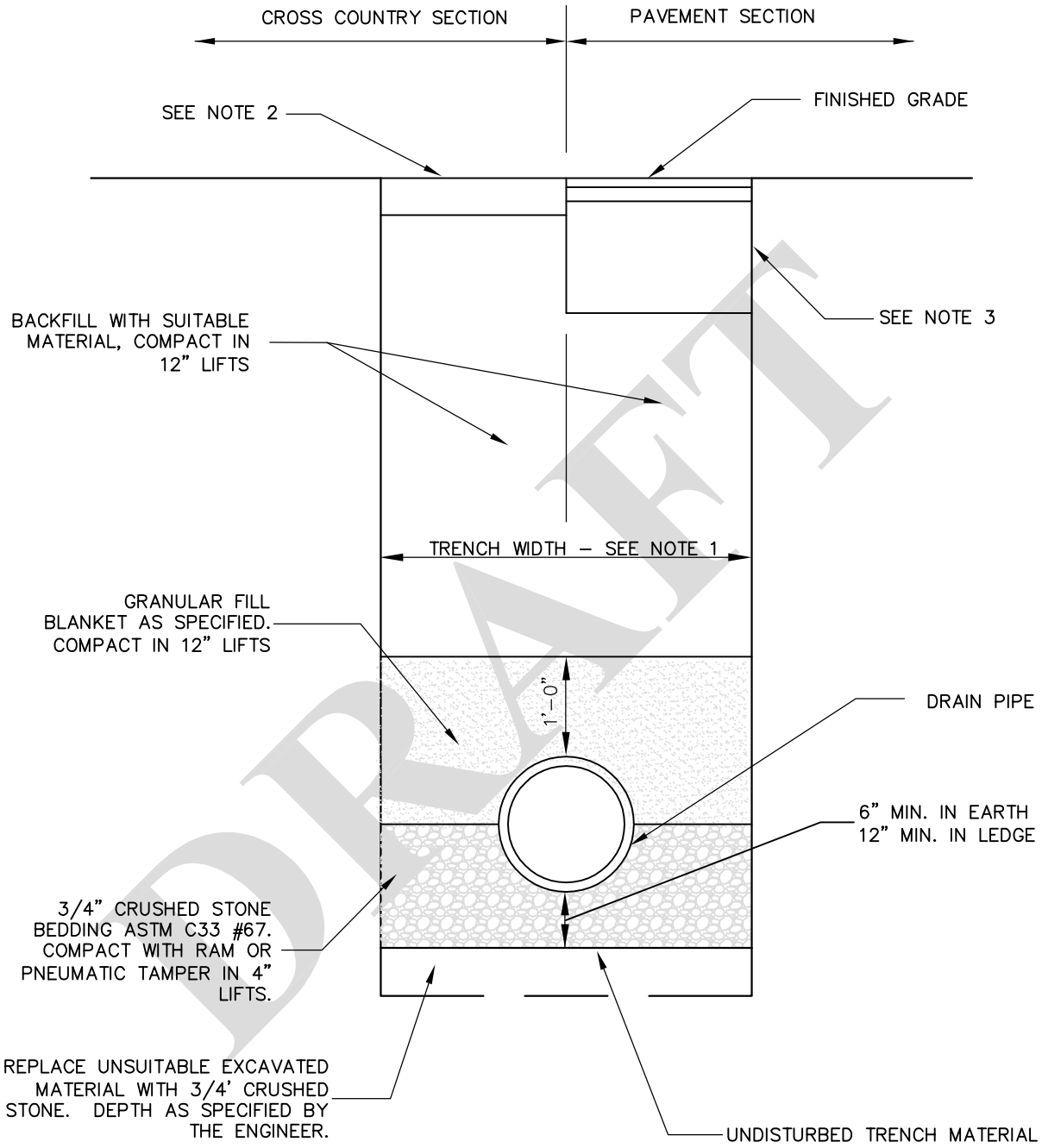
1. PRECAST CONCRETE SECTION AND SLAB TOP ASSEMBLIES SHALL WITHSTAND H-20 LOADING AND SHALL CONFORM TO ASTM C478.
2. DROP INLETS SHALL ONLY BE USED WHEN APPROVED BY THE MUNICIPAL SERVICES DIRECTOR.

CITY OF FRANKLIN, NH - CONSTRUCTION DETAILS

DROP INLET

D-13

JANUARY 2007



NOTES:

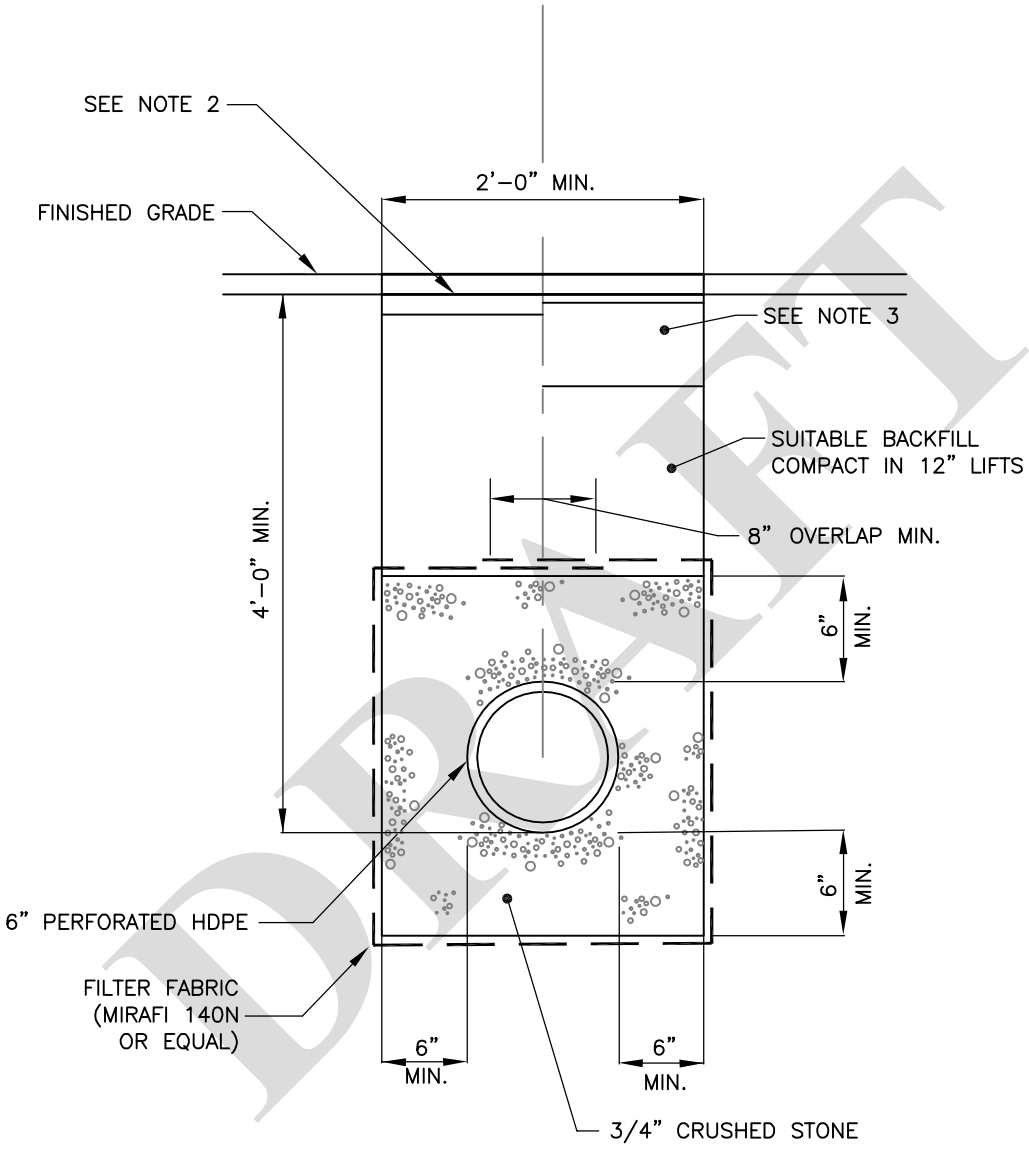
1. MAXIMUM ALLOWABLE TRENCH WIDTH SHALL BE THE GREATER OF 36" OR 2X THE NOMINAL PIPE DIAMETER. MINIMUM TRENCH WIDTH SHALL BE 36".
2. WHERE GRASS OCCURS, LOAM AND SEED ALL DISTURBED AREAS TO A MINIMUM DEPTH OF 4 INCHES UNLESS OTHERWISE NOTED. WHERE NO GRASS OCCURS, MATCH EXISTING MATERIALS AND DEPTHS OR PLACE A MINIMUM OF 6 INCHES OF GRAVEL, WHICHEVER IS GREATER.
3. REFER TO TYPICAL ROADWAY SECTIONS.

CITY OF FRANKLIN, NH – CONSTRUCTION DETAILS

DRAINAGE PIPE TRENCH

D-14

JANUARY 2007



NOTES:

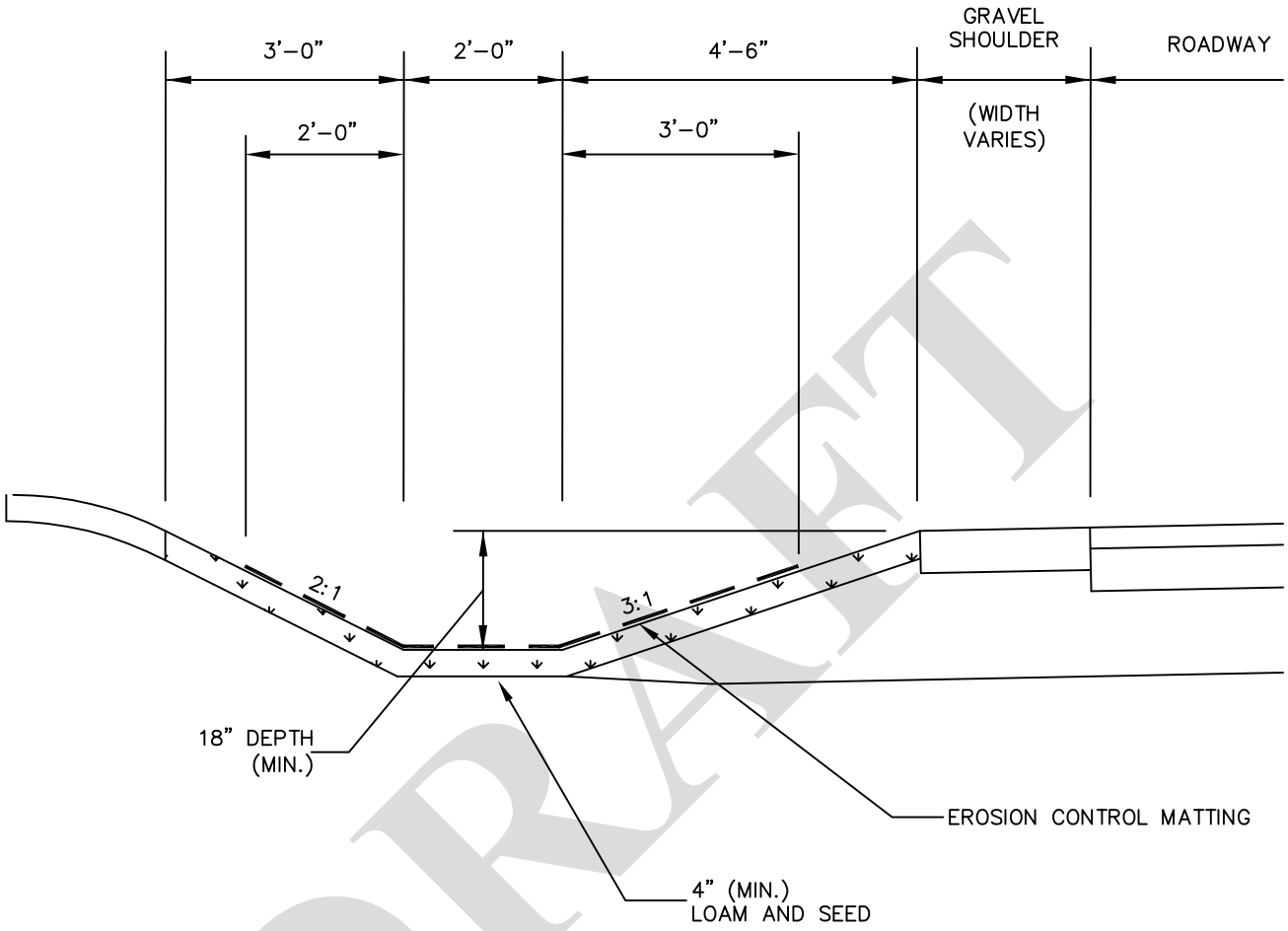
1. ALL UNDERDRAIN PIPES SHALL DISCHARGE TO A DRAINAGE MANHOLE, CATCH BASIN, OR HEADWALL.
2. WHERE GRASS OCCURS, LOAM AND SEED ALL DISTURBED AREAS TO A MINIMUM DEPTH OF 4 INCHES UNLESS OTHERWISE NOTED. WHERE NO GRASS OCCURS, MATCH EXISTING MATERIALS AND DEPTHS OR PLACE A MINIMUM OF 6 INCHES OF GRAVEL, WHICHEVER IS GREATER.
3. REFER TO TYPICAL ROADWAY SECTIONS.
4. UNDERDRIAN LOCATIONS WILL BE AS SHOWN ON THE APPROVED PLANS OR AS DIRECTED BY THE MUNICIPAL SERVICES DIERECTOR OR HIS DESIGNEE.

CITY OF FRANKLIN, NH – CONSTRUCTION DETAILS

UNDERDRAIN

D-15

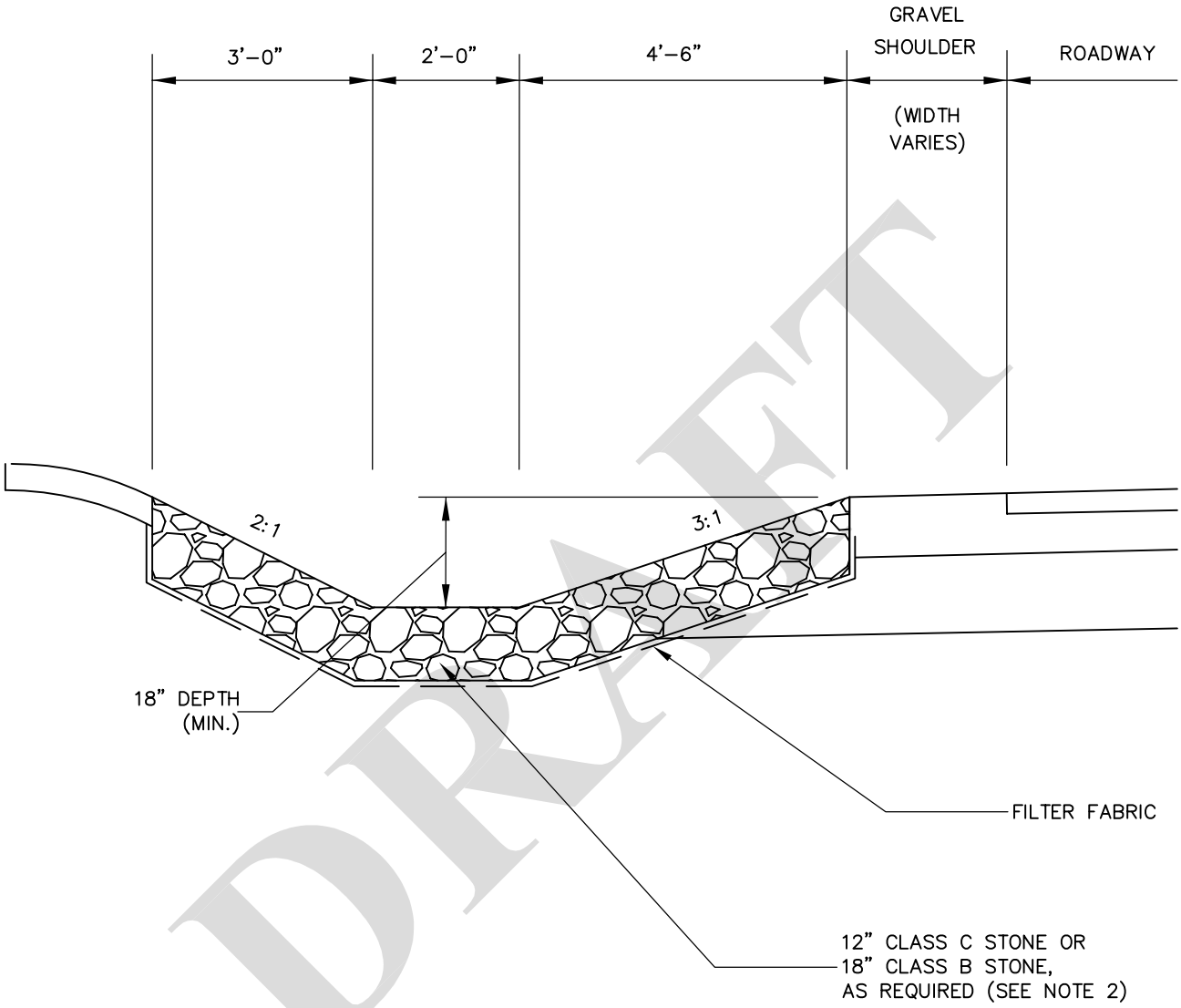
JANUARY 2007



NOTES:

1. VEGETATED SWALES WILL BE USED WHEREVER POSSIBLE INSTEAD OF STONE LINED SWALES. THE USE OF GEOSYNTHETICS AS A PERMANENT SOIL STABILIZATION TECHNIQUE IS ENCOURAGED. ALL GEOSYNTHETIC REINFORCED SWALE DESIGNS MUST BE APPROVED BY THE MUNICIPAL SERVICES DIRECTOR.

2. THE MAXIMUM DEPTH OF FLOW PERMITTED IN THE SWALE IS 6". IF THE DEPTH OF FLOW EXCEEDS 6" AN ALTERNATIVE DESIGN MUST BE APPROVED BY THE MUNICIPAL SERVICES DIRECTOR.



NOTES:

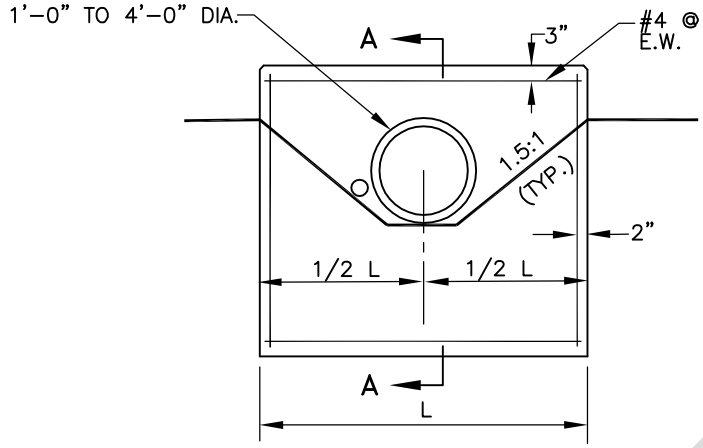
1. STONE SWALES WILL ONLY BE USED IF APPROVED BY THE MUNICIPAL SERVICES DIRECTOR.
2. THE CLASS OF STONE WILL BE DETERMINED BY HYDRAULIC CALCULATIONS, IN ACCORDANCE WITH NHDOT STANDARD PROCEDURES.
3. STONE AND FILTER FABRIC MATERIAL SPECIFICATIONS WILL BE IN CONFORMANCE WITH THE CITY'S TECHNICAL SPECIFICATIONS.

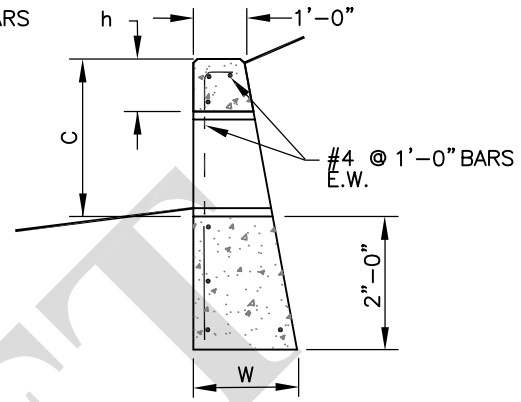
CITY OF FRANKLIN, NH – CONSTRUCTION DETAILS

STONE SWALE

D-17

JANUARY 2007





SECTION A-A

DIAMETER OF PIPE	L	H	W	h
12"	4'–3"	4'–3"	2'–1"	1'–0"
15"	6'–0"	4'–6"	2'–3"	1"–3"
18"	7'–0"	5'–0"	2'–4"	1'–6"
24"	9'–0"	5'–6"	2'–5"	1'–6"
30"	11'–0"	6'–0"	2'–7"	1'–6"
36"	13'–0"	6'–6"	2'–8"	1'–9"
42"	15'–9"	7'–3"	2'–10"	1'–9"
48"	17'–9"	7'–9"	3'–0"	1'–9"

NOTES:

1. MORTAR RUBBLE HEADWALLS ARE ACCEPTABLE. ALL FIELD STONES MUST BE EMBEDDED IN MORTAR AND A 1" MORTAR CAP MUST BE INSTALLED.
2. 3/4" CHAMFER ON ALL EXPOSED EDGES.
3. 1'–0" COMPACTED GRAVEL UNDER HEADWALL.
4. ALL REINFORCING BARS SHALL BE EPOXY COATED.
5. ALL MATERIALS SHALL BE IN CONFORMANCE WITH NHDOT STANDARD SPECIFICATIONS.