Storm Drainage Systems

A. Description

This work shall consist of furnishing, constructing and/or reconstructing catch basins, manholes; with frames, grates, or manhole covers; as shown on the plans. This work shall also consist of furnishing and installing, or removing and relaying, pipes, pipe end sections, and pipe sleeves at the locations shown or ordered, including the necessary joints, fittings and connections as required.

B. Materials

Certificates of Compliance shall be submitted by the Contractor, for each material or structure, to the City of Concord's Representative for review and approval.

Storage and Handling of Materials

Preventing damage: All materials shall be handled in a manner to prevent warping, twisting, bending, breaking, chipping, rusting or any damage whatsoever. Pipe and structures shall be lifted and moved with the appropriate apparatus without being pushed, pulled or rolled by equipment.

Storage of cement: Cement shall be stored under cover, off the ground, and shall be kept completely dry at all times.

Storage of reinforcing steel: All reinforcing steel shall be stored off the ground, or otherwise to prevent accumulations of dirt or grease, and in a position to prevent accumulations of standing water to minimize rusting.

Precast concrete handling: Precast concrete units shall be handled in a manner to prevent chipping or cracking.

Handling and storage of masonry products: Brick, block and similar masonry products shall be handled and stored in a manner to reduce breakage, chipping, cracking and spalling.

Damaged materials: All materials that have become so damaged as to be unfit for the intended use shall be promptly removed from the work site.

Pipe

Reinforced Concrete Pipe:

1. **Conformance to standard specifications:** Pipe shall conform to the standard specifications for reinforced concrete culvert and storm drain. Pipe shall be Class IV 3000D typically or Class V 3750D when required due to extra depth or loading.

2. **Gasketed pipe joints:** Gasketed pipe joints are required for all City installations and shall conform to ASTM C443 Standard Specifications for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

3. **Fittings and accessories:** Fittings and accessories must be approved by the Engineering Services Division prior to installation.

Polyvinyl Chloride (PVC) Pipe:

1. **Conformance to standard specifications:** Pipe and fittings shall conform to ASTM D-3034 and shall be SDR-35 or SDR-26.

2. **Gasketed pipe joints:** Joint compression rings shall be of an oil resistant rubber type, elastomeric seals conforming to ASTM D-3212, or flexible elastomeric seals conforming to ASTM 3212.

High Density Polyethylene Pipe (HDPE)

1. **Use of HDPE:** HDPE pipe shall only be used on private sites and must meet all the City's current concrete pipe standards for water tightness and sanitary sewer standards for roundness. Where a private drain line may cross the City of Concord's Right-of-Way, there shall not be a combination of two different products such as the use of concrete and HDPE. The entire drain line shall be constructed of either RCP or PVC.

2. **Conformance to standard specifications:** This product must be designed for the intended application and should it be proposed for traffic load conditions it must meet H-20 live load requirements. The manufacturer must recommend the product for closed mainline storm drain systems.

3. For use in culvert installations concrete headwalls are required.

4. **Gasketed pipe joints:** A watertight joint must meet or exceed concrete pipe standards ASTM C924, C969, and C1103. The pipe system must utilize a bell and spigot type joint design or a solid collar system to eliminate displacement and deformation at the joint. Joint integrity must meet ASTM D-3212.

5. **Compatibility:** Concentric corrugations or a smooth exterior is necessary to mate the pipe to concrete structures utilizing neoprene boot systems that maintain a watertight seal.

6. **Fittings:** Manufacturers fittings for lateral services must meet the City's current water tightness standards.

Ductile iron (DI) pipe:

1. **Conformance to standard specifications:** Ductile iron pipe shall conform to ANSI/AWWA C150/A21.50 (pressure class pipe) with size as shown on the drawings.

2. **Gasketed pipe joints:** Pipe shall have either the rubber ring type, push on joint, or standard mechanical joint. Rubber gasket joints shall conform to ANSI A21.11 for mechanical and push on type joints. All pipe and fittings shall have a cement mortar lining and bituminous seal coat on the inside, and a coal tar enamel coat on the outside.

Catch Basins

Eight inch (8-inch) walled, reinforced concrete structures are recommended when tying into existing structures and five inch (5-inch) minimum wall reinforced concrete structures are required for new construction. The structures shall be designed to handle H20 Loading.

Reinforcing shall be steel, or structural fibers. Steel shall conform to the requirements of NHDOT 544. Fibers shall only be used in structures with 4 feet or less inside diameter and shall be as shown on the NHDOT Qualified Products List.

For five-inch thick, reinforced structures, a neoprene boot to securely seal the pipe stub in the opening is preferred. If booting cannot be done due to trench constraints, a **sand stub** may be utilized to provide a secure seal.

Eccentric or Concentric conical top sections are required as illustrated on the standard details. Slab top sections shall be used only when the distance from top of grate to top of pipe is less than 48-inches.

Every catch basin is required to have a 3-foot sump as measured from the outlet pipe invert to the floor of the structure. The sump shall be a solid precast unit. Should a center hole be cast in the base, it must be plugged with mortar.

THE USE OF BARREL BLOCKS OR CONCRETE GRADE RINGS IS NOT PERMITTED FOR NEW CONSTRUCTION.

Catch basins shall be accurately located one (1) foot off the curb line for 4-foot I.D. structures to ensure that the frame will be flush to the curb and centered over the structure. In no case should the frame and grate not be flush against the face of the curb. Shall the frame and grate not be flush against the face of curb; the Contractor/Developer will be responsible for re-setting the frame/grate and or the entire structure to achieve the proper placement.

Although catch basins may not be required to be tested for water tightness, infiltration is not acceptable.

Should site conditions require modifications to structure openings, only methods approved in advance by the Engineering Services Division such as core drilling or sawing will be accepted.

All PVC pipe connections to structures (such as under-drain and footing drains) must be cored and booted to assure a secure seal.

Drain Manholes

Drain manholes shall be of similar construction to catch basins with the exceptions that a 30-inch opening for a top section is required and the 3' sump is replaced with a brick invert as noted in the Construction Requirements.

Frames, Grates and Covers

8" cast iron catch basin frames (4" frames are not allowed) and grates shall be NHDOT Type B grate for roadway slopes less than 3%, as shown on the detail of the New Hampshire Standard Plans for Road and Bridge Construction, Standard DR-1, Plate 2. Where roadway slopes are equal to or greater than 3%, NHDOT Type-F, "Bicycle Safe" frames and grates shall be installed as shown on the detail of the New Hampshire Standard Plans for Road and Bridge Construction, Standard DR-2, Plate 1. Where existing catch basins are located within a crosswalk or pedestrian route, a grate which meets current ADA guidelines shall be used (Neenah R-3210-Q or approved equal). North American and India

castings are allowed, provided the India castings are from SIGMA Corporation or approved equal. All castings shall be designed for H-20 Loading.

6" manhole frames and covers shall be NHDOT Standard Manhole cover and frame as shown in the New Hampshire Standard Plans for Road and Bridge Construction, Standard DR-2, Plate 2. All castings shall be designed to handle H20 Loading

Underdrain

Underdrain shall be a minimum 6" diameter PVC pipe meeting SDR-35 requirements or other straight pipe designated for roadway. Coiled slotted house foundation underdrain or corrugated metal underdrain is not permitted for roadway construction.

Stone Fill

Where indicated or required to stabilize a particular slope or water course, stone fill shall consist of: approved quarry stone, or broken rock of a hard, sound, and durable quality, reasonably free of thin or elongated pieces.

Masonry

Brick: Brick shall be solid, sound, hard, and have plain or smooth surfaces on both ends and on the face side, and be satisfactory to the City Engineer. Brick shall comply with A.S.T.M. Standard Specifications for Sewer Brick, Designation C32, for Grade SS, Hard Red Brick. Brick samples will be required for approval prior to incorporation in the work.

Cement: Cement shall be straight Portland Cement, Type I, II, or a Type I/II. Lime mortar or Masonry cement is not to be used on structures.

Mortar Sand: Mortar sand shall meet the following gradation requirements:

Sieve Size	% Passing
No. 8	100
No. 16	60-100
No. 50	15-35
No. 100	2-15
No. 200	0–5

Crushed Stone Bedding

Crushed stone shall be ¾ inch (ASTM #67) stone and meet the following gradation requirements:

Sieve Size	% Passing
1"	100
3/4"	90-100
3/8"	20-55
#4	0-10
#8	0–5

C. Construction Requirements

The Community Development Department in conjunction with the General Services Department will oversee all work related to these utilities. Unauthorized use of hydrants is strictly prohibited. Should a contractor desire to use City water for dust control, sewer

testing and flushing operations, etc. the City will furnish a temporary meter. A deposit is required and the contractor will be charged for the water used. **Only qualified City of Concord personnel are authorized to manipulate hydrants**. Unauthorized usage of City water is subject to a minimum $1,000.00 fine.

Excavation

Excavation shall be accomplished by methods that preserve the undisturbed state of the subgrade soils. A trench may be excavated by machinery to the designated subgrade, provided that the bottom of the trench remains in the undisturbed state and provides the proper foundation for the pipe bedding. Equipment may have to be modified by welding a blade to the bucket teeth to achieve the required shape to fit the lower 1/3 of the pipe exterior for pipe 36" in diameter and larger.

Crushed Stone Bedding

Contractor shall place ¾" crushed stone: for bedding, to the haunch of the pipe and a minimum 6" beneath the pipe throughout the bottom of the excavated trench. After placing the pipe, ¾" crushed stone shall be placed to ½ the outside diameter for pipe less than 24" inside diameter. ¾" crushed stone shall be placed to the top of pipe for diameters greater than or equal to 24".

Mortar

Mortar shall consist of two parts mortar sand to one part Portland Cement. To obtain the proper ratio, one bag of Type I or Type II Portland Cement should be mixed with two-five gallon buckets of mortar sand. The mix shall be thoroughly blended only in such quantity as may be required for immediate use, and shall be used before the initial set has taken place. The mix shall be constantly worked over with hoe or shovel to keep it workable. Adding water after mixing to bring a hardened mix "back to life" will not be allowed.

Brick Masonry

Brick masonry shall be protected from too rapid drying by approved means and shall be protected from weather and frost, as required. Bricks shall be laid in a full bed and joint of mortar without requiring subsequent grouting, flushing, or filling. Joints between bricks shall not exceed 3/8 inch and shall be tooled flush to the brick surface.

Brick masonry during winter conditions must be protected from freezing. A suitable heated shelter will be required to assure all materials remain above freezing for 3 days.

All brickwork used to adjust manhole and catch basin frames to grade shall be sealed on the outside of the structure with mortar.

Inverts: Manhole inverts shall be constructed to provide an uninterrupted flow channel and shall correspond in shape to the lower half of the pipe. Brick shall be laid on edge. Only solid masonry construction will be accepted under the brick shelf.

Mortar joints shall be tooled flush to the face of the brick to prevent minor depressions. Shelves shall be constructed to the crown of the pipe for diameters greater than 15 inches. The brick shelf shall be pitched to drain toward the through channel with one inch of difference from the structure wall to the channel edge. Puddles or undue turbulence through the manhole trough will necessitate reconstruction.

Adjusting Frames To Grade: Frames shall be centered over the catch basin / manhole opening. Manhole frames shall be set no less than 1/8-inch lower than the finish pavement or no more than 1/4 inch lower than finish pavement. Catch basin frames shall be set no less than 1/8" lower than the finish pavement or no more than 1/2 inch lower than finish pavement. A minimum of 2 courses of brick are required under the structure frame, yet the adjusting course shall not exceed approximately one foot of brick - (normally 5 course maximum). One course of brick may be laid on edge. Brick and mortar is the only masonry material to be used between the precast structure and the cast iron frame. The use of barrel blocks and concrete grade rings is not permitted.

Masonry Repairs: All work on existing facilities shall be performed by or under the direction of City forces. Only sound masonry materials shall be incorporated into the work, and any necessary repairs must first be approved by the City of Concord's Representative, and observed prior to backfilling.

Storm Drain Systems

1. The minimum pipe inside diameter for cross culverts and closed storm drain systems accepting roadway runoff shall be 15-inches. The minimum pipe inside diameter for driveway culverts shall be 12 inches. The use of pipe smaller in diameter than 12-inches is not permitted.

2. A minimum 4' of cover shall be provided over all storm drains. Should conditions result in storm drains with less than 36-inches of cover; 2" rigid polystyrene thermal insulation with a minimum "R" value of 10 will be required two-feet each side of the utility and a distance to be specified by the City of Concord's Representative, (a minimum of 8' is required). The City of Concord's Representative shall be contacted prior to the installation of the insulation.

3. Proper catch basin location is essential to assure compatibility with finished roadway curb and structure installations.

4. A minimum 6" of ¾" crushed stone bedding is required under the load bearing section of all storm drain pipe from the undisturbed stable soil to the mid-diameter of the pipe.

5. A minimum 8" of ¾" crushed stone bedding is required under all catch basins and manholes.

6. Granular fill over the pipe may be required should the excavated material contain >50% cobbles and threaten to injure the pipe.

7. Should unsuitable soils be encountered in the excavated trench all material will be removed and replaced with granular fill to the limits as directed by the City Engineer.

8. Manholes or catch basins shall be required at every change in vertical grade or horizontal pipe alignment.

9. Should storm drain pipelines or structures approach water lines or appurtenances with less than 36-inches of separation; 2" rigid polystyrene thermal insulation with a minimum "R" value of 10 will be required two-feet each side of the utility and a distance to be specified by the City of Concord's Representative, (a minimum of 8' is required).

The City of Concord's Representative shall be contacted prior to the installation of the insulation.

10. Headwalls shall be placed outside of the "clear zone" as defined in the Roadside Design Guide.

11. Prior to directional boring/drilling and or jacking, all utilities (communication, electric, gas, sewer, water, storm drain, etc) .in close proximity, shall be exposed to verify location. A fully detailed plan showing the proposed construction activity shall be submitted to the City Engineer for review at least two (2) weeks prior to the commencement of the construction activity. The proposed sleeve shall consist of either steel or SDR 11 with a traceable wire shall be placed over the utility.

12. High density polyethylene and PVC pipe used in conjunction with concrete structures may require special treatment to assure a watertight seal. Manufacturer's recommendations must be followed to assure long-term performance.

Underdrain

Underdrain, if not detailed on the approved plans, may be required should site conditions warrant. Seasonal high water table must be kept to a minimum of 2-feet below subgrade across the roadway section. Should the water table be encountered during subgrade preparation, an appropriate engineering solution must be submitted for approval to correct the situation.

Underdrain shall be bedded in crushed stone wrapped in the appropriate geotextile fabric.

All daylighted underdrain shall have a either a pre-cast concrete headwall or a masonry headwall along with a rodent proof end grate installed at the outlet.

Drain Laterals

1. Storm drain service taps will be accomplished using a sanitary tee connection at the main in accordance with the City of Concord's Building and Plumbing Codes, and the International Plumbing Code, 2003 Edition.

2. Perimeter foundation drains shall be PVC SDR 35.

3. Perimeter drain laterals (6-inch PVC) shall be bedded in ¾-inch crushed stone from the top of the pipe to 6-inches below the invert.

4. Drain cleanouts for house service connections shall be installed at the building foundation or as directed by the City of Concord's Representative.

5. Building foundation drains that discharge to daylight shall have a rodent proof end grate installed at the out-flow end of the pipe along with a pre-cast concrete headwall or a masonry headwall.

6. Should a building foundation perimeter drain discharge near a pond, stream bed, or an area subject to flooding then a check valve shall be installed before the outlet.

7. Shallow drains (less than 4-feet of cover) may require frost protection should they cross under paved areas. In no case, shall insulation be placed without the permission of the City of Concord's Representative.

8. For sump pump installations: 1-1/2-inches or 2-inches - polyethylene pressure pipe can be used to carry ground water from the foundation drain.

9. A cast iron cleanout box with a cover marked "drain" is required over 6-inch drain cleanouts.

Slope Stabilization

Maximum slopes for earthen structures intended for vegetation shall be 3:1. The use of slope stabilization products for slopes equal to or greater than 3:1 such as Geotextile fabrics or other approved alternatives are strongly encouraged in lieu of stone fill where conditions permit.

Should the contractor request the use of stabilization products in lieu of stone fill as shown on the approved design plans, the contractor shall obtain a written description of the proposed geotextiles and the stability of the slope using the proposed product from the design engineer and submit same to the City Engineer for review.

Stone Fill Requirements

Where indicated or required to stabilize a particular slope or water course, stone fill shall be graded as shown on the approved design plans.

If the approved design plans do not indicate the type of stone, the size, etc. for the slope or pipe outfall to be stabilized, the contractor shall contact the design engineer to determine the proper material and size to be used. The information shall be supported by type of design storm, design method, piping system, etc. All information shall be submitted to the City Engineer for review prior to the placement of the material.

Stone Fill	Minimum Depth
Class A	24"
Class B	18"
Class C	12"

Safety Barriers

Should perimeter fencing be required as shown on the approved design plans where hazardous conditions are identified, a 6-foot minimum height fence with a 14-foot access gate shall be constructed, using standard chain link fabric.

D. Inspection Requirements

Visual Inspections

Visual inspections of drain pipe will be performed to assure compliance with Construction Standards. Visual inspections are normally required to confirm the hydraulic integrity of Storm drains. Pipe must be sound and flawless. Cracked, chipped or deformed pipe must be replaced. Pipelines are required to be true to alignment and at a uniform slope between structures. "Ponding" or deviations in alignment will be cause for rejection. The Engineering Services Division shall determine if the ponding or deviations in alignment are cause for rejection during the review of the Storm drain video prepared by the Contractor.

Infiltration:
Storm drain systems are inspected for infiltration visually and by video camera. Should infiltration be observed, other than minor signs of moisture, repair or replacement will be required.

Observation for Uniformity of Flow:
Water used to flush lines will be observed for uniformity of flow through each pipeline from structure to structure.

Video Inspection

1. All pipelines will be subject to the scrutiny of a video inspection prior to acceptance to assure proper jointing and flow characteristics. **All video inspections shall be performed by the City of Concord General Services Division.**

2. Camera inspections will not be scheduled until construction of other utilities in the same area are completed and the pipeline under consideration has been backfilled and compacted to subgrade elevation for at least thirty days prior to the scheduled inspection. The Contractor shall contact General Services to schedule the inspection.

3. All structures are to be accessible to the video inspection vehicle and all pipelines shall be cleaned of all debris prior to the inspection. The presence of debris or insufficient flushing water will necessitate re-inspection following correction.

4. Video camera inspections will be performed after flushing the sanitary sewer main or lateral with water containing a visible dye and allowed to drain. Excessive ponding or alignment deviation deemed by the City of Concord's representative is cause for rejection.

5. Only tractor-type units will be utilized for mainline inspections, push cameras will only be allowed for lateral inspections.

6. The camera shall have pan and tilt capabilities.

7. The camera shall be approved by the manufacturer for the pipe size being inspected (typical camera is rated for 8"-24", without additional accessories).

8. Optional: The camera should be equipped with an inclinometer (these only show the general trend of the pipe slope, not to be viewed alone as acceptance criteria).

9. The camera footage shall be shown on-screen.

10. The unit should be able to provide accurate footage, (1'±) and all measurements shall be taken from the center of manhole structures.

11. The beginning of the inspection shall consist of a title screen that indicates the following information; date, time, location, company doing the inspection, contractor that laid the pipe, type of structure, pipe size and material, and if manhole numbers or line segments are not specifically labeled on the approved plans; than station numbers compete with right or left offsets shall be used to identify line segments.

12. When a lateral line is encountered during the inspection; the camera operator shall stop the camera unit and, using the pan and tilt function, inspect the lateral opening to the best of the camera's ability (dye should be introduced into the lateral, if feasible, to view flow characteristics).

13. When a questionable pipe joint is encountered during the inspection; the camera operator shall stop the camera unit and using the pan and tilt function, inspect the joint to the best of the camera's ability. (Operator should also traverse the joint with the camera unit to observe the amount of drop/rise the camera experiences over questionable joints).

14. When a sag is encountered during the inspection; the camera operator shall record the beginning and end of said sag, if of questionable depth, then the operator shall drag a ½" tall non-buoyant object through the sag with the camera unit to observe and record actual depth.

15. All defects observed shall be logged into some sort of data management software (PACP or WRC compliant) and compiled into a video report to be submitted with the video inspection.

16. All video inspection submittals shall be DVD format, no VHS will be accepted.

17. Any submittal not meeting these requirements will be rejected.

18. **All costs associated with the video inspection shall be the responsibility of the contractor. Contact the General Service Division for the current fee schedule.**

E. Testing Requirements

Deflection Test

Deflection test will be required on all flexible pipes. Concrete and Ductile Iron are considered to be rigid pipe.

HDPE Testing

Deformation testing will be required and must not exceed five per cent (5%) of the inside pipe diameter in any axis.