

PUBLIC WORKS MANUAL

Prepared For:

Town of New Castle
Public Works Department

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Revised December, 2022

TOWN OF NEW CASTLE

PUBLIC WORKS MANUAL

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CHAPTER I

DESIGN AND IMPROVEMENT STANDARDS

TEXT

DESIGN AND IMPROVEMENT STANDARDS

Boundary Survey and Monumentation.

The boundary survey, internal property lines and monumentations shall meet all of the requirements of Articles 50-53, Chapter 38, CRS 1973, as amended. Survey data shall be checked by the Garfield County Surveyor prior to approval of the final plat. The location of all monuments required by this section shall be indicated on the plat, and shall be installed as follows:

- A. All street centerline monuments shall be iron pin monuments five-eighths inch in diameter and eighteen inches long, set in concrete at least eight inches in diameter and located in the ground at all points on street centerlines where there is a change in direction or curvature, at all street intersections and at the radius point of a cul-de-sac.
- B. All monuments shall be set in monument boxes of a type approved by, or obtained through, the Town, and shall be set to the finished street grade before acceptance of the street for maintenance by the Town.
- C. All monuments shall have a cap bearing the number of the land surveyor setting the monuments.
- D. Accuracy between all monuments shall be not less than one part in ten thousand (1:10,000).
- E. In no case shall monuments be set more than one thousand four hundred feet (1,400') apart.

Lot and Block Design.

Each lot shall be designed to provide an adequate, accessible building site for a structure devoted to the intended use of the land. Except as provided under the Municipal Code. (Planned Unit Development), each lot shall meet or exceed the minimum requirements of applicable zone district regulations and shall have a minimum of twenty-five feet of frontage on a dedicated public street; the use of an easement for principal access to a lot is strongly discouraged and shall be used only after submittal to and acceptance by the Town Board. Lots with double frontage shall be avoided except where essential to provide separation from major arterials or because of the slope. Side lot lines shall be substantially at right angle or radial to street lines when feasible. All lots shall have a defined rear yard. Blocks shall be at least three hundred feet in length and not more than one thousand three hundred twenty feet in length between street intersections.

Pedestrian crosswalks or easements may be required in blocks whose lengths exceed one thousand feet. Corner lots shall contain sufficient area to accommodate a building devoted to the intended use of the lot, plus meet yard requirements under the applicable zone district regulation.

Planned Unit Development.

The Planning Commission may recommend approval of a subdivision which departs from the usual design or regularly platted lots and blocks as a part of a planned unit development in accordance with the provisions of the Municipal Code.

Street Improvements.

All street improvements described in the Town of New Castle Public Works Manual are the financial responsibility of the developer, subject to the provisions of the Town of New Castle Public Works Manual, unless specifically exempted through written agreement with the Town Council. All streets and alleys proposed for dedication to the public shall be laid out, graded and paved from curb to curb and striped. Curb and gutter and sidewalks shall be installed on all streets unless special circumstances warrant the Town Council to specifically waive installation in writing. In cases where a previously existing street which has not been brought up to Town specifications is located within a development, such street shall be paved with curb and gutter; sidewalk and other improvements shall be installed in order to meet Town specifications. If any subdivision is located adjacent to any existing street right-of-way, the developer shall provide at least the adjacent half of such street with improvements as required to bring such street up to Town specifications. The developer shall provide and install street signs at all street intersections and traffic control signs in accordance with the approved "Signing and Striping Plan". Permanent reference monuments and monument boxes shall be installed by the developer to Town specifications, as shall bicycle paths where they are required by Town regulations. Street lights when required by Town regulations shall be installed by the Town and the Town reimbursed for its costs, unless prior arrangement is made between the developer and the Town.

Street Design.

Geometric and Structural Design Criteria For Town Streets

Section 1. Design Report

A complete engineering design report, sealed by an Engineer, shall be submitted to the Town as required by the Town Engineer. Submittal of a preliminary version of this report may be required at Preliminary Plat, but the final version shall be submitted no later than concurrently with the

submittal of engineering plans at Final Plat. This review is to assure that the engineer has dealt with all development problems and had offered solutions which conform to the approved site plan and to Town Standards. If, in preparation of the report, the engineer finds that substantial changes from the preliminary plat are required to produce an economical development, he shall prepare a revised Preliminary Plat for submittal by the developer. Forcing engineering solutions to conform to an approved plat is strongly discouraged. The following reports shall be included:

Section 2. Soils Report

A soils report shall be prepared by an Engineer, specializing in soils analysis. This soils report will be used to substantiate street pavement design and grading plan designs, or for any other plans needing such analysis for a site, and should include base courses recommended beneath sidewalks, curbs and gutter, and pavement. Material specifications and compaction requirements should be addressed for all roadway materials (subgrade, select, ABC, AC, seals, etc.). The pavement section is to be designed for a 20-year life. Pavement thickness design method shall be current Asphalt Institute Method, or other method acceptable to the Town Engineer. If cut and fill slopes are proposed which exceed those allowed by Town standards, a slope stability analysis establishing maximum stable slope grades or stabilization methods must be included. Any cut or fill section exceeding two(2) feet in height or depth shall be stabilized and revegetated. If problem areas are found, further surveys may be required in those specific areas. The soils engineer shall address the following problems. Shrink-swell potential, ground water, wetness, depth of rock, erosion, flood hazard, allowable velocity in earth drainage channels, bearing capacity, corrosion potential, organic layers, ease of excavation and other pertinent issues.

Section 3. Street Report

A typical cross section will be shown for each type of street included in the subdivision. If surface drainage is to be carried in the street, then the drainage report shall show that the drainage for the design storm can be handled by the existing and proposed drainage facilities system.

For the "Standard Street Cross Sections", the designs will have the entire road/street prism (toe of fill to top of cut) within the necessary right-of way width where possible. In situations where widths of right-of-way beyond the standard minimums would substantially reduce developable areas (lot square footage), then the Town may accept "Easements" for that area outside the required right-of-way but necessary for utility accommodations and maintenance purposes.

For those details concerning sidewalks and sidewalk ramps, all design and construction must meet the applicable requirements of the "Americans With Disabilities Act" (ADA).

Base thickness and pavement thickness(pavement sections) are to be determined by an Engineer's report on soils analysis (CBR or "R" values) and asphalt thickness based on anticipated traffic loads including truck traffic during the period (usually first 2-3 years) when

buildings are being constructed in the development thereby generating concrete redi-mix trucks, rock and gravel delivery trucks, building block delivery trucks, lumber delivery trucks, utility installation equipment, furniture delivery vans, etc. Solid Waste collections trucks must be considered throughout the service life of any street.

The recommended method for pavement thickness design shall be "Thickness Design, Asphalt Pavements for Highways and Streets" Manual Series No. 1 (MS-1) dated February 1991 and published by the Asphalt Institute. Comparable pavement design methods acceptable to the Town Engineer may be used.

Any recommended asphalt pavement design thickness less than three(3) inches must be justified in writing by the Design Engineer and to the satisfaction of the Town Engineer.

The geometric designs (especially horizontal and vertical curves) will adhere to the criteria as set out in the following sources:

1. "A Policy on Geometric Design on Highways and Streets", latest edition, published by the American Association on State Highway and Transportation Officials(AASHTO).
2. "Traffic Engineering Handbook", latest edition, published by the Institute of Transportation Engineers (ITE).
3. The Town of New Castle "Subdivision Regulations" and "Public Works Manual".

All designs shall be subject to the approval of the Town Engineer, Board, and Staff who shall have the authority to approve less stringent or require more stringent design criteria in the interest of public safety.

In situations where the geometric design criteria as set out in the above referenced books can not be met* for the normally applicable design speed on a given type of street(local, arterial, etc.), then the design speed may be lowered to a design speed suitable for the type terrain and the anticipated traffic volumes. However, all efforts shall be made to ensure that a "balanced" street network evolves by providing enough streets with 25 mph or higher design speeds to counteract the effect of lowering the speed limits on some streets thereby restricting traffic flow capacities.

*In cases where meeting the design criteria would create inordinately deep cuts or high fills making access to adjoining properties unreasonably difficult either from the standpoint of construction or cost. Also to be considered is the fact that very steep approaches (side street or driveway) can be unsafe for driver control of vehicles.

At the points where developments tie into existing streets, the design plans shall show the horizontal and vertical alignment of the existing streets for a distance of 300 feet from the point

of intersection.

Traffic Report.

Recognizing that a balance must be reached between the need for vehicular traffic efficiency/safety(multiple streets and accesses) and the desires of a community for security(restricted access), the Town may require the developer to design the subdivision and street networks based upon an in-depth "Traffic/Access Impact Analysis" which is to be prepared by an engineer registered in the State of Colorado and who shall have an established proficiency in preparing traffic/access impact studies.

The results and recommendations of the "Traffic/Access Impact Analysis" shall set out the minimum traffic flow requirements while not unreasonably sacrificing the security of a neighborhood or community. The safety and convenience of the traveling public, especially ingress and egress during emergency situations, must be weighed against the need for security.

Section 1. Traffic/Access Impact Analysis Criteria

Impact of traffic generated by developments shall be analyzed. The developer shall submit a traffic/access impact report, prepared by an engineer, which addresses the impact of the traffic generated by the development upon the traffic flow, congestion, and safety of the surrounding streets and other traffic facilities. The report shall also identify the steps to be taken as part of the development to mitigate any adverse effects of the traffic generated by the development. For "phased" developments, the "Traffic/Access Impact Analysis" shall consider all phases through final build-out.

A traffic/access impact analysis and report is required as part of the submittal for a development which meets any of the following criteria:

1. A request for annexation to the Town of an area greater than one acre.
2. An area plan for which zoning and general land use types are proposed, but for which specific land uses and densities are not known.
3. A specific plan where specific land uses are known, and which will generate threshold level traffic.
4. A subdivision plan which generates threshold level traffic. Threshold level traffic is defined as: 100 or more peak direction trips to or from the site during either the peak hour of traffic on the adjacent roadway or the peak hour of traffic generation of the site itself.
5. A request for change of zoning where the development allowed by the new zoning

will generate threshold level traffic.

6. A site plan submittal for a single development which will generate threshold level traffic. This analysis need not be made if the site has previously been included in a complete traffic impact analysis for a larger area and the land use and intensity assumed for the site in that previous analysis is the same as that of the proposed development.
7. An analysis and report may also be required for development master plans or other developments to address localized safety and capacity deficiencies, or impact on adjacent neighborhoods. The Town Engineer or Board shall determine the cases in which such an analysis is required and the points which need to be addressed.
8. Any development for which a "Development Agreement" is adopted.
9. Prior to consideration of a preliminary plat be the Planning and Zoning Commission.

In the event that a traffic/access impact analysis determines that additional ingress, egress, dedication, signalization, or other action is required to mitigate the impact of the development upon traffic flow, the applicant or developer may be required to take such action or contribute financially to said action in proportion to the nature and extent of the impact of the proposed development prior to any approvals being granted by the Town, or as a condition of any such approvals.

This analysis and report will include roadways and intersections immediately adjacent to the development and those roadways on which at least 5% of peak hour capacity at an intersection approach will be composed of trips predicted to be generated by the new development.

If the Town of New Castle prepares a transportation plan for a specific area which is used as the basis of major street layout and area ingress and egress, any subsequent development proposed within that specific area will reimburse the Town a proportionate share of the cost of the study.

The traffic/access impact analysis shall be performed as a part of the site design process. At a minimum, the following factors shall be analyzed:

1. Study purpose and objectives.
2. Description of the site and study area.
3. Existing conditions in the area of the development.
4. Capacity analysis of the major street and project site access intersection locations

within the study area.

5. Safety, including intersections and driveway sight distance.
6. Circulation patterns.
7. Traffic control needs.
8. Transit needs or impacts
9. Transportation system management.
10. Neighborhood impacts.
11. Adequacy of on-site and off-site parking facilities.
12. Pedestrian and bicycle movements.
13. Service and delivery vehicle access.
14. Previous Studies and Technical References.
15. Accident Summary/History.
16. Anticipated nearby land use developments.
17. Trip generations, trip distribution, and modal split.
18. Projected future traffic volumes (20 year projections).
19. An assessment of the change in roadway operations resulting from the development traffic.
20. Recommendations for site access and transportation improvements needed to maintain traffic flow to, from, within, and past the site at an acceptable and safe level of service.
21. Roadway and driveway geometrics.

Section 2. Criteria For Secondary And/Or Emergency Access In Subdivision/PUD's

Traffic analysis for all subdivisions or PUD's must include an analysis, which includes but is not limited to the following criteria to determine whether secondary and/or emergency access is needed.

1. Population density projections
2. Roadway widths
3. Topography
4. Vegetation(fuel) types in area
5. Response times
6. Distance/location of closest major arterial
7. Roadway surface
8. Layout of roads in subdivision
9. Parking along streets or other possible restrictions
10. Reliability of primary access point(potential flooded areas, etc.)

Note: The Town Board, during the plat approval process, will make the final decision regarding the need for secondary and/or emergency access based upon the recommendations of the development traffic/access impact analysis and recommendations from the Planning and Zoning Commission, the Town Engineer, and Town Staff.

Street Design Standards.

Pursuant to section 16-04-020 of the municipal code, a “street” means a *right-of-way* reserved or dedicated for public use that provides principal vehicular and pedestrian access to adjacent properties. All newly constructed public streets shall be subject to the following standards and regulations. Exemptions to these standards shall be subject to the provisions of Title 16 of the municipal code.

- A. The street pattern shall conform to the most recently adopted transportation plan or comprehensive plan and shall afford safe and convenient access to all lots within the subdivision.
- B. Streets shall intersect with planned or existing streets as follows:
 1. Intersections of streets shall be at right angles unless otherwise approved by the Planning Commission and the Town Engineer.2. No more than two streets shall intersect at one point.

3. Two local streets meeting a third street from opposite sides shall meet at the same point, or their centerlines shall be offset at least one hundred feet (100').
 4. Arterial or collector streets meeting a third street from opposite sides shall meet at the same point, or their centerlines shall be offset at least two hundred feet (200').
 5. The Town Engineer may approve exceptions to the provisions of this subsection in extraordinary circumstances where safety is not compromised.
- C. Streets shall have the names of existing streets which are aligned in the Town, or as specified by the Town of New Castle Public Works Manual and approved by Garfield County Communications.
- D. Streets which are extensions of existing or platted streets shall bear the same classification as that assigned to the existing or platted street in the most recently adopted transportation or comprehensive plan and shall conform to any special standards pertaining to such classifications.
- E. Local residential streets shall be designed to discourage through traffic, and where a proposed subdivision borders on or includes a street designated arterial, intersections of proposed streets with such arterials shall be held to a minimum. Lots bordering arterial roadways may be either reverse-facing on an interior street within the subdivision or served by a frontage road.
- F. Streets shall be designed to bear a logical relationship to the existing topography.
- G. Dead-end streets shall not be permitted. A street may end in a permanent cul-de-sac providing that the street is not longer than six hundred sixty feet (660') and that the radius of the turning areas be at least forty-five feet (45') to the curb, and fifty feet (50') to the edge of the right-of-way. Where a street is designed to connect with a future street, a temporary turn-around shall be provided with a radius equal to that required for a permanent cul-de-sac or of an alternate design approved by the Town Engineer based on the traffic movement generated by the street in question. Such streets terminating in a temporary turn around may exceed the six hundred sixty foot (660') limit specified above if approval by the Town Engineer. If the temporary turn-around is to exist for a period longer than six (6) months, then the subdivider shall pave it and construct a curb and gutter and sidewalks if so directed by the Town Engineer. When the connection is finally made, the subdivider shall be responsible for constructing the turn-around area to fit the normal street design, and the Town shall reassign the excess right-of-way back to the owners of the adjacent property. Surface drainage on the cul-de-sac shall be towards the intersecting street or else a drainage easement shall be provided from the cul-de-sac.

H Private streets shall not be permitted. A “private street” means an undedicated, privately controlled, and privately maintained right-of-way. All newly constructed streets shall meet the Town of New Castle streets design standards.

I. All newly constructed streets shall comply with the "*Recommended Right-of-Way Cross-Sections*", (Appendix A) which may be adopted and amended from time to time by resolution of the Town Council. Streets, alleys, rights-of-way, sidewalks and easements shall comply with all federal and state specifications, and, in addition, shall meet the following minimum width standards:

1. “Arterial street” means a street, existing or proposed, which serves or is intended to serve as a major traffic way and is designated as a major street on the comprehensive plan. Arterial streets shall have a minimum right-of-way of one hundred feet (100'). The minimum paved portion of the street measured from flow line to flow line shall be sixty-four feet (64').
2. “Collector street” means those with low to medium traffic volume, whose purpose is to provide access to residential areas and to channel traffic from residential areas to arterial *streets*. Widths of new collector streets will vary depending on selected use in conformance with the “*Recommended Right of Way Cross Sections*” (Appendix A).
3. “Local residential street” means streets with low volume, low speed traffic that are intended to provide access to adjacent residential lots. Local residential streets shall have a minimum right-of-way of fifty-eight feet (58), with a minimum paved portion of thirty-six feet (36'), measured flow line to flow line. Pinch points for traffic calming and pedestrian crossing will be considered.
4. Alleys (where permitted), twenty feet (20');
5. Crosswalk easements, ten feet (10');
6. Drainage easements, ten feet (10'), or larger if so required by the Town Engineer;
7. Half-streets shall not be permitted, except when required to complete a half-street already in existence;
8. Minimum street gradient for all streets shall be four-tenths of one percent (0.4%). Maximum street gradient shall be eight percent (8%). Streets shall not exceed a gradient of four percent (4%) within one hundred feet (100') of an intersection. Vertical curves shall be used at changes of grade exceeding one percent (1%) and shall be designed to provide a minimum sight distance of two hundred feet (200') except for arterial streets which shall be subject to state and federal standards. To insure adequate sight distance, when street roadway lines deflect more than five degrees, connection shall be made by horizontal curves.

9. Where a street classified as arterial intersects with any other arterial street, no on-street parking shall be allowed on the arterial street within one hundred feet of the intersection. If the arterial street consists over its general length of only two traffic lanes, then a third lane shall be provided and stripes painted to the specifications of the Town Engineer to enable vehicles to make left turns at such intersections without impeding other traffic;
10. All utilities shall be installed before streets or alleys are surfaced.
11. Subdivision as-builts shall show dedicated rights-of-way;
12. All sewer and water utilities shall clearly show:
 - a. Invert in, invert out, and rim elevation on all manholes;
 - b. Locate all valves, manholes, fire hydrants and/or other utilities with at least two (2) ties from discernible objects;
 - c. Distance and slope between manholes to be noted as offsets to mains from curbs or property lines;
 - d. Dimension existing and/or added water and sewer taps from lot corners or readily discernible objects. Sewer taps shall have additional dimensions from the tap to the downstream manhole;
 - e. All dimensions to be from fixed permanent or readily discernible objects. Where water and sewer taps are located from lot lines, front footage will be noted from fixed and permanent point of origin;
 - f. Depth of the lateral or service line shall be noted at the property line.

Alleys and Easements.

Paved alleys may be provided and shall be required unless other provisions are made and approved for service access. Easements for utility purposes shall be required along all sides and real lot lines except those bordering dedicated streets and alleys.

Drainage. Drainage easements and improvements shall be designed by a registered engineer to accommodate expected run-off as determined by the drainage plan. Improvements shall be installed to specification by the Town Council through their designated representative. All drainage improvements described herein shall be the financial responsibility of the subdivider, except as may be provided otherwise in this Public Works Manual or Town Council.

The rate of runoff from any developed area shall not exceed the historic rate of runoff based on a twenty-five (25) year rainfall event.

The following methods of runoff estimation shall be utilized for determining the rate of runoff from a particular site as applicable:

1. Rational Method: Used for Drainage Basins less than 20 acres in size and for minor system design.
2. SCS TR 55 Methods: Used for drainage basins up to 20 square miles in size. Also used for flood flow determination and design in minor and major systems. Also used to compute flood storage volumes.
3. Unit Hydrograph: Used for drainage basins up to 1000 square miles in size. Also used for flood flow determination and design in minor and major systems. Also used to compute flood storage volumes.

General Utilities.

In the event oversized utilities are required, the developer or subdivider may request that Town Council consider an agreement or other arrangements for reimbursements shall be made and approved by Town Council, whereby the developer shall be allowed to recover the cost of the utilities that have been provided by him beyond the needs of his development and standard Town specifications. Any such cost-recovery agreement must be approved by Town Council.

The method and time of payment under the reimbursements shall be established in accordance with the current policies of the Town relating to the placement of such oversized utilities.

Water Distribution. The water main distribution system shall be designed to connect with the Town water system and make water available to each lot in the proposed subdivision. Each lot must be provided with an individual service line. Fire hydrants shall be located to ensure protection to each lot, but under no circumstances shall a lot be more than three hundred feet from the nearest hydrant based on front line distance. Design of the system shall be the responsibility of the subdivider with all plans subject to approval of the Town Council through their designated representatives. Installations of the system shall be to Town specifications and at the direction of the Town Council through their designated representatives. Financial responsibility for the water distribution system shall be subject to existing Town regulations and agreement relating thereto between the Town Council and the subdivider, except as may be provided otherwise in this Public Works Manual.

Sanitary Sewage Collection.

If the Town is to supply sanitary sewage collection, the sewage collection system shall be

designed to connect with the Town system and provide an individual service line to each lot in the proposed subdivision. Design of the system shall be the responsibility of the subdivider with all plans subject to the approval of the Town Council through their designated representative. Financial responsibility for the sanitary sewage collection system shall be subject to existing Town regulations and agreements relating thereto between the Town Council and the subdivider, except as may be provided otherwise in the Public Works Manual or by Town Council.

All Other Utilities.

Other utilities serving individual lots including, but not limited to, electrical lines, gas lines, or telecommunication lines, shall be buried and connected separately from the exterior of each lot unless an exemption is granted by the Building Official. Facilities necessary and appurtenant to underground facilities or other installation of peripheral overhead electrical transmission and distribution feeder lines, or other installation of either temporary or peripheral overhead communications, distance, trunk, or feeder lines may be above ground.

Sidewalks.

Sidewalks are required on both sides of all streets and shall be at least five feet (5') wide for residential streets and five feet (5') to six feet (6') wide for collector streets. Local residential streets shall have mountable curb and gutter with sidewalks separated from the curb by a landscape buffer measuring five feet, four inches (5'-4"). Collector streets shall have vertical curb and gutter with sidewalks separated from the curb by a landscape buffer measuring five feet, four inches (5'-4"). Design of sidewalks in commercial and industrial areas shall be approved by the Planning Commission. Permanent objects within the landscape buffers are prohibited, except as may be provided otherwise in the Public Works Manual or by Town Council

When right-of-way, geographic, or topographic limitations prevent sidewalks on both sides of the street, then a single sidewalk shall be provided and shall be at least six feet (6') wide. In such cases alternate pathways shall be provided to accommodate pedestrians.

All sidewalks shall be ramped at all street intersections or other pedestrian crossing areas. The design and construction of sidewalk ramps must meet the applicable requirements of the "Americans with Disabilities Act" (ADA). **Signing and Striping Plans.**

A complete signing and striping plan shall be submitted as part of the construction drawings. This plan shall include all project streets and intersections and all intersections with existing streets. The design of these improvements shall be in accordance with the MUTCD and shall include all necessary traffic control signage. Street name signs shall be installed at all intersections. The developer will be responsible for their installation.

Bicycle Paths.

Developers, when required, shall install a bicycle path at least eight feet (8') in width along the right-of-way of any sub-arterial street and any arterial street which is not bordered by a frontage road. The initial site of the path along any street shall be determined by the Planning Commission and the Town Engineer. Each developer who extends the path shall keep the path continuous and with as little change in grade as possible. If topography necessitates that the path change from one side of the street to the other, or if the path intersects with another arterial or sub-arterial street, crossways shall be provided. All bicycle paths shall be ramped at intersections. Paths and crossways shall meet construction and design standards set by the Town Council through their designated representatives. Any bike path constructed as part of the New Castle Trail System shall be constructed in accordance with the design requirements of the New Castle Trail System Planning Program.

Street Lighting.

The developer shall install street lights at points designated by the Town or Public Service Company. The poles for such lights shall be metal and the design of both poles and the lights themselves shall meet specifications established by the Town Council through their designated representatives.

Snow Storage

All newly constructed streets shall be designed to accommodate snow storage. Turf areas, without obstructions, may be utilized for this purpose. A minimum functional area equaling fifteen percent (15%) of the paved area shall be provided contiguous to the right-of-way. Individual snow storage areas shall not be separated by more than 300 feet. Obstructions in the snow storage areas include fences, utility boxes, bushes and large landscape boulders.

Project Acceptance Procedure.

Initial Submittal

1. Acceptance Request Letter
2. Pre-final "As-built" Drawings
3. Stamped certification letter from design engineer verifying all improvements were built to meet the requirements of the Town of New Castle. Copies of all tests performed shall be included.
4. Support documentation (installation and operation manuals) of those facilities and equipment constructed/installed as part of project.
5. Submittal detailing any and all specific requirements (as listed below) and

actions taken to meet these requirements.

- a) Subdivision Improvement Regulations
- b) Zone District Regulations
- c) Commitments or Requirements made during Public Hearing
- d) Contractual Agreements
- e) Annexation Agreements
- f) Any/All Other

Town Review of Submittals

Response to Initial Submittal shall be given by the Town within thirty (30) days after receiving all required material. This response shall be as listed below:

1. Staff recommendation to the Town Council accepting improvements as is.
2. Staff recommendation to the Town Council accepting improvements under specific conditions. A document of specific conditions shall be included.
3. Letter to the developer listing specific inadequacies in the Submittals or improvements. The developer must resubmit request for project acceptance once these inadequacies have been addressed.

Final Acceptance.

When all requirements of the Project Acceptance Procedure have been met, the developer/owner shall have submitted "final as-builts" as defined herein. The warranty period shall start on the date of official Town Board acceptance. No building permits will be issued until Final Acceptance has been made.

"As-Built" Plans.

Finished plans of all public improvements shall be required before the Town will accept the improvements. As-built drawings shall include, but are not limited to, the following requirements:

- A. Detailed and accurate information on all improvements completed as part of a project. Locations, dimensions, elevations, types of material, and all other information needed to provide a comprehensive and complete representation of the final project shall be included. Rights of way and easement lines shall also be shown.
- B. Pre-final as-builts shall be submitted on completion of all work within a phase of the development, and the final as-built plans shall be received before final acceptance.
- C. Pre-final as-builts will be submitted for review and/or correction. Pre-finals will be four

each, blue line.

- D. Final as-builts will be submitted as Autocad or DXF drawings and reproducible mylar and will become property of the Town of New Castle and a part of permanent Town records.
- E. Final "As-Built" drawings shall be submitted before final acceptance of improvements. They shall be stamped "As-Builts" and be signed as such by a Registered Professional Engineer.
- F. No building permits will be issued until steps A through E above are completed.

Acceptance at Warranty Expiration.

Acceptance of Utility Improvements

The warranty period for new utility improvements, including water distribution, sanitary sewer collection, street lighting, signage and striping shall expire after the duration specified in section 16.32.020 (B) of the New Castle Municipal Code unless otherwise required by Town Council. Within thirty (30) days of the warranty's expiration, the subdivider/developer shall request a reinspection of the utility improvements. When the Town finds that the utility improvements meet Town standards, they shall acknowledge acceptance of the utility improvements to the subdivider/developer by way of written letter.

Acceptance of Street Improvements

The warranty period for newly constructed streets, including travel lanes, bike lanes, parking lanes, and sidewalks, shall expire after the duration specified in section 16.32.020 (B) of the New Castle Municipal Code unless otherwise provided by Town Council. The subdivider/developer shall be responsible for requesting an inspection of the street improvements at the end of the warranty period. When the Town finds that the street improvements meet Town standards, performance indicators, and threshold values, they shall acknowledge acceptance of the street improvements to the subdivider/developer by way of a written letter. Warranty work will be required when the threshold limits for a condition parameter has been exceeded and the maximum allowable number of defects was exceeded for one or more condition parameters. The warranty criteria and recommended corrective actions are shown in tables 1 and 2 below.

Table 1. Warranty Thresholds and Requirements		
Condition Parameter	Threshold Limits Per Segment (Segment Length = 528 Feet)	Maximum Segment Per Driving Lane Mile
Longitudinal Crack	30% of segment length	1
Longitudinal Joint Crack	10% of segment length	1
De-bonding	5% of segment length	1
Raveling	8% of segment Length	1
Flushing	4% of segment length	1
Rutting	Average rut depth = 1/4 inch	1
Condition Parameter		
	Threshold Limits Per Segment (Segment Length = 7 Feet)	Maximum Segment Per Driving Lane Mile
Deflection caused by settlement	Maximum deflection depth = 3/8 inch	1
Condition Parameter		
	Threshold Limits Per Segment (Segment Length = 1 mile)	Maximum Segment Per Driving Lane Mile
Transvers crack	15 Cracks	1

Table 2. Recommended Corrective Actions	
Condition Parameter	Recommended Action
Longitudinal Crack	Cut and seal
Longitudinal Joint Crack	Cut and seal
De-bonding	2 inch mill and resurface
Raveling	2 inch mill and resurface
Flushing	2 inch mill and resurface
Rutting	2 inch mill and resurface
Deflection caused by settlement	Sub soil mitigation, full depth mill and resurface
Transvers crack	2 inch mill and resurface

CHAPTER II

A. TYPICAL WATER UTILITY DETAILS WA-

B. TYPICAL SEWER UTILITY DETAILS SW-

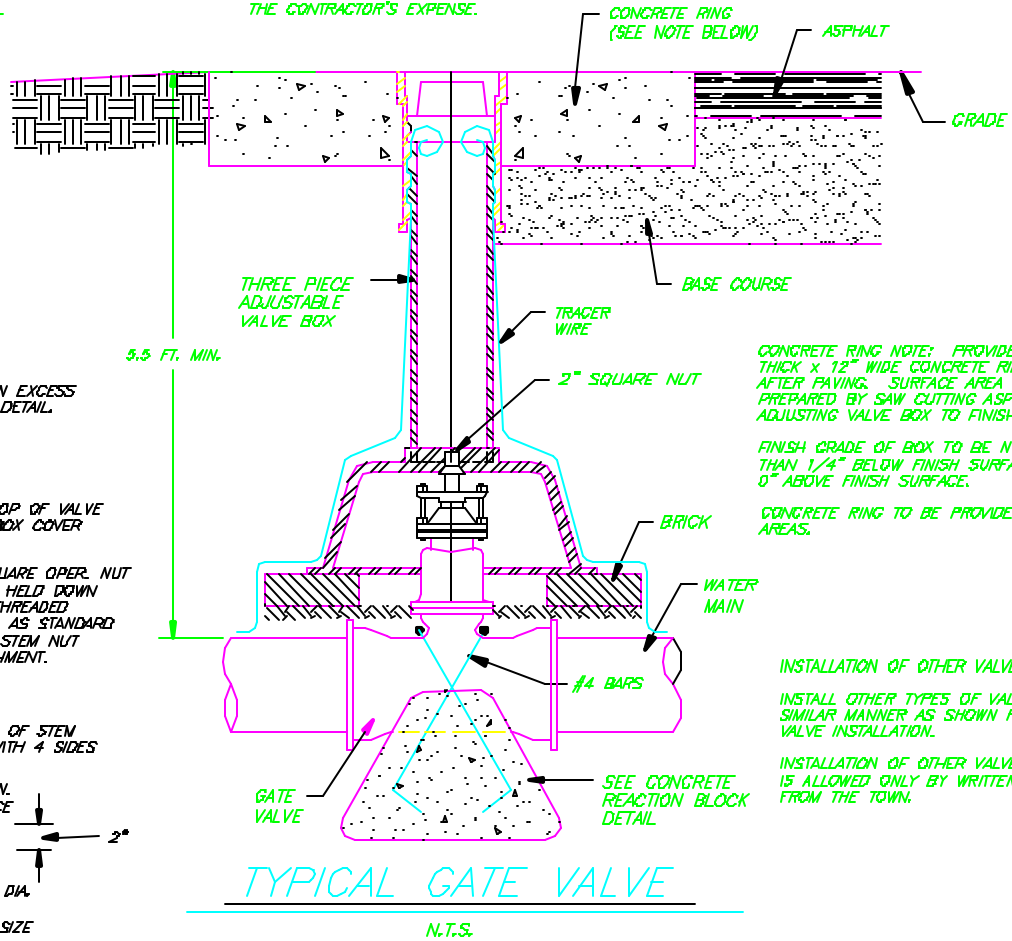
**C. TYPICAL STREET CROSS-SECTION DETAILS
ST-**

**D. TYPICAL ROADWAY AND DRAINAGE DETAILS
DR-**

NOTE: IN UNPAVED AREAS, PROVIDE A SLIGHT GRADE FOR FINISH GRADE AWAY FROM TOP OF VALVE BOX. SEE CONCRETE RING NOTE FOR PLACEMENT OF CONCRETE RING IN UNPAVED AREAS.

NOTES:

1. ALL VALVES ADJACENT TO FITTING SHALL BE FLANGE X MM. FITTING SHALL BE FLANGED NEXT TO VALVE. LINE VALVES TO BE MM X MM.
2. DESIGN LOCATIONS OF VALVES ARE OUTSIDE OF CONCRETE CURB/GUTTER AND VALLEY PANS. INSTALLED VALVES WHICH CONFLICT WITH CONCRETE AREAS SHALL BE RELOCATED AT THE CONTRACTOR'S EXPENSE.



CONCRETE RING NOTE: PROVIDED A 5" THICK X 12" WIDE CONCRETE RING PLACED AFTER PAVING. SURFACE AREA SHALL BE PREPARED BY SAW CUTTING ASPHALT AND ADJUSTING VALVE BOX TO FINISH GRADE.

FINISH GRADE OF BOX TO BE NO MORE THAN 1/4" BELOW FINISH SURFACE AND 0" ABOVE FINISH SURFACE.

CONCRETE RING TO BE PROVIDED IN ALL AREAS.

INSTALLATION OF OTHER VALVE TYPES:

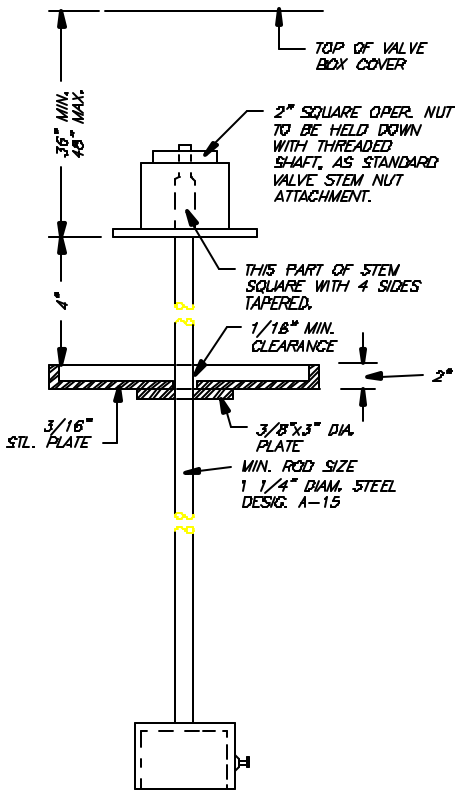
INSTALL OTHER TYPES OF VALVES IN A SIMILAR MANNER AS SHOWN FOR THE GATE VALVE INSTALLATION.

INSTALLATION OF OTHER VALVE TYPES IS ALLOWED ONLY BY WRITTEN APPROVAL FROM THE TOWN.

TYPICAL GATE VALVE

N.T.S.

NOTE: FOR WATERLINE DEPTHS IN EXCESS OF 6', SEE DEEP VALVE SETTING DETAIL.



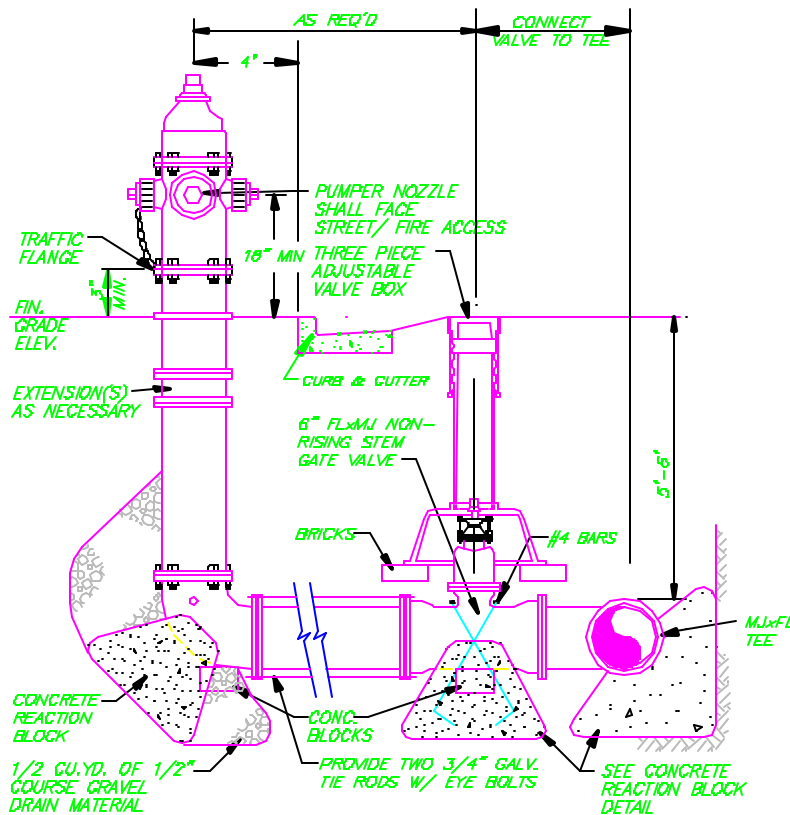
DEEP VALVE SETTING

GATE VALVE & VALVE BOX DETAIL

TOWN OF NEW CASTLE

NOT TO SCALE

DWG: WA-10



- NOTES: 1) ALL JOINTS FROM MAIN TO HYDRANT SHALL BE HARNESSED MECHANICAL JOINTS OR FLANGED JOINTS.
- 2) HYDRANT, VALVE AND FITTINGS TO BE 250 P.S.I. RATED.
- 3) POLYETHYLENE WRAP SHALL COVER D.I.P. ASSEMBLY FROM HYDRANT BASE TO WATER MAIN.
- 4) ALL HYDRANT LEAD PIPING TO BE 6" D.I.P.
- 5) CENTERLINE OF HYDRANT TO BE 4'-0" FROM BACK OF CURB UNLESS OTHERWISE NOTED.
- 6) FOR FIRE HYDRANTS ON END OF WATER LINE.
- 7) CARE SHOULD BE TAKEN TO ASSURE THAT WEEP HOLE REMAINS FREE DRAINING.

FIRE HYDRANT ASSEMBLY INSTALLATION DETAIL

FIRE HYDRANT
SETTING DETAIL

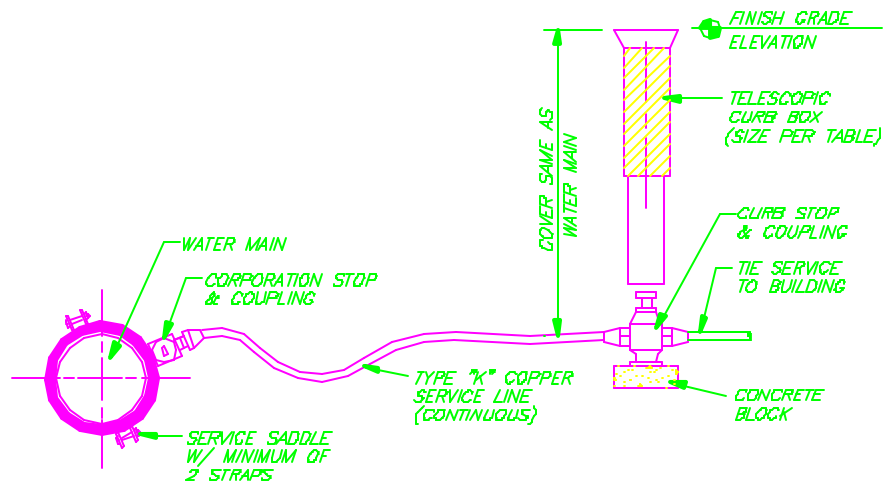
TOWN OF NEW CASTLE

NOT TO SCALE

DWG: WA-20

SERVICE PIPE	CORP. STOP	CURB STOP	SERVICE BOX
3/4"	3/4"	3/4"	3"
1"	1"	1"	3"
1 1/4"	1 1/4"	1 1/4"	3"
1 1/2"	1 1/4" - 1 1/2"	1 1/2"	3"
2"	1 1/2" - 2"	2"	3"

NOTE: CONTRACTOR TO VERIFY THE REQUIRED SERVICE SIZE WITH THE TOWN PRIOR TO INSTALLATION. THE TOWN WILL REQUIRE INDIVIDUAL DEMAND REQUIREMENTS BY THE SERVICE PRIOR TO SERVICE SIZE VERIFICATION.



TYP. WATER SERVICE DETAIL

NOTE:

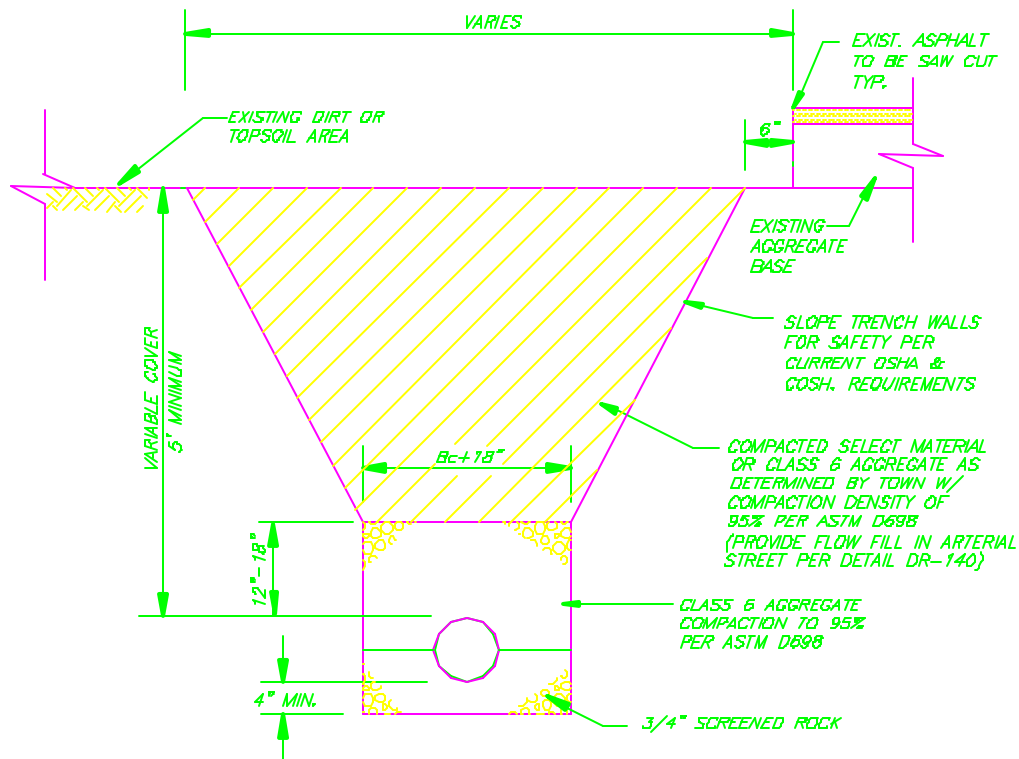
1. LEAVE CORPORATION STOP AT MAIN IN THE "ON" POSITION.
2. LOCATE THE CURB STOP (AND SERVICE BOX) ON PRIVATE PROPERTY WITHIN TWO (2') FEET OF THE PROPERTY LINE OR AS APPROVED BY THE TOWN.
3. DIRECT TAPS ARE AN ACCEPTABLE ALTERNATIVE GIVEN WRITTEN TOWN APPROVAL.

WATER SERVICE
INSTALLATION DETAIL

TOWN OF NEW CASTLE

NOT TO SCALE

DWG: WA-30



- 1) PAVEMENT REPLACEMENT SHALL MEET EXISTING THICKNESS AND KIND WITH THE FOLLOWING MINIMUMS: ASPHALT SURFACING = 3" MIN., AGGREGATE BASE COURSE = 8" MIN.
- 2) FOR UNPAVED SURFACES, BASE COURSE REPLACEMENT SHALL MEET EXISTING THICKNESS WITH THE FOLLOWING MINIMUMS: AGGREGATE BASE COURSE = 12" MIN.
- 3) DIRT / TOPSOIL PLACEMENT SHALL MEET EXISTING THICKNESS AND KIND WITH THE FOLLOWING MINIMUMS: 4" TOPSOIL.
- 4) SELECT MATERIAL AS FOLLOWS: 6" MAXIMUM SIZE IN TOP 12" OF BACKFILL
12" MAXIMUM SIZE IN REMAINDER OF BACKFILL
- 5) PROVIDE TRACER WIRE TAPED TO THE TOP OF PIPE FOR PVC INSTALLATIONS.
(TYPE OF TAPE TO BE APPROVED BY THE TOWN.)
- 6) PROVIDE POLYETHYLENE WRAP AROUND DUCTILE IRON PIPE INSTALLATIONS. USE A MINIMUM OF 12" LAPS WITH THE POLYETHYLENE WRAP. TAPE WRAP WITH TOWN APPROVED TAPE AT 3'-0" O.C.
- 7) DETAIL ABOVE FOR "DRY TRENCH" CONDITIONS. FOR UNSTABLE OR "WET TRENCH" CONDITIONS PROVIDE A MINIMUM OF 4" OF 1 1/2" SCREENED ROCK UNDER BEDDING MATERIAL WITH FILTER FABRIC PLACED BELOW AND ABOVE THE SCREENED ROCK.

TRENCH CROSS SECTION

SCALE: 3/4" = 1'-0"

STANDARD WATER
MAIN TRENCH SECTION

TOWN OF NEW CASTLE

NOT TO SCALE

DWG: WA-40



SCHMUESER | GORDON | MEYER

MEMORANDUM

TO: Chris Hale, P.E.
Enartech, Inc
P.O. Drawer 160
Glenwood Springs, CO 81602

FROM: Jefferey S. Simonson, P.E.

DATE: 10-29-2002

SUBJ: Lakota Canyon Ranch
Water line cover requirements

Chris,

Per your request, I have evaluated the Public Works Manual and have determined the following information exists regarding waterline cover requirements for the Town of New Castle. Please note the following:

1. Detail WA-10, Gate Valve and Valve Box Detail denotes a 5.50 foot depth of cover.
2. Detail WA-20, Fire Hydrant Setting Detail denotes a 5'-6" depth of cover requirement.
3. Detail WA-40, Standard Water Main Trench Section denotes a depth of cover of 5'-0".
4. Section 2300.3.05.A. denotes the minimum bury of 5 ½ feet to the top of pipe being required.

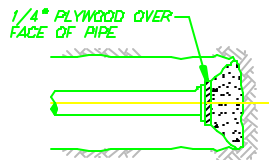
Based upon my review of the Public Works Manual, it appears that Detail WA-40 was incorrectly dimensioned when denoted with a depth of cover of 5'-0". The remaining references in the Public Works Manual depict the 5 ½' depth of cover requirement. As waterline has not been installed, we presume that you will direct the contractor to modify the depth as depicted on your drawing to 5 ½' instead of 5'-0".

Please call with any questions.

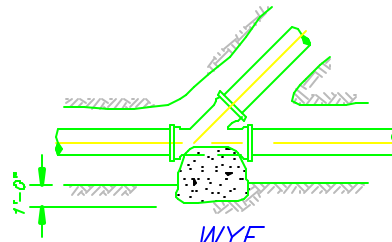
Thanks

Jeff S.

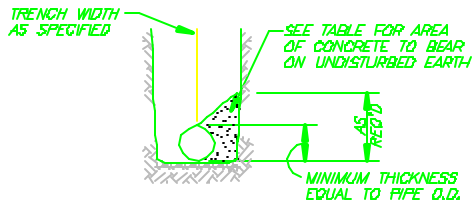
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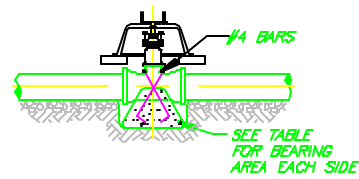
DEAD END



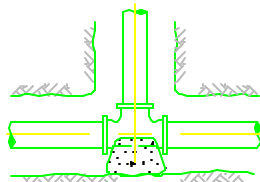
WYE



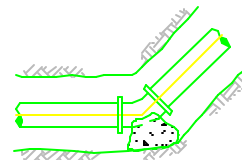
SECTION



GATE VALVE



TEE



90°, 45°, 22.5°, OR 11.25°
ELBOW, HORIZONTAL OR
BOTTOM OF VERTICAL

SIZE (INCHES)	ELBOWS				TEES & DEAD ENDS	GATE VALVES
	90° (SQ. FT.)	45° (SQ. FT.)	22.5° (SQ. FT.)	11.25° (SQ. FT.)		
4	1.8	1.0	0.5	0	1.3	0.5
6	4.0	2.2	1.1	0	2.8	0.7
8	7.1	3.8	2.0	1.0	5.0	2.4
10	11.1	6.0	3.0	1.5	7.8	4.5
12	16.0	8.6	4.4	2.2	11.3	7.3
14	21.7	11.8	6.0	3.0	15.4	11.0
16	28.4	15.3	8.0	4.0	20.0	16.6
18	36.0	19.4	10.0	5.0	25.4	24.9

AREAS GIVEN IN TABLE ARE BASED UPON AN INTERNAL STATIC PRESSURE OF 100 P.S.I. AND A SOIL BEARING CAPACITY OF 1000 LBS. PER SQ. FT. BEARING AREAS FOR ANY PRESSURE AND SOIL BEARING CAPACITY MAY BE OBTAINED BY MULTIPLYING THE TABULATED VALUES BY A CORRECTION FACTOR "F".

F = $\frac{\text{ACTUAL SPECIFIED TEST PRESSURE IN HUNDREDS OF LBS.}}{\text{ACTUAL SOIL BEARING CAPACITY IN THOUSANDS OF LBS. PER SQ. FT.}}$

INSTALLATION OF THRUST BLOCKS ARE NOT ALLOWED FOR CONDITIONS OUTSIDE OF THOSE LISTED UNTIL SUBMITTAL OF CALCULATIONS FOR THE CORRECTION FACTOR ARE SUBMITTED TO AND REVIEWED BY THE TOWN AND WRITTEN APPROVAL BY THE TOWN IS GIVEN.

TABLE OF BEARING AREAS IN SQ. FT.

TYP. CONCRETE REACTION BLOCK DETAILS

THRUST BLOCKING
DETAILS

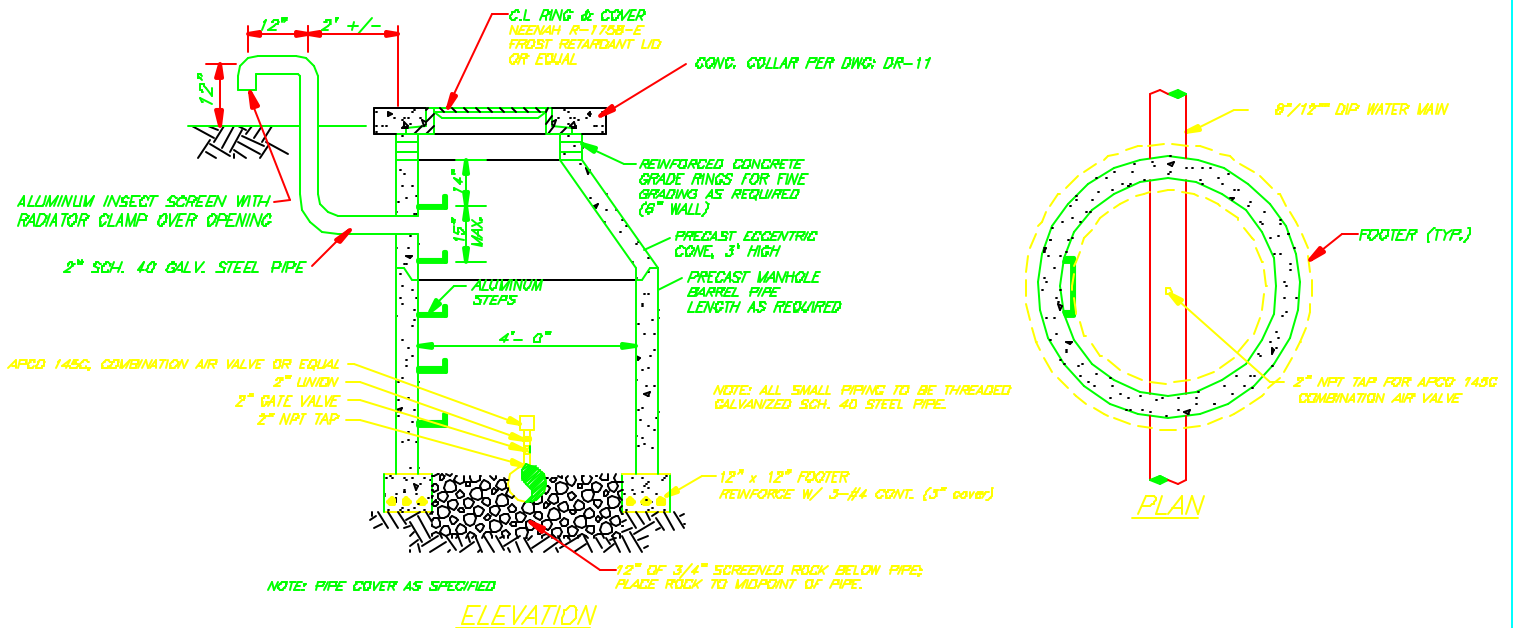
TOWN OF NEW CASTLE

NOT TO SCALE

DWG: WA-50

MANHOLE CONSTRUCTION NOTES:

1. Use Rub-R-Nak preformed gasket (2 layers) or grout in place between all bottom section, barrel sections, concrete grade rings, and top castings.
2. Backfill within 24" of manhole: Class 2 aggregate or native materials with less than 3" size.
3. Precast rings or metal riser ring course shall be utilized where required with 2 courses minimum and 12 courses maximum (2 minimum, 12" maximum height).
4. Grade adjustment as follows: Greater than, or equal to, 1 foot, concrete barrel sections; less than 1 foot, concrete or metal grade rings.
5. Finish grade as follows: with asphalt or concrete pavements flush; with base course surface or dirt/topsoil -3" below grade.



COMBINATION AIR VALVE MANHOLE DETAIL

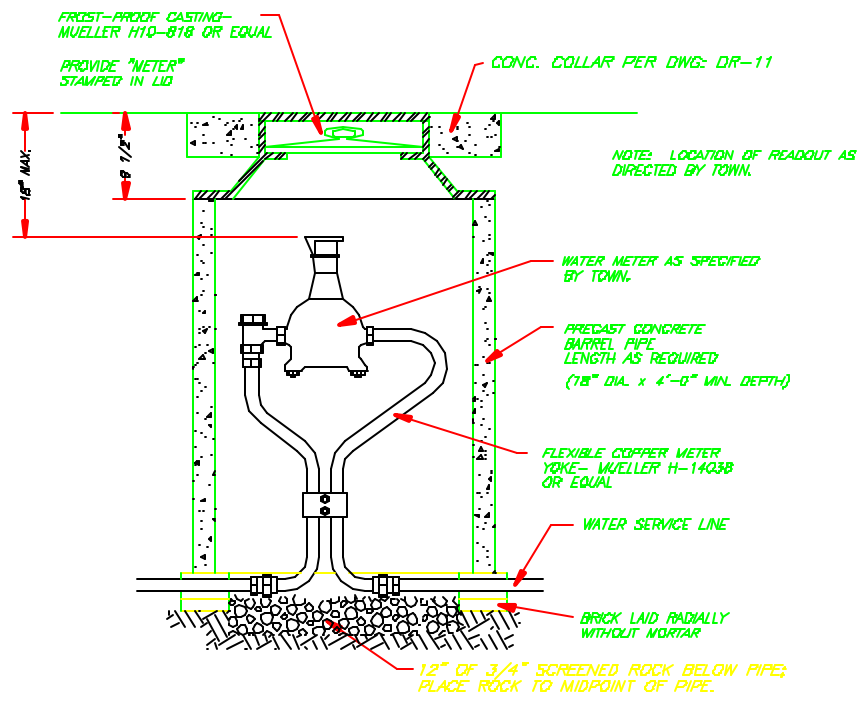
N.T.S.

COMBINATION AIR VALVE MANHOLE

TOWN OF NEW CASTLE

NOT TO SCALE

DWG: WA-60



OUTSIDE METER SETTING DETAIL

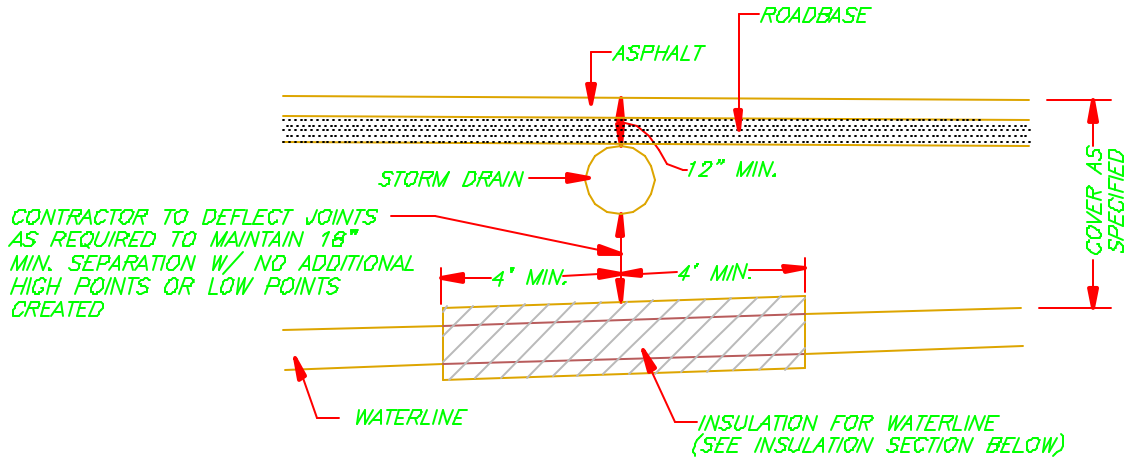
N.T.S.

OUTSIDE METER
 SETTING DETAIL

TOWN OF NEW CASTLE

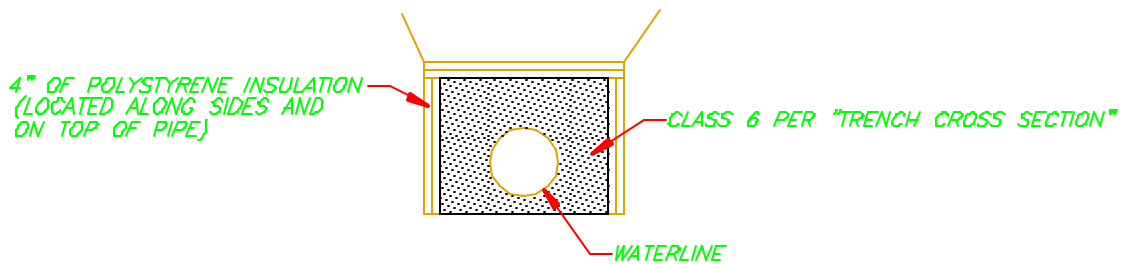
NOT TO SCALE

DWG: WA-70



ELEVATION WATERLINE/CULVERT CROSSING

NO SCALE



INSULATION SECTION

NO SCALE

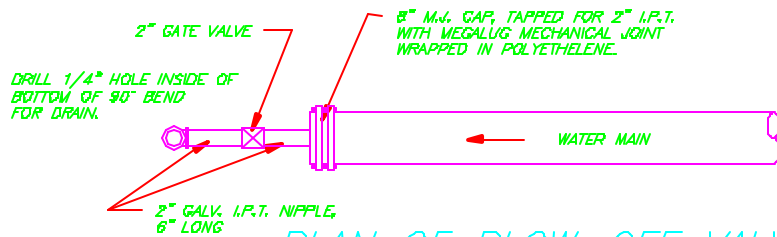
NOTE: AS DRAWN, THE INSULATION DETAIL ADDRESSES CULVERT CROSSINGS. PROVIDE THE SAME DETAIL FOR THOSE INSTANCES WHERE THE WATERLINE IS INSTALLED WITHIN 5' OF OPEN AIR.

WATERLINE INSULATION
DETAIL

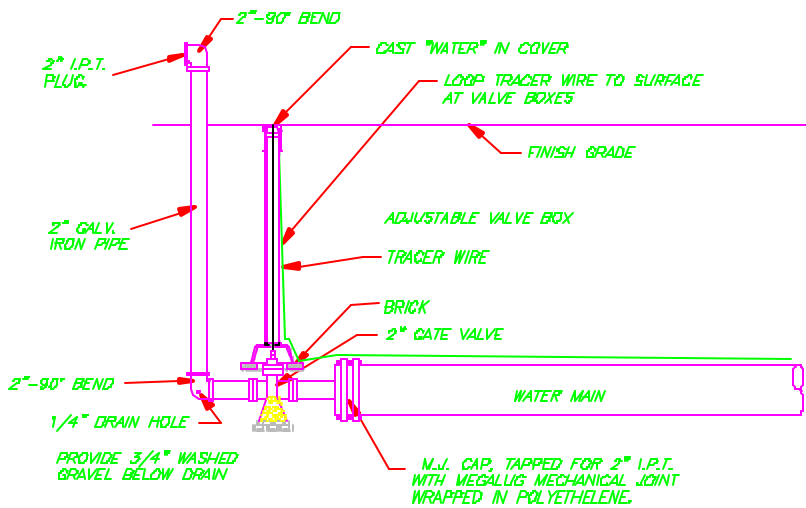
TOWN OF NEW CASTLE

NOT TO SCALE

DWG: WA-80



PLAN OF BLOW-OFF VALVE
NO SCALE



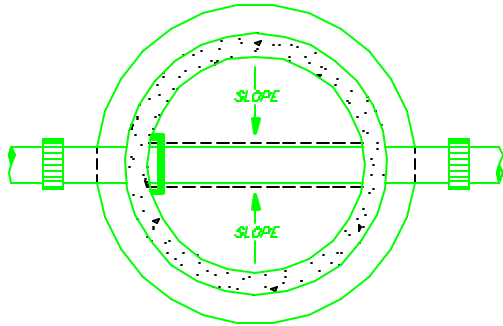
ELEVATION OF BLOW-OFF VALVE
NO SCALE

BLOW OFF
DETAIL

TOWN OF NEW CASTLE

NOT TO SCALE

DWG: WA-90



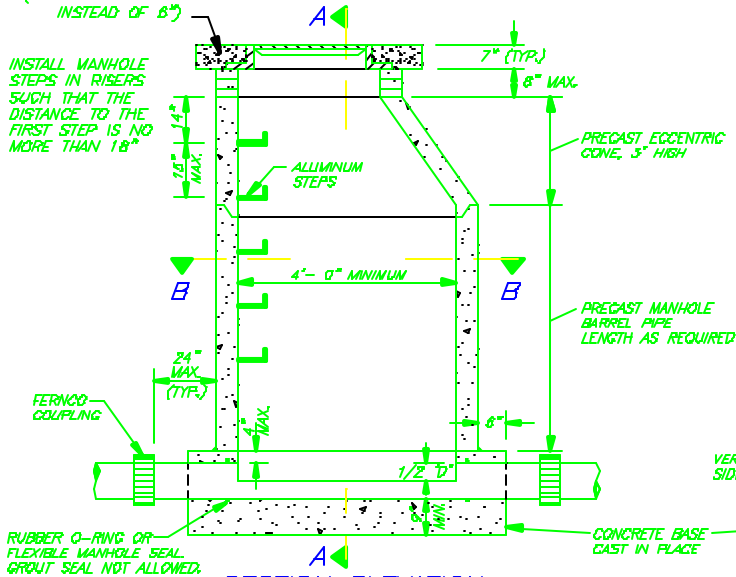
NOTES:

1. All bases shall be cast in place or precast concrete; use #4 rebar on 12" c-c both ways in poured bases.
2. Joint to be located on each side of all manholes, maximum of 24" from inside face.
3. Where available from pipe manufacturer, use expandable water stop or special sleeve as per manufacturer's specifications.
4. Slope to be located on side of bench or over upstream pipe.
5. Use Rub-R-Nek preformed gasket (2 layers) or grout in place between all bottom section, barrel sections, concrete grade rings, and top castings.
6. Backfill within 24" of manhole: Class 6 aggregate or native materials with less than 3" size.
7. Precast rings or metal riser ring course shall be utilized where required with 2 courses minimum and 12 courses maximum (2" minimum, 12" maximum height).
8. Grade adjustment as follows: Greater than, or equal to, 1 foot, concrete barrel sections; less than 1 foot, concrete or metal grade rings.
9. Finish grade as follows: With asphalt or concrete pavements flush with base course surface or dirt/topsoil -3" below grade.

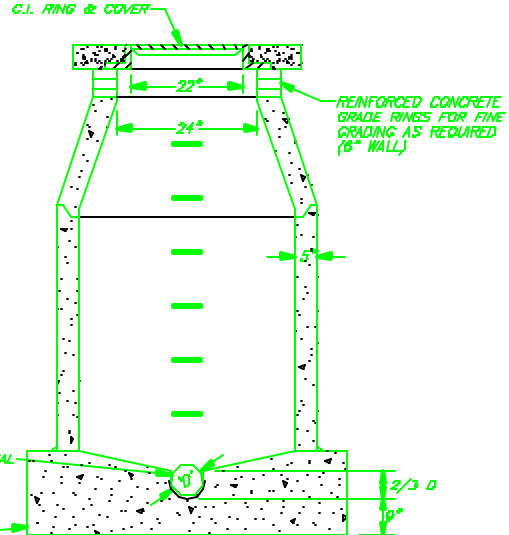
CONCRETE COLLAR PER
DWG: DR-11
(PROVIDE 7" DEPTH
INSTEAD OF 6")

SECTION B - B

INSTALL MANHOLE
STEPS IN RISERS
SUCH THAT THE
DISTANCE TO THE
FIRST STEP IS NO
MORE THAN 18"



SECTION ELEVATION



SECTION A - A

STANDARD MANHOLE DETAIL

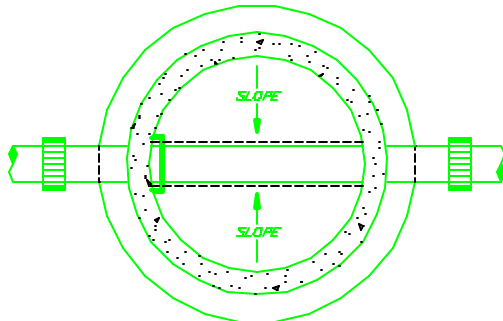
N.T.S.

STANDARD SEWER
MANHOLE DETAIL

TOWN OF NEW CASTLE

NOT TO SCALE

DWG: SW-10

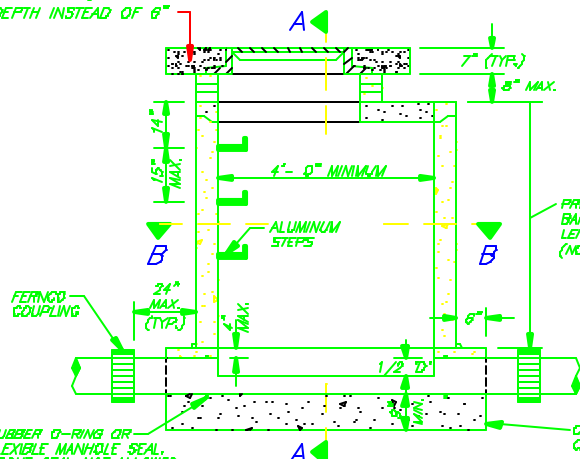


SECTION B - B

CONCRETE COLLAR PER DWG: DR-11, PROVIDE 7" DEPTH INSTEAD OF 6"

NOTES:

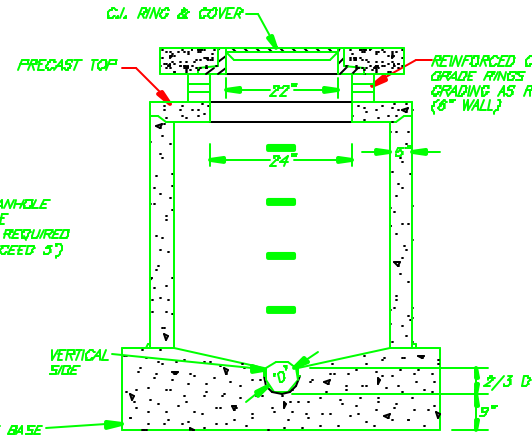
1. All bases shall be cast in place or precast concrete; use #4 rebar on 12" c-c both ways in poured bases.
2. Joint to be located on each side of all manholes, maximum of 24" from inside face.
3. Where available from pipe manufacturer, use expandable water stop or special sleeve as per manufacturer's specifications.
4. Steps to be located on side of bench or over upstream pipe.
5. Use Rub-R-Nek preformed gasket (2 layers) or grout in place between all bottom section, barrel sections, concrete grade rings, and top castings.
6. Backfill within 24" of manhole: Class B aggregate or native materials with less than 3" size.
7. Precast rings or metal riser ring course shall be utilized where required with 2 courses minimum and 12' course maximum (2' minimum, 12" maximum height).
8. Grade adjustment as follows: Greater than, or equal to, 1 foot, concrete barrel sections; less than 1 foot, concrete or metal grade rings.
9. Finish grade as follows: With asphalt or concrete pavements flush with base course surface or dirt/topsoil -3" below grade.



SECTION ELEVATION

RUBBER O-RING OR FLEXIBLE MANHOLE SEAL, GROUT SEAL NOT ALLOWED.

PRECAST MAN-HOLE BARREL PIPE LENGTH AS REQUIRED (NOT TO EXCEED 5')

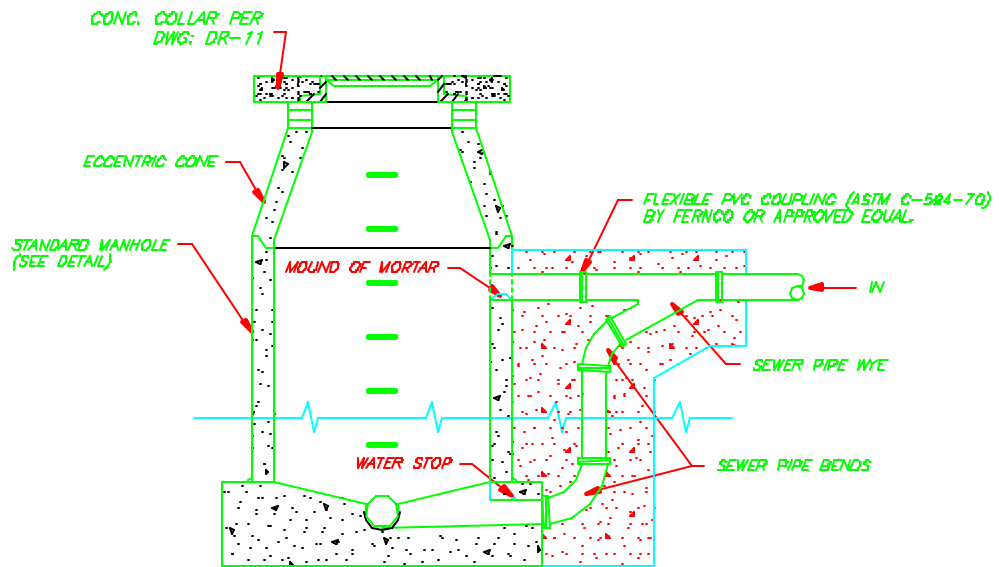


SECTION A - A

SHALLOW MANHOLE DETAIL

N.T.S.

SHALLOW SEWER MANHOLE DETAIL	
TOWN OF NEW CASTLE	
NOT TO SCALE	DWG: SW-20



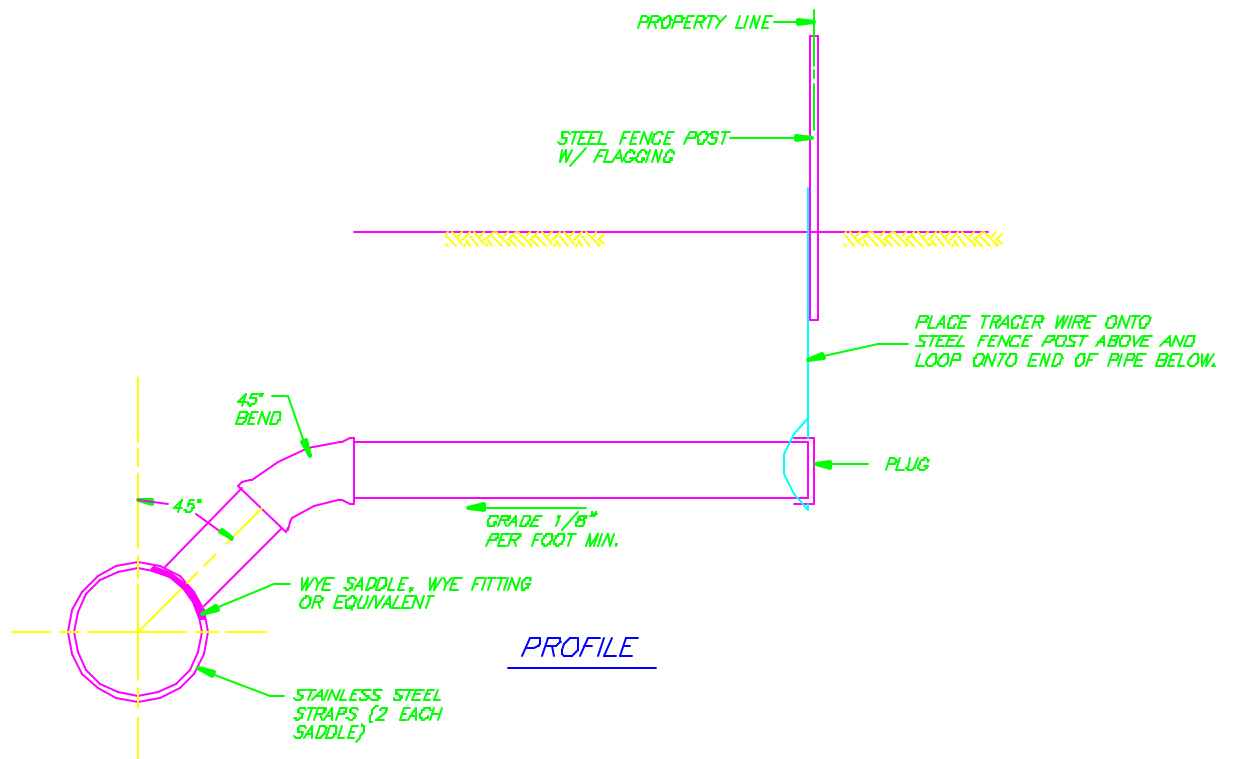
DROP CONNECTION TO STANDARD MANHOLE

DROP MANHOLE
CONNECTION DETAIL

TOWN OF NEW CASTLE

NOT TO SCALE

DWG: SW-30



- 1) IN-LINE WYE FOR EXISTING STRUCTURES
- 2) WYE SADDLE FOR OTHER SERVICES.
- 3) BACKFILL UNDER WYE TO BE SCREENED ROCK OR CLASS 6 AGGREGATE,
95% COMPACTION DENSITY PER ASTM D-698.
- 4) MINIMUM COVER - 5 FEET.

STANDARD SEWER SERVICE CONNECTION DETAIL

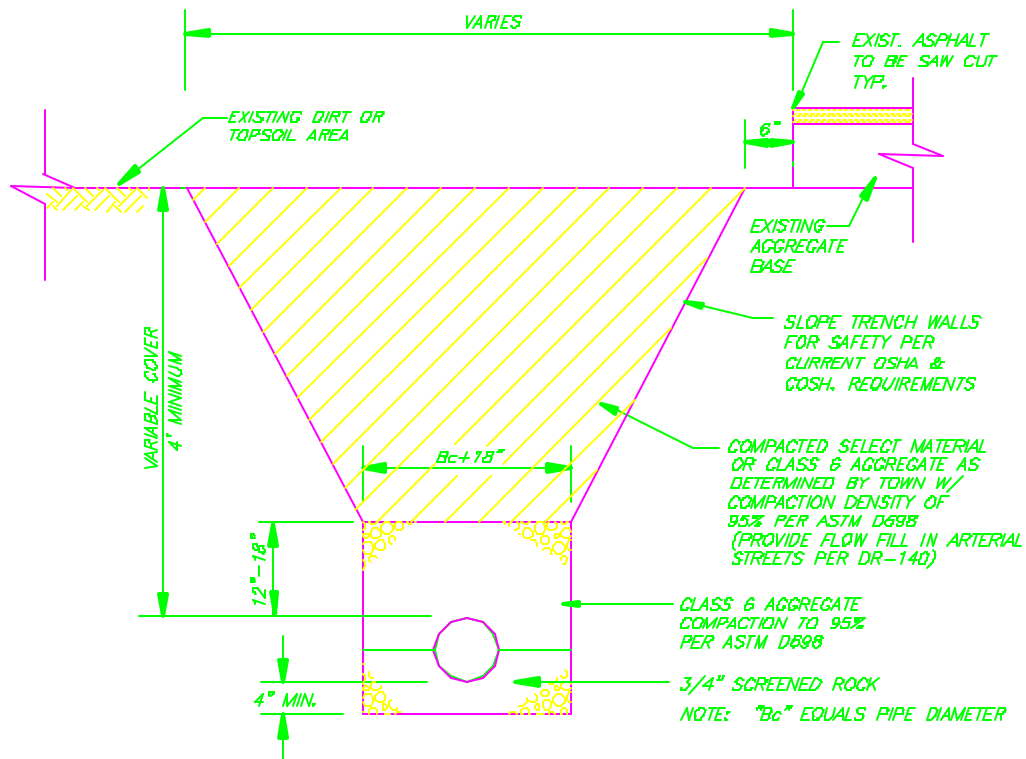
N.T.S.

SEWER SERVICE
CONNECTION DETAIL

TOWN OF NEW CASTLE

NOT TO SCALE

DWG: SW-40



- 1) PAVEMENT REPLACEMENT SHALL MEET EXISTING THICKNESS AND KIND WITH THE FOLLOWING MINIMUMS: ASPHALT SURFACING = 3" MIN., AGGREGATE BASE COURSE = 8" MIN.
- 2) FOR UNPAVED SURFACES, BASE COURSE REPLACEMENT SHALL MEET EXISTING THICKNESS WITH THE FOLLOWING MINIMUMS: AGGREGATE BASE COURSE = 12" MIN.
- 3) DIRT / TOPSOIL PLACEMENT SHALL MEET EXISTING THICKNESS AND KIND WITH THE FOLLOWING MINIMUMS: 4" TOPSOIL.
- 4) SELECT MATERIAL AS FOLLOWS: 6" MAXIMUM SIZE.
(ROCKS TO BE PLACED SO THAT NO VOIDS ARE CREATED.)
- 5) DETAIL ABOVE FOR "DRY TRENCH" CONDITIONS. FOR UNSTABLE OR "WET TRENCH" CONDITIONS PROVIDE A MINIMUM OF 4" OF 1 1/2" SCREENED ROCK UNDER BEDDING MATERIAL WITH FILTER FABRIC PLACED BELOW AND ABOVE THE SCREENED ROCK.

TRENCH CROSS SECTION

SCALE: 3/4" = 1'-0"

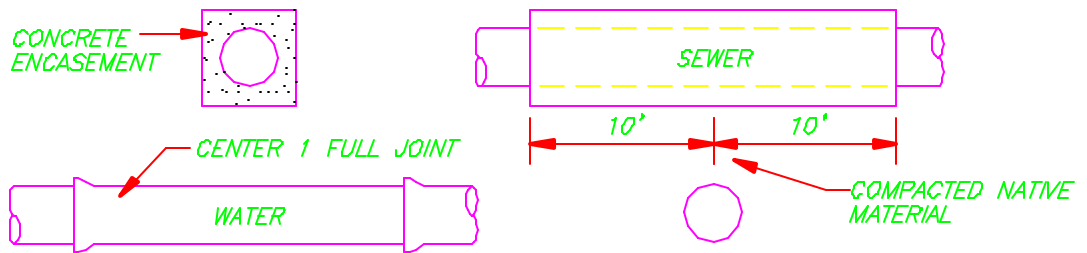
STANDARD SEWER
MAIN TRENCH SECTION

TOWN OF NEW CASTLE

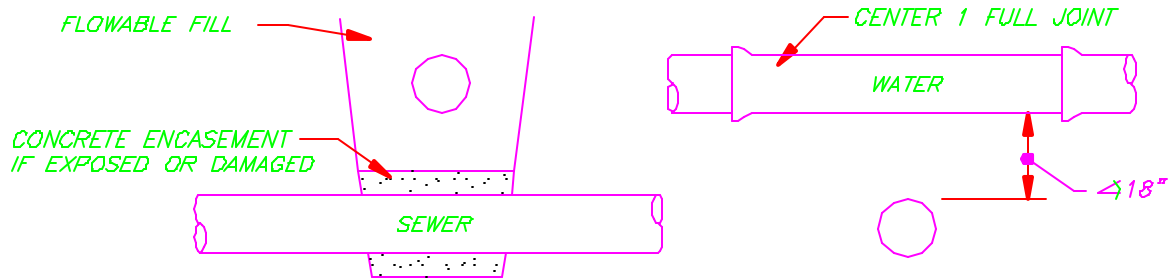
NOT TO SCALE

DWG: SW-50

CONCRETE ENCASEMENT SHALL HAVE
A MINIMUM OF 6" FROM PIPE TO
OUTSIDE EDGE OF CONCRETE



CONDITION #1: NEW WATER MAIN BELOW EXIST. SEWER MAIN



CONDITION #2: NEW WATER MAIN LESS THAN 18" ABOVE EXIST. SEWER MAIN

- 1) SEWER/WATER LINE TO BE CONSTRUCTED OF ONE JOINT (18" MINIMUM) OF C-900 PVC, DR-18 PIPE, CENTERED ON SEWER/WATER LINE FOR PERPENDICULAR CROSSING. FOR SKEW CROSSINGS, USE C-900 PIPE UNTIL HORIZONTAL SEPARATION EXCEEDS 10'.

WATER / SEWER CROSSING

WATER/SEWER
CROSSING DETAIL

TOWN OF NEW CASTLE

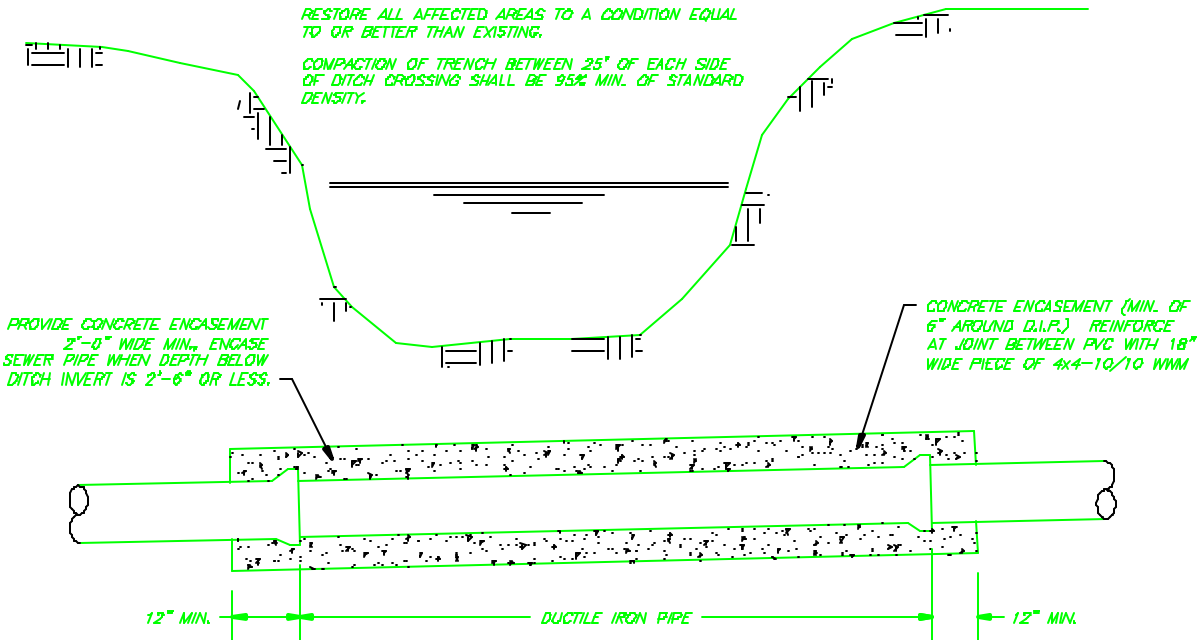
NOT TO SCALE

DWG: SW-60

NOTE: WHEN EITHER SIDES OR BOTTOM OF CHANNEL ARE OF GUNITE, CONG. OR MATERIAL OTHER THAN NATURAL SOIL, THE MATERIAL SHALL BE REPLACED IN KIND AFTER CONSTRUCTION OF DITCH CROSSING.

RESTORE ALL AFFECTED AREAS TO A CONDITION EQUAL TO OR BETTER THAN EXISTING.

COMPACTION OF TRENCH BETWEEN 25° OF EACH SIDE OF DITCH CROSSING SHALL BE 95% MIN. OF STANDARD DENSITY.



PROVIDE CONCRETE ENCASEMENT 2'-0" WIDE MIN., ENCASE SEWER PIPE WHEN DEPTH BELOW DITCH INVERT IS 2'-6" OR LESS.

CONCRETE ENCASEMENT (MIN. OF 6" AROUND D.I.P.) REINFORCE AT JOINT BETWEEN PVC WITH 18" WIDE PIECE OF 4x4-10/10 WWM

12" MIN.

DUCTILE IRON PIPE

12" MIN.

DITCH CROSSING DETAIL

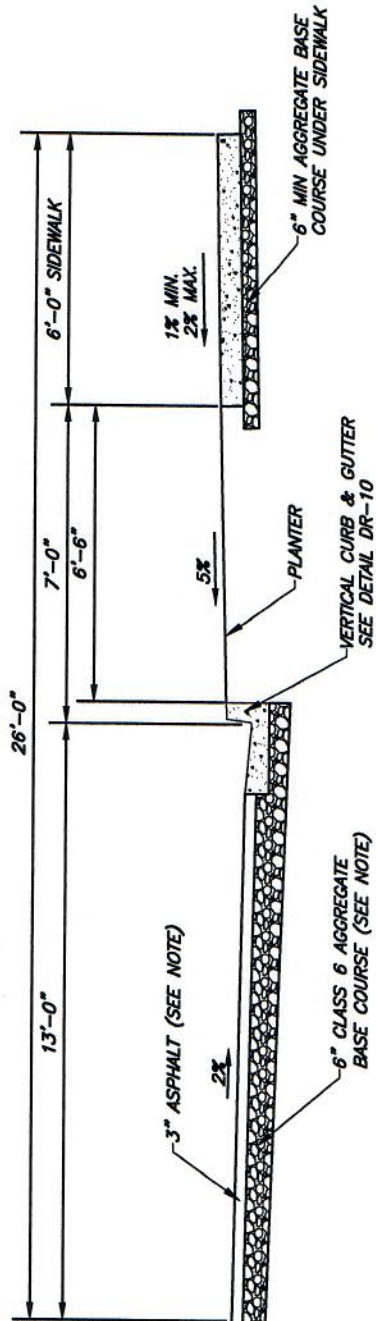
NO SCALE

DITCH
CROSSING DETAIL

TOWN OF NEW CASTLE

NOT TO SCALE

DWG: SW-70



**MINOR COLLECTOR STREET WITH NO PARKING
AND NO BIKE LANE 52'-0" ROW**

NOT TO SCALE

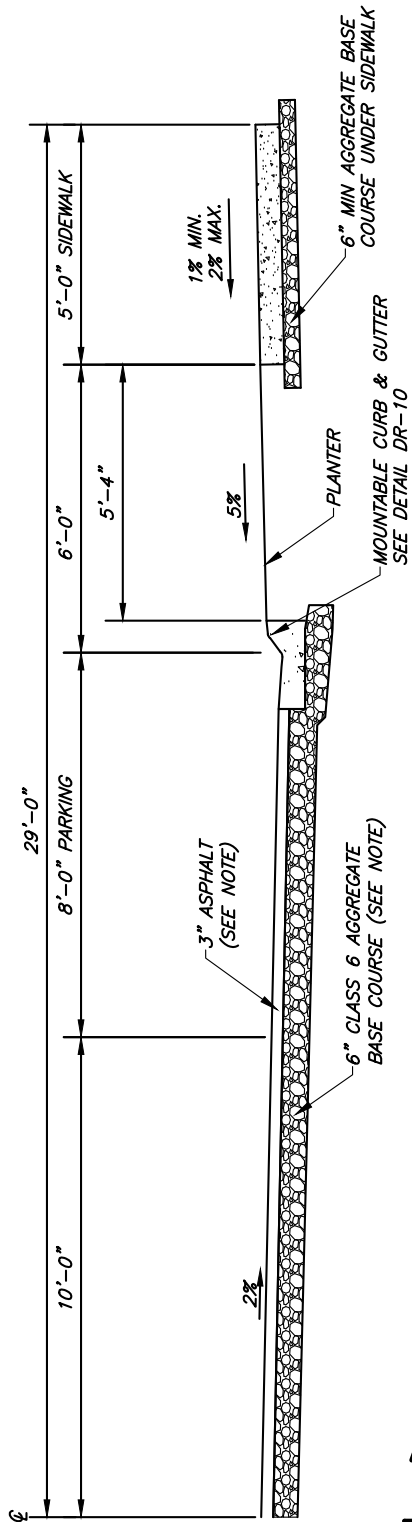
- NO RESIDENTIAL ACCESS

**MINOR COLLECTOR
STREET NO PARKING
AND BIKE LANE SECTION
TOWN OF NEW CASTLE**

NOT TO SCALE

DWG: ST-40

NOTE: ASPHALT AND BASE DEPTHS IDENTIFIED ARE MINIMUMS. PROVIDE DEPTHS AS DETERMINED BY SOILS REPORT AND ENGINEERS DESIGN BASED UPON PROJECTED TRAFFIC CONDITIONS, LOADING AND SOIL STRENGTHS.



NOTE:
 ASPHALT AND BASE DEPTHS IDENTIFIED ARE
 MINIMUMS. PROVIDE DEPTHS AS DETERMINED BY
 SOILS REPORT AND ENGINEERS DESIGN BASED UPON
 PROJECTED TRAFFIC CONDITIONS, LOADING AND SOIL
 STRENGTHS.

RESIDENTIAL STREET 58'-0" ROW

NOT TO SCALE

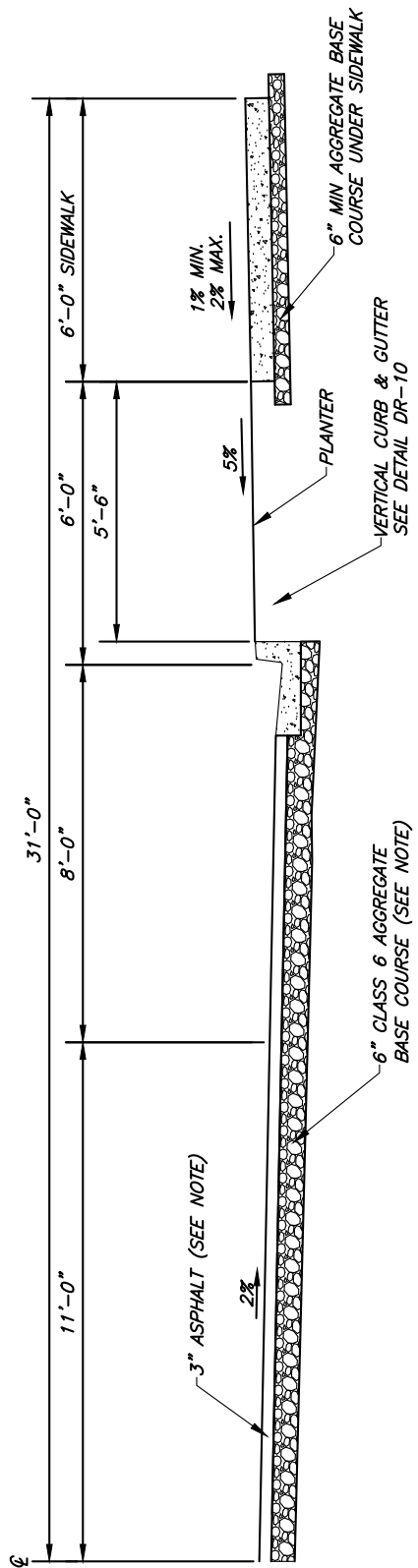
RECOMMENDED RIGHT OF WAY CROSS SECTION

RESIDENTIAL STREET 58'-0" ROW SECTION

TOWN OF NEW CASTLE

NOT TO SCALE

DWG: ST-10



**COLLECTOR STREET WITH PARKING
AND NO BIKE LANE 62'-0" ROW**

NOT TO SCALE

RESIDENTIAL ACCESS

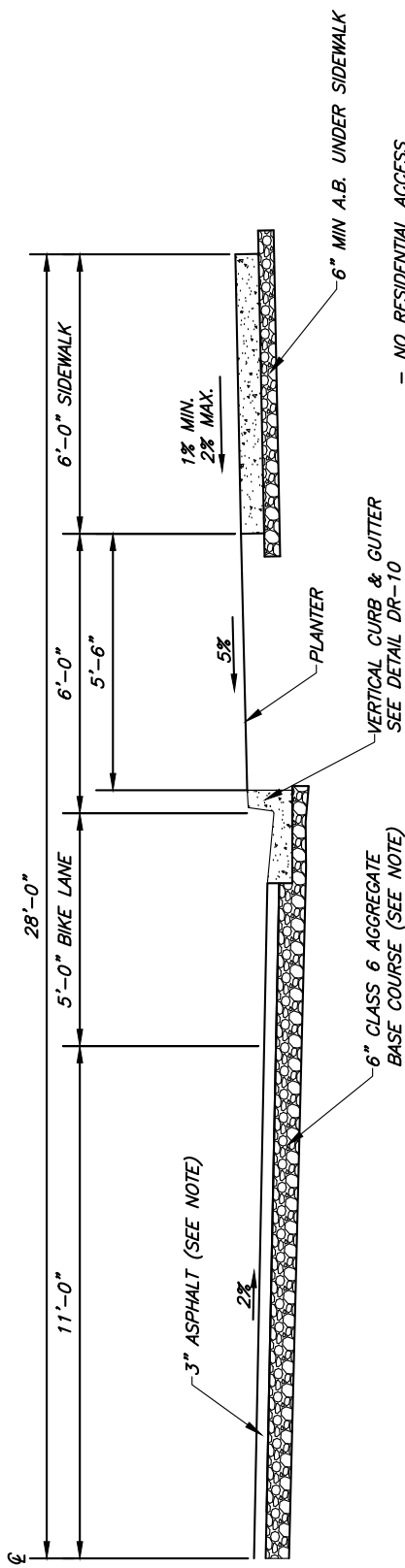
NOTE: ASPHALT AND BASE DEPTHS IDENTIFIED ARE MINIMUMS. PROVIDE DEPTHS AS DETERMINED BY SOILS REPORT AND ENGINEERS DESIGN BASED UPON PROJECTED TRAFFIC CONDITIONS, LOADING AND SOIL STRENGTHS.

COLLECTOR STREET NO BIKE LANE SECTION

TOWN OF NEW CASTLE

NOT TO SCALE

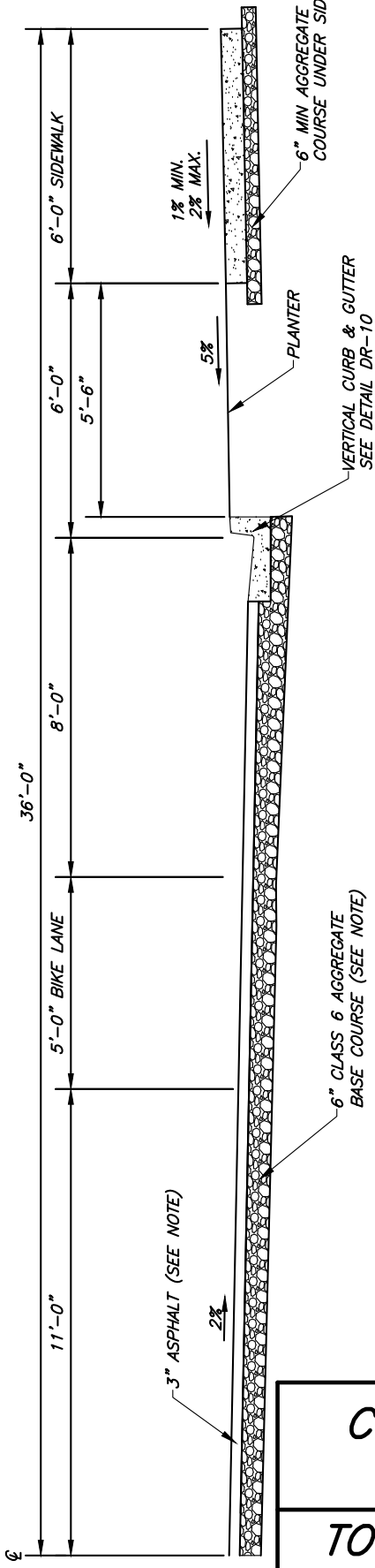
DWG: ST-30



- NO RESIDENTIAL ACCESS
- REAR FACING LOTS ONLY
- WHERE BIKE LANE CONNECTIVITY IS IMPORTANT

**COLLECTOR STREET NO PARKING
WITH BIKE LANE 56'-0" ROW**

NOT TO SCALE



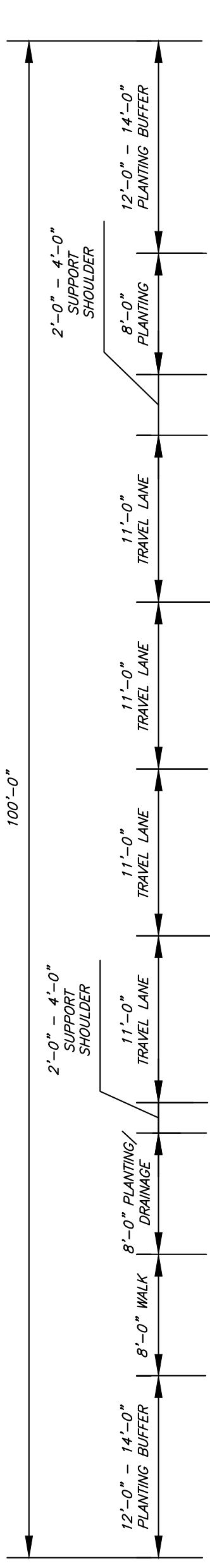
- RESIDENTIAL ACCESS
- WHERE BIKE LANE CONNECTIVITY IS IMPORTANT

**COLLECTOR STREET WITH PARKING
AND BIKE LANE 72'-0" ROW**

NOT TO SCALE

NOTE: ASPHALT AND BASE DEPTHS IDENTIFIED ARE MINIMUMS. PROVIDE DEPTHS AS DETERMINED BY SOILS REPORT AND ENGINEER'S DESIGN BASED UPON PROJECTED TRAFFIC CONDITIONS, LOADING AND SOIL STRENGTHS.

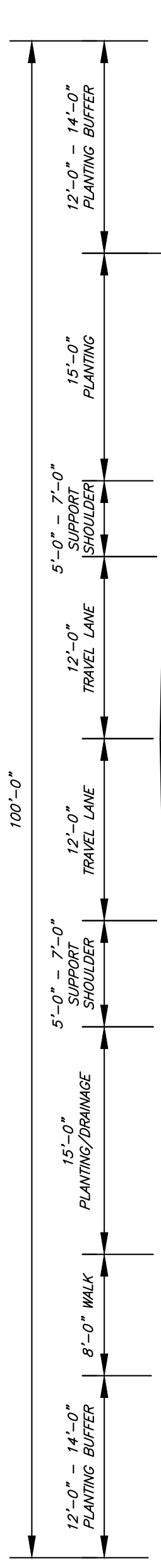
COLLECTOR STREET SECTION	
TOWN OF NEW CASTLE	
NOT TO SCALE	DWG: ST-20



CASTLE VALLEY BLVD.

FULL BUILD OUT

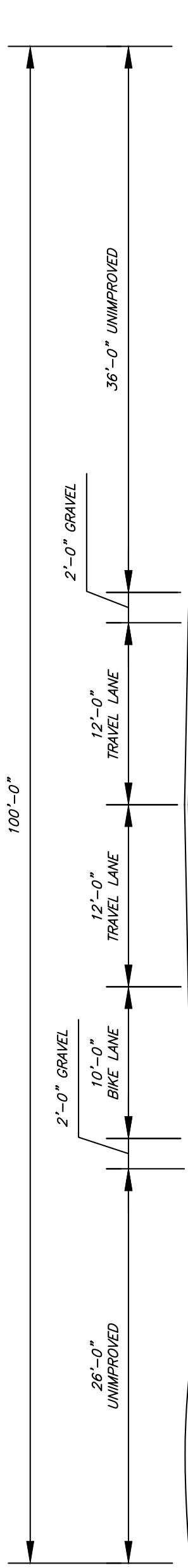
NOT TO SCALE



CASTLE VALLEY BLVD.

PHASE I

NOT TO SCALE



CASTLE VALLEY BLVD.

EAST BORDER OF CASTLE VALLEY RANCH TO BURNING MOUNTAIN

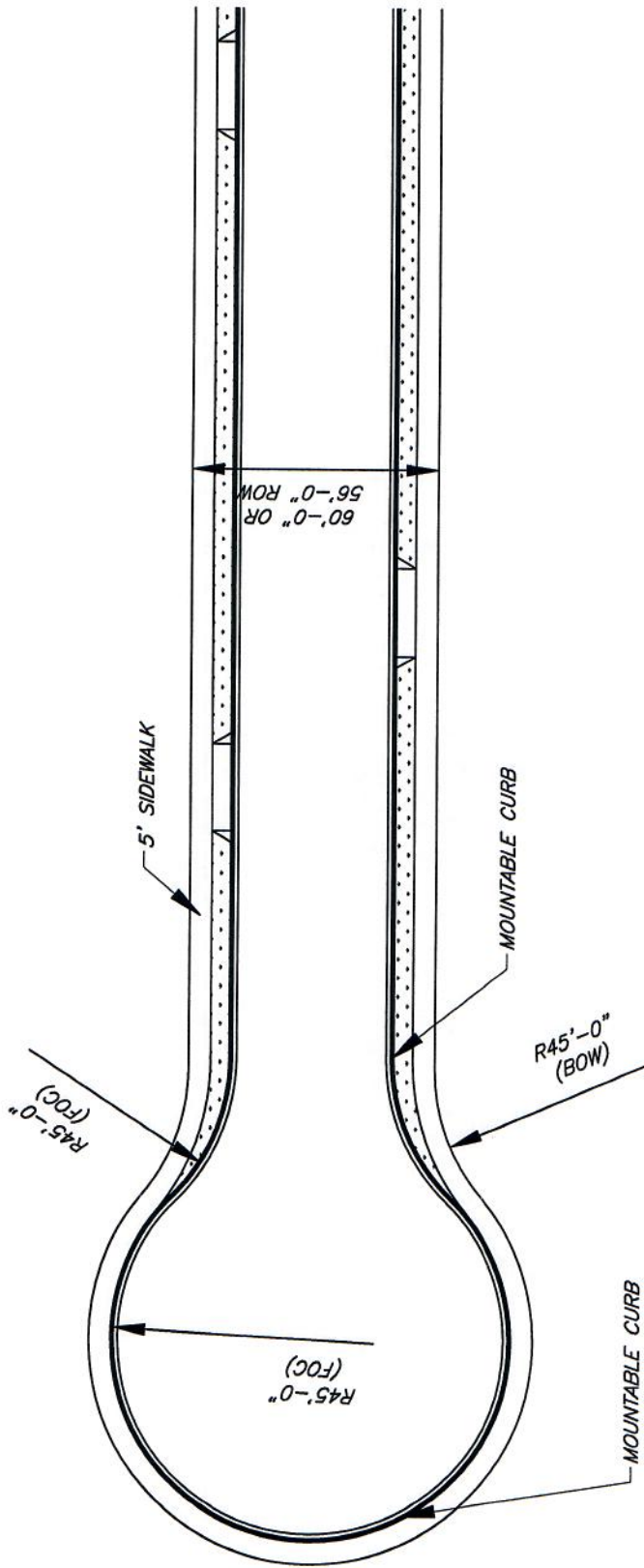
NOT TO SCALE

CASTLE VALLEY BLVD.

TOWN OF NEW CASTLE

NOT TO SCALE

DWG: ST-60

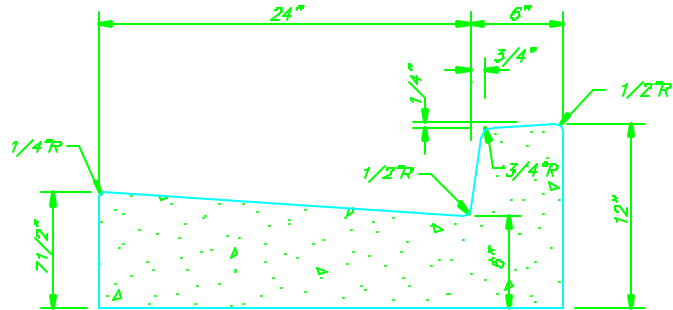


TYPICAL CUL-DE-SAC

NOT TO SCALE

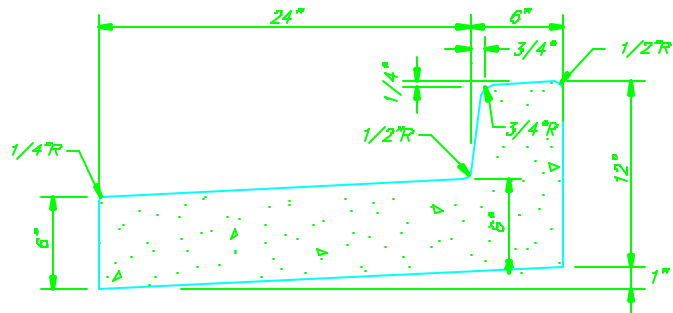
- NOTES:
1. CUL-DE-SACS ONLY ARE ALLOWED ON RESIDENTIAL STREETS.
 2. CUL-DE-SAC CENTER POINT MA BE OFFSET FROM STREET CENTERLINE.
 3. EASEMENTS REQUIRED FOR STREET LIGHTS.

TYPICAL CUL-DE-SAC	
TOWN OF NEW CASTLE	
NOT TO SCALE	DWG: ST-50



STANDARD CURB & GUTTER

SCALE: 1 1/2" = 1'-0"



INVERTED CURB & GUTTER

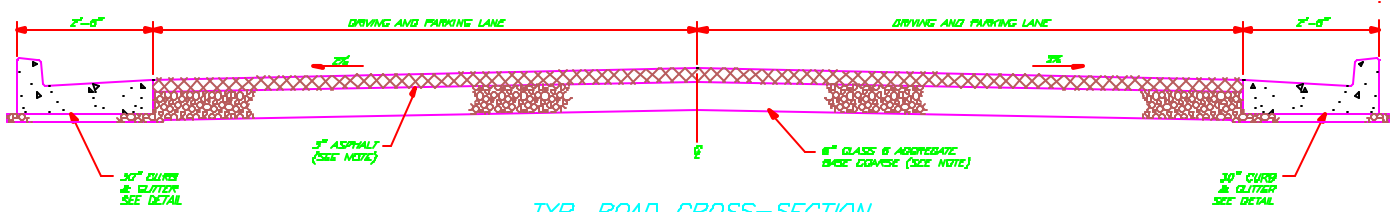
SCALE: 1 1/2" = 1'-0"

30" CURB AND
GUTTER DETAILS

TOWN OF NEW CASTLE

NOT TO SCALE

DWG: DR-20

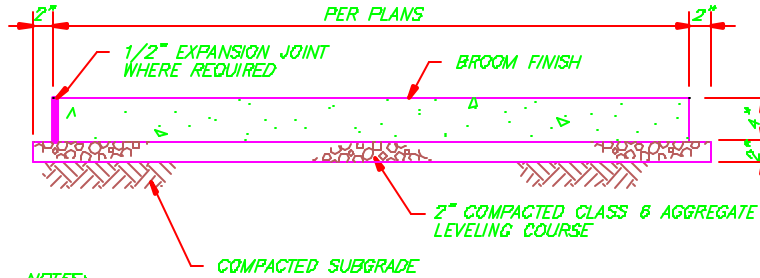


TYP. ROAD CROSS-SECTION

SCALE: 3/4" = 1'-0"

NOTE: ASPHALT AND BASE DEPTHS IDENTIFIED ARE MINIMUMS. PROVIDE DEPTHS AS DETERMINED BY SOILS REPORT AND ENGINEER'S DESIGN BASED UPON PROJECTED TRAFFIC CONDITIONS, LOADING AND SOIL STRENGTHS.

TYPICAL ROADWAY SECTION
 TOWN OF NEW CASTLE
 NOT TO SCALE DWG: DR-30

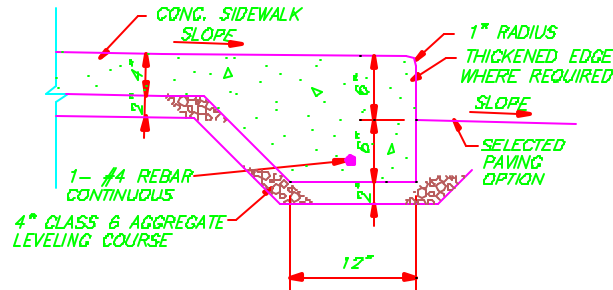


NOTES:

- 1) EXPANSION JOINTS: NO MORE THAN 100' ON CENTER AND AT DRIVEWAYS.
- 2) DUMMY JOINTS: 1" DEEP BY 1/8" - 1/4" WIDTH AT INTERVALS EQUAL TO SIDEWALK WIDTH.
- 3) USE 1/4" RADIUS ON ALL EDGES.
- 4) USE 6" DEPTH OF CONCRETE ON ALL DRIVEWAYS.
- 5) CURE FOR 72 HOURS USING CURING COMPOUND, PLASTIC COVERING OR MOISTURE.
- 6) USE 3750 PSI CONCRETE WITH FIBERMESH ADDITIVE AT 1-1/2 LBS./G.Y. MAXIMUM SLUMP 4".

CONCRETE SIDEWALK

SCALE: 1" = 1'-0"



TYP. DETACHED SIDEWALK W/ THICKENED EDGE

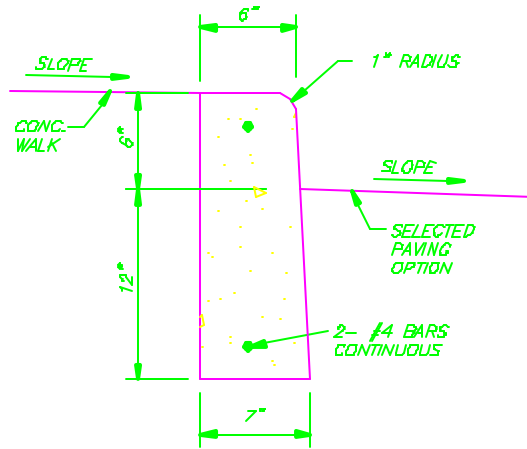
SCALE: 1" = 1'-0"

TYPICAL SIDEWALK AND SIDEWALK W/THICKENED EDGE

TOWN OF NEW CASTLE

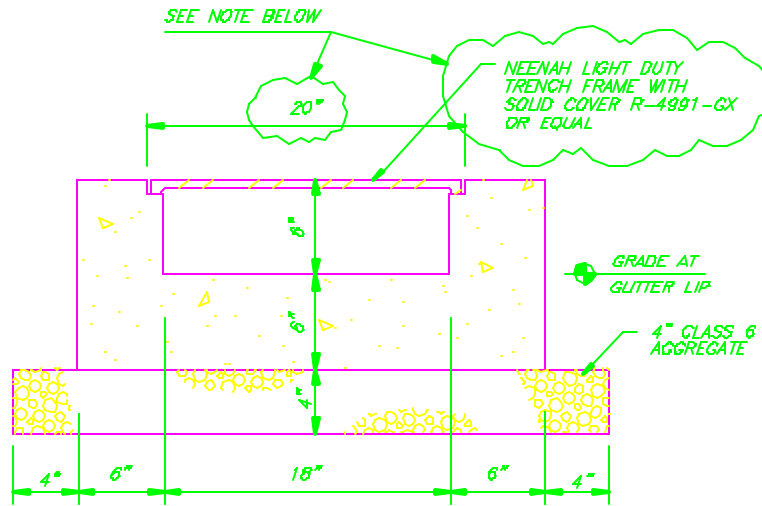
NOT TO SCALE

DWG: DR-40



CURB DETAIL

SCALE: 1 1/2" = 1'-0"



CONCRETE TRENCH DETAIL

SCALE: 1 1/2" = 1'-0"

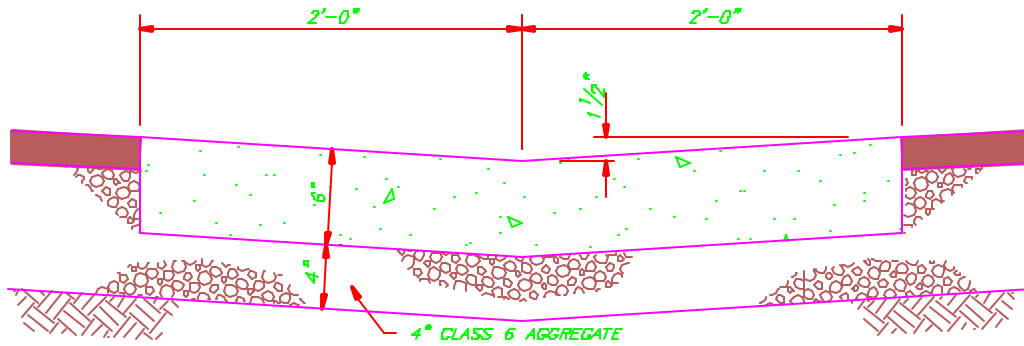
NOTE: TRENCH WIDTH AND TRENCH FRAME AND COVER TO BE DETERMINED BASED UPON A DRAINAGE STUDY AND SIZE FOR THE 25 YEAR RUNOFF.

CURB AND TRENCH
DRAIN DETAILS

TOWN OF NEW CASTLE

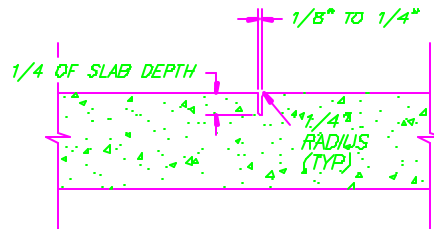
NOT TO SCALE

DWG: DR-50



VALLEY PAN DETAIL

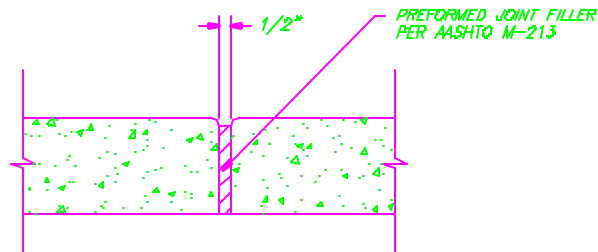
SCALE: 1 1/2" = 1'-0"



NOTE: LOCATION OF CONTRACTION JOINTS TO BE AS DETAILED OR AS DETERMINED IN FIELD WITH AND APPROVED BY TOWN.

STANDARD CONTRACTION JOINT

N.T.S.



NOTE: EXPANSION JOINTS TO BE LOCATED ADJACENT TO ANY EXISTING CONCRETE OR FIXED STRUCTURE.

STANDARD EXPANSION JOINT

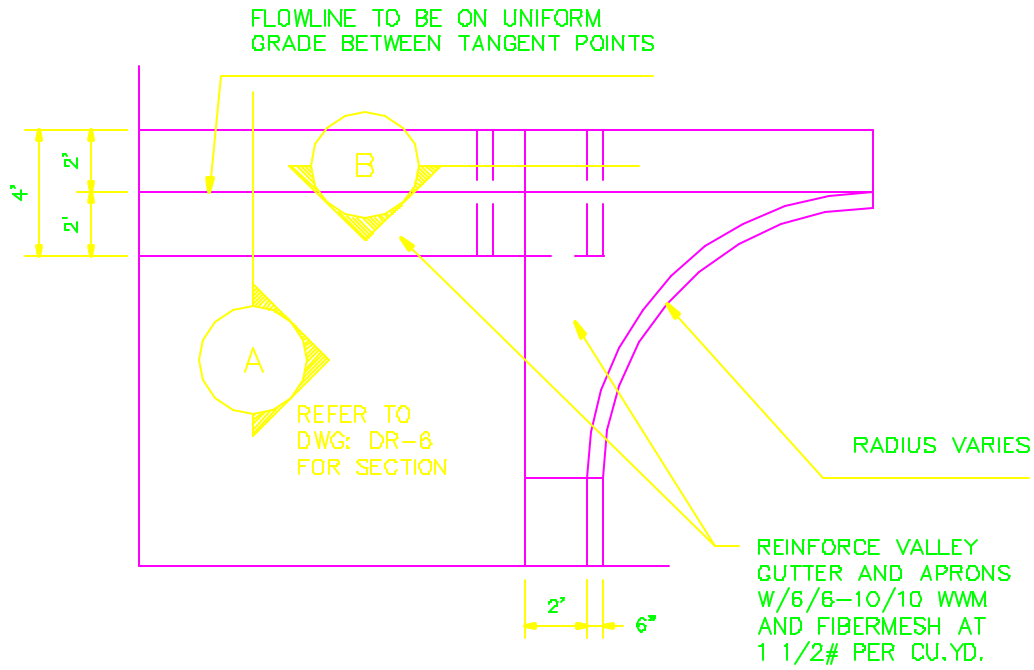
N.T.S.

VALLEY PAN DETAIL AND
EXPANSION AND CONTRACTION
JOINT DETAILS

TOWN OF NEW CASTLE

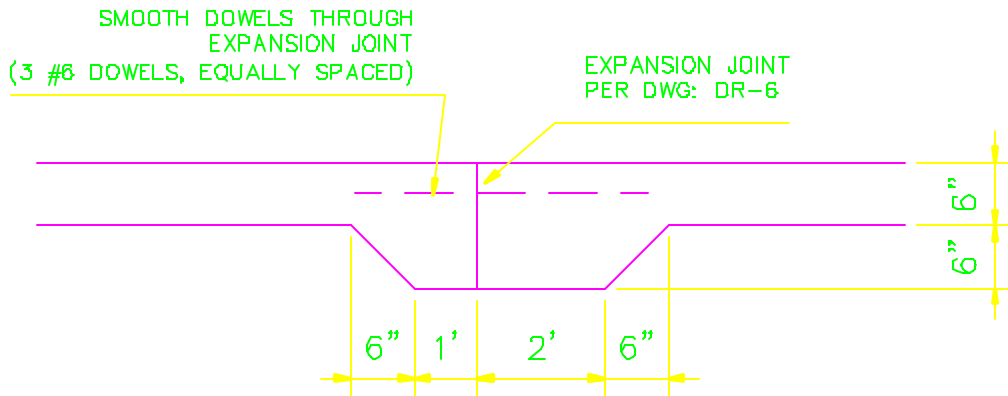
NOT TO SCALE

DWG: DR-60



PLAN VIEW

N.T.S.



SECTION



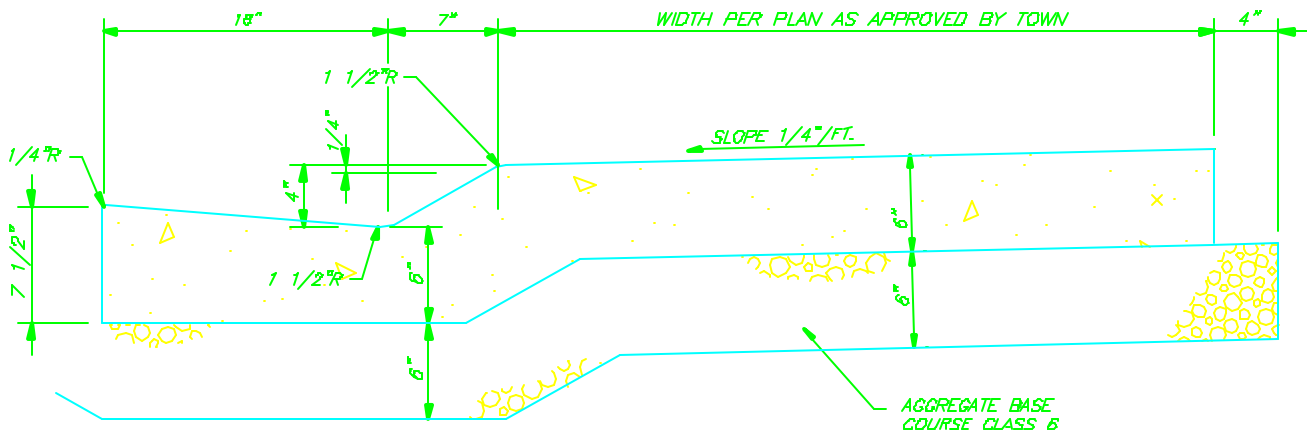
VALLEY GUTTER
AT INTERSECTION

TOWN OF NEW CASTLE

NOT TO SCALE

DWG: DR-70

PROVIDE FIBERMESH REINFORCEMENT IN
CONCRETE MIX AT 1 1/2 # PER CU.YD.



CURB JOINT: CONTRACTION = 10'-0"
INTERVALS: EXPANSION = 100'-0"

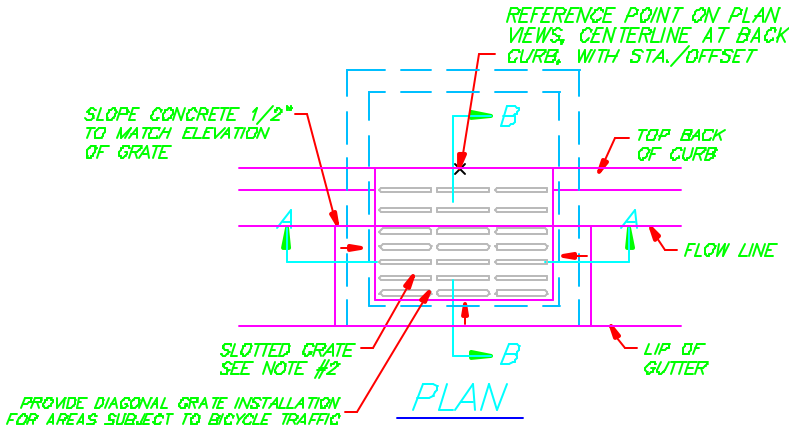
MOUNTABLE CURB & GUTTER W/ SIDEWALK

MOUNTABLE CURB,
GUTTER AND SIDEWALK

TOWN OF NEW CASTLE

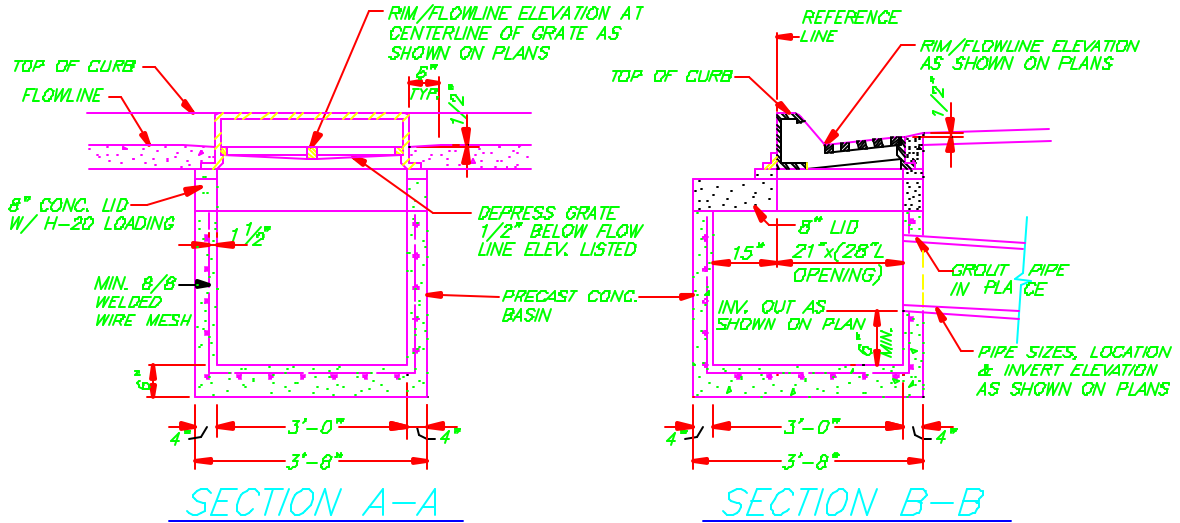
NOT TO SCALE

DWG: DR-80



NOTES:

- 1) FRAME, GRATE & CURB INLET TO BE NEENAH R-3501-P OR APPROVED EQUAL SEE BELOW.
- 2) DOUBLE INLET FRAME, GRATE & CURB INLET TO BE NEENAH R-3504-F OR APPROVED EQUAL. (ABUTTING SIDE FLANGES TO BE OMITTED TO FORM DOUBLE). THE CONCRETE BASIN FOR THE DOUBLE INLET SHALL BE THE SAME AS SHOWN, EXCEPT THAT THE OVERALL WIDTH OF SECTION A-A SHALL BE 6'-10" RATHER THAN 3'-8".
- 3) FRAME & GRATE SHALL BE ASPHALT PAINT-DIPPED BY MANUFACTURER.
- 4) PRECAST CONCRETE ADJUSTMENT RINGS (IF REQUIRED) SHALL BE GROUTED IN PLACE.
- 5) SET GRATE W/ CONC. LEVELING COURSE TO MATCH LONGITUDINAL SLOPE OF THE ROAD.
- 6) CAST IN PLACE INLET BOXES ARE AN ACCEPTABLE ALTERNATIVE TO PRE-CAST GIVEN WRITTEN APPROVAL FROM TOWN.
- 7) GRATE AND FRAME SPECIFIED ARE FOR MOUNTABLE CURB AND GUTTER INSTALLATIONS. PROVIDE NEENAH R-3227-D CURB INLET FRAME, DIAGONAL GRATE AND CURB BOX FOR VERTICAL CURB INSTALLATIONS.



TYPE I DRAIN INLET DETAIL

NOT TO SCALE

DRAIN INLET
TYPE 1

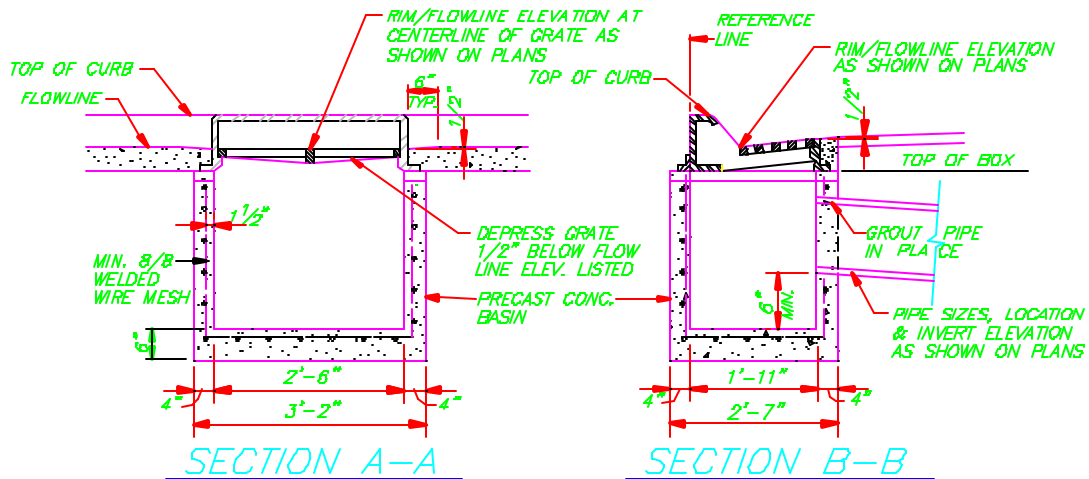
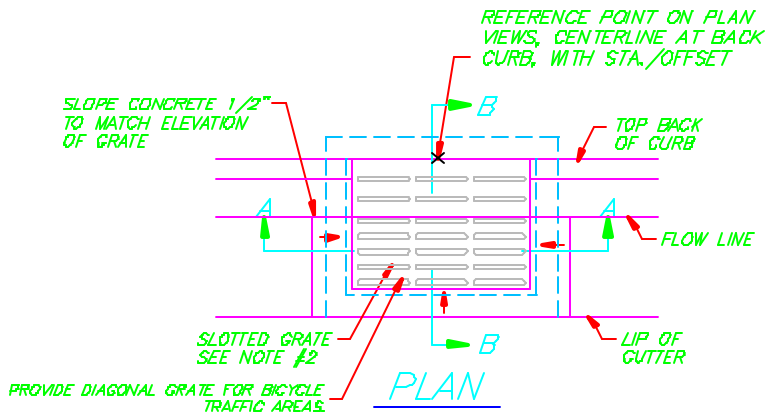
TOWN OF NEW CASTLE

NOT TO SCALE

DWG: DR-90

NOTES:

- 1) FRAME, GRATE & CURB INLET TO BE NEENAH R-3501-P OR APPROVED EQUAL.
- 2) DOUBLE INLET FRAME, GRATE & CURB INLET TO BE NEENAH R3504-F OR APPROVED EQUAL. (ABUTTING SIDE FLANGES TO BE OMITTED TO FORM DOUBLE). THE CONCRETE BASIN FOR THE DOUBLE INLET SHALL BE THE SAME AS SHOWN, EXCEPT THAT THE OVERALL WIDTH OF SECTION A-A SHALL BE 6'-10" RATHER THAN 3'-8".
- 3) FRAME & GRATE SHALL BE ASPHALT PAINT-DIPPED BY MANUFACTURER.
- 4) PRECAST CONCRETE ADJUSTMENT RINGS (IF REQUIRED) SHALL BE GROUTED IN PLACE.
- 5) SET GRATE W/ CONG. LEVELING COURSE TO MATCH LONGITUDINAL SLOPE OF THE ROAD.
- 6) INLET FRAME AND GRATE SHOWN ARE FOR MOUNTABLE CURB INSTALLATIONS. PROVIDE NEENAH R-3228-BD CURB INLET FRAME, DIAGONAL GRATE AND CURB BOX FOR VERTICAL CURB INSTALLATIONS.



TYPE II DRAIN INLET

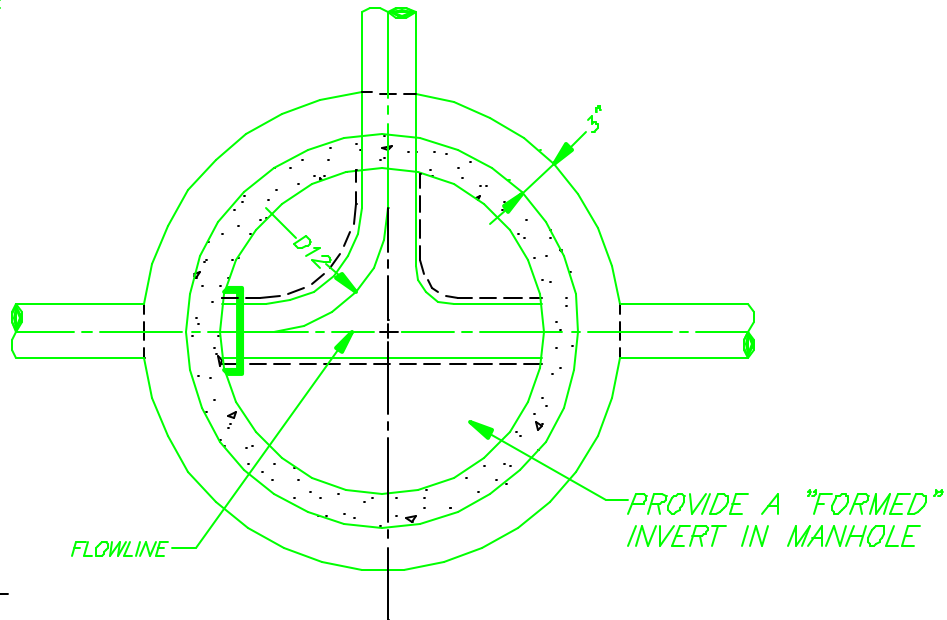
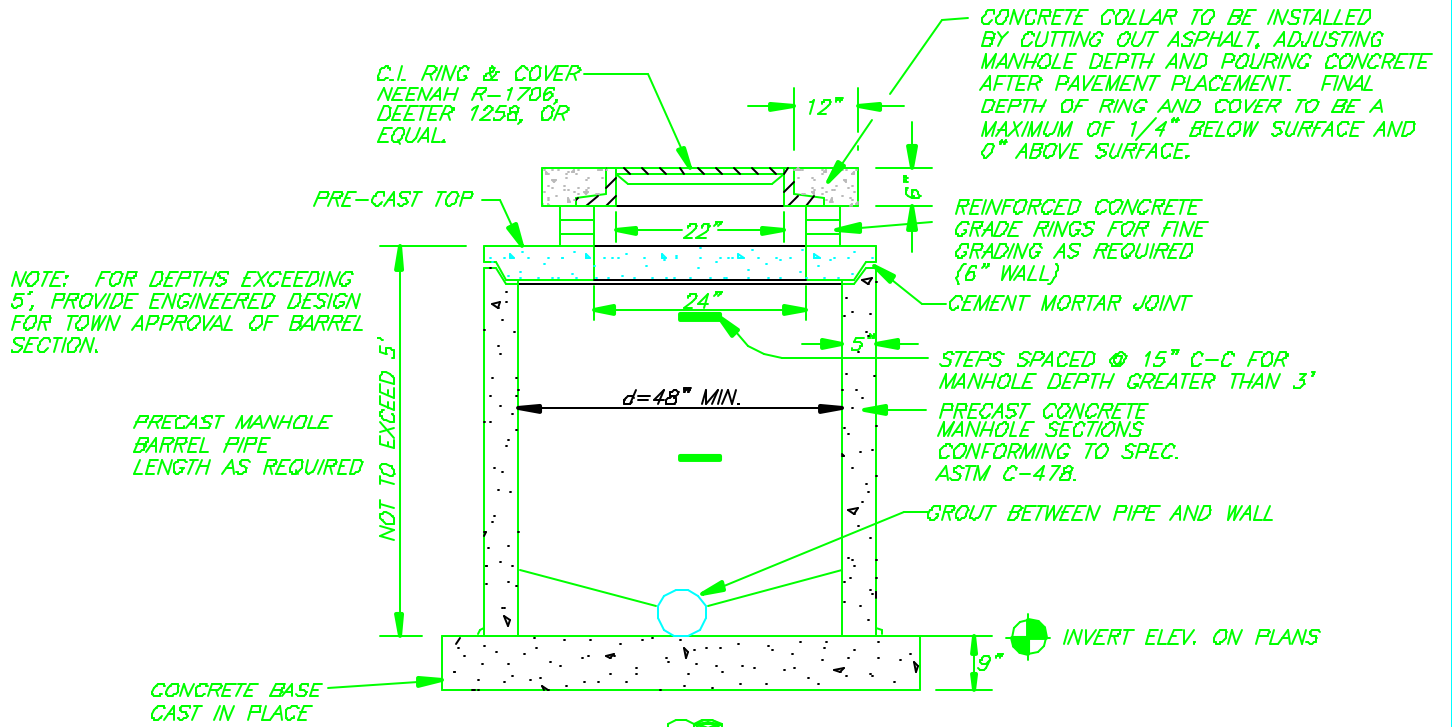
N.T.S.

DRAIN INLET
TYPE 2

TOWN OF NEW CASTLE

NOT TO SCALE

DWG: DR-100



NOTES:

1. Precast rings or metal riser ring course shall be utilized where required with 2 courses minimum and 6 courses maximum (1" minimum, 6" maximum height).
2. Where available from pipe manufacturer, use expandable water stop or special sleeve as per manufacturer's specifications.
3. All bases shall be cast in place or precast concrete; use #4 rebar on 12" c-c both ways in poured bases.
4. Set each ring in a full bed of mortar and grout all inside joints.

STORM DRAIN MANHOLE DETAIL

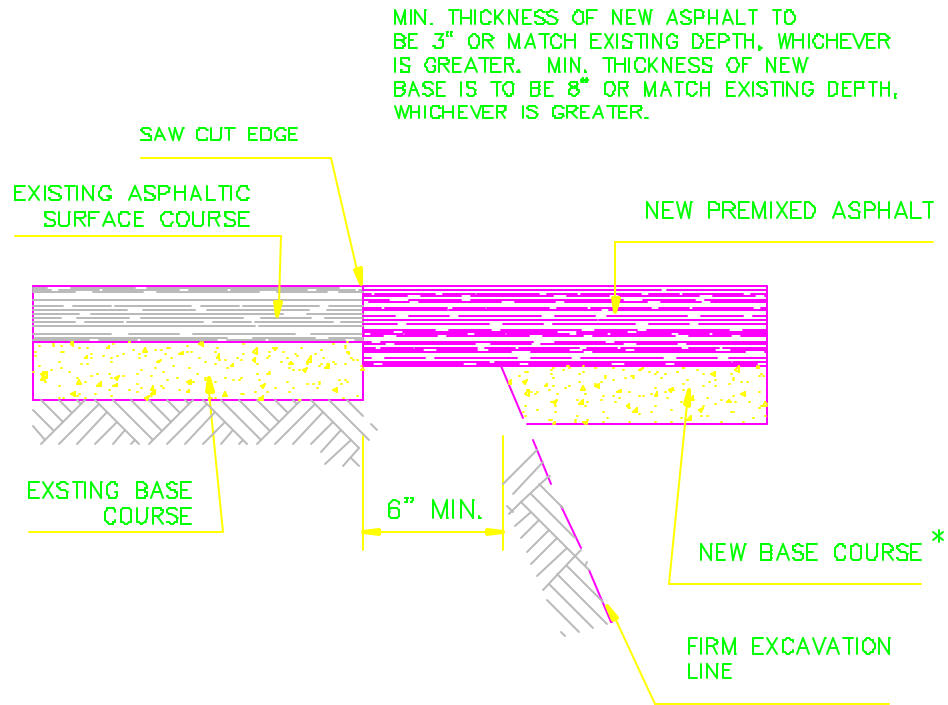
N.T.S.

STORM DRAIN
MANHOLE

TOWN OF NEW CASTLE

NOT TO SCALE

DWG: DR-110



NOTE: WHERE EXISTING PAVEMENT IS A SEAL COAT OR ROAD MIX ASPHALTIC SURFACE, A PREMIXED COLD APPLIED ASPHALTIC CONCRETE MAY BE USED.

WHERE EXIST. PAVEMENT IS A MACHINE PLACED HOT MIXED ASPHALTIC CONCRETE, A PREMIXED HOT APPLIED CONCRETE WILL BE USED.

ALL REPLACEMENT MATERIAL SHALL BE COMPACTED TO A DENSITY OF 95% OPTIMUM DENSITY.

TEMPORARY A.C. REPAIR TO BE PLACED THE SAME DAY AS COMPLETION OF BACKFILL. CONTRACTOR WILL MAINTAIN TEMPORARY REPAIR UNTIL PERMANENT REPAIR HAS BEEN COMPLETED.

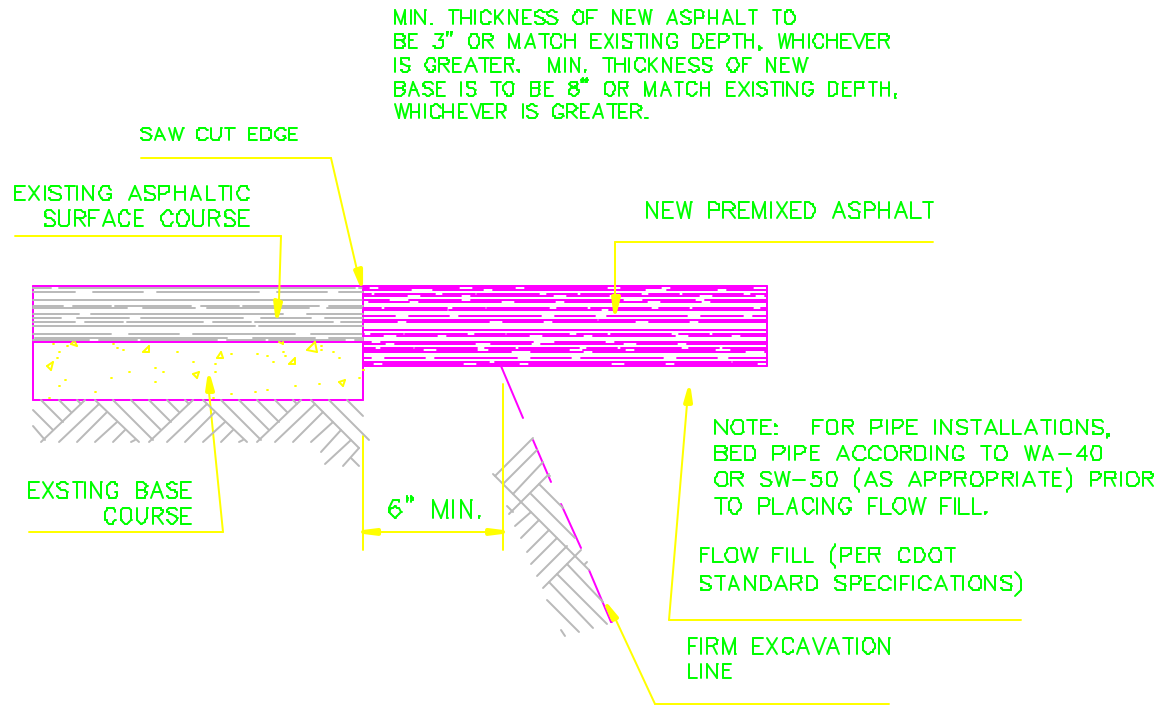
* NOTE: SEE DETAIL DR-140 FOR FLOW FILL OPTION FOR BACKFILL IN ARTERIAL STREETS.

ASPHALTIC PAVEMENT
REPLACEMENT

TOWN OF NEW CASTLE

NOT TO SCALE

DWG: DR-130



NOTE: WHERE EXISTING PAVEMENT IS A SEAL COAT OR ROAD MIX ASPHALTIC SURFACE, A PREMIXED COLD APPLIED ASPHALTIC CONCRETE MAY BE USED.

WHERE EXIST. PAVEMENT IS A MACHINE PLACED HOT MIXED ASPHALTIC CONCRETE, A PREMIXED HOT APPLIED CONCRETE WILL BE USED.

ALL REPLACEMENT MATERIAL SHALL BE COMPACTED TO A DENSITY OF 95% OPTIMUM DENSITY.

TEMPORARY A.C. REPAIR TO BE PLACED THE SAME DAY AS COMPLETION OF BACKFILL. CONTRACTOR WILL MAINTAIN TEMPORARY REPAIR UNTIL PERMANENT REPAIR HAS BEEN COMPLETED.

PROVIDE FLOWABLE FILL BACKFILL WHEN WORK IS PERFORMED ON AN ARTERIAL STREET IDENTIFIED, BUT NOT LIMITED TO THE FOLLOWING STREETS:

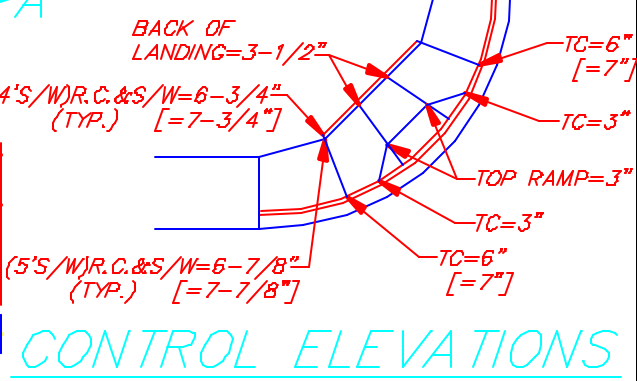
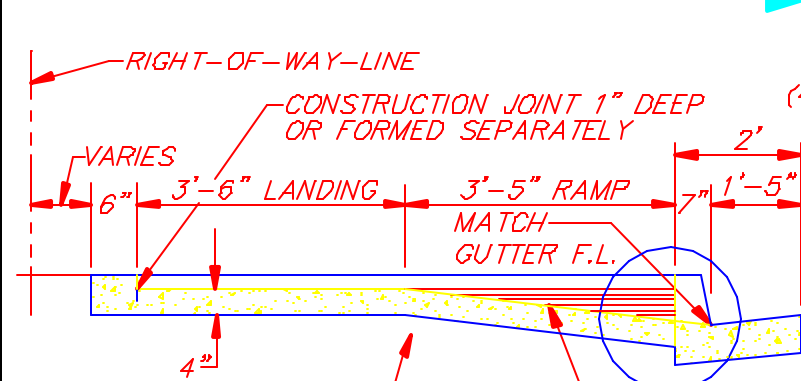
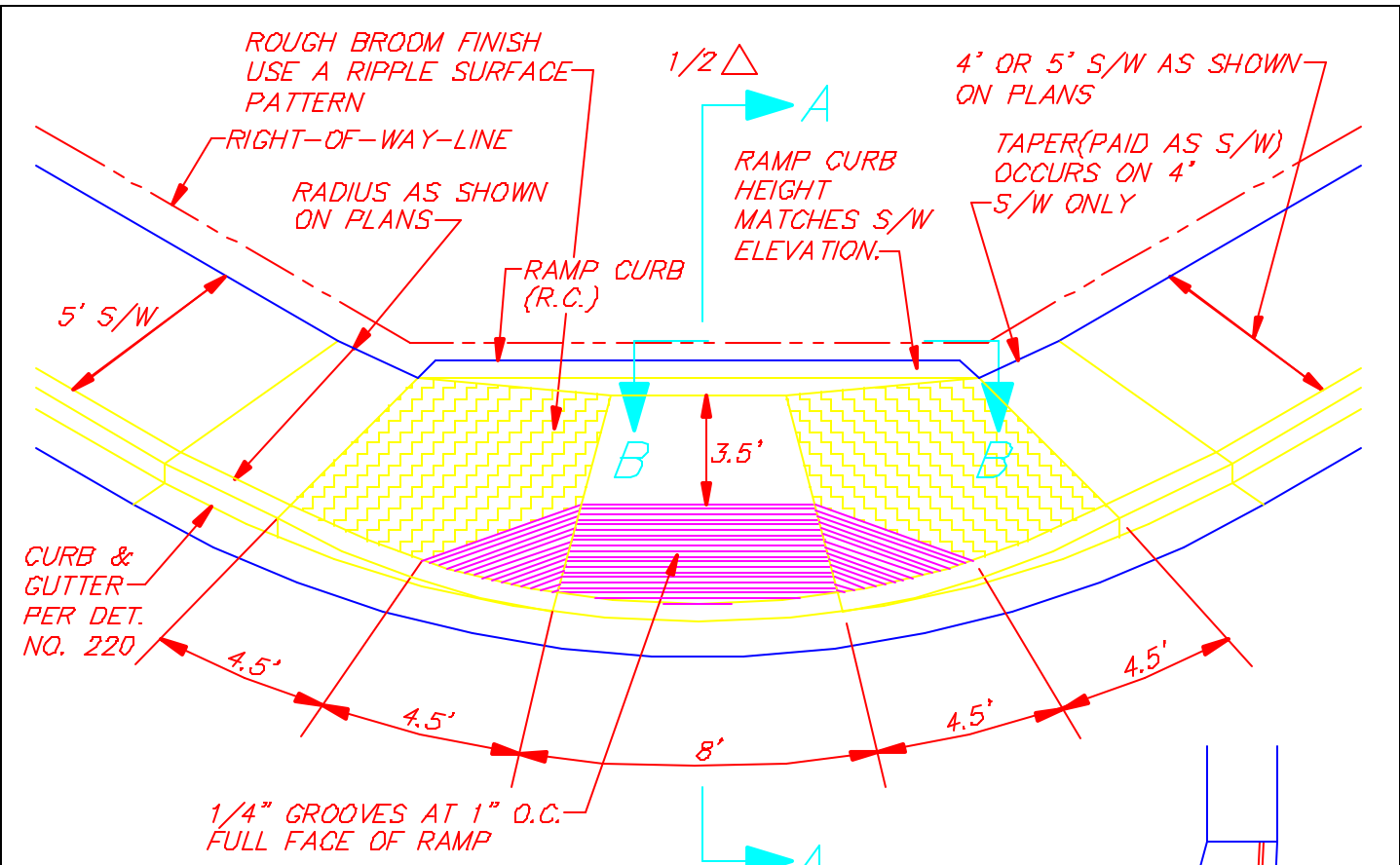
MIDLAND AVENUE
 CASTLE VALLEY BOULEVARD
 HWY 6&24/MAIN STREET
 7TH STREET
 FRONT STREET
 CO. RD. 335

ASPHALTIC PAVEMENT
 REPLACEMENT

TOWN OF NEW CASTLE

NOT TO SCALE

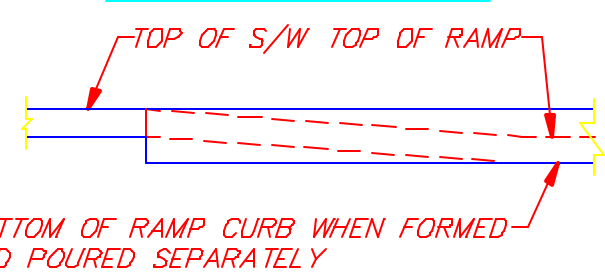
DWG: DR-140



SUBGRADE PREPARATION, SEE SECT. 301

FOR GROOVE SLOPING RAMP FACE, SEE DETAIL NO. 1 ON TYPE D RAMP DET. 234

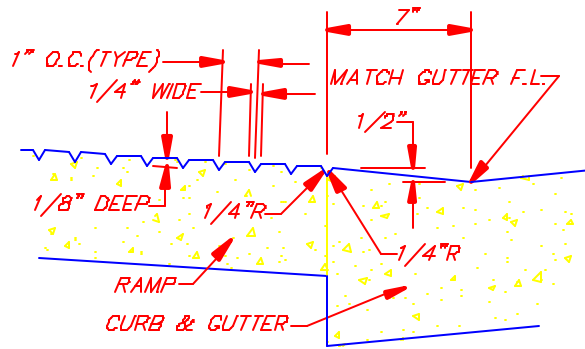
SECTION A-A



SECTION B-B

- NOTES:
- CONTROL ELEVATIONS SHOWN ARE IN RELATION TO THE GUTTER AND ARE LOCATED RADIALLY. GUTTER ELEV.=0
 - CLASS 'B' CONC. CONSTRUCTION AS PER SECT. 725
 - WHEN CURB HEIGHTS OF 7" ARE SHOWN ON PLANS, USE DIMENSIONS SHOWN IN []'S

SIDEWALK RAMPS— TYPE A	
TOWN OF NEW CASTLE	
NOT TO SCALE	DWG: DR-150



CONTROL ELEVATIONS

NOTES:

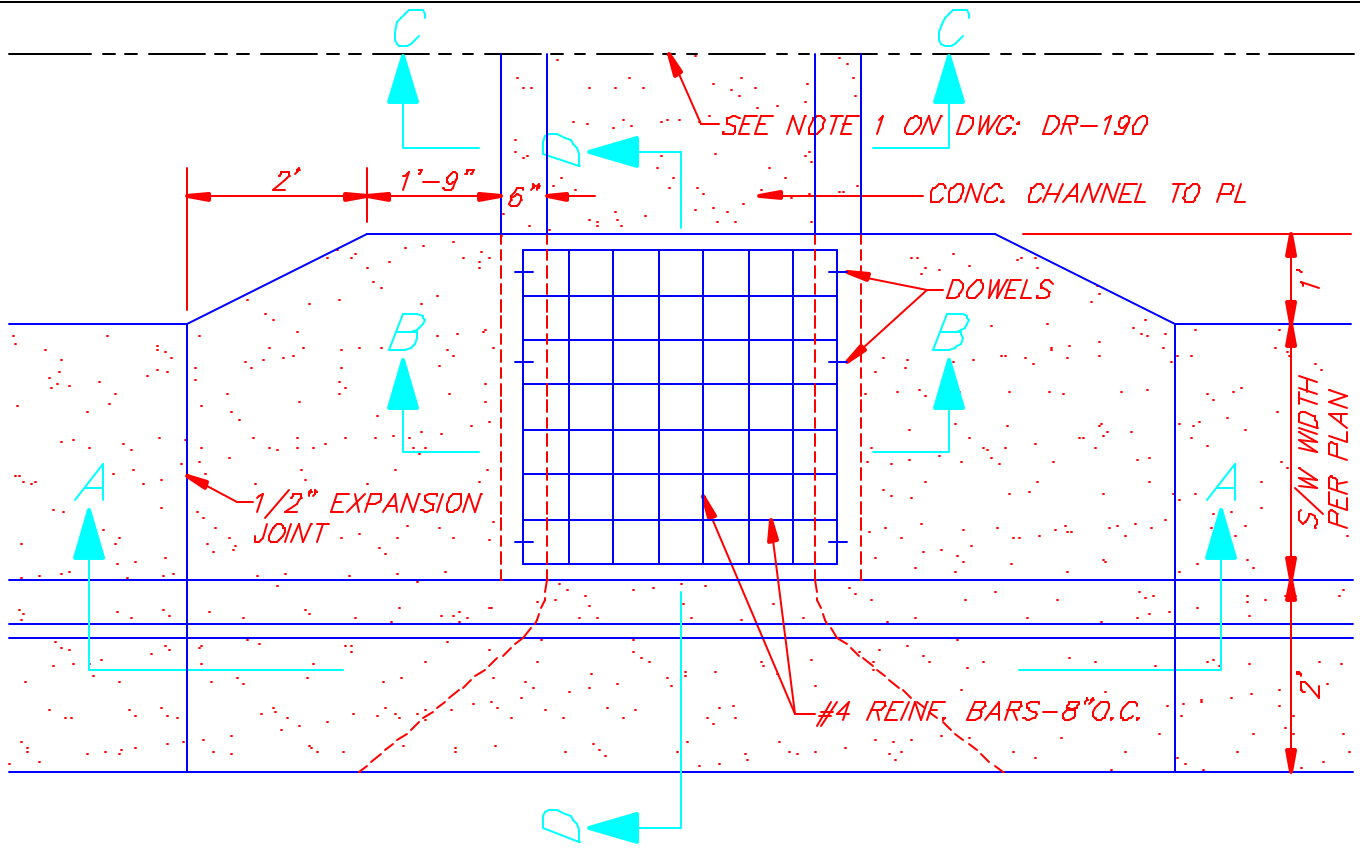
1. CONTROL ELEVATIONS SHOWN ARE IN RELATION TO THE GUTTER AND ARE LOCATED RADIALLY. GUTTER ELEV.=0
2. CONG. CONSTRUCTION AS PER SECT. 3100

SIDEWALK RAMPS—
 DETAIL

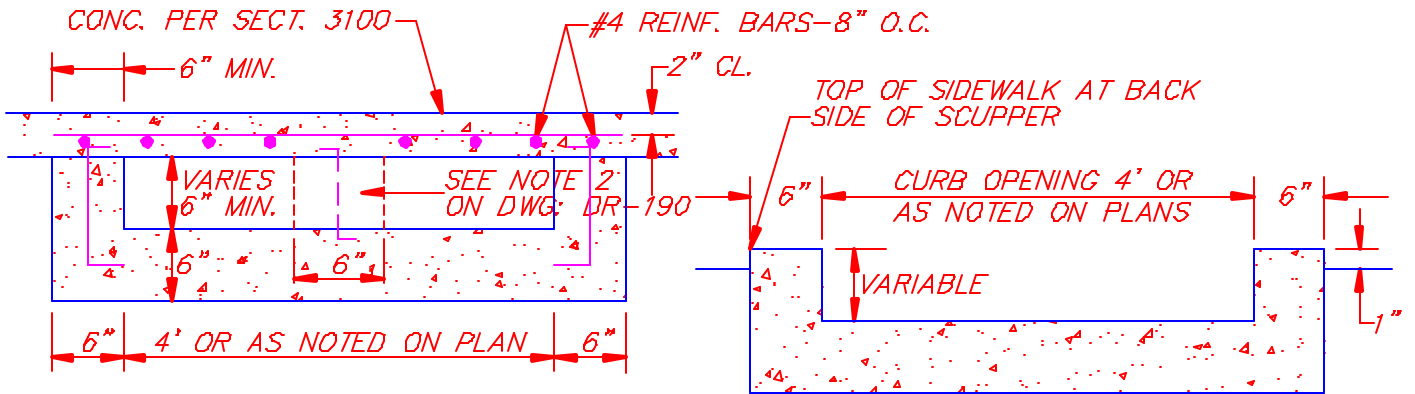
TOWN OF NEW CASTLE

NOT TO SCALE

DWG: DR-170

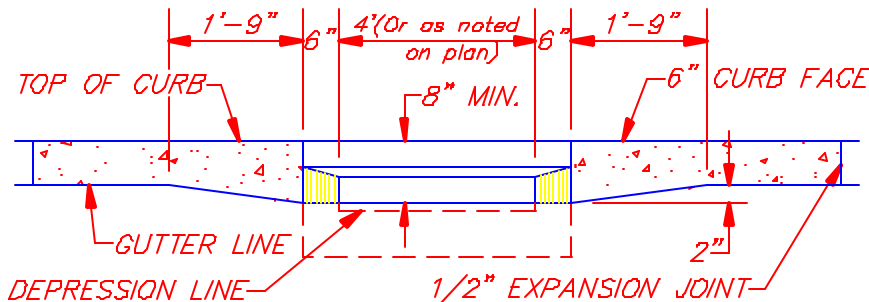


SCUPPER PLAN VIEW



SECTION B-B

SECTION C-C
SPILLWAY



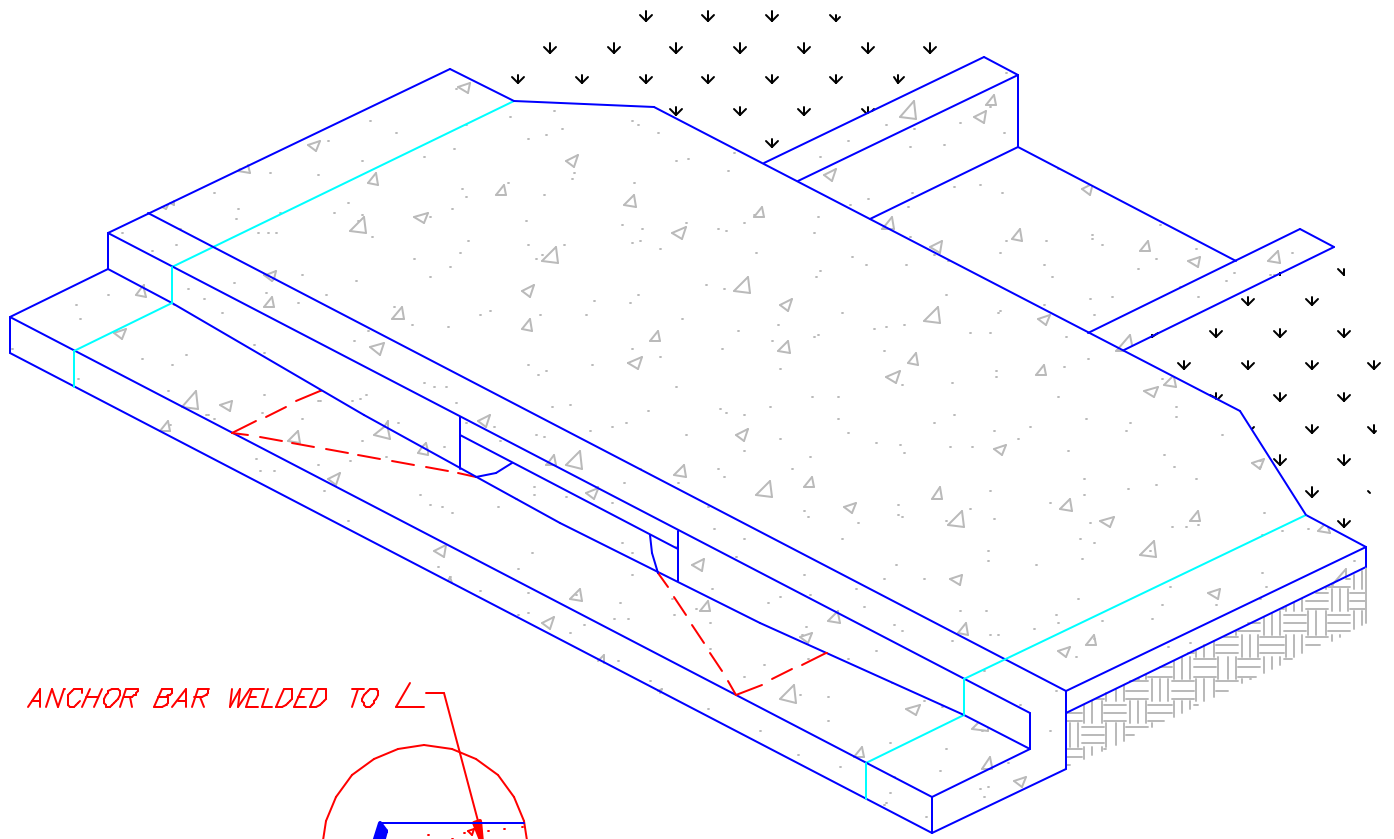
SECTION A-A

CONCRETE SCUPPER

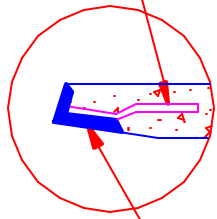
TOWN OF NEW CASTLE

NOT TO SCALE

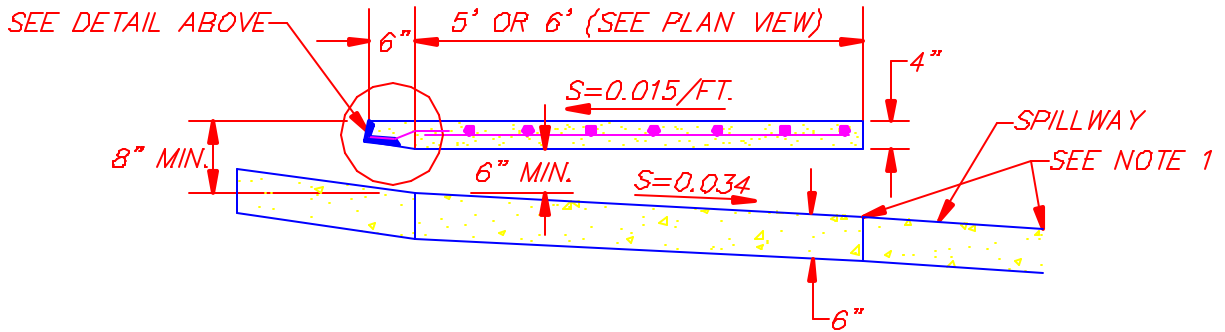
DWG: DR-180



ANCHOR BAR WELDED TO L



1/2" x 3" x 4" L



SECTION D-D

NOTES:

1. TRANSITION TO SPILLWAY/CHANNEL AS PER APPROVED PLANS.
2. A CENTER WALL SHALL BE INSTALLED IN SCUPPERS WIDER THAN 4' OR IF MORE THAN 1 SCUPPER IS BUILT IN SERIES.
3. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER, A.S.T.M. D-1751.

CONCRETE SCUPPER

TOWN OF NEW CASTLE

NOT TO SCALE

DWG: DR-190

CHAPTER III

TECHNICAL SPECIFICATIONS

TEXT

TABLE OF CONTENTS

TECHNICAL SPECIFICATIONS

DIVISION 1000

1100Detouring/Traffic Control

DIVISION 2000

2100Removal of Structures and Obstructions

2110Excavation and Embankment

2120Excavation and Backfill For Structures

2130Trenching, Backfilling and Compaction

2140Embedment and Base Course Aggregate

2150Dust Suppression

2200Culvert Drainage Pipe

2210Riprap

2300Water Transmission and Distribution Lines

2310Meter Vault

2400Sanitary Sewer Lines

2500Hot Bituminous Pavement

2510Cold-In-Place Recycling

2520Concrete Curb and Gutter, Sidewalk, Curbwalk and Driveway

2610Metal Guardrail

2710Finished Grade and Restoration

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2720Seeding, Sodding and Topsoil
2730 Revegetation - Seeding, Sodding, Hydroseeding
2740 Trees, Plants and Ground Cover

DIVISION 3000

3100Cast-In-Place Concrete
3200Masonry

DIVISION 4000

4100Wire Fencing
4200Underground Sprinkler System
4300 Fountain
4400Lighting

SECTION 1100

DETOURING/TRAFFIC CONTROL

1.1 GENERAL

1.2 Scope. This work shall consist of furnishing, installing, moving, maintaining and removing temporary traffic signs, advance warning signs, barricades, channelizing devices, delineators, and flagmen as required by the latest revision of the "Manual on Uniform Traffic Control Devices for Streets and Highways" and the latest revisions of the Colorado Supplement thereto, in accordance with the Drawings and these Specifications.

1.3 Related Work Specified Elsewhere.

All Sections.

1.4 Reference Standards.

A. State of Colorado, Division of Highways S-Standards, Sheets S-614-50 (pages 1-4), and S-614-51.

B. "Manual on Uniform Traffic Control Devices for Streets and Highways". MUTCD

1.5 Submittals.

A. Submit a "Traffic Control Plan" to the Town for acceptance prior to construction.

1.6 Field Conditions. The traffic control through the construction areas is the responsibility of the Contractor. The Contractor's "Traffic Control Plan" shall include the proposed methods of handling traffic for each of the different stages of construction within the guidelines of this Specification. The Contractor will prepare a schedule of traffic control devices necessary for each anticipated and identified construction operation. Control devices may be used at more than one location.

Approval of the proposed method of handling traffic shall constitute authorization to furnish the devices on the schedule. If, at any time, it is determined that unnecessary units are on the schedule or that additional units are required, the Town will furnish the Contractor with a revised schedule of authorized devices. Any change in the plans or the method of handling traffic shall be approved by the Town. Approval of the proposed method of handling traffic in no way shall relieve the Contractor of liability specifically provided for in the Contract. Before proceeding with construction, the Contractor shall have written approval from the Town of the proposed method of handling traffic.

2.1 MATERIALS

2.2 General. All materials shall conform to the applicable portions of the Reference Standards.

3.1 METHODS AND PROCEDURES

3.2 General. All methods and procedures shall conform to the approved "Traffic Control Plan" including all approved revisions.

3.3 Flagmen. Provide as needed, as directed by Engineer or as stated on Drawings to control traffic encroaching in construction zone.

3.4 Barricades, Flashing warning Lights. Provide for all open trenches, equipment and material storage, etc., and as called for on the Drawings and located within limits of construction. Protection to be in place 24 hours per day.

End of Section

SECTION 2100

REMOVAL OF STRUCTURES AND OBSTRUCTIONS

1.1 GENERAL

1.2 Scope. This Work shall consist of furnishing all labor, equipment, materials and miscellaneous items for the removal and satisfactory disposal or abandonment in place of all fences, signs, structures, old pavements, roads, sidewalks, retaining walls and any other obstructions. It shall also include salvaging of designated materials; backfilling the resulting trenches, holes, and pits; and the restoration and clean-up of the affected area.

This Work shall include sawing concrete and asphalt in reasonably close conformity with the dimensions of these Specifications to create lines of weakness in order to facilitate controlled breaking for removal.

1.3 Submittals. Copies of written agreements for disposal areas will be given to the Engineer before work begins.

2.00 MATERIALS. Not applicable.

3.1 METHODS AND PROCEDURES

3.2 General. The Contractor shall remove and dispose of all signs, structures, fences, old pavements, abandoned pipelines, and other obstructions. All salvageable materials noted shall be removed, without unnecessary damage, in sections or pieces which may be easily transported and stored.

3.3 Disposal. Unusable material may be disposed of outside the limits of view from the project with written permission of the property owner on whose property the material is placed. Copies of all agreements with property owners are to be furnished the Engineer.

Where portions of structures are to be removed, the remaining portions shall be prepared to fit new construction. The work shall be done in accordance with Drawings, and in such manner that materials to be left in place shall be protected from damage; all damage to portions of structures to remain in place shall be repaired by the Contractor at his expense. Reinforcing steel projecting from the remaining structure shall be cleaned and aligned to provide bond with new extension.

3.4 Salvage. Salvage all items shown on the Drawings. During demolition, Owner or his representatives may designate additional materials to be salvaged rather than disposed. All salvage materials shall be removed from the job site by the Contractor and stored at a site to be designated by the Owner.

3.5 Pipe to be left in place. All small metal pipe and metal culverts shall have the ends crushed and crimped back where possible. The ends of all masonry and plastic pipe products shall be completely back-filled with concrete or grout a minimum of 18" or one pipe diameter, whichever is greater. All headwalls and appurtenances shall be removed. Where shown on the Drawings, pipe shall be backfilled their full length.

3.6 Sawing of Concrete. The sawing of concrete shall be done carefully, and all damages to concrete remaining in place, due to Contractor's operations, shall be repaired by the Contractor at

his expense. An effective dust control method must be utilized throughout concrete sawing operations.

3.7 Safety. Operations that may damage or constitute a hazard to the traveling public will not be permitted.

3.8 Removal of Culverts and Other Drainage Structures. Culverts and other drainage structures in areas under traffic use shall not be removed until satisfactory arrangements have been made to accommodate traffic.

Where portions of existing structures lie wholly or in part within the limits of a new structure, they shall be removed as necessary to accommodate the construction of the proposed structure.

3.9 Removal of Pipe. Pipes indicated on the Drawings to be removed for salvage and reuse shall be carefully removed, cleaned and every precaution taken to avoid damage to the pipe. Removal of pipe shall include all appurtenances. Pipe to be salvaged shall be taken to the Owner's designated storage yard; pipe to be re-laid shall be stored by the Contractor so that no damage to pipe will occur. The Contractor shall replace, at his expense, all pipe lost or damaged due to negligence, improper storage or improper construction techniques.

3.10 Removal of Pavement, Sidewalks, Curbs, etc. All concrete pavement, sidewalks, curbs, gutters, etc., designated for removal, shall be broken into pieces, the size of which shall not exceed approximately 400 pounds or 3 square yards of surface area, and shall be disposed of in a suitable manner.

Where old concrete construction abuts new concrete construction, edges of pavement sidewalks, curbs, etc., to be left in place shall be sawn to a true line with a vertical face.

Asphalt and bituminous pavements to be cut to the full depth of pavement with a vertical face in a straight line parallel to the limit of excavation. Cuts shall be made with a saw, or as approved in writing by the Town, so as to provide a straight, true cut. Concrete pavements, including curbs, gutters and sidewalks, to be saw cut to the full depth of pavement with a vertical face in a straight line parallel to the limit of excavation. An effective method of dust control shall be utilized throughout concrete sawing operations.

Feathering of new asphalt pavements onto old pavements will not be permitted under this Contract.

3.11 Abandonment of Manholes, Catch Basins, Inlets, etc. Remove all portions of structure to 12 inches below finish grade. Fill all voids with concrete or Class 1 Structure Backfill (95% density). Backfill to surface with concrete, Class 6 aggregate and/or bituminous asphalt or topsoil to match final surface treatment.

End of Section

SECTION 2110

EXCAVATION AND EMBANKMENT

1.1 GENERAL

1.2 Scope. Work to be performed under this section shall include all labor, equipment, materials and miscellaneous items necessary to perform all clearing and grubbing, excavation, backfilling, compacting, testing and related work not specified elsewhere, as shown on the Drawings and required by the Specifications.

All work within the rights-of-way of the Federal Government, the Colorado Division of Highways, County Governments or Municipal Governments shall be done in compliance with requirements issued by those agencies. All such requirements shall take precedence over these Specifications. It shall be the Contractor's responsibility to secure all required excavation permits and pay all costs thereof.

1.3 Related Work Specified Elsewhere.

Section 2120 - Excavation and Backfill For Structures
Section 2140 - Embedment and Base Course Aggregate

1.4 Reference Standards.

A. State Department of Highways, Division of Highways, State of Colorado, "Standard Specifications for Road and Bridge Construction," latest edition.

1.5 Field Conditions.

A. Existing Utilities. Underground utilities, except service lines, known to the Engineer have been shown on the Drawings. Locations are approximate only and may prove to be inaccurate. The Contractor is responsible for verification of the existence, location and protection of all utilities within the construction limits.

Before commencing with work, the Contractor shall notify all public and private companies who may have utilities within the project limits. The Contractor shall coordinate with these entities all excavation performed. The Contractor shall obtain all permits required by utility owners.

In the event of damage to any existing utility, the Contractor shall be solely responsible for the repair and payment for repair of all such damage.

The Contractor shall make arrangements for and pay all costs for relocation of utilities requiring relocation as indicated on the Drawings. Should utility obstructions, not shown on the Drawings, be encountered and require relocation, the Contractor shall notify the Owner and the Engineer and shall make arrangements necessary for such relocation.

B. Existing Improvements. The Contractor shall restore or protect from damage all existing improvements encountered in performance of the work. Improvements damaged as a result of this work shall be restored to original condition or better, as

determined by the Engineer.

Adjacent property shall be protected by the Contractor from any damage. The Contractor shall be held solely liable for any damage to adjacent property and shall be responsible for all costs resulting from repair of such damage.

- C. Soil Conditions. It shall be the responsibility of the Contractor to examine soil conditions and characteristics, including the presence of groundwater, that will be encountered within the limits of construction.

1.6 Protection of Work.

- A. Safety. All excavations shall be protected by barricades, lights, signs, etc. as required by governing federal, state and local safety codes and regulations.
- B. Sheeting, shoring and bracing. Except where banks are cut back on a stable slope, provide and maintain sheeting, shoring and bracing systems necessary to protect adjoining grades and structures from caving, sliding, erosion or other damage, and suitable forms of protection against bodily injury, all in accordance with applicable codes and governing authorities.

Remove sheeting and shoring systems as excavations are backfilled in a manner to protect the construction or other structures, utilities or property. Do not remove any sheeting after backfilling.

Sheeting and shoring systems shall be structurally designed and sufficiently braced to provide necessary restraining of retained backfill. Prior to installation of such systems, methods of installation and materials proposed shall be discussed with and approved by Engineer. All systems shall be in strict compliance with local, state and federal safety regulations. Contractor is solely liable for non-compliance.

- C. Site Drainage. Excavation to be protected from surface water drainage at all times.

1.7 Blasting. No blasting shall be permitted without written consent of the Town. Blasting shall be done only after the Town receives permission from the appropriate governmental authority(ies). Blasting shall be performed only by properly licensed, experienced individuals and in a manner such that no damage to any property or persons will occur due to either the blast or debris.

Contractor shall provide proof of insurance as required by these Specifications, the governing authority or as required by the Town prior to any blasting. All damage as the result of blasting shall be repaired, at the Contractor's expense, to the satisfaction of the Town. All earth or rock loosened by blasting shall be removed from excavations prior to proposed construction. It is advised to make preblasting evaluations of adjacent properties when possible.

1.8 Construction in Streets. When construction operations are located within streets, make provisions at cross streets and walks for free passage of vehicles and pedestrians. Do not block streets or walks without prior approval.

2.1 MATERIALS

All materials for construction fills and backfills shall meet specified requirements for gradation and other factors defining suitability for the intended use. All classes of suitable material shall be free from perishable matter, debris, frozen material and stones and/or cemented pieces larger than

permitted by the specified gradation. Classification of materials shall be as follows:

2.2 Excavation. Excavation shall consist of the excavation of all materials of whatever character required for the Work, obtained within the right-of-way, including surface boulders and excavation for ditches and channels and not being removed under some other item.

2.3 Materials for Embankment. Embankment material shall consist of approved material acquired from excavations, hauled and placed in embankments in reasonably close conformity with the line, grades, thicknesses and typical cross sections shown on the plans or as designated.

When source of embankment material is not designated on the plans, approval of the source will be contingent on the material having a resistance value of at least that shown on the plans, when tested by the Hveem Stabilometer, and a maximum dry density of not less than 90 pounds per cubic foot.

2.4 Topsoil. Topsoil shall consist of selectively excavated, loose, friable loam reasonably free of admixtures of sub-soil, refuse, stumps, roots, rocks, brush, weeds or other material which would be detrimental to the proper development of vegetative growth; topsoil to be free of any stone or rock greater than 3" in size.

3.1 METHODS AND PROCEDURES

3.2 Clearing and Grubbing.

A. Preservation of Existing Conditions.

The Engineer will establish right-of-way lines and construction lines and designate all trees, shrubs, plants and other things to remain. The Contractor shall preserve all things designated to remain.

B. Clearing and Grubbing.

Clear and/or grub all surface objects and all trees, stumps, roots and other protruding obstructions, not designated to remain, including mowing, as required, except undisturbed stumps and roots and non-perishable solid objects which will be a minimum of two feet below subgrade or slope embankment. Outside cut or fill limits, but within construction limits, stumps may be left at finish grade if allowed by Engineer.

Except in areas to be excavated, backfill stump holes and other holes from which obstructions are removed, with embankment material and compacted in accordance with Section 3.05.

C. Disposal.

If perishable material is burned, burn under the constant care of competent watchmen at such times and in such a manner that the surrounding vegetation, the other adjacent property or anything designated to remain on the right-of-way, will not be jeopardized. Burning shall be done in accordance with applicable laws and ordinances.

When permitted, materials and debris which cannot be burned and perishable

materials may be removed from the right-of-way and disposed of at locations off the project outside the limits of view from the project with the written permission of the property owner on whose property the materials and debris are placed. The Contractor shall make all necessary arrangements with property owners for obtaining suitable disposal locations and the cost involved shall be included in the unit price bid.

All merchantable timber in the clearing area which has not been removed from the right-of-way prior to the beginning of construction, shall become the property of the Contractor, unless otherwise specified.

D. Scalping.

Scalp areas where excavation or embankment is to be made. Scalping shall include the removal of material such as brush, roots, sod, grass, residue or agricultural crops, sawdust, and other vegetable matter from the surface of the ground.

E. Hedges.

Hedges shall be pulled or grubbed in such a manner as to assure complete and permanent removal. Scattered hedge or shrubs not classified as hedge shall be removed as specified for hedge.

F. Topsoil.

Strip topsoil from all areas to be disturbed by construction. Topsoil to be stockpiled separately from excavated materials.

3.3 Construction Requirements. The excavation and embankments required shall be finished to smooth and uniform surfaces. Materials shall not be wasted without permission of the Engineer. The Engineer reserves the right to change grade lines, cut slopes or fill lines during the progress of the work.

3.4 Excavation. Material outside of the limits of excavation will not be disturbed. Prior to beginning excavation operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with these Specifications. The Contractor shall not excavate beyond the dimensions and elevations established. Common excavation shall include all materials of whatever nature encountered in the work for construction of excavations to the lines and grades called for on the Drawings. Structure excavation shall include all earthwork required for the construction of structures to the lines and grades called for on the Drawings. If any areas are inadvertently over-excavated, fill such over-excavation with embankment material and compact in accordance with Section 3.05.

A. Tolerances. In those areas upon which a subbase material is required, upon which finished landscaping improvements, including sodding or lawn seeding, or upon which a structure is to be constructed directly, deviation of not more than 1 inch shall be permitted when tested with a 16-foot straight edge. Deviation from grade shall not exceed 1 inch at any point.

In those areas upon which a base course material is required, deviation of not more than 0.04 foot shall be permitted when tested with a 16-foot straight edge. Deviation from grade shall not exceed 0.04 foot at any point.

In those areas where no additional construction, other than topsoil addition and native seeding will occur, the finished surface shall be smooth and shall not deviate from grade by more than 0.5 foot at any point.

- B. Groundwater Control. Contractor to maintain facilities on site to remove all groundwater from excavated area and keep water below the bottom of the excavation to a point such that a firm base for equipment or concrete installation exists. Facilities shall be maintained until all backfilling is in place at least 24 inches above anticipated water levels before water removal. All water removal shall be subject to approval by the Engineer.
- C. Stockpile Excavated Material. Excavated material to be stockpiled so as not to endanger the work or public safety. Maintain existing vehicular and pedestrian traffic with minimum disruption. Maintain emergency access and access to existing fire hydrants and water valves. Maintain natural drainage courses and street gutters.

Backfill material to be segregated from stock piled topsoil and unusable backfill materials.

- D. Over-excavation. Whenever the site is over-excavated more than 0.1' to eliminate point bearing by rocks or stones beneath proposed structures or when grade tolerances are exceeded, the Contractor is to re-establish grade using material recommended by the project engineer and accepted by the Town. Compaction shall be to 95% maximum density. All work to re-establish grade shall be at the Contractor's expense.
- E. Unstable Materials. Materials which are not capable of supporting superimposed loadings are defined as unstable materials. Should unstable materials be encountered during excavation, immediately notify Engineer. If, in the opinion of the Engineer, unstable soil excavation is required and the Contractor could not have reasonably been expected to discover the existence of such materials during his site investigation, than a contract price for Unstable Soil Excavation shall be negotiated between Owner & Contractor. No payment shall be made for materials excavated prior to notification of the Engineer and negotiation of payment for extra work.

Inclusion of a bid item for Unstable Soil Excavation indicates such excavation is anticipated. The Contractor is to notify the Engineer prior to any unstable soil excavation; no payment shall be made for excavation prior to authorization of Engineer.

- F. Rock Excavation. Rock excavation shall be defined as removal of boulders in excess of three (3) cubic yards or solid or fractured rock, which requires techniques, such as blasting or jacking for removal, other than those which are being employed by the Contractor or are normally used in excavation, such as use of backhoes, trenchers, draglines, etc. Should unanticipated rock conditions be encountered, immediately notify the Engineer. If in the opinion of the Engineer, rock excavation is required and the Contractor had in fact made a diligent and determined effort to remove the material using normal excavation procedures as stated above and the Contractor could not have reasonably been expected to determine the existence of such material during his site investigation, then a contract price for Rock Excavation shall be negotiated between the Contractor and the Owner. No payment shall be

made for excavation performed prior to determination of a negotiated price.

Rock shall be removed to a 4" depth below grade. In addition, all rock loosened during jacking, blasting, etc. shall be removed from the site. For payment purposes, maximum depth to be paid for shall be 12" below required grade. All over-excavation shall be replaced as specified in Subsection 3.03, D.

Inclusion of a bid item for Rock Excavation indicates such excavation is anticipated. Contractor to notify Engineer prior to any rock excavation; no payment shall be made for excavation prior to notification.

- G. **Disposal of Excess Excavation.** Contractor to dispose of excess excavation off-site. The Owner shall have the right to elect to have the excess excavation disposed of at a designated site within the Work limits. Excavation may be wasted on site only if approved by the Engineer and shall be done at the direction of the Engineer. Disposal in any case shall be the sole responsibility of the Contractor.

3.5 **Pavement Materials.** Prior to placing pavement materials, fabric or any embankment, the entire subgrade shall be scarified to a depth of 8 eight inches (8") adjusted to a moisture content near optimum and compacted to at least 95% of the maximum standard Proctor Density. The final subgrade shall be proof-rolled with a heavy loaded pneumatic-tire vehicle. Areas which deform excessively under wheel loading are not stable and should be improved prior to placing pavement materials.

In unstable and wet subgrade areas, a stiff synthetic geogrid equal to Tensar SS-1 fabric may be used to improve the subgrade. Use of a geogrid material shall be designed and submitted to the Town by a licensed soils engineer. The final subgrade should then be proof-rolled similar to the remaining on-deflecting natural subgrade areas.

3.6 **Embankment and Backfilling.** Do not begin embankments until construction below grade has been approved, underground utility systems have been inspected, tested and approved and trash and debris have been cleaned from the excavation.

Place approved excavated material in successive uniform maximum loose layers not exceeding 8 inches for the full width of the cross-section in all accessible areas. Place material in successive uniform loose layers not exceeding 4 inches in areas not accessible or permitted for the use of self propelled rollers or vibrators. Do not place fill on muddy or frozen subgrade, or until subgrade is approved by the Engineer.

Plow, step, or bench sloped surfaces steeper than 4 to 1 on which fill or backfill is to be placed in such a manner that fill material will adequately bond with existing surfaces. Scarify all surfaces to receive backfill to a depth of 6" before filling.

Construct fills and embankments to the lines and grades indicated on the Drawings within tolerances stated in Section 3.03, A above.

Use suitable materials removed from the excavation prior to obtaining material from borrow areas.

Where otherwise suitable material is too wet, aerate, dry or blend to provide the moisture content specified for compaction.

3.7 **Compaction.** During placing and/or compacting operations of earth or earth-and-rock

mixtures, the moisture content of materials in the layers being compacted shall be near optimum and uniform throughout the layer. In general, maintain the moisture content of the material being placed and compacted within 2% of optimum condition as determined as ASTM Standard D698.

- A. **Compaction Equipment.** Perform all compaction with approved equipment well suited to location and material being compacted. Use heavy vibratory rollers or sheepsfoot rollers where heavy equipment is authorized. Do not operate heavy equipment closer to structures than a horizontal distance equal to height of backfill above bottom of structure foundation. Compact remaining area with hand tampers suitable for material being compacted. Place and compact backfill around pipes with care to avoid damage.

Compact fill materials to following densities at optimum moisture content based on ASTM D698 or AASHTO T99:

1. Structure fill under or within 5' horizontally of all concrete structures: 95%.
 2. Backfill beneath or within 5' horizontally or within the area defined by a line extended at an angle of 1:1 of existing or proposed pavements, roadways, sidewalks, curbs, utility lines or other improvements: 95%
 3. Backfill within lagoon berm: 95%
 4. Backfill within public or designated rights-of-way: 90% or as shown on the Drawings.
 5. Backfill within undeveloped, green or undesignated area: 85%.
- B. **Jetting.** Jetting and water inundation are generally not permitted methods of compaction. The Engineer may allow jetting under certain field conditions. Techniques including depth of lifts, amount of water to be used, penetration of hose jet, etc., shall be at the direction of the Engineer. No jetting will be allowed on materials with a 200-minus gradation of greater than 15%. Contractor shall pay cost of all water used, soil classification testing and compaction testing and any retesting or additional compaction required. No jetting shall be done prior to written approval and direction of the Engineer.
- C. **Maintenance.** Contractor to maintain all embankment in satisfactory condition during the extent of the contract and warranty period. All surface deterioration determined to be the responsibility of the Contractor and all settlement shall be repaired at once by the Contractor upon notice by the Owner. All costs for repair and all liability as a result of surface deterioration or settlement shall be the responsibility of the Contractor.

3.8 **Proof Rolling.** Proof rolling with a heavy rubber-tired roller will be required as designated on the plans or when ordered. Proof rolling shall be done after specified compaction has been obtained. Areas found to be weak and those areas which failed shall be ripped, scarified, wetted if necessary and recompacted to the requirements for density and moisture at the Contractor's expense. Equipment to be used for proof rolling may also be fully loaded, tandem axle dump truck or water truck or rubber-tired roller with equivalent loading characteristics.

3.9 **Surface Restoration.** All existing surface improvements and site conditions disturbed or

damaged during construction to be restored to a condition equal to preconstruction condition. All restoration costs are considered incidental to excavation and backfill.

- A. Improvements. Replace, repair or reconstruct all improvements as required. Work will not be accepted until restoration is accepted by Engineer and all affected property owners.
- B. Final Grading. The Contractor is to re-establish existing final grade or finish to final grades as modified and shown on the Drawings. The Contractor is to backfill to proper subgrade elevation with backfill material to allow placement of surface improvements or materials.
- C. Roadways. All roadways to be restored to original condition with material types removed. Materials and methods to conform to Section 2140 - Embedment and Base Course Aggregate and Section 2500 - Hot Bituminous Pavement. Additional requirements are:
 - 1. Minimum base course material on gravel roadways or minimum depth gravel beneath hard surface roadways to be 8".
 - 2. Minimum asphalt pavement surfacing to be 3".
 - 3. Minimum concrete pavement surfacing to be 6".

The above are minimums. Replacement shall be equal to these minimums or to the depth of the existing materials, whichever is greater.

All repairs to streets shall be same day or as approved by the Town in writing.

- D. Green Areas. Place excavated topsoil from the roadway or from pits directly upon constructed cut and fill slopes without the use of stockpiles whenever conditions and the progress of construction will permit.

Do not place topsoil until the areas to be covered have been properly prepared and grading operations in the area have been completed.

Place and spread topsoil at locations and to the thickness shown on the plans. Key to the underlying material by the use of harrows, rollers or other equipment suitable for the purpose.

Apply water to the topsoil at the locations and in the amounts designated. Apply in a fine spray by nozzles or spray bars in such manner that it will not wash or erode the topsoil areas.

All loose exposed rock larger than six inches shall be removed from slopes that are to receive topsoil.

See Section 2730," Revegetation - Seeding, Sodding, Hydroseeding".

4.1 QUALITY CONTROL - FIELD

- 4.2 Inspection and Testing. Inspection and testing to be performed at the direction of the

Engineer. Contractor to cooperate fully with all persons engaged in testing. Contractor to excavate as required to allow testing; Contractor to backfill all test excavations in accordance with these Specifications.

4.3 Density Testing and Control.

- A. Reference Standards. Density/moisture relationships to be developed for all soil types encountered according to ASTM D698 or AASHTO T99.
- B. Field Testing. Testing for density during compaction operations to be done in accordance with ASTM D2922 using nuclear density methods.
- C. Frequency of Testing. Frequency of testing to be done at the direction of the Engineer.
- D. Retesting. In the event of failure to meet compaction criteria, Contractor shall re-excavate and re-backfill at direction of Engineer. All retesting to be paid for by Contractor and to be performed by soils testing firm approved by the Engineer.

End of Section

SECTION 2120

EXCAVATION AND BACKFILL FOR STRUCTURES

1.1 GENERAL

1.2 Scope. Work to be performed under this section shall include all labor, equipment, materials and miscellaneous items necessary to perform all clearing and grubbing, excavation, backfilling, compacting, testing and related work not specified elsewhere, as shown on the Drawings and required by the Specifications.

All work within the rights-of-way of the Federal Government, the Colorado Division of Highways, County Governments or Municipal Governments shall be done in compliance with requirements issued by those agencies. All such requirements shall take precedence over these Specifications. It shall be the Contractor's responsibility to secure all required excavation permits and pay all costs thereof.

1.3 Related Work Specified Elsewhere.

Section 2140 - Embedment and Base Course Aggregate
Section 3100 - Cast-In-Place Concrete

1.4 Reference Standards.

A. State Department of Highways, Division of Highways, State of Colorado, "Standard Specifications for Road and Bridge Construction," latest edition.

1.5 Field Conditions.

A. Existing Utilities. Underground utilities, except service lines, known to the Engineer have been shown on the Drawings. Locations are approximate only and may prove to be inaccurate. The Contractor is responsible for verification of the existence, location and protection of all utilities within the construction limits.

Before commencing with work, the Contractor shall notify all public and private companies who may have utilities within the project limits. The Contractor shall coordinate with these entities all excavation performed. The Contractor shall obtain all permits required by utility owners.

In the event of damage to any existing utility, the Contractor shall be solely responsible for the repair and payment for repair of all such damage.

The Contractor shall make arrangements for and pay all costs for relocation of utilities requiring relocation as indicated on the Drawings. Should utility obstructions, not shown on the Drawings, be encountered and require relocation, the Contractor shall notify the Owner and the Engineer and shall make arrangements necessary for such relocation.

B. Existing Improvements. The Contractor shall restore or protect from damage all existing improvements encountered in performance of the work. Improvements damaged as a result of this work shall be restored to original condition or better, as determined by the Engineer.

Adjacent property shall be protected by the Contractor from any damage. The Contractor shall be held solely liable for any damage to adjacent property and shall be responsible for all costs resulting from repair of such damage.

- C. Soil Conditions. It shall be the responsibility of the Contractor to examine soil conditions and characteristics, including the presence of groundwater, that will be encountered within the limits of construction.

1.6 Protection of Work.

- A. Safety. All excavations shall be protected by barricades, lights, signs, etc. as required by governing federal, state and local safety codes and regulations.
- B. Sheeting, shoring and bracing. Except where banks are cut back on a stable slope, provide and maintain sheeting, shoring and bracing systems necessary to protect adjoining grades and structures from caving, sliding, erosion or other damage, and suitable forms of protection against bodily injury, all in accordance with applicable codes and governing authorities.

Remove sheeting and shoring systems as excavations are backfilled in a manner to protect the construction or other structures, utilities or property. Do not remove any sheeting after backfilling.

Sheeting and shoring systems shall be structurally designed and sufficiently braced to provide necessary restraining of retained backfill. Prior to installation of such systems, methods of installation and materials proposed shall be discussed with and approved by Engineer. All systems shall be in strict compliance with local, state and federal safety regulations. Contractor is solely liable for non-compliance.

- C. Site Drainage. Excavation to be protected from surface water drainage at all times.

- 1.7 Blasting. No blasting shall be permitted without written consent of the Engineer. Blasting shall be done only after Engineer receives permission from the appropriate governmental authority(ies). Blasting shall be performed only by properly licensed, experienced individuals and in a manner such that no damage to any property or persons will occur due to either the blast or debris.

Contractor shall provide proof of insurance as required by these Specifications, the governing authority or as required by Engineer prior to any blasting. All damage as the result of blasting shall be repaired, at the Contractor's expense, to the satisfaction of the Engineer. All earth or rock loosened by blasting shall be removed from excavations prior to proposed construction.

- 1.8 Construction in Streets. When construction operations are located within streets, make provisions at cross streets and walks for free passage of vehicles and pedestrians. Do not block streets or walks without prior approval.

2.1 MATERIALS

All materials for construction fills and backfills shall meet specified requirements for gradation and other factors defining suitability for the intended use. All classes of suitable material shall be free

from perishable matter, debris, frozen material and stones and/or cemented pieces larger than permitted by the specified gradation. Classification of materials shall be as follows:

2.2 Materials for Structure Backfill. Structure backfill shall be composed of materials designated as Class 1, Class 2, Class 3 or Class 4.

- A. Class 1 Backfill (CDOH Section 703.08 - Class 1). Class 1 backfill shall be composed of materials from excavations, borrow areas, or other sources. This material shall conform to the following requirements when tested with laboratory sieves:

<u>Sieve Designation</u>	<u>% by Weight Passing</u>
2 inch	100
No. 4	30-100
No. 50	60 max.
No. 200	5-20

In addition, this material shall have a liquid limit not exceeding 35 and a plasticity index of not over 6 when determined in conformity with AASHTO T89 and T90.

- B. Class 2 backfill (CDOH Section 703.08 - Class 2). Class 2 backfill shall be composed of suitable materials developed from excavation, borrow areas or other sources. If the material contains rock fragments which, in the opinion of the Engineer, will be injurious to the structure, the material will not be used for backfilling. In addition, no rock larger than 4" shall be placed within the structure backfill zones shown on M-206-1 and M-206-2.

- C. Class 3 Backfill (CDOH Section 703.03 - Class 6). Class 3 backfill shall consist of crushed stone, crushed slag, crushed gravel, or natural gravel conforming to the following requirements when tested with laboratory sieves.

<u>Sieve Designation</u>	<u>% by Weight Passing</u>
3/4 inch	100
No. 4	30-65
No. 8	25-55
No. 200	5-12

In addition, this material shall have a liquid limit not exceeding 30 and a plasticity index of not over 6 when determined in conformity with AASHTO T89 and T 90.

- D. Class 4 Backfill (CDOH Section 703.03 - Class 2). Class 4 backfill shall be composed of suitable materials developed from excavation, borrow areas, or other sources. If the material contains rock fragments that in the opinion of the Engineer will be injurious to the structure, the native material will not be used for backfilling and the Contractor will be required to furnish Class 1 backfill material at a unit price mutually agreed upon between Contractor and Owner.

2.3 Topsoil. Topsoil shall consist of selectively excavated, loose, friable loam reasonably free of admixtures of sub-soil, refuse, stumps, roots, rocks, brush, weeds or other material which would be detrimental to the proper development of vegetative growth.

3.1 METHODS AND PROCEDURES

3.2 Site Preparation.

- A. Clearing. Remove all vegetation, stumps, roots, organic matter, debris and other miscellaneous structures and materials from work site. Dispose of off-site.
- B. Topsoil Removal. Strip existing topsoil from all areas to be distributed by construction. Topsoil to be stockpiled separately from excavated materials.
- C. Pavement Removal. See Section 2100 - Removal of Structures and Obstructions.
- D. Preservation of Trees. Refer to plans for designation of all trees, shrubs, plants and other vegetation within the project site to remain. Do not remove trees outside of excavated or filled areas, unless their removal is authorized by the Engineer. Protect trees left standing from permanent damage by construction operations.

3.3 Construction Requirements. The excavation and embankments required shall be finished to smooth and uniform surfaces. Materials shall not be wasted without permission of the Engineer. The Engineer reserves the right to change grade lines, cut slopes or fill lines during the progress of the work.

3.4 Structure Excavation. Material outside of the limits of excavation will not be disturbed. Prior to beginning excavation operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with these Specifications. The Contractor shall not excavate beyond the dimensions and elevations established.

Structure excavation shall include all earthwork required for the construction of structures to the lines and grades called for on the Drawings.

If any areas are inadvertently over-excavated, fill such over-excavation with Class 1 or Class 3 backfill.

- A. Tolerances. In those areas upon which a subbase or base course material is required, upon which a structure is to be constructed directly, within 20 feet of the edge of any structure, or for any surfaces which are constructed for drainage purposes, deviation of not more than 1 inch shall be permitted when tested with a 16-foot straight edge. Deviation from grade shall not exceed 1 inch at any point.

In those areas where no additional construction, other than topsoil addition, will occur, the finished surface shall be smooth and shall not deviate from grade by more than 0.5 foot at any point.

- B. Groundwater Control. Contractor to maintain facilities on site to remove all groundwater from excavated area and keep water below the bottom of the excavation to a point such that a firm base for equipment or concrete installation exists. Facilities shall be maintained until all backfilling is in place at least 24 inches above anticipated water levels before water removal. All water removal shall be subject to approval by the Engineer.
- C. Stockpile Excavated Material. Excavated material to be stockpiled so as not to endanger the work or public safety. Maintain existing vehicular and pedestrian traffic with minimum disruption. Maintain emergency access and access to existing fire hydrants and water valves. Maintain natural drainage courses and street gutters.

Backfill material to be segregated from stock piled topsoil and unusable backfill materials.

- D. Over excavation. Whenever the site is over excavated more than 0.1' to eliminate point bearing by rocks or stones beneath proposed structures or when grade tolerances are exceeded, the Contractor is to re-establish grade using material recommended by the project engineer and accepted by the Town. Compaction shall be to 95% maximum density. All work to re-establish grade shall be at the Contractor's expense.

- E. Unstable Materials. Materials which are not capable of supporting superimposed loadings are defined as unstable materials. Should unstable materials be encountered during excavation, immediately notify Engineer. If, in the opinion of the Engineer, unstable soil excavation is required and the Contractor could not have reasonably been expected to discover the existence of such materials during his site investigation, than a contract price for Unstable Soil Excavation shall be negotiated between Owner & Contractor. No payment shall be made for materials excavated prior to notification of the Engineer and negotiation of payment for extra work.

Inclusion of a bid item for Unstable Soil Excavation indicates such excavation is anticipated. The Contractor is to notify the Engineer prior to any unstable soil excavation; no payment shall be made for excavation prior to authorization of Engineer.

- F. Rock Excavation. Rock excavation shall be defined as removal of boulders in excess of three (3) cubic yards or solid or fractured rock, which requires techniques, such as blasting or jacking for removal, other than those which are being employed by the Contractor or are normally used in excavation, such as use of backhoes, trenchers, draglines, etc. Should unanticipated rock conditions be encountered, immediately notify the Engineer. If in the opinion of the Engineer, rock excavation is required and the Contractor had in fact made a diligent and determined effort to remove the material using normal excavation procedures as stated above and the Contractor could not have reasonably been expected to determine the existence of such material during his site investigation, then a contract price for Rock Excavation shall be negotiated between the Contractor and the Owner. No payment shall be made for excavation performed prior to determination of a negotiated price.

Rock shall be removed to a 4" depth below grade. In addition, all rock loosened during jacking, blasting, etc. shall be removed from the site. For payment purposes, maximum depth to be paid for shall be 12" below required grade. All over-excavation shall be replaced as specified in Subsection 3.03, D.

Inclusion of a bid item for Rock Excavation indicates such excavation is anticipated. Contractor to notify Engineer prior to any rock excavation; no payment shall be made for excavation prior to notification.

- G. Disposal of Excess Excavation. Contractor to dispose of excess excavation off-site. The Owner shall have the right to elect to have the excess excavation disposed of at a designated site within the Work limits. Excavation may be wasted on site only if approved by the Engineer and shall be done at the direction of the Engineer. Disposal in any case shall be the sole responsibility of the Contractor.

3.5 Backfilling. Do not begin backfilling until construction below grade has been approved,

underground utility systems have been inspected, tested and approved and trash and debris have been cleaned from the excavation.

Place approved excavated material in successive uniform maximum loose layers not exceeding 8 inches for the full width of the cross-section in all accessible areas. Place material in successive uniform loose layers not exceeding 4 inches in areas not accessible or permitted for the use of self propelled rollers or vibrators. Do not place fill on muddy or frozen subgrade, or until subgrade is approved by the Engineer.

Construct fills to the lines and grades indicated on the Drawings within tolerances stated in Section 3.03, A above. Use suitable materials removed from the excavation prior to obtaining material from borrow areas. Where otherwise suitable material is too wet, aerate, dry or blend to provide the moisture content specified for compaction.

3.6 Compaction. During placing and/or compacting operations with earth or earth-and-rock mixtures, the moisture content of materials in the layers being compacted shall be near optimum and uniform throughout the layer. In general, maintain the moisture content of the material being placed and compacted within 2% of optimum condition as determined as ASTM Standard D698.

- A. **Compaction Equipment.** Perform all compaction with approved equipment well suited to location and material being compacted. Use heavy vibratory rollers or sheepsfoot rollers where heavy equipment is authorized. Do not operate heavy equipment closer to structures than a horizontal distance equal to height of backfill above bottom of structure foundation. Compact remaining area with hand tampers suitable for material being compacted. Place and compact backfill around pipes with care to avoid damage.

Compact fill materials to following densities at optimum moisture content based on ASTM D698 or AASHTO T99 as shown on the Drawings or as follows:

1. Structure fill under all concrete structures: 100%.
 2. Backfill beneath or within 5' horizontally of existing or proposed structures, pavements, roadways, sidewalks, curbs, utility lines or other improvements: 95%
 3. Backfill within public or designated rights-of-way: 90% or as shown on the Drawings.
 4. Backfill within undeveloped, green or undesignated area: 85%.
- B. **Maintenance.** Contractor to maintain all backfill in satisfactory condition during the extent of the contract and warranty period. All surface deterioration determined to be the responsibility of the Contractor and all settlement shall be repaired at once by the Contractor upon notice by the Owner. All costs for repair and all liability as a result of surface deterioration or settlement shall be the responsibility of the Contractor.

3.7 Surface Restoration. All existing surface improvements and site conditions disturbed or damaged during construction to be restored to a condition equal to preconstruction condition. All restoration costs are considered incidental to excavation and backfill.

- A. **Improvements.** Replace, repair or reconstruct all improvements as required. Work will not be accepted until restoration is accepted by Engineer and all affected

property owners.

- B. Final Grading. The Contractor is to re-establish existing final grade or finish to final grades as modified and shown on the Drawings. The Contractor is to backfill to proper subgrade elevation with backfill material to allow placement of surface improvements or materials.
- C. Roadways. All roadways to be restored to original condition with material types removed. Materials and methods to conform to Section 2140 - Embedment and Base Course Aggregate and Section 2500 - Hot Bituminous Pavement. Additional requirements are:
 - 1. Minimum base course material on gravel roadways or minimum depth gravel beneath hard surface roadways to be 8".
 - 2. Minimum asphalt pavement surfacing to be 2".
 - 3. Minimum concrete pavement surfacing to be 6".

The above are minimums. Replacement shall be equal to these minimums or to the depth of the existing materials, whichever is greater.

All repairs to streets shall be same day or as approved by the Town in writing.

- D. Green Areas. Restore all green areas as specified in Section 2730 - Revegetation - Seeding, Sodding, Hydroseeding.

4.1 QUALITY CONTROL - FIELD

4.2 Inspection and Testing. Inspection and testing to be performed at the direction of the Engineer. Contractor to cooperate fully with all persons engaged in testing. Contractor to excavate as required to allow testing; Contractor to backfill all test excavations in accordance with these Specifications.

4.3 Density Testing and Control.

- A. Reference Standards. Density/moisture relationships to be developed for all soil types encountered according to ASTM D698 or AASHTO T99.
- B. Field Testing. Testing for density during compaction operations to be done in accordance with ASTM D2922 using nuclear density methods.
- C. Frequency of Testing. Frequency of testing to be done at the direction of the Engineer.
- D. Retesting. In the event of failure to meet compaction criteria, Contractor shall re-excavate and re-backfill at direction of Engineer. All retesting to be paid for by Contractor and to be performed by soils testing firm approved by the Engineer.

4.4 Payment for Testing. Owner responsible for all costs of initial testing of backfill. Contractor to pay all costs of any retesting required.

End of Section

SECTION 2130

TRENCHING, BACKFILLING AND COMPACTION

1.1 GENERAL

1.2 Scope. Work to be performed under this section shall include all labor, equipment, materials and miscellaneous items necessary to perform all excavation, backfilling and compaction of underground pipelines, conduits, cables and appurtenances shown on the Drawings and specified herein.

All work within the rights-of-way of the Federal Government of the Colorado Division of Highways, County Governments or Municipal Governments shall be done in compliance with requirements issued by those agencies. All such requirements shall take precedence over these Specifications. It shall be the Contractor's responsibility to secure all required excavation permits and pay all costs thereof. Contractor will be required to obtain necessary road cut permits.

1.3 Related Work Specified Elsewhere.

Section 2140 - Embedment and Base Course Aggregate

Section 2200 - Culvert Drainage Pipe

Section 2300 - Water Transmission and Distribution Lines

Section 2400 - Sanitary Sewerlines

1.4 Field Conditions.

- A. Existing Utilities. Underground utilities, except service lines, known to the Engineer have been shown on the Drawings. Locations are approximate only and may prove to be inaccurate. The Contractor is responsible for verification of the existence, location and protection of all utilities within the construction area.

Before commencing with work, the Contractor shall notify all public and private companies who may have utilities within the project limits. The Contractor shall coordinate with these entities all excavation performed. The Contractor shall obtain all permits required by utility owners.

In the event of damage to any existing utility, the Contractor shall be solely responsible for the repair and payment for repair of all such damage.

The Contractor shall make arrangements for and pay all costs for relocation of utilities requiring relocation as indicated on the Drawings. Should utility obstructions, not shown on the Drawings, be encountered and require relocation, the Contractor shall notify the Owner and the Engineer and shall make arrangements necessary for such relocation.

- B. Existing Improvements. The Contractor shall restore or protect from damage all existing improvements encountered in performance of the work. Improvements damaged as a result of this work shall be restored to regional condition or better, as determined by the Engineer.

Adjacent property shall be protected by the Contractor from any damage. The Contractor shall be held solely liable for any damage to adjacent property and shall be responsible for all costs resulting from repair of such damage.

- C. Soil Conditions. It shall be the responsibility of the Contractor to examine soil conditions and characteristics, including the presence of groundwater that will be encountered within the limits of construction.

1.5 Protection of Work.

- A. Safety. All excavation shall be protected by barricades, lights, signs, etc., as required by governing federal, state and local safety codes and regulations.
- B. Sheeting, Shoring and Bracing. Where trench walls are not excavated at a stable slope, the Contractor shall provide and maintain support sufficient to prevent caving, sliding or failure and property or bodily damage. Any damage due to inadequate support shall be repaired at the sole expense of the Contractor.

Under normal construction conditions, support shall be removed as work progresses. Support shall remain installed if directed by the Engineer or if pipe does not have sufficient strength to support backfill based on trench width as defined by the sheeting. Sheeting shall not be removed after the start of backfilling.

Use of a movable trench shield or coffin box will not be allowed where pipe strength is insufficient to support backfill as defined by the trench width after the trench shield is removed.

The Contractor shall be held solely responsible for any violation of applicable safety standards. Particular attention is called to minimum requirements of OSHA and COSH (Colorado Occupational Safety and Health).

- C. Site Drainage. Excavation to be protected from surface water at all times.

1.6 Blasting. No blasting shall be permitted without written consent of the Town. Blasting shall be done only after Engineer receives permission from the appropriate governmental authority(ies). Blasting shall be performed only by properly licensed, experienced individuals and in a manner such that no damage to any property or persons will occur due to either the blast or debris. Contractor shall provide proof of insurance as required by these Specifications, the governing authority or as required by the Town prior to any blasting. All damage as the result of blasting shall be repaired, at the Contractor's expense, to the satisfaction of the Town. All earth or rock loosened by blasting shall be removed from excavations prior to proposed construction.

1.7 Construction in Streets. When construction operations are located within streets make provisions at cross streets and walks for free passage of vehicles and pedestrians. Do not block streets or walks without prior approval.

1.8 Submittals.

- A. Bedding Material
 - 1. Submit sieve analysis

- B. Select Fill
 - 1. Submit sieve analysis

2.1 MATERIALS

2.2 Embedment Material. Pipe line embedment material shall comply with the appropriate classes as listed below and as illustrated in the Construction Drawings:

- A. Class A - Use where indicated on the Drawings and where improper trenching or unexpected trench conditions require its use as determined by the Engineer.
 - 1. Characteristics - Concrete cradle foundation with densely compacted Class 6 aggregate base backfill to 12" above top of pipe, or densely compacted Class 6 aggregate granular foundation with concrete arch cover to 6" above top of pipe.
- B. Class B - Use for all plastic, clay and asbestos - cement pipe under normal construction conditions.
 - 1. Characteristics - Densely compacted Class 6 aggregate or 3/4" screened rock granular foundation of depth shown on Typical Details with densely compacted Class 6 aggregate or 3/4" screened rock to 12" above top of pipe.
- C. Class C - Use for all types of pipe not specified under Class B where normal construction conditions exist.
 - 1. Characteristics - Densely compacted Class 4 aggregate or 3/4" screened rock granular foundation of depth shown on Typical Details with densely compacted Class 4 aggregate or 3/4" screened rock to 12" above top of pipe.

2.3 Select Material. Subject to approval by the Engineer, select material shall be allowed in place of the aggregate backfill for Classes B & C embedment.

- A. Characteristics - Soil materials free from rocks, clods, and organic material, uniformly graded as follows:

<u>Pipeline Material</u>	<u>Gradation Limits</u>
Plastic, clay and Asbestos - Cement	3/4 inch max. with less than 15% passing No. 200 sieve
All others	1 1/2 inch max. with less than 20% passing No. 200 sieve

2.4 Concrete for Embedment. Shall be 2000 psi concrete (28 day compressive strength). Reinforcement shall conform to ASTM A185, Grade 40.

2.5 Backfill Material.

- A. Characteristics - Native materials free from debris, organic matter and frozen material. Uniformly graded sufficient to allow proper compaction.
- B. Gradation - No material greater than 3 inch diameter in top 12 inches of backfill.

Generally no boulders greater than 6 inch diameter in remainder of trench to be uniformly dispersed so as not to interfere in compactive effort.

3.1 METHODS AND PROCEDURES

3.2 Site Preparation.

- A. Clearing. Remove all vegetation, stumps, roots, organic matter, debris and other miscellaneous structures and materials from work site. Dispose of off-site.
- B. Topsoil Removal. Strip existing topsoil from all areas to be disturbed by construction. Topsoil to be stockpiled separately from excavated materials.
- C. Pavement Removal. See Section 2100 - Removal of Structures and Obstructions.

3.3 Trench Excavation.

- A. Limits of Excavation. Trenches to be excavated along lines and grades shown on the Drawings, or as modified in the field by the Engineer. Trench widths for pipe loading to be measured 12 inches above top of pipe.

Minimum trench width to be the outside diameter of the pipe or conduit plus 16 inches.

Maximum trench width to be the outside diameter of the pipe or conduit plus 24 inches for all pipes or conduits with outside diameter of 24 inches or less, and plus 30 inches for all pipes or conduits with outside diameters greater than 24 inches.

If maximum trench width is exceeded, Contractor will provide at his expense, higher strength pipe or special bedding including concrete at the direction of the Engineer.

Trench excavation not to be completed more than 100 feet in advance of pipe installation. Backfill to be completed within 100 feet of pipe installation.

- B. Groundwater Control. Contractor to maintain facilities on-site to remove all groundwater from trench and keep water at least 12 inches below the trench bottom to a point such that a firm base for pipe or conduit installation exists. Facilities shall be maintained until all concrete is cured and backfilling is in place at least 24 inches above anticipated water levels before water removal is discontinued; all water removal shall be subject to approval by the Engineer.

- C. Stockpile Excavated Material. Excavated material to be stockpiled so as not to endanger the work or public safety. Maintain existing vehicular and pedestrian traffic with minimum disruption. Maintain emergency access and access to existing fire hydrants and water valves. Maintain natural drainage courses and street gutters.

Backfill material to be segregated from stockpiled topsoil and unusable backfill materials.

- D. Excavation for Appurtenances. Excavation to be done in accordance with these Specifications and as shown on the Drawings. Adequate working clearances to be maintained around appurtenances. Provisions for base and bottom preparations shall apply to all appurtenances.

Precautions to be taken to maintain trench widths in the vicinity of adjacent pipelines and conduits.

3.4 Bottom Preparation.

- A. Bedding. A minimum of four(4) inches of bedding material will be required for all installations. Bedding material shall consist of 3/4" screened rock or as approved by the Town in writing.
- B. Bell Holes. Material to be removed to allow installation of all fitting and joint projections without affecting placement of pipe.
- C. Over excavation. Whenever the trench is over excavated to eliminate point bearing by rocks or stones, the Contractor is to re-establish grade using Class 6 aggregate or bedding material as stated above. For Class 6 aggregate, compaction shall be 95% maximum density. All work to re-establish grade shall be at the Contractor's expense.
- D. Unstable Materials. Materials which are not capable of supporting superimposed loadings are defined as unstable materials. Should unstable materials be encountered during excavation, immediately notify Engineer. If, in the opinion of the Engineer, unstable soil excavation is required and the Contractor could not have reasonably been expected to discover the existence of such materials during his site investigation, then a contract price for Unstable Soil Excavation shall be negotiated between Owner and Contractor. No payment shall be made for materials excavated prior to notification of the Engineer and negotiation of payment for extra work.

Inclusion of a bid item for Unstable Soil Excavation indicates such excavation is anticipated. The Contractor is to notify the Engineer prior to any unstable soil excavation; no payment shall be made for excavation prior to authorization of Engineer.

- E. Rock Excavation. Rock excavation shall be defined as removal of boulders in excess of three (3) cubic yards of solid or fractured rock, which makes hand shaping of the bottom impossible and which requires techniques, such as blasting or jacking for removal, other than those which are being employed by the Contractor or are normally used in trench excavation, such as use of backhoes, trenchers, draglines, etc. Should unanticipated rock conditions be encountered, immediately notify the Engineer. If in the opinion of the Engineer, rock excavation is required and the Contractor has in fact made a diligent and determined effort to remove the material using normal excavation procedures as stated above, and the Contractor could not have reasonably been expected to determine the existence of such material during his site investigation, then a contract price for rock excavation shall be negotiated between the Contractor and the Owner. No payment shall be made for excavation performed prior to determination of a negotiated price.

Rock shall be removed to a 4" depth below grade, Additionally, all rock loosened during jacking, blasting, etc., shall be removed from the trench. For payment purposes, maximum trench width to be paid for shall be as defined in Subsection 3.02, A. Maximum depth to be paid for shall be 12" below required grade. All overexcavation shall be replaced as specified in Subsection 3.03, C.

Inclusion of a bid item for rock excavation indicates such excavation is anticipated.

Contractor to notify Engineer prior to any rock excavating; no payment shall be made for excavation prior to notification.

3.5 Backfilling.

- A. Tamping Equipment. It is the contractors responsibility to meet the minimum compaction requirements as stated in these specifications or other accepted project documents. Given the following requirements, the contractor shall determine the type of equipment and methods used when backfilling trenches to meet these requirements. Except immediately next to the pipe, mechanical or air operated tamping equipment to be used. Hand equipment such as T-bar to be used next to pipe if necessary. Care to be taken when compacting under, along side and immediately above pipe to prevent crushing, fracturing or shifting of the pipe.
- B. Moisture Control. Generally maintain moisture of backfill material with ± 2% of optimum moisture content as determined by ASTM D698. Maintain closer tolerances as needed to obtain densities required.
- C. Compaction. Maximum density (100%) based on ASTM D698 or AASHTO T99.
 - 1. Bedding Material, including material used for over-excavation of any kind: 95%
 - 2. Select Material: 95%
 - 3. Backfill beneath existing or proposed pavement, roadways, sidewalks, curbs, utility lines and other improvements or within 5' horizontally of such improvements: 95%
 - 4. Backfill within other public or designated right-of-way: 90% or as shown on the Drawings.
 - 5. Backfill within undeveloped, green or undesignated area: 85%
- D. Placing Backfill. The contractor is reponsible to meet density requirements during trench backfill and shall place material to be compacted in lifts not to exceed amounts necessary to meet these requirements. In no case shall these lift thicknesses exceed the following:
 - 1. Bedding and select material: 6" (or see Section 3.03A).
 - 2. Backfill Material: 12" where 95% compaction required. 24" where less than 95% compaction required.
- E. Backfilling Appurtenances. Backfilling to be done generally at the same time as adjacent pipelines. Backfilling procedure to conform to this section. Use special techniques or materials as shown on drawings.
- F. Disposal of Excess Excavation. Contractor to dispose of excess excavation off-site. The Owner shall have the right to elect to have the excess excavation disposed of at a designated site within the work limits. Excavation may be wasted on-site only if approved by the Engineer. Disposal in any case shall be the sole responsibility of

the Contractor.

- G. Maintenance of Backfill. Contractor to maintain all backfill in a satisfactory condition during the extent of the contract and warranty period. All surface deterioration determined to be the responsibility of the Contractor and all settlement shall be repaired at once by the Contractor upon notice by the Owner. All costs for repair and all liability as a result of surface deterioration or settlement shall be the responsibility of the Contractor.
- H. Clay Barrier Water Stops. Clay barriers may be required to be installed full depth in trench in place of all bedding material and backfill. This barrier shall be full depth and two feet thick and installed every 500 lineal feet of trench.

3.6 Surface Restoration. All existing surface improvements and site conditions disturbed or damaged during construction to be restored to a condition equal to preconstruction condition. All restoration costs are considered incidental to excavation and backfill.

- A. Improvements. Replace, repair or reconstruct all improvements as required. Work will not be accepted until restoration is accepted by Engineer and all affected property owners. Improvements include, by example, other utilities, culverts, structures, curb and gutter, mail boxes, signs, etc.
- B. Final Grading. The Contractor is to re-establish existing final grade or finish final grades as modified and shown on the Drawings. The Contractor is to backfill to proper subgrade elevation with backfill material to allow placement of surface improvements or materials.
- C. Roadways. All roadways to be restored to original condition. Materials and methods to conform to Section 2140 Embedment and Base Course Aggregate, Section 2500, Hot Bituminous Pavement. Additional requirements are:

Paved Streets:

- 1. Pipes shall be bedded with bedding materials in accordance with subsection 3.03 of this heading and the trench shall be backfill full depth with class 6 Aggregate Base Course in accordance with section 2140 2.00 of this manual. Minimum density requirements for all materials shall be 95% of maximum. In addition, those streets that are designated as arterials by the Town, shall be backfilled with CDOT spec "flowable fill" per Standard Drawing DR-140 of this manual.
- 2. All street cuts on paved surfaces shall be repaired with asphalt concrete prior to reopening street to traffic. Temporary repairs shall be maintained by the contractor until permanent repairs are completed.
- 3. Minimum base course material on gravel roadways to be 8" or match existing whichever is greater.
- 4. Minimum bituminous surfacing to be 3" or match existing whichever is greater.
- 5. Minimum concrete paving to be 6" or match existing whichever is greater.

- D. Green Areas. Restore all green areas as specified in Section 2730 - Revegetation - Seeding, Sodding, Hydroseeding.

4.1 QUALITY CONTROL - FIELD

4.2 Compaction. It should be fully understood that it will be the sole responsibility of the Contractor to achieve the specified densities for all embedment and backfill material placed. Contractor will be responsible for ensuring that correct methods are being used for the placement and compaction of said materials. Correct backfill methods include, but are not limited to:

1. Use of proper equipment for existing soil condition encountered.
2. Moisture content of existing soils; determination if water should be added or if soil should be air dried to reduce moisture content.
3. Thickness of backfill lift.

Contractor may, at his own expense, have an approved geotechnical engineer monitor the methods of backfill and compaction used to ensure that the desired densities are being obtained.

Inspection and testing will be performed as directed by the Engineer. Testing will be conducted as a quality control check to verify the Contractor's compliance with the standards indicated in the Specifications.

4.3 Inspection and Testing. Inspection and testing to be performed at the direction of the Engineer. Contractor to cooperate fully with all persons engaged in testing. Contractor to excavate as required to allow testing. Contractor to backfill all test excavations in accordance with these Specifications.

4.4 Density Testing and Control.

- A. Reference Standards. Density/moisture relationships to be developed for all soil types encountered according to ASTM D698 or AASHTO T99.
- B. Field Testing. Testing for density during compaction operations to be done in accordance with ASTM D2922 using nuclear density methods or other methods as approved by the Town.
- C. Frequency of Testing. Minimum of one (1) test every 250' trench per lift or as directed by Engineer. Contractor to excavate to depths required by Engineer for testing and backfill test holes to density specified. Testing to be paid for by Owner.
- D. Retesting. In the event of failure to meet compaction criteria, Contractor shall re-excavate and re-backfill at direction of Engineer. All retesting to be paid for by Contractor and to be performed by soils testing firm approved by the Engineer.

4.5 Payment for Testing. Owner responsible for all costs of initial testing of backfill. Contractor to pay all costs of any retesting required.

End of Section

SECTION 2140

EMBEDMENT AND BASE COURSE AGGREGATE

1.1 GENERAL

1.2 Scope. This work shall consist of furnishing and placing one or more courses of aggregate on the prepared surface in accordance with these Specifications in reasonably close conformity with the lines, grades and typical cross sections shown on the drawings or established by the Engineer in the field.

1.3 Related Work Specified Elsewhere.

Section 2120 - Excavation and Backfill for Structures
 Section 2130 - Trenching, Backfilling and Compaction
 Section 2300 - Water Transmission and Distribution Lines
 Section 2500 - Hot Bituminous Pavement

1.4 Submittals.

A. Aggregates. Certified statement from independent testing laboratory, acceptable to Engineer, of material compliance.

2.00 MATERIALS

Aggregate used for pipeline bedding, base course and subbase course and specified by Class in other sections of this Specification shall conform to the gradation schedule shown below.

CLASSIFICATION TABLE FOR AGGREGATE BASE COURSE*

Percentage by Weight Passing Square Mesh Sieves

Sieve Designation	LL not greater than 35			LL not greater than 30				
	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	
4 inch	----	100	----	----	----	----	----	
3 inch	----	95-100	----	----	----	----	----	
2½ inch		100	----	----	----	----	----	
2 inch	95-100	----	100	----	----	----	----	
1½ inch	----	----	----	90-100	100	----	----	
1 inch	----	----	----	95-100	----	100	----	
¾ inch	----	----	----	50-90	----	100	----	
No. 4		30-65	----	35-50	30-70	10-65	----	No. 8----
----	----	----	----	25-65	20-85	No. 200	3-15	3-15
20 max.	3-12	3-15	3-12	5-15				

*Reproduced from Colorado Department of Highways Standard Specifications for Road and Bridge Construction.

3.1 METHODS AND PROCEDURES

3.2 Placing. Placement shall not commence until all subgrade requirements have been completed and the prepared subgrade has been accepted by the Town. The base course material shall be placed on the previously prepared subgrade at the locations and in the proper quantities to conform to the typical cross sections as shown on the Drawings and as directed by the Engineer. Placing and spreading shall be done by means of spreader machine, moving vehicle, motor grader or other approved equipment methods. The material shall be placed without segregation. Any segregated areas shall be removed and replaced with uniformly graded material at the Contractor's expense.

The base material may be placed in lifts of up to 6 inches, providing that after compaction, uniform density is obtained throughout the entire depth of the lift. If the required depth exceeds 6 inches, it shall be placed in two or more lifts of approximately equal thicknesses. If uniform density cannot be obtained by 6 inch lifts, the maximum lift shall not exceed 4 inches in final thickness.

3.3 Compacting. Rolling will be continuous until the base material has been compacted to not less than 95% of maximum density as determined by ASTM D698 or AASHTO T99. Water shall be uniformly applied as necessary during compaction to obtain optimum moisture content and to aid in consolidation. The surface of each layer shall be maintained during the compaction operations in such a manner that a uniform texture is produced and the aggregates are firmly keyed.

The finished base course surface shall be smooth and free of ruts and irregularities and true to grade and crown as shown on the plans or as directed by the Engineer. The final surface shall be finished with a surface smoothness tolerance of ¼ inch, measured as vertical ordinate from the face to a ten-foot straight edge. The Town may require the contractor to stringline the base course surface to assure conformity to the plans and specifications. The base course shall be maintained in this condition by watering, drying, rolling or blading as necessary, or as the Engineer may direct, until the surface material is placed. All segregation will be removed prior to paving to the satisfaction of the Town.

4.1 QUALITY CONTROL - FIELD

4.2 Inspection and Testing. Inspection and testing to be performed at the direction of the Engineer. Contractor to cooperate fully with all persons engaged in testing. Contractor to excavate as required to allow testing; Contractor to backfill all test excavations in accordance to these Specifications.

4.3 Density Testing and Control.

- A. Reference Standards. Density/moisture relationships to be developed for all soil types encountered according to ASTM D698 or ASSHTO T99.
- B. Field Testing. Testing for density during compaction operations to be done in accordance with ASTM D2922 using nuclear density methods or other methods as may be approved by the Town.
- C. Frequency of Testing. Conduct a minimum of one test for each layer of specified depth of fill or backfill as follows:

Foundations: For each 100 lineal feet or less of trench.

Slabs on Grade: For each 2,000 square feet or less of building area.

Pavement and Walks: For each 2,000 square feet or less.

All Other Areas: For each 5,000 square feet or less.

Utility Trenches: For each 250 lineal feet or less of trench.

4.4 Payment for Testing. Owner is responsible for all costs of initial testing of backfill. Contractor to pay for all costs of any retesting required.

End of Section

SECTION 2150

DUST SUPPRESSION

1.1 GENERAL

1.2 Scope. Work under this Section shall include furnishing all materials, labor, equipment and miscellaneous items necessary to provide dust control over the entire project site.

1.3 Related Work Specified Elsewhere.

All *Division 2000 & 3000* Sections

1.4 Submittals.

A. Chemical Products. Descriptive literature defining chemical constituents.

2.1 MATERIALS

2.2 Magnesium Chloride.

<u>Constituents</u>	<u>Percentage by Weight</u>
Magnesium Chloride	Approximately 28%-36%
Sulphate	2.5%
Potassium, sodium, calcium	Less than 1%
Nitrate	-0-

3.1 METHODS AND PROCEDURES

3.2 Dust Control. Dust control to be considered an integral part of the Work. Control shall be provided from the start of construction until the Work is complete. Fugitive dust as a result of construction shall be controlled at all times.

3.3 Watering. For road construction, the Contractor shall have a water truck on site at all times for dust control. It is the contractors sole responsibility to provide adequate dust control. The Town may require the contractor to increase dust control efforts as it determines necessary. Any additional dust control, as ordered by the Town, shall be at the contractors expense.

For utility construction, dust control may be accomplished by water truck or spray system from an on-site water system if approved. Contractor shall be prepared to provide dust control until the final surface is completed.

The Contractor shall obtain a water meter from the Town for metering any water taken from the municipal water system whether from fire hydrants or private taps.

3.4 Chemical Control. Where required by the Engineer and approved by the Town, dust control shall be provided by the use of magnesium chloride chemical spray to the road surface.

After the surface has been prepared, the road shall be pre-wet to a very damp condition. The product shall be applied using a watering truck with spray applicator, providing an even distribution across the surface. Application rate shall be 1/3 - 1/2 gallon per square yard. The surface shall be re-sprayed until complete coverage is attained.

End of Section

SECTION 2200

CULVERT DRAINAGE PIPE

1.1 GENERAL

1.2 Scope. Work under this section includes furnishing, installing, cleaning and testing drainage pipe (including culverts) underdrains, trench drains, bands, collars, inlet section, outlet sections and all other items appurtenant to drainage pipe. This section does not include pipe for storm sewer systems.

1.3 Related Work Specified Elsewhere.

Section 2110 - Excavation and Embankment
Section 2120 - Excavation and Backfill For Structures
Section 2130 - Trenching, Backfilling, and Compaction
Section 2140 - Embedment and Base Course Aggregate

1.4 Reference Standards.

Colorado State Department of Transportation Standards
Specifications for Road and Bridge Construction Section 707 and M-Standards

1.5 Submittals. Product data including catalogue cut sheets and descriptive literature.

1.6 Protection of Work. All pipe and appurtenances shall be carefully handled, stored and protected in such a manner as to prevent damage to materials and protective coatings and linings. At no time shall such materials be dropped or dumped into trench.

Precaution shall be taken to prevent foreign matter from entering the pipe and appurtenances prior to and during installation. Place no debris, tools, clothing or other materials in the pipe during installation.

2.1 MATERIALS

This item covers the types of material that will be required for the construction and installation of drainage pipe. All materials used shall be new and the best quality available. All material used shall be in accordance with applicable standards of the American National Standards Institute (ANSI), the American Standards Association (ASA), the American Society of Testing and Materials (ASTM) and the American Association of State Highway Transportation Officials (AASHTO).

2.2 Corrugated Galvanized Steel Pipe and Pipe Arches.

A. Pipe and Bands.

1. Conform to Section 707.02 and applicable section of AASHTO M-36.
2. Size, length and shape as shown on Drawings.
3. Corrugations to be 2-2/3" x 1/2" or 3" x 1" unless shown otherwise.

4. Gauge to be determined based on HS-20 loading with a minimum to be 16 gauge.
5. Bands to be "Hugger" type with forged steel bars secured to connecting bar with tension straps.
6. Gasket use rubber O-ring, two for each joint.
7. Pipe seams shall be continuous weld type.

B. End Sections.

1. Conform to M-603-CA.

2.3 Corrugated Aluminum Pipe.

A. Pipe and Bands.

1. Conform to Section 707.06 and AASHTO M-196.
2. Size, length and shape as shown on Drawings.
3. Corrugations to be 2-2/3" x 1/2" unless shown otherwise.
4. Thickness to be determined based on HS-20 loading with a minimum of 0.060".
5. Bands to be "Hugger" type with forged steel bars secured to connecting bar with tension straps.
6. Gasket use rubber O-ring, two for each joint.
7. Pipe seams shall be continuous weld type.

B. End Sections.

1. Conform to M-603-CA.

2.4 Corrugated Polyethylene Pipe.

A. Pipe, bands and fittings.

1. Conform to the following applicable specifications:

ASTM F405, standard specification for corrugated polyethylene tubing and fittings.

ASTM F667, standard specifications for large diameter corrugated polyethylene tubing and fittings.

AASHTO M252, standard specification for polyethylene corrugated drainage tubing.

2. Size, length and shape as shown on Drawings.

3.1 METHODS AND PROCEDURES

3.2 General. Excavation, installation, and backfill shall be done in accordance with section 02221 "Trenching, Backfilling, and Compaction" of this manual.

3.3 Cleaning and Inspection. Clean all pipe and appurtenances thoroughly of all foreign material and inspect for cracks, flaws or other defects prior to installation. Mark all defective, damaged or unsound materials with bright marking crayon or paint and remove from job site.

3.4 Pipe Installation. Pipe shall be laid in straight sections except as noted on the plans. Jointing of the pipe shall be made in accordance with the directions of the manufacturer of the pipe and the manufacturer of the coupling. All pipe to be installed with minimum cover of 12 inches.

3.5 Pipe Embedment. Pipe shall be embedded according to all applicable details.

3.6 Metal Apron Endwalls. Metal apron endwalls (end sections) shall be constructed at the ends of all drainage pipe as shown on the plans. All entrance endwalls shall have toe plates. Excavation for endwalls shall be such that the endwall rests on undisturbed soil in its final position. Excavation for toe plates shall be such that the inside of the toe plate rests on undisturbed soil in its final position.

4.1 QUALITY CONTROL - FIELD

4.2 Inspection and Testing. Inspection and testing to be performed in accordance with section 2130 "Trenching, Backfilling, and Compaction" of this manual and at direction of the Engineer. Contractor to cooperate fully with all testing procedures.

Any pipe section which has been damaged in any way which, in the opinion of the Town, may affect the structural integrity of the pipe or reduce the expected corrosion resistance of the pipe, shall be removed and replaced. At the option of the Town, re-coating of minor dents and deformities with an approved fluid applied galvanized material may be allowed.

End of Section

SECTION 2210

RIPRAP

1.1 GENERAL

1.2 Description.

- A. Work shall consist of the furnishing and placement of riprap according to the location(s) as shown on the project drawings.
- B. Work shall conform to the provisions of Section 506 "Riprap" of the Standard Specifications for Road and Bridge Construction, State Department of Highways, Division of Highways, State of Colorado, latest edition except as modified wherein or as accepted in project documents.

2.1 PRODUCTS

2.2 Riprap

- A. Riprap shall consist of hard, dense rough fractured rock as nearly cubical as possible. Thin slab, flaking rock and sandstone shall not be used. The rock shall have a minimum specific gravity of 2.25. Removed concrete may not be substituted for rock.
- B. The average diameter of rock shall be as shown on the project drawings.

3.1 CONSTRUCTION METHODS

3.2 Slope Preparation. Areas on which the riprap is to be placed will be trimmed and dressed to conform to cross sections shown on the Drawings within an allowable tolerance of plus or minus two inches (2") from the theoretical slope lines and grades. Where such areas are below the allowable minus tolerance limit, they shall be brought to grade by filling with material similar to the adjacent material and well compacted with no additional compensation to be allowed to the Contractor for any extra materials thus required.

3.3 Filter Cloth. As required by accepted Submittals

3.4 Bedding Blanket. To be six inches (6") thick placed on top of prepared slope and under riprap where called for on Drawings.

<u>Sieve Measure</u>	<u>% By Weight Passing Square Mesh Sieves</u>	
3"		100
3/4"	20	90
#4	0	20
#200	0	3

3.5 Riprap Placement. Stone for riprap will be placed on the prepared slope in such a manner as to produce a reasonably well-graded mass of rock with the minimum practicable percentage of voids, and will be constructed within tolerances specified herein and to the slopes, lines, and grades shown on the Drawings or as otherwise approved by the Town.

The placement of riprap at all drainage pipe will be such as not to obstruct the flow in any way. In all other areas, a tolerance of plus or minus three inches (3") from the slope lines and grades shown on the drawings shall be allowed in the finished surface of the riprap (see Section 506.03).

Riprap will be placed to its full course of thickness in one operation. The placing shall progress upwards on the slopes. The riprap will be carefully placed on the prepared slope in such a manner that adjacent stones are in close contact and, in general, have their greatest dimensions across or perpendicular to the slope. Through stones will be well distributed throughout the mass.

As used herein, a "through stone" is defined as a stone whose dimension as normal to the surface being riprapped is not less than the full depth of riprap. The finished riprap will be free of objectionable pockets of small stone and clusters of larger stones. Placing riprap in layers will not be permitted.

End of Section

SECTION 2300

WATER TRANSMISSION AND DISTRIBUTION LINES

1.1 GENERAL

1.2 Scope. Work under this Section shall include furnishing all materials, labor, equipment and miscellaneous items necessary to install, disinfect, and test all raw water and potable water transmission and distribution pipelines and appurtenances as specified herein and shown on the Drawings.

1.3 Related Work Specified Elsewhere.

Section 2130 - Trenching, Backfilling and Compaction
Section 2140 - Embedment and Base Course Aggregate
Section 2500 - Hot Bituminous Pavement

1.4 Submittals. Product data including catalog sheets and descriptive literature shall be submitted for all materials and equipment specified. Submittal shall state manufacturer's compliance with all published standards referenced herein.

1.5 Protection of Work. All pipe fittings, valves and equipment shall be carefully handled, stored and protected in such a manner as to prevent damage to materials and protective coatings and linings. At no time shall such materials be dropped or dumped into trench.

Precaution shall be taken to prevent foreign matter from entering the pipe, fittings and valves prior to and during installation. Place no debris, tools, clothing or other materials in the pipe during installation.

At such time as pipe installation is suspended, either temporarily or overnight, the open end of the pipe shall be sealed with a watertight plug to prevent entrance of trench water, debris or foreign matter.

Under no circumstances shall trench water be allowed to enter the pipeline. When water is present in the trench, the seal shall remain in place until such time as the trench is pumped dry. Whenever trench water becomes evident, adequate measures shall be taken to prevent pipe floatation.

If, in the opinion of the Engineer, the Contractor is incapable of keeping the pipe free of foreign matter during installation, the Engineer shall require the Contractor to cover the pipe ends with close woven bags until the start of the joining operation.

2.1 MATERIALS

This item covers the types of materials that will be required for the construction and installation of water lines. All materials used shall be new, of the best quality available, and conform with applicable standards as indicated herein. [NOTE: Local jurisdiction specifications (i.e., municipality, district, etc.), will govern when two or more alternatives are given in these specifications, or where there is a discrepancy between these specifications and local jurisdiction specifications.

2.2 Ductile Iron Pipe and Fittings.

- A. Ductile Iron Pipe.
 - 1. Reference Standard - ANSI 21.51/AWWA C151-86
 - 2. Thickness Class - 52
 - 3. Pipe joints shall be push on joints, except where specifically shown or detailed otherwise.

- B. Fittings
 - 1. Type - All fittings shall be mechanical joint, except where specifically shown or detailed otherwise.
 - 2. Reference Standard - ANSI/AWWA C153 for flanged, mechanical joint "compact" and push-on joints.
 - 3. Material - Ductile iron
 - 4. Pressure Rating - 350 psi

- C. Joints
 - 1. Mechanical, Reference Standard - ANSI A. 21.11/AWWA C111-72
 - 2. Push-on, Reference Standard - ANSI A 21.11/AWWA C111-72
 - 3. Flanged, Reference Standard - ANSI B 16.1, Class 125

- D. Gaskets
 - 1. Type - Rubber-ring gasket shall be suitable for the specified pipe sizes and pressure
 - 2. Reference Standard - AWWA C-111
 - 3. Lubricant - A non-toxic vegetable soap lubricant shall be supplied with the pipe

- E. Protective Coating
 - 1. Underground Service - Manufacturer's standard bituminous coating - minimum 1 mil thickness.
 - 2. Polyethylene Film Envelope - Polyethylene encasement shall conform to AWWA C-105-88 or ANSI A.21.5. Film shall be Class C with a nominal thickness of 8 mils. Tape for securing the film shall have a minimum thickness of 8 mils and a minimum width of 1 inch. The polyethylene film shall be free of streaks, pinholes, tears or blisters.

- F. Protective Lining
 - 1. Type - Cement mortar
 - 2. Reference Standard - ANSI A 21.4/AWWA C104.85
 - 3. Thickness - Standard

2.3 Polyvinyl Chloride (PVC) Pipe and Fittings.

- A. PVC Pipe

1. Materials - ASTM D1784, Type 1, Grade 1, PVC 1120, 2000 psi design stress.
2. Reference Standard - AWWA C-900.
3. Class - 200 (DR-14), all sizes.
4. Markings - Manufacturer's name, nominal size, class pressure rating, PVC 1120, NSF logo, identification code.
5. Specialties - Electric tracing wire, 14 gauge solid copper insulated wire.
6. Size - Shall conform to outside diameter of DIP.

B. Fittings

1. Type - All fittings shall be mechanical joint except where specifically shown or detailed otherwise.
2. Reference Standard - ANSI/AWWA C-110/A.21.10.
3. Pressure Rating - 250 psi.
4. Gasket Reference Standard - AWWA C-111.

C. Joints

1. Push-on rubber gasket.
2. Gasket Reference Standard - AWWA C-111.

2.4 Fire Hydrants.

A. Dry Barrel Type

1. Reference Standard - AWWA C502-80.
2. Outlet Size - one 4 1/2 inch, two 2 1/2 inch.
3. Hydrant Size - 5 1/4 inch.
4. Inlet Size - 6 inch.
5. Operation - 1½-inch pentagonal national standard operating nut, open counter clockwise.
6. Special Features - outlet hydrant shall open when turned to the left (counter clockwise).
7. Depth of Bury - As shown on Drawings.
8. Additional Requirements - Furnish hydrant complete with pipe and tee, 6 inch (6") restrained mechanical joint gate valve and thrust blocks. Hydrant shall be restrained to the hydrant tee by 3/4 inch threaded rods protected from corrosion by the use of an approved bituminous coating.
9. Traffic Model with break-away bolts and coupling.
10. Manufacturers Reference - Mueller Centurion or Kennedy.

2.5 Valves.

A. Gate Valves

1. Double Disk
 - a. Size as shown on Drawings.
 - b. Reference Standard - AWWA C500-86.
 - c. Style - Iron body, bronze-mounted, non-rising stem, double disk, parallel seat, NRS valves with O-ring seals.

- d. Rotation - Open, left or counterclockwise.
- e. Pressure rating - 200 psi.
- f. Operator - 2" square nut.
- g. Manufacturer's Reference - Dresser, Kennedy
- h. Ends - MJ unless specified on Drawings.

2. Resilient

- a. Size as shown on Drawings.
- b. Reference Standard - AWWA C500-86.
- c. Style - Iron body, bronze stem resilient seat gate valves, lubrication free, unobstructed through port to minimize head loss, entire body encapsulated inside and out with epoxy coating.
- d. Pressure Rating - 200 psi.
- e. Wrench Nut - 2 inch square.
- f. Manufacturer's Reference - Dresser M&H RSGV.

B. Combination Air Release Valve.

- 1. Size - 1" Orifice, or as recommended by manufacturer for correct application.
- 2. Inlet - 1" Pipe Thread
- 3. Materials
 - Body - Cast Iron
 - Float - Stainless Steel
 - Seat - Buna-N
 - Lever Frame - Delsrin
- 4. Pressure Rating - 200 psi
- 5. Manufacturer's Reference - APCO
- 6. Performance - Permits efficient filling or draining of long pipelines, for protection against vacuum, and will continuously vent pockets of air as they accumulate in pipeline.

2.6 Valve Boxes.

A. Screw Type - Three Piece

- 1. Material - Cast Iron
- 2. Size - 5 1/4 inch diameter
- 3. Type - Three piece adjustable screw type
- 4. Cover - Deep socket type with the work "water" cast in the top
- 5. Base - #160 type with 20.5" bottom opening

2.7 Mechanical Couplings. M.J. solid sleeves allowed of as approved by the Town..

2.8 Water Service & Tap Components.

A. Corporation Stops

- 1. Material - Brass or bronze
- 2. Size - As shown on Drawings
- 3. Reference Standard - AWWA C800-55
- 4. Thread inlet - Tapered (CC) Type

5. Thread outlet - Copper Service Thread for flared connection.
 6. Manufacturer's Reference - Mueller H 15000, Ford F600
- B. Copper Service Pipe
1. Reference Standard - AWWA 75-CR Type K
 2. Size - As shown on Drawings.
- C. Curb Box
1. Material - Cast iron box, complete w/lid and red brass screw.
 2. Type - McDonald 5605 with stationary rod.
 3. Size - 1" - 1½", depending on local jurisdiction preference.
- D. Curb Stop
1. Materials - Cast bronze body, resilient O-ring seal, standard tee-head operator. Teflon ball valve.
 2. Size - As shown on Drawings.
 3. Inlet - Copper service thread for flared connection.
 4. Outlet - Copper service thread for flared connection.
 5. Manufacturer's Reference - Mueller Oriseal III, Ford B22-333, McDonald 6100.
 6. Valve stem shall be brought to within four(4) feet or closer of finish grade through the use of approved stem riser materials.
- E. Service Clamps
1. For use with Ductile Iron Pipe:
 - A. Materials - Bronze service clamp, O-ring gasket, double strap, (CC) threads.
 - B. Manufacturer's Reference - Mueller H16 series, Smith Blair 323, or equal.
 2. For use with PVC Pipe:
 - A. Materials - Bronze service clamp, O-ring gasket, two section of three section clamp, (CC)threads.
 - B. Manufacturer's Reference - Mueller H-134 series, Smith Blair 397, or equal.

2.9 Concrete for Thrust Blocks and Encasing of Pipe. Concrete for thrust blocks and for encasing the water pipe line shall have a 28-day compressive strength of not less than 3000 psi.

2.10 Tracer Wire. No. 14 or larger, insulated, solid copper. All splices to be watertight, underground type, (Tracer wire is required for ductile iron pipe).

3.1 METHODS AND PROCEDURES

3.2 Cleaning and Inspection. Clean all pipe, fittings, valves and related material thoroughly of all foreign material and inspect for cracks, flaws or other defects prior to installation. Mark all defective, damaged or unsound materials with bright marking crayon or paint and remove from jobsite.

The Contractor shall take all necessary precautions to prevent any construction debris from entering the water lines during construction of water lines and appurtenances. If this debris should enter the distribution system, the Contractor shall furnish all labor and material necessary to clean the system. Under no circumstances will the Contractor flush the debris into an existing distribution system.

3.3 Verification. Verify dimensions and class of all existing and proposed pipe, valves, fittings and equipment prior to installation to ensure the piping system will fit together properly.

3.4 Pipe Embedment.

- A. Placing Embedment Material - Refer to Section 2130 for placement methods.
- B. Embedment Classes - Refer to Section 2140 for embedment materials as listed below.

Bedding material shall be 3/4" screened rock in accordance with section 2130 of this manual. Contractor shall compact trench bottom before placing bedding.

3.5 Pipe Installation.

- A. Methodology - Pipe shall be laid in straight section with bell ends facing the direction of laying unless otherwise directed by the Engineer. Where pipe is laid on a grade of ten percent (10%) or greater, the installation shall proceed uphill with the bell ends facing upgrade. The pipeline shall be installed so that a continuous positive or negative grade is maintained between high and low points to avoid air pockets. Jointing of the pipe shall be made in accordance with the directions of the manufacturer of the pipe and the manufacturer of the coupling.

The pipe shall be brought to correct line and grade, and secured in place with the bedding material as specified herein.

- B. Pipeline Depth - as indicated on Drawings, or as per local jurisdiction but always below frost level. Depth shall be based on depth below finished grade of a project and not existing grade.
- C. Concrete Encasement - Install concrete encasement where indicated on the drawings or as required by other sections of this Specification. Concrete shall have a three thousand (3000)psi compressive strength. Reinforcing shall consist of four (4) evenly spaced longitudinal No. 4 rebars.
- D. Installation of Ductile Iron Pipelines.
 - 1. Pipe Handling. Pipe should be lowered into the trench with ropes, slings or machinery. Under no circumstances should the pipe be pushed off the bank and allowed to fall into the trench.
 - 2. Pipe Laying. Pipe shall be laid in straight sections, in an uphill direction, with bell ends facing in the direction of laying, unless directed otherwise by the Engineer.

3. Jointing of Push-on Joints. In joining the pipe, the exterior four inches of the pipe at the spigot end and the inside of the adjoining bell shall be thoroughly cleaned to remove oil, grit, tar (other than standard coating) and other foreign matter. The gasket shall be placed in the bell with the large round side of the gasket pointing inside the pipe so it will spring into its proper position inside the pipe bell. A thick film of the pipe manufacturer's joint lubricant shall be applied to the gasket over its entire surface. The spigot end of the pipe shall then be wiped clean and inserted into the bell to contact the gasket. The pipe shall be forced all the way into the bell by crowbar or by jack and choker slings.
4. Pipe Cutting. The cutting of pipe for fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining and so as to leave a smooth end at right angles to the axis of the pipe. The flame cutting of pipe by means of an oxyacetylene torch will not be allowed.
5. Polyethylene Film Envelope. Encase main and fittings using procedures recommended by manufacturer. Special care shall be used at all overlap joints.

E. Installation of Polyvinyl Chloride (PVC) Pipe.

1. Pipe Handling. Pipe should be carefully lowered into the trench to avoid pipe falling into trench.
2. Pipe Laying. Pipe shall be laid in straight sections with bell ends facing the direction of laying. When pipe laying is not in progress, the open end of the pipe shall be closed by a water-tight plug.
3. Jointing the Pipe. The outside of the spigot and the inside of the bell shall be thoroughly wiped clean. Set the rubber ring in the bell with the marked edge facing toward the end of the bell. Lubricate the spigot end using a thin film of the manufacturer-supplied lubricant. Push the pipe spigot into the bell. Position the completed joint so that the mark on the pipe end is in line with the end of the bell.
4. Pipe Cutting. The cutting of pipe for fitting or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe and so as to leave a smooth end at right angles to the axis of the pipe. Bevel the end of the pipe with a bevelling tool after the pipe is cut. Place a clearly visible position mark at the correct distance from the end of the field-cut pipe.

3.6 Installation of Pipeline Appurtenances.

- A. General. Install all valves, meters, manholes, and other equipment appurtenant to pipeline at the locations indicated on the drawings or as otherwise designated by the Engineer to accommodate field conditions. A minimum bury of five and a half (5 1/2) feet to the top of pipe is required. Any variations from this must be submitted for approval in writing to the Town and approval given prior to installation. Any pipe found not to meet these requirements shall be relocated at the expense of the

contractor. Record "as-built" measurements prior to backfill referencing all appurtenant equipment to the nearest permanent surface improvement.

- B. Installation of Valves. Install valves in the pipeline in the same manner specified for laying and jointing the pipe and in accordance with details included in Drawings.
- C. Valve Boxes. Except where specified otherwise, install valve boxes on all buried valves. Install boxes such that no stress is transmitted to the valve. Set boxes plumb and directly over the valve with the top of the box placed flush with the finished grade. Backfill and thoroughly compact around each box. Provide extended stems on valves where required such that the operating nut is not lower than seven feet (7') below finished grade.
- D. Fire Hydrants. Install hydrants in accordance with the standard details on the drawings. All tie rods and appurtenances to be completely covered with a bitumastic coating prior to backfill. Hydrant to be set plumb and true to grade. Contractor to bag or cover the fire hydrant that is not in operation.
- E. Reaction Anchor and Blocking. Concrete thrust blocks shall be provided, as shown in the details included with the Drawings for all tees, elbows, plugs, reducers, valves, fire hydrants and crosses if one or more sides of the cross is plugged. The bearing area of the block shall be at least equal to that stated on the drawings. The bearing surface shall be against undisturbed earth. The block shall be placed normal to the thrust as shown on the drawings. Concrete for thrust blocks shall have three thousand (3000) psi compressive strength.

Contractor will be required to use either plywood forms or plastic to protect the nuts and bolts on the fittings when the concrete reaction block is placed.

Contractor to also use star clamps or wood blocking as a method of temporary restraint to secure fittings while concrete reaction blocks set up. (Note: Temporary restraint to be used for those cases where a tie-in is being made and the water needs to be turned back on as soon as possible).

F. Hot Taps. Contractor shall install and test tapping saddles and valves in accordance with the manufacturers recommendations. If testing procedures are not defined, then testing shall be performed prior to actual tap by methods approved by the Town.

3.7 Connection to Existing Water Facilities. All main line connections between existing and proposed piping shall be made during non-business hours or at a time which is acceptable to the Town. All shut-offs shall be planned 24 hours in advance and all persons affected by the shut-off shall be given a 24 hour notice in the local newspaper and/or local radio at the Contractor's expense. In addition, the Contractor shall personally warn those affected 1 hour before the water is shut off.

The tie-ins between existing and proposed mains shall be made so that both the proposed main and existing main are in service at the same time. Only after both mains are in service can the individual proposed service lines tie into the existing service line on the building side of the curb valve. The affected property shall be given a minimum of 1 hour notice before the water is shut off. The new line must have passed the pressure testing and bacteriological test prior to connecting the services to the proposed water line.

Remove existing curb boxes and locate new curb boxes on property line whenever possible. Contractor is to provide all necessary fittings needed to reconnect service line on property side of curb box.

Take all precautions to prevent contamination when making connections to existing potable water lines. No trench water, mud or other contaminating substances shall be permitted to enter the pipeline.

Swab the interior of all new pipe, fittings and valves installed in the existing pipeline with a 5 percent (50,000 ppm) chlorine solution prior to installation. After the connection is completed, flush the main to remove all contaminated water.

3.8 Protection of Water Supplies. Water lines shall be located a minimum of ten feet (10') horizontally from existing or proposed sewer mains. Wherever the sewer line crosses above or within eighteen inches (18") beneath the water mains, the sewer line shall be made impervious by the method listed below:

Portland Cement Concrete Encasement per standard drawing in this manual.

1. For twenty feet centered over the waterline.

In all cases, select granular backfill shall be used to prevent any settling of the higher pipe.

3.9 Service Connections. Customer service connections shall be installed in accordance with the details set forth on the Project drawings or the appropriate standard drawing contained in this manual. Terminate the service with a curb stop and box and mark with a metal fence post or metal stake extending a minimum of three feet above finish grade except where shown otherwise on the Drawings.

3.10 Tracer Wire. Tape electrical tracing wire to the top of the pipe at 20-foot intervals to prevent dislocation of the wire during backfilling. Extend wire to ground surface at all valves, fire hydrants, and other locations shown on drawings. The tracer wire shall be extended to finish grade as detailed on the appropriate standard drawing of this manual. Provide sufficient slack in the wire outside of the box to compensate for any future adjustment to the valve box. Required on all water mains.

4.1 FIELD QUALITY CONTROL

4.2 General. A minimum forty-eight(48) hours notice to be given to the Town prior to all testing. Only Testing performed in the presence of Town Personnel will be accepted.

4.3 Operation of Water Valves. Existing water valves and new valves directly connected to the Town's water system shall be operated by Town personnel only.

4.4 Hydrostatic Tests. Make pressure and leakage tests on all newly laid pipe. Furnish all necessary equipment and material, make all taps in the pipe as required, and conduct the tests. The tests shall be conducted between valved sections of the pipeline, or as approved by the Town.

Furnish the following equipment and material for the tests:

<u>Amount</u>	<u>Description</u>
---------------	--------------------

2	Approved graduated containers
2	Pressure gauges
1	Hydraulic force pump approved by the Engineer
1	Additional 1/2 inch pressure tap for Engineer's test gauge
	Suitable hose and suction pipe as required

Conduct the tests after the trench has been partially backfilled with the joints left exposed for inspection, or when completely backfilled, as permitted by the Town. Where any section of pipe is provided with concrete reaction blocking, do not make the pressure test until at least 5 days have elapsed after the concrete thrust blocking is installed. If high-early cement is used for the concrete thrust blocking, the time may be cut to 2 days.

Conduct pressure test in the following manner, unless otherwise approved by the Town: after the trench has been backfilled or partially backfilled as hereinbefore specified, fill the pipe with water, expelling all air during the filling. The test pressure shall be 100 psi or 1½ times normal working pressure at the point of lowest project elevation whichever is greater.

A. Duration

1. The duration of each pressure test shall be 2 hours, unless otherwise directed by the Engineer.

B. Procedure

1. Slowly fill the pipe with water and allow to stand for 24 hours. Expel all air from the pipe. Allow and maintain the specified test pressure by continuous pumping if necessary for the entire test period. The test pressure shall be calculated for the point of lowest elevation, or as specified by the Engineer. The pump suction shall be in a barrel or similar device, or metered so that the amount of water required to maintain the test pressure may be measured accurately.
2. Before the line is pressurized, the Engineer shall verify that all necessary main line valves are open or closed with regard to the section of line being tested. In addition, the Engineer shall verify that all hydrant valves are open.

C. Leakage

1. Leakage shall be defined as the quantity of water necessary to hold the specified test pressure for the duration of the test period. No pipe installation will be accepted if the leakage is greater than the number of gallons per hour as determined by the following formula:

Install Equation Editor and double-click here to view equation.

In the above formula:

L = Allowable leakage, in gallons per hour
N = Number of joints in the length of pipe tested

- D = Nominal diameter of pipe, in inches
P = Average test pressure during the leakage test, in pounds per square inch gauge.

- D. The pressure testing of water service lines shall follow the same procedure as outlined in the section. In all cases, however, the corporation stop, service line and curb stop shall be visually inspected under full test pressure and any leaks fixed.
- E. Correction of Excessive Leakage
1. Should any test of pipe laid disclose leakage greater than that allowed, locate and repair the defective joints or pipe until the leakage of a subsequent test is within the specified allowance.

5.1 DISINFECTION OF POTABLE WATERLINES

5.2 General. Flush and disinfect potable waterlines in accordance with the procedure set forth in AWWA C601-68 Disinfecting Water Mains.

Provide all temporary blow-offs, pumps, chlorination equipment, chlorine and all other necessary apparatus required.

5.3 Pipe Cleaning. If the pipe contains dirt or heavy encrusted matter that, in the opinion of the Engineer, will not be removed during the flushing operation, the Contractor shall clean and swab the interior of the pipe with a five percent (50,000 ppm) chlorine solution.

- A. Preliminary Flushing. Flush pipeline to disinfection, except when the tablet method is used, to remove all remaining foreign material. The flushing operation shall develop a minimum velocity of 2.5 ft./sec.

5.4 Chlorine Application. In general, chlorine shall be applied using the continuous feed method. However, on large diameter lines where this would not be practical, the slug method may be used. The tablet method may be used on short extensions (up to 2500 feet) of small diameter mains (12 inches and smaller).

- A. Continuous Feed Method. Introduce water into the line at a constant rate while adding chlorine at a minimum concentration of 50 mg/l. Maintain the chlorinated water in the pipeline for a minimum of 24 hours after which period the treated water shall contain no less than 25 mg/l of chlorine throughout the entire length. Repeat the above procedure if the residual at the end of 24 hours fails to meet the minimum concentration.
- B. Tablet Method. This method shall not be used if trench water or foreign material has entered the line or if the water is below 5°C (41°F). Because preliminary flushing cannot be used, this method shall only be used when scrupulous cleanliness has been exercised.

Place tablets in each section of pipe in sufficient number to produce a dose of 50 mg/l. Refer to Table 3 of AWWA C601 for the required minimum number of tablets. All tablets within the main must be attached at the top of the pipe. Introduce water into the pipeline at a rate no greater than 1 ft./sec. and retain the water in the pipeline for a period of 24 hours.

5.5 Final Flushing. After the required retention period, flush all heavily chlorinated water from the main until the chlorine concentration is no higher than that prevailing in the system.

5.6 Bacteriologic Tests. After completion of the final flushing and prior to placing the pipeline in service, the Town shall be notified to collect samples from the end of the line and test for bacteriologic quality to show the absence of coliform organisms.

5.7 Repetition of Procedure. If the original disinfection fails to produce satisfactory samples, repeat the disinfection procedure until satisfactory results are obtained.

5.8 Tracer Wire. A continuity test will be required for final acceptance of pipeline construction.

5.9 Valve Operation. Existing water valves and new valves directly connected to the Town's water system shall be operated by Town personnel only.

5.10 Compliance with Requirements. Failure to comply with these requirements may result in the suspension of the contractors license. In addition, all expenses as a result of this failure to comply shall be the sole responsibility of the contractor. This shall include any fines imposed by the Colorado Department of Health and the Town of New Castle.

End of Section

SECTION 2310

METER VAULT

1.1 GENERAL

1.2 Scope. Work to be included under this section shall include furnishing a meter vault together with all appurtenances as specified herein or as required for proper operation of the meter. The work includes providing the vault and all of the necessary piping, valves and fittings, placement of all equipment in the vault, delivery to the job site, start-up services, and providing operation/maintenance instructions.

Work not a part of this section includes all site work, excavation and backfill, foundation preparation, connection of inlet and outlet piping to the vault, and removal of the vaults from the delivery vehicle.

1.3 Submittals. Each bidder shall submit sufficient information with his proposal so the Owner can determine that there will be compliance with the vault plans and these specifications.

2.1 MATERIALS

2.2 Valve Vault. The valve vaults shall be rolled, vertical cylinder capsules sized as shown on the plans and meeting the following requirements:

- A. Material reference standard: Structural steel meeting ASTM A-36.
- B. Minimum wall thickness: $\frac{1}{4}$ "
- C. Member design: Manual of Steel Construction, 6th Edition.
- D. Fabrication: Welding in accordance with AISC Specifications, Section 24 and 25, and the American Welding Society.
- E. Top and bottom plate: Welded air-tight to sidewall, $\frac{1}{4}$ " minimum thickness.
- F. Bottom Reinforcement: Minimum of two 8" channels in parallel with two 6" channels placed perpendicular to the main channels. Actual design by manufacturer.
- G. Top reinforcement: Minimum of two (2) 4" x 4" x $\frac{1}{4}$ " angles. Actual design by manufacturer.
- H. Lifting plates: Four (4) required at perimeter and located to ensure proper balance during setting.
- I. Manway: Bilco Type S, 2'-6" x 3'-0" with Neoprene Draft Seal. All vaults shall be keyed alike to match existing Town vaults.
- J. Sump: 12" diameter, 8" depth, $\frac{1}{4}$ " plate.

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K. Corrosion Protection:

- i) Sandblast to bright metal after fabrication.
- ii) One coat minimum 2 mil dry thickness of AWWA Type Vinyl System Primer.
- iii) Two coats, minimum 2 mil each coat dry thickness of finishing enamel formulated of vinyl copolymer plastic resins reinforced with acrylic.
- iv) Provide one quart primer and finish coatings to Owner for touch-up.
- v) Provide two (2) seventeen-pound packaged magnesium anodes for cathodic protection.
- vi) Interior piping shall also be painted as specified above, except the interior of the pipe shall be coated with coal tar epoxy meeting AWWA C-210-78.

L. Manufacturer's reference: Engineered Fluid Process, Centralia, Illinois.

2.3 Meter. Shall be a 6-inch, 150-pound flanged turbo meter with a straight through flow design and integral straightened valves. The meter shall have a flow range of from 40 gpm to 2000 gpm. Accuracy of the meter shall be maintained within $\pm 1\%$ over the meter's entire flow range.

Pressure drop through the meter shall be no greater than 4.5 psi at the maximum flow of 2000 gpm. The meter housing shall be of cast iron material. The rotor bearing spindle and end stone shall all be of ceramic material and the internal straightening valves of 316 stainless steel manufacturer's reference Badger meter.

2.4 Meter Transmitter/Register. Mounted on the flow meter shall be a magnetically driven flow transmitter/register not requiring the use of a stuffing box. The transmitter shall consist of a hermetically sealed switch, explosive-proof enclosure, 6-digit totalizer with $\frac{1}{4}$ " high digits, and a center sweep test circle. The register shall have a capacity of 10 million gallons.

The transmitter switch shall be rated for 10 watts DC, one amp, 250-volt DC maximum.

2.5 Flow Recorder, Totalizer. The flow recorder shall be a large case, servo (?) type circular chart recorder suitable for wall mounting. The recorder shall receive a 4-20 mA signal from the flow meter signal converter. The recorder shall have an integral totalizer visible through a window in the door of the case. The scale and chart shall be engraved in flow units of from 40 to 2000 gpm. The chart shall be of 12" diameter with a 7-day rotation. The totalizer shall be a 7-digit non-reset counter, and shall have a multiplier of 1000.

The case and door shall be constructed of cast aluminum. The door shall have a shatter-proof glass window. The overall construction shall provide environmental protection meeting the requirements of NEMA-12.

The accuracy of the recorder shall be $\pm 1\%$ of actual over the full range.

The power supply to the recorder shall be 120V/1/60Hz. A one-year supply of charts and ink shall be provided.

2.6 Pulse to Current Signal Converter. The flow transmitter signal converter shall accept the

pulse rate input from the meter and provide a 4-20 mA output proportional to flow rate. the converter shall have an accuracy of $\pm 0.05\%$ of span.

2.7 Strainer. The strainer shall be a single basket type capable of handling potable raw water at a flow rate of 2000 gpm with an approximate pressure 10 psig. The strainer body shall be of fabricated steel construction with 6" flanged inlet and outlet connections and shall have a bolted access cover.

The strainer access cover shall be provided with a lifting eye. The basket shall be of side entry construction to minimize pressure drop.

The strainer basket shall be of 304 structural steel construction with 3/16-inch diameter perforated openings.

2.8 Butterfly Valve. Butterfly valves shall be Centerline AAM Series wafer type valves.

2.9 Gate Valves. Not Applicable.

2.10 Piping and Fittings. All internal piping and fittings shall be Schedule 40, black, seamless steel pipe meeting AWWA C-200 or ASTM A-106 for steel pipe and butt welding fittings.

2.11 Compression Coupling. A dresser coupling, straight line or flanged adapter type, shall be used in each major pipe run to prevent binding of the pipe and also facilitate removal of the major valve located in that pipe run.

2.12 Dehumidifier. The dehumidifier shall be EBCO Model D-1500-1 capable of 15 pints per day water removal.

2.13 Lights. The lights shall be Guth Model 10621 fluorescent lights.

2.14 Convenience Outlet. On the side of the control panel, a weather-proof duplex convenience outlet shall be installed.

2.15 Light and Power Panel. All circuit breakers shall be incorporated to a NEMA 12 control panel. The electric service provided for this station will be 240-volt, single-phase, 60-cycle, three-wire. There shall be provided dead front thermal magnetic circuit breakers for one main 60-amp breaker, additional breakers for the above specified items and one spare 20-amp breaker.

3.1 METHODS AND PROCEDURES

3.2 Start-Up. The vault manufacturer shall furnish a factory representative to put the vault into automatic operation and demonstrate the vault function to the Owner's representative. The Owner shall determine when the factory representation shall provide these start-up services.

3.3 Operation & Maintenance Instructions. The manufacturer shall provide two bound sets of complete O & M instructions.

4.1 QUALITY CONTROL

4.2 Testing. Prior to shipment, the vaults shall be operated, at the manufacturer's facility, to check for faulty equipment, leaking pipe joints, and leak-proof welds. The meter shall be factory calibrated. The vaults shall be put into operation at the manufacturer's facility under conditions which simulate job site. The manufacturer shall provide the Owner a certification of this test prior to

delivery.

4.3 Quality Guarantee. The manufacturer shall provide the Owner a written guarantee which guarantees that, if work or materials are found to be defective or substandard within one year after installation of the vault, the manufacturer will, without cost to the Owner, correct such defective or substandard work or materials.

End of Section

SECTION 2400 SANITARY

SEWER LINES

1.1 GENERAL

1.2 Scope. Work under this section shall include furnishing all materials, labor and tools necessary to perform all installation, cleaning and testing of all sanitary sewer lines and appurtenances as specified herein and shown on the Drawings.

1.3 Related Work Specified Elsewhere.

Section 2130 - Trenching, Backfilling and Compaction
Section 2140 - Embedment and Base Course Aggregate
Section 2500 - Hot Bituminous Pavement

1.4 Submittals. Product data including catalog sheets and descriptive literature shall be submitted for all materials and equipment specified. Submittals shall state manufacturer's compliance with all published standards referenced herein.

1.5 Protection of Work. All pipe, fittings and equipment shall be carefully handled, stored and protected in such a manner as to prevent damage to materials. At no time shall such materials be dropped or dumped into trench.

Precaution shall be taken to prevent foreign matter from entering the pipe and fittings prior to and during installation. Place no debris, tools, clothing or other materials in the pipe during installation.

At such time as pipe installation is suspended, either temporarily or over night, the open end of the pipe shall be sealed with a water-tight plug to prevent entrance of trench water, debris or foreign matter.

Under no circumstances shall trench water be allowed to enter the pipeline. When water is present in the trench, the seal shall remain in place until such time the trench is pumped dry. Whenever trench water becomes evident, adequate measures shall be taken to prevent pipe flotation.

If, in the opinion of the Engineer, the Contractor is incapable of keeping the pipe free of foreign matter during installation, the Engineer shall require the Contractor to cover the pipe ends with close woven bags until the start of the jointing operation.

2.1 MATERIALS

This item covers the types of materials that will be allowed for the construction and installation of sewer lines. All materials used shall be new, of the best quality available and conform with applicable standards as indicated herein.

2.2 Ductile Iron Pipe and Fittings. Only as approved by the Town.

2.3 Polyvinyl Chloride (PVC) Pipe and Fittings (Gravity Main)

A. PVC Pipe, through 15" diameter.

1. Material Reference Standard - ASTM D1784
 2. Pipe Reference Standard - ASTM D3034
 3. Class - SDR35
 4. Markings - Manufacturer's name, nominal size, PVC classification, Type PSM, SDR35, PVC gravity sewer pipe, ASTM D3034 and code number.
- B. PVC Pipe, 18" to 27" diameter.
1. Material Reference Standard - ASTM D1784
 2. Pipe Reference Standard - ASTM F679
 3. Markings - Manufacturer's name, nominal size, PVC cell classification, PS 46 PVC Sewer Pipe and ASTM F679.
 4. Variance - PVC piping meeting the stiffness requirement of ASTM F679 but not meeting wall thickness requirement will be allowed under this specification. Manufacturers will be required to provide a list of at least five (5) similar projects with references in which pipe has been successfully used and laboratory testing data showing the pipe meets the structural requirements of ASTM F679.
- C. Fittings
1. Type - PVC push-joint or mechanical joint
 2. Materials - ASTM D1784
 3. Reference Standard - ASTM D3034 or ASTM F679
- D. Joints
1. Type - push-on rubber gasket
 2. Gasket reference standard - ASTM F477

2.4 Force Main.

- A. PVC Pipe.
1. Materials - ASTM D 1784, Type 1, Grade 1, PVC 1120, 2000 psi design stress.
 2. Reference Standard - AWWA C-900.
 3. Class- 150 (DR-18).
 4. Markings - Manufacturer's name, nominal size, class pressure rating, PVC 1120, NSF logo, identification code.
 5. Specialties - Electrical tracing wire, 14 gauge solid copper insulated wire.
 6. Size - Shall conform to outside diameter of DIP.
- B. Fittings
1. Type - All fittings shall be mechanical joint except where specifically shown or detailed otherwise.
 2. Reference Standard - ANSI/AWWA C0110/A.21.10
 3. Pressure Rating - 250 psi
 4. Gasket Reference Standard - AWWA C-111

2.5 Concrete for Thrust Blocks and Encasing of Pipe. Concrete for thrust blocks and for

encasing the sewer pipeline shall have 28 day compressive strength of not less than 3000 psi.

2.6 Manholes.

A. Concrete Rings/Cones

1. Type - Precast
2. Reference Standard - ASTM C478
3. Size - Four-foot inside diameter

B. Manhole Bases

1. Shall be precast or cast-in-place, depending upon local jurisdiction standards, with integrally cast-in water stops. Tee tops of base shall be at least 12 inches above top of pipe.
2. Reference Concrete Standard - ASTM C150 Type II modified or Type V.

C. Manhole Steps

1. Material - Aluminum, ASTM C478
2. Size/Type - ½" round stock x 10" wide aluminum with slip-proof tread.
3. Mounting - Grouted in place on concrete ring with ASTM C150 Type II modified Portland Cement mortar and sand grout for water tight joint.

D. Joints

1. Type - Rub'r Nek preformed gasket as manufactured by K.T. Snyder Co., Inc., Houston, Texas or equal.
2. Cement Mortar Material Reference Standard - One part Portland Cement, Type II, modified with three parts of sand. Cement mortar to be used with concrete grade rings only.

E. Grade Adjustment Rings

1. Type - Precast ASTM C150 Type II modified concrete
2. Size - Not less than 6" wide x heights to allow for one inch adjustments.

F. Frame and Cover

1. Material Reference - Grey Iron, ASTM A48, Class 30
2. Cover - Stamped with "SEWER", machined bearing surface with ring
3. Type - Heavy, combined weight of ring and cover greater than 375 pounds.
4. Manufacturer Reference - Neenah, R-1706

2.7 Sewer Service Line Materials.

A. Wyes - Required for all new sewer line construction.

1. Material - ASTM D3034 PVC
2. Strength - for use with SDR35
3. Joint - Slip-on rubber gasket

B. Saddles (Required for tapping existing mains).

1. Material - ASTM D3034 PVC
2. Joint - Rubber seal to main with stainless steel compression bands. Slip-on service joint with rubber gasket.

2.8 Shear Gates. Not applicable.

2.9 Flat Gate. Not applicable.

2.10 Butterfly Valves. Not applicable.

2.11 Gate Valves. Not applicable.

2.12 Valve Boxes. Not applicable.

2.13 Tracer Wire. 14 gauge, insulated, solid copper wire. To be used on all force main installations.

3.1 METHODS AND PROCEDURES

3.2 Cleaning and Inspection. Clean all pipe, fittings and related materials thoroughly of all foreign material and inspect for cracks, flaws or other defects prior to installation. Mark all defective, damaged or unsound materials with bright marking crayon or paint and remove from job site.

The Contractor shall take all necessary precautions to prevent any construction debris from entering the sewer lines during construction. If this debris should enter the pipe line system, the Contractor shall furnish all labor and materials necessary to clean the system. Under no circumstances will the Contractor flush the debris into an existing sanitary sewer system.

3.3 Placement of Pipe.

A. Batter Boards. Not applicable

B. All pipe shall be installed to the line and grade as shown on the approved project drawings. Any changes must be approved by the Town through the project engineer. A minimum bury of four and a half (4 1/2) feet is required. Any variations from this must be submitted for approval in writing to the Town and approval given prior to installation. Any pipe found not to meet these requirements shall be relocated at the expense of the contractor.

C. Laser Beam. If bending of the beam due to air temperature variations becomes apparent with "in pipe" units, a fan shall be provided to circulate air in the pipe. Air velocity shall not be so excessive as to cause pulsating or vibrating of the beam. If, in the opinion of the Engineer, the beam cannot be accurately controlled, this method of setting line and grade shall be abandoned.

3.4 Pipe Embedment.

A. Placing embedment material - Refer to Section 2130 for placement methods.

B. Embedment Classes - Refer to Section 2130 and Construction Drawings for embedment materials for each class listed below:

1. Pipe shall be embedded according to applicable details of this manual and as shown on the Project Drawings.

3.5 Pipe Installation.

- A. Installation of Ductile Iron Pipe Lines. When approved by the Town, installation specifications shall be provided by the project engineer.
- B. Installation of Polyvinyl Chloride (PVC) Pipe.
 1. Pipe Handling. Pipe should be carefully lowered into the trench to avoid pipe falling into trench.
 2. Pipe Laying. Pipe shall be laid true to line and grade, in an uphill direction, with bell ends facing upstream. When pipe laying is not in progress, the open end of the pipe shall be closed by a watertight plug.
 3. Jointing the Pipe. The outside of the spigot and the inside of the bell shall be thoroughly wiped clean. Set the rubber ring in the bell with the marked edge facing toward the end of the bell. Lubricate the spigot end using a thin film of the manufacturer-supplied lubricant. Push the pipe spigot into the bell. Position the completed joint so that the mark on the pipe end is in line with the end of the bell.
 4. Pipe Cutting. The cutting of pipe for manholes or for fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining and so as to leave a smooth end at right angles to the axis of the pipe. Bevel the end of the pipe with a bevelling tool after the pipe is field cut. Place a clearly visible position mark at the correct distance from the end of the field-cut pipe.

3.6 Sewer Manhole Installation.

- A. General. Manholes shall be furnished and installed to depths and dimensions shown on the Drawings and/or staked in the field. Manholes shall be constructed of precast concrete rings in accordance with details shown on the Drawings.
- B. Connections to Manholes. The first length of sewer pipe into and out of any manhole shall be a maximum of 24" as measured from the inside face of the manhole to the end of the pipe. In addition, extra care shall be taken by grouting or other means of sealing to assure positive water-tight manholes around the inlet or outlet pipes. Expandable water stops, special sleeves or a rubber gasket cemented to the sewer pipe shall be used. All pipe shall be grouted in place with non-shrink grout.
- C. Manhole Floor and Inverts. Manhole bases shall be constructed to conform to the details shown on the Drawings. The invert channels shall be smooth and semi-circular in shape, conforming to the inside of the incoming and outgoing sewer pipelines. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. Where large differences in invert elevations exist, sloped flow channels shall be formed so the wastewater does not undergo a vertical drop. The invert channels may be formed directly in the concrete

of the manhole base. The floor of the manhole outside the channel shall be smooth and shall slope toward the channels.

- D. **Finish Grade and Adjustment.** To bring the manhole cover to the correct elevation, the top section of each manhole shall be constructed of pre-cast concrete grade adjustment rings. These rings shall be not less than six inches (6") wide and furnished in heights to allow for two inch (2") adjustments. Grade adjustment with rings shall be eight inches (8") maximum and two inches (2") minimum. All rings shall be grouted in place.
- E. **Manhole Stubs.** All pipe stubs required from manholes are shown on the Drawings. Stubs shall extend approximately 24" from the outside face of the manhole and shall be capped or plugged with manufactured fittings to form a water-tight installation.

3.7 Connection to Existing Sewer Facilities. Connections to existing sewer facilities where live flows exist shall be made only after prior consultation with and receipt of written permission from the Engineer. No bypass of sewage to the surface will be allowed in the completion of this connection. Connections shall be made as shown on the Drawings. All connections between pipes of different materials shall be made with approved manufactured connectors.

3.8 Protection of Water Supplies. Sewer lines shall be located a minimum of ten feet (10') horizontally from existing or proposed water mains. Where the sewer line crosses above the waterline, or is less than eighteen inches (18") vertically below the invert of the water line, or is less than ten feet (10') horizontally from the water main, the sewer line shall be made impervious by the method listed below:

- A. The sewer pipe shall be reinforced with a concrete encasement. The encasement shall be at least six inches (6") thick on all sides of the sewer pipe and extend ten feet (10') on either side of the water main. Use three No. 4 rebar the length of the encasement.

If clearance is less than 12 inches vertically, the space between the water and sewer mains shall be filled by 3000 psi concrete.

In all cases, bedding material shall be used to prevent any settling of the higher pipe.

3.9 Service Connections. Customer service connections shall be installed in accordance with the details set forth on the construction Drawings. After the service connection is installed, the end shall be plugged water-tight with a manufactured plug and marked with a metal fence post or metal stake extending a minimum of three feet above finish grade except as shown otherwise on the Drawings. A #2 wire shall be securely attached to the post and the end of the service pipe.

3.10 Detection Tape. Not required.

4.1 FIELD QUALITY CONTROL

4.2 Alignment and Grade. Sewer pipelines will be checked by the Engineer to determine whether any displacement of the pipe has occurred after the trench has been backfilled. The test will be as follows:

A light will be flashed between manholes, or if the manholes have not as yet been constructed, between the locations of the manholes, by means of a flashlight. If the

illuminated interior of the pipeline shows poor alignment, displaced pipe, earth or other debris in the pipe, or any other kind of defect, the defects determined by the Engineer shall be remedied by the Contractor at his own expense. Test will be repeated after completion of backfilling and any poor alignment, displaced pipe, or other defects determined by the Engineer, shall be corrected.

In addition to the above, the Owner shall, at his option and at his expense, televise the interior of the line prior to acceptance. All defects shall be noted and corrected as stated above.

4.3 Leakage Test. Sewerlines shall be tested using a low pressure air test only; water tests will not be allowed. Only after the sanitary sewers, including appurtenances and sanitary laterals have been installed, backfilled and cleaned, shall the Contractor proceed with an air test on the installed facilities.

A. Low Pressure Air Test Procedure. The section of sewerline to be tested should be flushed and cleaned prior to conducting the low pressure air test. This serves to clean out any debris, wet the pipe, and produce more consistent results. Isolate the section of sewerline to be tested by means of inflatable stoppers or other suitable test plugs. One of the plugs should have an inlet tap, or other provision for connecting a hose to a portable air control source.

If the test section is below the groundwater level, determine the height of the ground water above the spring line of the pipe at each end of the test section and compute the average. For every foot of groundwater above the pipe spring line, increase the gauge test pressure by 0.43 pounds per square inch. Connect the air hose to the inlet tap and a portable air control source. The air equipment should consist of necessary valves and pressure gates to control the rate at which air flows into the test section and to enable monitoring of the air pressure within the test section. Also, the testing apparatus should be equipped with a pressure relief device to avoid the possibility of loading the test section with the full capacity of the compressor.

Add air slowly to the test section until the pressure inside the pipe is raised to 4.0 psig greater than the average back pressure of any groundwater that may be over the pipe. After a pressure of 4.0 psig is obtained, regulate the air supply so that the pressure is maintained between 3.5 and 4.0 psig (above the average ground water back pressure) for a period of two minutes. This allows the air temperature to stabilize in equilibrium with the temperature of the pipe walls. The pressure will normally drop slightly until temperature equilibrium is obtained.

Determine the rate of air loss by the time/pressure drop method. After the two minute air stabilization period, the air supply is disconnected and the test pressure allowed to decrease to 3.5 psig. The time required for the test pressure to drop from 3.5 psig to 3.0 psig is determined by means of a stopwatch and this time interval is then compared to the required time in the attached table to determine if the rate of air loss is within the allowable time limit. If the time is equal to or greater than the times indicated in the tables, the pipeline shall be deemed acceptable.

MINIMUM DURATION FOR AIR TEST PRESSURE DROP

Pipe Size		Time
<u>Inches</u>	<u>mm.</u>	<u>Minutes</u>

4	100	2½
6	150	4
8	200	5
10	225	6½
12	305	7½
15	380	9½

Upon completion of the test, open the bleeder valve to allow air to escape. Plugs should not be removed until all air pressure in the test section has been released. During this time, no one should be allowed in the trench or manhole while the pipe is being decompressed. Air test shall also include service lines and appurtenances.

4.4 Manhole Inspection. During the construction of the manholes, the Contractor shall, in accordance with good practice, ensure that no earth, sand, rocks or other foreign material exists on the joint surfaces during assembly of the section. The Engineer shall check each manhole to determine whether the manhole fulfills the requirements of the Drawings and Specifications.

- A. Visual Examination. The Engineer shall visually check each manhole, both exterior and interior, for flaws, cracks, holes, or other inadequacies which might affect the operation or water-tight integrity of the manhole. Should any inadequacies be found, the Contractor, at his own expense, shall make any repairs deemed necessary by the Engineer.
- B. Leakage Test. All manholes shall be tested for leakage and all tests shall be witnessed by the Engineer. The leakage test shall be conducted prior to backfilling around the manhole and shall be carried out in the following manner:
 - 1. All lines leading into or out of the manhole shall be tightly plugged.
 - 2. The manhole shall be filled with water to a level of at least one foot above the uppermost joint. The water shall be allowed to stand for two hours to allow for normal water absorption into the manhole material. The test shall be run for at least two hours. The amount of water required to refill the manhole shall be measured as the manhole is refilled at the end of the test. The depth of the manhole shall be considered as the in-place measurement between the invert of the sewer and the rim of the casing. This depth measurement multiplied by the allowable leakage rates in the table below yields the maximum allowable amount of water required to refill the manhole at the end of a two-hour test.

MAXIMUM ALLOWABLE MANHOLE LEAKAGE
(Two-hour Test)

<u>Diameter of Manhole (Inches)</u>	<u>Leakage Gal/Vertical Ft/2 Hours</u>
48	0.08
60	0.10

4.5 Deflection Test for Non-Rigid Pipe. The maximum allowable pipe deflection for a completely backfilled, non-rigid sewer pipe shall not exceed five percent (5%) of the nominal internal pipe diameter. Deflections in non-rigid pipe shall be checked by measurement or by pulling a mandrel

with the minimum allowable diameter through the pipe. The minimum allowable diameter shall be equal to the minimum interior diameter of the pipe, as specified in the applicable portions of the ASTM Standard Specifications or the pipe manufacturer's recommendations, minus five percent of the minimal interior diameter of the pipe. Those sections of non-rigid pipe with deflections greater than the maximum allowable five percent shall not be acceptable and the Contractor will remove and replace these sections at his own expense.

Deflection tests will be run if in the opinion of the Town testing is warranted. The program for testing shall be determined by the Town. The Contractor shall furnish all labor, tools and equipment necessary to make the tests and to perform any work incidental thereto.

End of Section

**SECTION 2500 HOT
BITUMINOUS PAVING**

1.1 GENERAL

1.2 Scope. Work to be performed under this section shall include all labor, equipment, materials and miscellaneous items necessary to furnish and install one or more courses of bituminous mixture constructed on a prepared surface in accordance with the Specifications or as shown on the Drawings. The finished product shall be in close conformity with the lines, grades, thickness, and typical cross sections shown on the Drawings or as established in the field.

1.3 Related Work Specified Elsewhere.

Section 2140 - Embedment and Base Course Aggregate

1.4 Reference Standards. All work is to be performed in accordance with the "State Department of Highways - Division of Highways - State of Colorado - Standard Specifications for Road and Bridge Construction", latest edition as revised herein. The reference Specifications are not reproduced in their entirety.

1.5 Submittals.

- A. Mix Design. Provide complete mix design by independent testing laboratory, including certifications of all material compliance.
- B. Prime Coat. Certification of material.
- C. Tack Coat. Certification of material.

1.6 Coordination. It shall be the responsibility of the Contractor under this section to coordinate this work with all other trades involved in the project. No paving work shall be started until the work of others has progressed to a point that a definable area can be paved; patching, blending, butting, etc. of work under this section will not be allowed except as required as part of the normal paving operation.

2.1 MATERIALS

2.2 Composition of Mixture. Reference Section 403.02 (further reference 401.02 through 401.06) Section 702, Section 703, and Section 704, with revisions and additions as follows:

- A. Use Grading E (Reference Section 703.04); maximum aggregate size may be 5/8".
- B. Asphalt Cement to be Viscosity Grade AC-10 (ASTM D946), 5.7% by \pm 0.5% by weight of mix.
- C. Marshall Property Requirements:

Stability, lbs.	500 min.
Flow, 0.02 inch	8-18
Voids, total mix %	3-11
Aggregate voids filled %	65-75
Compaction, blows ea. end	50

- D. Immersion-Compression:

Voids in total mix %	3% - 6%
Compressive strength psi	250 min.
Retained strength %	75
- E. Minimum temperature of mixture emptied from pugmill, 280°F.
- F. Delete last sentence, second paragraph, Section 401.06.
- G. Delete Section 702.05.
- H. Contractor to provide to the Engineer, a job mix composition meeting this section. Submittal shall include testing results sufficient to show compliance. Testing shall be under the certification of an independent testing laboratory acceptable to the Engineer.
- I. Contractor may use an approved anti-stripping additive.

2.3 Prime Coat. Reference Section 702.03.

- A. Prime coat shall be MC-70 (ASTM D2026)

2.4 Tack Coat. Reference Section 702.04.

- A. Tack Coat to be SS-1 or SS-1n (ASTM D977) or CSS-1h (AASHTO M208).

3.1 METHODS AND PROCEDURES

Reference Section 403.03 (further reference 401.07 through 401.20) and Section 407.04 through 407.08.

- A. Maximum compacted pavement depth per pass to be 2½". Minimum compacted pavement depth per pass to be 1 1/2 times the maximum aggregate size.
- B. Prime not required unless indicated on Drawings. Prepared base course or subgrade surfaces receiving pavement courses shall be primed at Contractor's expense if the surface has deteriorated, due to traffic, weather or time lapse between surface preparation and placement of bituminous materials, such that in the opinion of the Engineer, use of prime coat is required.
- C. Tack coat required between lifts, on all abutting old pavement surfaces and for overlays on existing pavements unless waived by Engineer. Application rate shall be 0.05 to 0.10 gallons per square yard diluted.

Dilution shall be one part tack emulsion to one part water.

All cut asphalt surfaces that are to butt new pavement sections shall be tacked with a liberal application of tack coat prior to paving.

3.2 Compaction. Minimum density of 95% of a laboratory job mix specimen.

3.3 Surface Tolerances. Section 401.20. No skin patching will be allowed.

4.1 FIELD QUALITY CONTROL

4.2 Inspection and Testing. Inspection and testing to be performed at the direction of the Engineer. Contractor to cooperate fully with all persons engaged in testing.

4.3 Density Testing and Control.

- A. Reference Standards. Density relationship to be developed in accordance with ASTM D2950.
- B. Field Testing. Testing for density during compaction operations to be done using nuclear density methods.
- C. Frequency of Testing. Minimum of three tests or one test per every 2000sf per lift whichever is greater.
- D. The Town reserves the right to base final acceptance on core samples and tests.
- E. Retesting. In the event of failure to meet compaction criteria, Contractor shall recompact and/or replace defective work at direction of the Town. All retesting to be paid for by Contractor and to be performed by a testing firm approved by the Town.

End of Section

SECTION 2510

COLD IN-PLACE RECYCLING

1.1 GENERAL

1.2 Scope. This work shall consist of furnishing all labor, equipment, materials and miscellaneous items for the recycling of existing asphalt pavement and base course. It shall also include the reshaping and compaction of recycled material prior to final asphalt surfacing.

1.3 Submittals. Provide submittal information on equipment for pulverizing and compaction operations.

1.4 Related Work Specified Elsewhere.

Section 2100 - Removal of Structures and Obstructions

Section 2140 - Embedment and Base Course Aggregate

Section 2500 - Hot Bituminous Pavement

2.00 MATERIALS

Not Applicable

3.1 METHODS AND PROCEDURES

3.2 General. The Contractor shall furnish a power operated self-propelled machine capable of mixing to the required plan depth of cut, and pulverizing to the size required in a single path of the machine. The machine shall be sufficient in size and equipped with cutters that will accurately cut a uniform plane over the entire width of the cut. The machine shall be of such design that a viable indication is given at all times that the machine is cutting to the proper depth required for establishing plan typical sections, cross slope and grade. [95%] of pulverized material shall pass a 1½" screen.

The aggregate asphalt mixture and added materials shall be mixed initially by a rotary mixer.

The Contractor shall furnish a mixing machine of sufficient size and equipped with mixing blades as to be capable of obtaining a uniform blending of the existing and added materials to produce a homogeneous mixture of recycled material.

After the mixture has been thoroughly mixed and aerated, it shall be spread and shaped with a grader. Spreading shall be performed to provide a uniform layer of loose material which, when compacted, shall not exceed the planned thickness and in such a manner that segregation will be minimal.

The mixture shall be considered ready for Contractor when it will bear the weight of the roller without undue displacement or cracking. Rolling shall be performed in a longitudinal direction starting at the edges and progressing towards the center, overlapping at least one-half the roller width on successive passes.

The Contractor shall demonstrate his ability to obtain a minimum density of 95% of a laboratory specimen prepared in accordance with AASHTO T-245.

The Contractor shall provide a vibratory sheep's foot compactor with a minimum centrifugal force of 50,000 pounds.

The recycled material shall be so shaped that, when compacted, the surface of the recycled pavement shall have no deviations in excess of one-half inch in ten feet ($\frac{1}{2}$ " in 10') when checked with a ten-foot straight edge.

End of Section

SECTION 2520 CONCRETE

CURB AND GUTTER, SIDEWALK, CURBWALK AND DRIVEWAY

1.1 GENERAL

1.2 Scope. This Work shall include furnishing all materials, labor, equipment and miscellaneous items necessary for the construction of concrete curb, gutter, sidewalk, handicap ramps, driveway or any combination thereof, all in accordance with these Specifications and in close conformity with the lines, grades, and typical sections as shown on the plans or established in the field.

1.3 Related Work Specified Elsewhere.

Section 2140 - Embedment and Base Course Aggregate
Section 3100 - Cast-in-Place Concrete

1.4 Reference Standards.

- A. American Concrete Institute(ACI)
- B. All work in this section must meet requirements of Section 3100 "Cast-in-Place Concrete" of this manual.

2.00 MATERIALS

The materials shall conform to the requirements specified in the following:

Section 2140 - Embedment and Base Course Aggregate
Section 3100 - Structural Concrete

2.01 Joint Filler. Pre-molded, preformed conforming to AASHTO M213 to the full depth of the section.

2.2 Structural Concrete. 28-day compressive strength of 3,750 psi. See Section 3100 for complete Specification.

2.3 Fibermesh. Fibermesh additive at the rate of 1½ pounds/cubic yard shall be used with all concrete. Use shall be in accordance with manufacturer's recommendations.

3.1 METHODS AND PROCEDURES

3.2 Excavation. Excavation shall be made to the required depth and width to permit the installation and bracing of the forms. The foundations shall be shaped and compacted to a firm even surface conforming to the section shown on the plan. Material determined to be unsuitable or non-compact by the Engineer will be removed and replaced.

3.3 Forms. Forms shall be wood or metal and shall extend for the full depth of the concrete. All forms shall be straight, free from warp and of sufficient strength to resist the pressure of the concrete without springing. Bracing and staking of forms shall be such that the forms remain in alignment both horizontally and vertically until removal. Satisfactory slip forms may be used when approved. Use of curbing machine will be permitted providing line and grade tolerances can be met.

Steel plates that can be shaped to the desired radius shall be used on all short radii. Open joints shall be formed with a steel separator plate conforming to the section being installed.

Oil and clean all forms prior to placement of concrete.

3.4 Mixing and Placing. The foundations shall be thoroughly moistened immediately prior to the placing of the concrete. Compaction of the concrete shall have thorough consolidation achieved by tamping, spading, vibrating or other acceptable methods. Forms shall be left in place until the concrete has set sufficiently to prevent deformation due to removal. Upon removal of the forms, the curb face shall be immediately finished to a uniform surface. In the case of matching existing concrete finishes, an approved method shall be used.

3.5 Finishing. The surface shall be floated with a wood or magnesium float and given a broom finish. No plastering of the surface will be permitted. All outside edges of slabs and joints shall be rounded to a ¼ inch radius. Broom marks to be perpendicular to traffic or pedestrian flow for installation of sidewalk or concrete flatwork. Broom marks to be parallel to traffic flow for installation of curb and gutter.

3.6 Joints. Expansion joints shall be made using ½" pre-molded expansion joint. Construction joints, using ½" pre-molded joint filler, shall be placed at the end of a day's run or during a day's work if there is more than a 30 minute delay in concrete delivery.

Construction joints shall be formed around all appurtenances such as manholes, utility poles, adjacent structures, etc., extending into or abutting the Work. Pre-molded expansion joint filler ¼" thick shall be installed in these joints. Expansion joint filler shall be installed between concrete sidewalks and any fixed structure.

Dummy joints (contraction joints) shall be made by a forming tool to a depth of ¼" of the section with a width of 1/8" to ¼". Open joints shall be made with a separator plate, 1/8" to ¼" in width. Dummy joints in lieu of open joints will be permitted with use of curbing machine.

Joint spacing shall be located as follows:

- A. Expansion joints: Every 100' on center; at end of corner radius; at driveway sections; as shown on Drawings.
- B. Construction joints: As required during construction; at appurtenances and structures through or abutting Work.
- C. Dummy or open joints: Every 10' on center for curb and gutter and curbwalk; equal to width of sidewalk for sidewalk; as shown on Drawings.

3.7 Curing. Immediately upon completion of the finishing, concrete shall be moistened and kept moist for a minimum of five(5) days. In lieu of wetting, use of a membrane curing compound, at the direction of the Town, will be permitted.

3.8 Backfilling. After the concrete has set sufficiently, the areas behind the curb shall be backfilled to the required elevations and shall be thoroughly compacted in accordance with Section 2120 Excavation and Backfill For Structures.

4.1 FIELD QUALITY CONTROL

4.2 Tolerances. All vertical surfaces shall not vary more than $\frac{1}{4}$ " in 10' in the horizontal direction. Surface deviation shall not exceed $\frac{1}{4}$ " when measured with a 16' straight edge.

4.3 Concrete Strength. Compression strength tests shall be taken in accordance with section 3100 4.01 of this manual. The results shall be submitted to the Town. All substandard strength concrete shall be removed and replaced at the contractor's expense. All testing shall be at the contractor's expense.

End of Section

SECTION 2610

METAL GUARDRAIL

1.1 GENERAL

1.2 Scope. Work under this section shall consist of furnishing all materials, labor, equipment and miscellaneous items necessary to furnish and install metal guardrails as shown on the Drawings.

1.3 Reference Standards. All Work and materials shall be in compliance with applicable standards of the Colorado Department of Highways.

2.00 MATERIALS

2.01. General. All materials shall conform to M-606-2, Guardrail for Local Roads and Type 3 Bridge Rail, Department of Highways Bridge Standards.

2.2 "W" Beam Rail. The types of guardrail are designated as follows:

Type 3	Guardrail	- "W" Beam
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The rail elements shall be corrugated sheet steel beams conforming to the requirements of AASHTO M 180 of the designated class and type. The beams and metal offset devices shall be galvanized.

2.3 Guardrail Posts. Railing posts shall be of wood or metal I-beam.

A. Wood posts shall be fabricated from an approved or specified timber species and shall be of the quality, diameter or section, and length as specified or as shown on the Drawings. When treated posts are specified, they shall be fabricated or framed before treatment. Timber preservatives shall conform to the requirements of AASHTO M 133. Preservative treatment shall conform to the requirements for "Preservative Treatments for Timber" of the AASHTO Standard Specifications for Highway Bridges.

B. Metal I-beam posts specifications shall be submitted to the Town for approval.

2.4 Guardrail Hardware. Splices and end connections shall be of the type and design specified or shown on the Drawings, and shall be of such strength as to develop the full design strength of the rail elements.

End anchor rods and accessories shall be as specified or as shown on the Drawings and shall be of such size and strength as to develop the full design strength of the rail elements.

High strength bolts, nuts and washers conforming to ASTM A325 shall be hot dip galvanized in accordance with AASHTO M232, or electroplated in accordance with ASTM A164, or cadmium plated in accordance with ASTM A165. Unless otherwise specified, all other fittings, bolts, washers and other accessories shall be galvanized in accordance with the requirements of AASHTO M111 or AASHTO M232, whichever may apply.

Where high strength bolts are required, they shall conform to the requirements of ASTM A325. Nuts, bolts and washers shall be galvanized in accordance with AASHTO M232 or ASTM B454, Class 50 thickness, and threaded to the dimensional tolerance required.

2.5 Structural Steel. Steel shall be of the self-rusting type or "Corten".

2.06. Painting System. Not Applicable.

3.1 METHODS AND PROCEDURES

3.2 Post and Rail Elements.

- A. Posts shall be set firm and aligned with a tolerance of $\pm \frac{1}{4}$ " from plumb, grades and lines as staked. All fittings and metal plates shall be placed securely in position to conform to designated dimensions and requirements.

Posts shall be set as required in Drawings by one of the following methods:

1. Driven in place.
2. Set in dug holes.
3. Set in concrete base.
4. Posts on bridges shall be as shown on Drawings.

Driving of posts shall be accomplished with approved methods and equipment that will leave the posts in their final position free from any distortion, burring or any other damage.

Excavated post holes shall have a firm bottom and be backfilled with acceptable material placed in layers and thoroughly compacted.

When required, posts shall be spliced with break-away plates as shown on the Drawings.

Dissimilar metal-to-metal or aluminum-to-concrete posts or rail installations shall have contact surfaces separated by an approved protective coating.

Wood posts cut in the field shall have the cut surfaces protected with two coats of hot creosote or a 5% pentachlorophenol-in-oil solution. When the cut surface is above ground, the treating solution to be used shall be the same type as was used in the original treatment.

- B. Rail elements shall be erected in a manner resulting in a smooth, continuous installation. All bolts in the finished rail shall be drawn tight. Bolts shall be of sufficient length to extend beyond the nuts. Rail shall be shop bent for installations on horizontal curves having a radius of 150 feet or less.

3.3 Painting. Not applicable.

4.1 FIELD QUALITY CONTROL

4.2 Inspection and Testing. Inspection and testing to be performed at the direction of the Engineer. Contractor to cooperate fully with all persons engaged in testing.

End of Section

SECTION 2710

FINISHED GRADING AND RESTORATION

1.1 GENERAL

1.2 Scope. This Work shall consist of finish grading, restoration of grounds and clean-up. This shall be a continuous process from project start-up to final acceptance of the Work by the Engineer.

1.3 Related Work Specified Elsewhere. This section pertains to all other sections of these Specifications.

2.1 MATERIALS AND METHODS

2.2 General Clean-Up. Clean-up shall include the regrading, resurfacing, rebuilding and replacing of all surfaces on which construction took place, and rebuilding or replacing any areas disturbed by the construction. The streets or roads where disturbed shall be resurfaced by the Contractor, including both gravel and oil roads, and shall be replaced in as good or better condition than that at the start of construction. The Engineer shall be the sole judge as to whether streets, roads or property have been restored to a condition as good or better than at the start of construction.

The Contractor shall, at all times, keep property on which Work is in progress free from accumulation of waste material or rubbish caused by employees or caused by the Work, and he shall carry on a constant program to maintain Work area, structure sites, right-of-ways and the surface of streets and roads in a condition satisfactory to the appropriate authority, grantor of the right-of-way, and the Engineer.

Preliminary clean-up shall commence as soon as the construction site is occupied by the Contractor (including his employees, supplies, materials or equipment) and shall be a continuous process, if necessary, in order that the site of the Work shall have an appearance and/or utility equal to or better than the start of the Work.

Upon completion of the Work, the Contractor shall remove all remaining rubbish, tools, equipment, scaffolds and surplus materials from the job and leave the Work area clean and free of debris.

3.1 RESTORATION

3.2 General. All driveways, retaining walls, concrete flatwork, drainage ditches, trees, shrubs, and other miscellaneous items shall be returned to as good or better than original conditions if they are damaged by Work.

3.3 Landscaping. Any disturbed landscaping shall be restored to equal to or better than preconstruction conditions.

3.4 Ditches. Because of the large amount of lateral irrigation and drainage ditches, special care shall be taken to ensure the ditches are maintained during construction at the preconstruction capacities and restored to pre-existing conditions.

End of Section

SECTION 2720

SEEDING, SODDING AND TOPSOIL

1.1 GENERAL

1.2 Scope. Work to be performed under this section shall include furnishing all labor, equipment, materials and miscellaneous items necessary to perform all soil preparation, seeding, sodding, erosion blanketing and related work not specified elsewhere, as shown on the Drawings and required by the Specifications.

1.3 Related Work Specified Elsewhere.

Section 2110 - Excavation and Embankment
Section 2130 - Trenching, Backfilling and Compaction
Section 2710 - Finished Grade and Restoration

1.4 Description of Work. The extent of landscape development work is shown on the Drawings and in schedules.

A. Subgrade Elevations. Excavation, filling and grading required to establish elevations shown on the Drawings are not specified in this section. Refer to earthwork sections.

1.5 Quality Assurance.

A. Subcontract the landscape work by a single firm specializing in landscape work.

B. Source Quality Control:

1. Substituting. If specified landscape material is not obtainable, submit to Engineer proof on non-availability and proposal for use of equivalent material. When authorized, adjustment of contract amount will be made.
2. Topsoil. Before delivery of topsoil, furnish Engineer with written statement giving location of properties from which topsoil is to be obtained, names and addresses of owners, depth to be stripped, and crops grown during past 2 years.

1.6 Submittals.

- A. Certification. Submit seed vendor's certified statement for each grass seed mixture required, stating botanical and common name, percentage by weight, and percentages of purity, germination, and weed seed for each grass seed species.
- B. Planting Schedule. Submit planting schedule showing scheduled dates for each type of planting in each area of site.
- C. Maintenance Instructions. Begin maintenance immediately after planting and continue maintenance of all seeded areas and sodded areas, until all work has been accepted by the Engineer.

1.7 Delivery, Storage and Handling.

A. Plant Materials.

1. Sod. Time delivery so that sod will be placed within 24 hours after stripping. Protect sod against drying and breaking of rolled strips.

1.8 Job Conditions.

A. Work Progress. Proceed with and complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.

B. Utilities. Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

C. Excavations. When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Engineer before planting.

D. Planting Time. Plant or install materials during normal planting seasons for each type of landscape work required. Correlate planting with specified maintenance periods to provide maintenance from date of substantial completion.

E. Planting Schedule.

1. Sodding for law areas shall be performed after the spring thaw and prior to consistent ground freezing in the fall.

- a. "Spring thaw" shall be defined as the earliest date in a new calendar year in which seed can be buried 1/2 inch into the surface soil (topsoil) through normal drill seeding methods.

- b. Consistent ground freeze shall be defined as that time during the fall months in which the surface soil (topsoil), due to freeze conditions, prevents burying the seed 1/2 inch through normal drill seeding operations. At no time shall sod be laid, seed be sown, drilled or otherwise planted when the surface soil or topsoil is in a frozen or crusted state.

2. Dryland seeding shall be performed after spring thaw until June 30th or after September 1 until consistent ground freeze.

1.9 Special Project Warranty.

A. Warranty lawns through specified maintenance period, and until final acceptance.

2.1 MATERIALS

2.2 Topsoil.

A. Topsoil for landscape work will be available at site.

2.3 Soil Amendments.

- A. Peat Humus. FS Q-P-166 and with texture and pH range suitable for intended use.
- B. Commercial Fertilizer. Complete fertilizer of neutral character, with some elements derived from organic sources and containing following percentages of available plant nutrients:
1. For lawns, provide fertilizer with not less than 4% phosphoric acid and not less than 2% potassium, and percentage of nitrogen required to provide not less than 1 lb. of actual nitrogen per 1000 s.f. of lawn area. Provide nitrogen in a form that will be available to lawn during initial period of growth.
 2. For dryland seeded areas, provide fertilizer with commercial type mixture of 16-16-8 or similar ratio, not less than 15 lbs per acre for nitrogen rate.

2.4 Grass Materials.

A. Dryland Grass Seed. Provide fresh, clean, new-crop seed complying with tolerance for purity and germination established by Official Seed Analysis of North America. Provide seed of grass species, proportions and minimum percentages of percentages of purity, germination, and maximum percentage of weed seed, as specified.

RIGHT-OF-WAY MIXTURE

<u>Seed List</u>	<u>Lbs. pls/acre</u>
Alkali Sacaton	0.5 lbs.
Indian Ricegrass "Nespar"	1.0 lbs.
Thickspike Wheatgrass	2.0 lbs.
Sanddrop Seed	0.5 lbs.
Crested Wheatgrass	4.0 lbs.
Russian Wildrye	<u>4.0 lbs</u>
	12.0 lbs.

Forb Mixture

Mat Saltbrush	1.5 lbs.
Castle Valley Saltbrush	1.5 lbs.
Winterfat	0.5 lbs.
Sage	<u>0.5 lbs.</u>
	4.0 lbs.

B. Sod. Not Applicable

Kentucky Bluegrass (Poa Pratensis).

C. Lawn Grass Seed. Not Applicable.

Lawn Grass Seed Mixture.
Grass Seed Mixture.

		<u>Pure Seed</u>	<u>Germ.</u>	<u>Weed Seed</u>
Bluegrass (including Kentucky and American)	85%	80%	50%	
Manhattan Perennial Ryegrass	98%	90%	50%	

Proportion by weight

Bluegrass 70%
Manhattan Ryegrass 30%

Sowing Rate

Sow at the rate of 4 lbs. per 100 square feet.

2.5 Miscellaneous Landscape Materials.

A. Erosion Blanket. Not Applicable.

B. Mulch

1. Mulch all seeded areas with conweb long fiber mulch, hay or straw. Material for straw mulching shall consist of straw or oats, barley, wheat or rye and shall not contain seed of noxious weeds. Clean field hay may be substituted for straw when approved by the Engineer. Straw or hay in such an advanced stage or decomposition as to smother or retard the normal growth of grass will not be accepted.

3.1 METHODS AND PROCEDURES

3.2 Inspection.

- A. Installer must examine subgrade, verify elevations, observe conditions under which work is to be performed, and notify Contractor (of if none, Owner) of unsatisfactory conditions. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.3 Preparation for Planting Lawns. Not Applicable.

3.4 Sodding New Lawns. Not Applicable.

3.5 Seeding New Lawns. Not Applicable.

3.6 Dryland Seeding.

- A. Prior to revegetation, planting or topsoil placement, all cut or fill slopes will be contoured to blend with adjacent terrain. Various slope molding techniques will be used to enhance the aesthetic quality of the slope, while maximizing the revegetation potential. All cut and fill slopes also being rounded at the toe to blend with the existing terrain. Additionally, where soils and steepness of slope permit, terraces will be constructed to aid the revegetation process.
- All topsoil, including existing vegetation, from excavation areas will be stockpiled with adequate precaution taken for erosion control. The incorporation of plant material into the topsoil will aid in erosion control and once the topsoil is re-spread, perhaps the plant material will renew its growth. All available topsoil will be re-spread on disturbed areas to insure seed germination and serve as a mulch layer. Where soil texture is desirable for plant growth, as determined by the Engineer, topsoil may not be re-spread if supplies are limited. Mulch and fertilizer will be applied to the subsoil layer to increase its revegetation potential.

Slopes that are flat enough to be mechanically scarified shall be done in a manner so that the scarification ridges run parallel to the contour of the slopes. Slopes too steep for mechanical scarification shall be roughed during topsoil replacement.

B. Seeding Dryland Areas

1. Seeding shall be done by hydroseeding, drilling, or hand broadcasting. Hydroseed shall be applied in a water and light mulch slurry after which mulch will be applied to cover the seed. Any areas that cannot be reached by hydroseeding or drill seeding shall be hand broadcast. Areas seeded by hand broadcasting shall be lightly raked.

C. Mulching

1. Conweb fiber mulch, previously specified, shall be applied at a rate of 1500 lbs./acre. Hay or straw shall be applied in a uniform manner at a rate of 1.5 tons/acre.

3.7 Cleanup and Protection.

- A. During landscape work, keep pavements cleaned and work area in an orderly condition.
- B. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged landscape work as directed.
- C. Water and care for seeding planted until a lush 3" high stand of cover is established.

4.1 FIELD QUALITY CONTROL

4.2 Inspection. When landscape work is completed, including maintenance, Engineer will, upon request, make an inspection to determine acceptability. Landscape work may be inspected for acceptance in parts agreeable to Engineer, provided work offered for inspection is complete, including maintenance. Where inspected landscape work does not comply with requirements,

replace rejected work and continue specified maintenance until reinspected by Engineer and found to be acceptable. Remove rejected plants and materials promptly from project site.

End of Section

SECTION 2730

REVEGETATION - SEEDING, SODDING, HYDROSEEDING

1.1 GENERAL

1.2 Scope

A. Furnish labor, materials, equipment and services to complete the following work which shall include but not necessarily be limited to:

1. Soil Preparation and Scarification
2. Topsoil Placement
3. Seeding, hydroseeding or sodding
4. Fertilizing
5. Mulching
6. Installing erosion blanket
7. Maintaining areas

1.3 Related Work Specified Elsewhere.

Section 2110 - Excavation and Embankment
Section 2120 - Excavation and Backfill For Structures
Section 4200 - Underground Sprinkler System

2.1 MATERIALS

2.2 Seed Mix. Seed shall be at least 95% pure and shall have a minimum germination percentage of 85%. Seed shall be furnished separately or in mixtures in standard containers with the same seed name, lot number, net weight, percentages of purity and of germination and hard seed, and percentage of maximum weed seed content clearly marked for each kind of seed. The Contractor shall furnish the Engineer duplicate signed copies of a statement by the vendor certifying that each lot of seed has been tested by a recognized laboratory for seed testing within 6 months of date of delivery. This statement shall include: Name and address of laboratory, date of test, lot number of each kind of seed, and the results of tests as to name, percentage of weed content for each kind of seed furnished, and in case of a mixture, the proportions of each kind of seed.

(See Table Next Page)

A.	<u>Recommended Dryland Seed Mix</u> <u>(below 9000 feet)</u>	<u>% of Total/</u> <u>1000 Sq. Ft.</u>
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Western Wheat Grass (50% split or as available)	50%
Slender Wheat Grass (50% split or as available)	50%
Green Needle Grass	6¼%
Candy or Upland Bluegrass	3¼%
Hard Fescue	9½%
Creeping Red Fescue	9½%
Kentucky Bluegrass "Troy"	9%
Lupine (Wildflower substitutes are acceptable)	12½%
Globe Mallow	
Scarlet Gilia	
Flax	
Aspen Daisy	

B. Recommended Seed Mixture (9,000-10,500 feet)

Lincoln Smooth Brome	25%
Orchard Grass (Pot Omac)	20%
Nord Crest Wheat	20%
Slender Wheat Grass	20%
Russian Wild Rye	15%

C. Recommended Seed Mixture (10,500 feet and above)

Kentucky Blue Grass	25%
Timothy	25%
Chewing Fescue	10%
Pennlawn Red Fescue	10%
Meadow Foxtail	10%
Manchar Smooth Brome	10%
Alsike Clover	10%

Note: As an addition to the basic above, add oats, barley or winter wheat as a seasonal cover crop.

2.3 Fertilizer. Fertilize all seeded areas with a commercial type 15-40-5 mixture of similar ratio. Fertilizer shall be standard commercial fertilizers supplied separately or in mixtures containing the percentages of total nitrogen, available phosphoric acid, and water-soluble potash. They shall be applied at the rate specified in these Specifications and shall meet the specified requirements of the applicable Federal and State laws. They shall be furnished in standard containers with name, weight and guaranteed analysis of contents clearly marked thereon. No cyanamide compounds or hydrated lime shall be permitted in mixed fertilizers.

2.4 Topsoil. Material stripped from site consisting of loose friable loam reasonably free of admixtures of subsoil, refuse, stumps, rocks, brush, weeds or other material detrimental to proper development of vegetative growth. Topsoil shall be a minimum depth of six inches (6").

2.5 Straw Mulch. Mulch all seeded and hydroseeded areas with straw mulch. Material for straw mulching shall consist of straw or oats, barley, wheat or rye and shall not contain seed of noxious weeds. Clean field hay may be substituted for straw when approved by the Engineer. Straw or hay in such an advanced stage of decomposition as to smother or retard the normal growth of grass will not be accepted.

2.6 Tacifier. Straw mulch shall be secured by TerraTack or approved equal.

2.7 Erosion Blanket. Erosion Blanket shall be as specified on Drawings. The blanket shall be smolder resistant, not toxic to vegetation or germination of seed and shall not be toxic or injurious to humans.

3.00 EXECUTION

3.01 Time of year to Seed and Hydroseed.

Spring Seeding

Fall Seeding

Spring thaw to July 1st

Oct. 15th until consistent ground freeze

- (a) "Spring thaw" shall be defined as the earliest date in a new calendar year in which seed can be buried 1/2 inch into the surface soil (topsoil) through normal drill seeding methods.
- (b) "Consistent ground freeze" shall be defined as that time during the fall months in which the surface soil (topsoil) due to freeze conditions, prevents burying the seed 1/2 inch through normal drill seeding operations. At no time shall seed be sown, drilled or otherwise planted when the surface soil or topsoil is in a frozen or crusted state.
- (c) Seeding at any time other than within the above seasons shall be allowed only when the Contractor submits a written request for permission to do so and permission is granted. In the request, the Contractor must agree to apply the specified seed at a rate of not less than 25 percent greater per unit area than the rates specified for use within the seeding season. The additional materials shall be furnished and placed at the Contractor's expense. The Contractor must also agree to reseed, re-mulch and repair any areas seeded out-of-season which fail to wind, erosion, lack of germination and/or disturbance by the Contractor.
- (d) Where out-of-season seeding is ordered, the cost of additional material if required will be paid for, and in this event, the Contractor will not be held responsible for damage or failure beyond his control due to out-of-season seeding.

3.2 Topsoil Excavation. Remove all sod, topsoil, organic earth, stockpile topsoil as designated on Drawings or as directed by Engineer.

3.3 Topsoil Placement.

- A. General: When job site has been shaped and ready for placement of topsoil, cover all cut-fill areas and construction scars with topsoil to depth of 6". Contour all surfaces to approximate grade and blend with existing adjacent terrain in accordance with detail drawings.

- B. Slope Rounding: Round top and bottom of slopes and feather into undisturbed natural terrain. Avoid abrupt grade changes, making smooth transitions from slopes to more level areas.
- C. Slope Molding: Avoid long continuous slope faces by molding face of slope to accent existing adjacent terrain. Steepened slope faces near ridges and bluffs, laid back to link to natural draws, creating an undulating face.
- D. Surface Roughing: Gouge slope surfaces of 2:1 or steeper with horizontal ridges and trenches to depth of 6" minimum, creating roughened surface to lessen erosion, improve moisture percolation and soil layer binding. Trenches or ridges shall not be longer than 30' to prevent water accumulation and flowing water to cause rivulets.

3.4 Preparation for Planting of Lawns.

- A. Grade lawn areas to smooth, even surface with loose, uniformly fine texture. Roll and rake and remove ridges and fill depressions as required to meet finish grades. Limit fine grading to areas which can be planted immediately after grading.
- B. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.
- C. Restore lawn areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.
- D. Preparation of Unchanged Grades. Where lawns are to be planted in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil for lawn planting as follows:

Till to a depth of not less than six inches, apply soil amendments and initial fertilizers as specified; remove high areas and fill depressions; till soils to a homogeneous mixture of fine texture free of lumps, cods, stones, roots and other extraneous matter.

3.5 Fertilizing. Apply fertilizer at the rate of 100 lbs. per acre.

3.6 Seeding and Sodding.

- A. HYDROSEEDING
 - 1. Seed and fertilizer shall be applied by spraying them on slopes of 3:1 or greater gradient in the form of an aqueous mixture and by using the methods and equipment described herein.
 - 2. Spraying Equipment. The spraying equipment shall have a container or water tank equipped with a liquid level gauge calibrated to read in increments not larger than 50 gallons over the entire range of the tank capacity, mounted so as to be visible to the nozzle operator. The container or tank shall also be equipped with a mechanical power-driven agitator capable of keeping all the solids in the mixture in complete suspension at all times until used.

The unit shall also be equipped with a pressure pump capable of delivering 100 gallons per minute at a pressure of 100 pounds per square inch. The pump shall be mounted in a line which will recirculate the mixture through the tank whenever it is not being sprayed from the nozzle. All pump passages and pipelines shall be capable of providing clearance for 5/8" solids. The power unit for the pump and agitator shall have controls mounted so as to be accessible to the nozzle operator. There shall be an indicating pressure gauge connected and mounted immediately at the back of the nozzle.

The nozzle pipe shall be mounted on an elevated supported stand in such a manner that it can be rotated through 360° horizontally and inclined vertically from at least 20° below to at least 60° above the horizontal.

There shall be a quick-acting, three-way control valve connecting the recirculating line to the nozzle pipe and mounted so that the nozzle operator can control and regulate the amount of flow of mixture delivered to the nozzle. At least three different types of nozzles shall be supplied so that mixtures may be properly sprayed over a distance varying from 20 feet to 100 feet. One shall be a close-range jet nozzle. For ease of removal and cleaning, all nozzles shall be connected to the nozzle pipe by means of quick-release couplings.

In order to reach areas inaccessible to the regular equipment, an extension hose at least 50 feet in length shall be provided to which the nozzles may be connected.

3. Mixtures. Seed and fertilizer shall be mixed together in the relative proportions specified, but not more than a total of 220 pounds of these combined solids shall be added to and mixed with each 100 gallons of water.

All water used shall be obtained from fresh water sources and shall be free from injurious chemicals and other toxic substances harmful to plant life. Brackish water shall not be used at any time. The Contractor shall identify to the Engineer all sources of water at least 2 weeks prior to use. The Engineer may take samples of the water at the source or from the tank at any time and have a laboratory test the samples for chemical and saline content. The Contractor shall not use any water from any source which is determined to be unsuitable by the Engineer following such tests.

All mixtures shall be constantly agitated from the time they are mixed until they are finally applied to the seedbed. All such mixtures shall be used within 2 hours from the time they were mixed or they shall be wasted and disposed of at locations acceptable to the Engineer.

Mixtures of seed and fertilizer shall only be sprayed upon previously prepared seedbeds. The mixture shall be applied by means of a high-pressure spray which shall always be directed upward into the air so that the mixtures will fall to the ground like rain in a uniform spray. Nozzles or sprays shall never be directed toward the ground in such a manner as might produce erosion or runoff.

Particular care shall be exercised to ensure that the application is made uniformly and at the prescribed rate and to guard against misses and overlapped areas. Proper predetermined quantities of the mixture in accordance with Specifications shall be used to cover specified sections of known area. Checks on the rate and uniformity of application may be made by observing the degree of wetting of the ground or by distributing test sheets of paper or pans over the area at intervals and observing the quantity of material deposited thereon.

Seeding shall be at 1.5 lbs. per 1000 sq. ft. or 65 lbs. per acre.

B. DRYLAND SEEDING

1. Do not use wet seed or seed which is moldy or otherwise is damaged in transit or storage.
2. Sow seed using a spreader, seeding machine or drill seeder. Do not seed when wind velocity exceeds 5 miles per hour. Distribute seed evenly over entire area by sowing equal quantity in 2 directions at right angles to each other.
3. Sow not less than 1.5 lbs. per 1000 sq. ft.
4. Rake seed lightly into top 1/8" of soil, roll lightly, and water with a fine spray.

C. SODDING NEW LAWNS

1. Lay sod within 24 hours from time of stripping. Do not plant dormant sod or if ground is frozen.
2. Lay sod to form a solid mass of with tightly-fitted joints. Butt ends and sides of sod strips; do not overlap. Stagger strips to offset joints in adjacent courses. Work from boards to avoid damage to subgrade or sod. Tamp or roll lightly to ensure contact with subgrade. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering or adjacent grass.
3. Secure sod on slopes with wood pegs to prevent slippage. Water sod thoroughly with a fine spray immediately after planting.
4. Maintain sodded lawns by watering, fertilizing, weeding, mowing, trimming and other operations such as rolling, regrading and replanting as required to establish a smooth, acceptable lawn, free of eroded or bare areas until project is accepted by the Owner.

3.7 Mulching. Straw Mulching. All seeded areas shall be mulched, as a separate process, with straw at a rate of 1½ tons/acre. Straw shall be applied in a uniform manner using standard straw blowing equipment. Areas not accessible, by reach, to straw blowing equipment shall be mulched by hand.

Areas not properly mulched or damaged shall be repaired and re-mulched in an acceptable manner, at Contractor's expense. Mulch removed by circumstances beyond the Contractor's control shall be repaired as ordered.

3.8 Tacifier. Straw mulch not covered by erosion blanket shall be secured by TerraTack tacifier or approved equal. TerraTack shall be applied at a rate of 180 lbs/acre.

3.9 Erosion Blanket. Areas requiring erosion blanket are designated on the Drawings and are generally on slopes of 1½:1 or greater. The blanket must be placed no later than 24 hours after seeding. The material shall be applied smoothly but loosely on the soil surface without stretching. The upslope end of each piece of blanket shall be buried in a narrow trench six inches deep. After the blanket is buried, the trench should be tamped firmly closed.

In cases where one roll of blanket ends and a second roll starts, the upslope piece should be brought over the buried end of the second roll so that there is a twelve (12) inch overlap to form a junction slot.

Overlaps of blanket which run down the slope, outside edges and center, shall be stapled on two foot intervals. Each width of jute mesh shall have a row of staples down the center as well as along the edge. Check slots and junction slots will be stapled across at six inch intervals.

End of Section

SECTION 2740

TREES, PLANTS AND GROUND COVER

1.1 GENERAL

1.2 Scope of Work. Work to be performed under this Section shall include all furnishing of plants and related materials, labor and equipment required to complete the installation of the exterior landscape work indicated on the Drawings.

1.3 Related Work Specified Elsewhere.

Section 4200 - Underground Sprinkler System
Section 2710 - Finished Grade and Restoration

1.4 Quality Assurance.

A. Reference Standards.

Plants shall be first class representatives of the specified species or variety, in healthy conditions with normal well developed branch root systems, free of all objectionable features, and shall conform to the requirements of the *USDA Standard For Nursery Stock*, 1969 Edition, *AAN Standardized Specifications*, *The American Joint Committee on Horticulture (AJCH)* [plant names should meet the standards of AJCH], *The American National Standard Institute (ANSI)* [nursery stock should meet ANSI Standard Specifications], and *The Colorado State Nursery Act of 1965*. Where standards may conflict, use the standard which requires the highest quality of performance.

B. Inspection and Approval.

Engineer reserves the right to reject, at any time or place prior to acceptance of, any and all materials and plants which, in his opinion, fails to meet specifications. Inspection of plants are primarily for quality, size and variety, but other requirements are not waived even though visual inspection results in approval. Plants may be inspected where growing, but inspection at the place of growth shall not preclude the right of rejection at the site. Rejected plants and other materials shall be promptly removed from the site and replaced with suitable specimens. All trees and shrubs shall be from a point or origin similar in altitude and climate as the construction site.

C. Acceptable Contractor.

Landscape work shall be subcontracted to a single firm specializing in this type of work.

1.5 Source Quality Control.

A. Substitutes.

If specified landscape material is unobtainable, submit to Engineer proof of unavailability and proposals for use of equivalent material. When authorized, adjustment of contract amount will be made.

B. Trees and Shrubs.

1. Provide trees and shrubs grown in a recognized nursery in accordance with good horticulture practice.
2. Provide healthy, vigorous stock free of disease, insects, eggs, larvae and defects such as knots, sun-scald, injuries, abrasions, or disfigurement.
3. Sizes. Provide trees and shrubs of sizes shown or specified. Trees and shrubs of larger size may be used if acceptable to Engineer, and if sizes or roots or balls are increased proportionately.

C. Inspection.

Engineer reserves the right to inspect trees and shrubs at site before planting, for compliance with requirements for name, variety, size and quality.

1.6 Submittals.

- A. Certificates. All required state, federal or other inspection certificates shall accompany the invoice for plant materials, showing source of origin and shall be filed with the Engineer prior to acceptance of the material.
- B. Topsoil. Before delivery of topsoil, furnish Engineer with written statement giving locations of properties from which topsoil is to be obtained, names and addresses of owners, depth to be stripped and crops growing during past two years.
- C. Planting Schedule. Submit planting and seeding schedule to Engineer showing scheduled dates for each type of planting in each area of site.
- D. Maintenance Data. At completion of work, furnish three (3) copies of written maintenance instructions to Engineer for maintenance and care of installed individual plant types through their full grange season.
- E. Warranty. At completion of work, furnish written warranty to Engineer based upon requirements of Paragraph 1.08.

1.7 Delivery, Storage and Handling.

A. Delivery.

1. Deliver packaged landscape materials to site in original unopened containers bearing manufacturer;s information (chemical analysis, name, trade name, trademark and conformance to state law.
2. Provide freshly dug trees and shrubs. Do not prune prior to delivery. Do not

bend or bind-tie trees or shrubs in such a manner as to damage bark, break branches or destroy natural shape. Provide protective covering during delivery.

3. Deliver trees and shrubs after preparations for planting have been completed and plant immediately. If planting is delayed more than six hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and keep roots moist.
4. Do not remove container-grown stock from container until planting time.
5. Each plant shall be identified by means of a grower's label affixed to the plant. The grower's label shall give the data necessary to indicate conformance to specifications. Use durable waterproof labels with water resistant ink which will remain legible for at least 60 days. Notify Engineer prior to delivery of plant materials to the site so that a pre-planting inspection may be made or indicate delivery schedule in advance so plant material may be inspected upon arrival at job site, whichever is more appropriate.
6. Removal unacceptable plant material immediately from job site.

B. Storage.

1. Deliver balled and burlapped stock directly from nursery and heel-in immediately if not being planted within the same day.
2. The Contractor will not be responsible for malicious destruction of plantings after installation. He shall be responsible for replacement of vandalized materials not yet installed. Report all cases of vandalism promptly to the Architect.

C. Handling.

1. Do not drop plants. Do not lift plants by the trunk, stems or foliage. The ball of the plant shall be natural, not made, and the plant shall be handled by the ball at all times. No balled or burlapped plant shall be accepted if the ball is broken or the trunk is loose in the ball.
2. All plants shall be protected at all times from drying out or other injury. Minor broken or damaged roots shall be pruned before planting. Major damage shall be cause for rejections as determined by the Engineer.

1.8 Job Conditions.

A. Existing Conditions.

1. Contractor shall determine location of utilities and perform work in a manner which will avoid possible damage. Hand excavate as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties

concerned.

2. The Contractor shall be responsible for proper repair of the sprinkler system and other underground pipe or electrical wiring damaged by operations under this section. Repairs will be made by contractors designated by the Engineer with cost being charged to this Contractor.
3. If a new tree or shrub is necessary due to interference with utility boxes or pits and underground piping or wiring, the Contractor shall notify the Engineer and receive approval of a new location. The Engineer must approve the precise location of all plants prior to pit excavation and installation.
4. When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Engineer before planting.

B. Protection.

The Contractor shall inform the Owner in writing if special tree protection and traffic control must be installed to protect the planting from damage after the Owner assumes responsibility for maintenance.

C. Planting Schedule.

1. Sequencing/Scheduling.

Proceed with the complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.

2. Plant and install materials during normal planting seasons for each type of landscape work required. Correlate planting with specified maintenance periods to provide maintenance from date of substantial completion.

3. Prepare a proposed planting schedule and submit to Engineer. Schedule dates for each type of landscape work during normal seasons for such work in area or site. Correlate with specified maintenance periods to provide maintenance from date of substantial completion. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.

1.9 Warranty.

A. Plant Material Guarantee.

All plants shall be guaranteed to remain alive and healthy for a full twelve (12) month period. A final inspection will be done by the Engineer at that time. Replacements shall be guaranteed an additional twelve (12) months. Inspection of the planting work, to determine its completion for beginning the guarantee period will be made by

the Engineer upon notice requesting such inspection by the Contractor. All planting must be alive and healthy in order to be considered complete.

B. Final Inspection and Replacements.

Inspection of the planting to determine its final acceptance will be made at the conclusion of the guarantee period by the Engineer representative. No plants will be accepted unless they are alive and healthy. The Contractor shall replace any plants which are dead, or in the opinion of the Engineer, are in an unhealthy or unsightly condition, and/or have lost their natural shape due to dead branches. The cost of such replacement(s) shall be borne by the Contractor and shall be included in his bid price for this section of the Work.

C. Guarantee for Seeded Areas.

Areas failing to show an adequate germination of grass shall be replanted according to the instructions in Section 3.00 of the Specifications.

2.00 MATERIALS

2.1 Topsoil.

- A. Topsoil will be stockpiled for re-use in landscape work. If quantity of stockpiled topsoil is insufficient, provide additional topsoil as required to complete landscape work.
- B. Provide new topsoil for soil mix for backfill of trees and shrubs which is fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than 2 1/2" in any dimension, and other extraneous or toxic matter harmful to plant growth.
- C. Obtain topsoil from local sources or from areas having similar soil characteristics to that found at project site. Obtain topsoil only from naturally, well-drained sites where topsoil occurs in a depth of not less than four inches; do not obtain from bogs or marshes.

2.2 Soil Amendments.

- A. Commercial Fertilizer. Complete fertilizer of neutral character, with some elements derived from organic sources and containing the following plant nutrient ratio: 20-20-5. Fertilizer shall be delivered to the site in unopened containers bearing the manufacturer's guaranteed analysis.
- B. Foliar Fertilizer. All tree and shrubs shall be foliar fertilized with "Rapidgro" or similar fertilizer. Dilute and apply fertilizer according to manufacturer's specifications. Foliar fertilization must be complete within two weeks of planting.

2.3 Soil Mixtures.

- A. Plant pits: Soil Mixture containing one part Colorado Mountain Peat to three parts

topsoil. These materials must be thoroughly mixed so there is no visible segregation of materials.

2.4 Plant Materials.

- A. Quality. Provide trees, shrubs and other plants complying with recommendations and requirements of ANSI Z60.1 "*Standard For Nursery Stock*" and as specified in Section 1.03.
- B. Plant List. A complete list of plants including names, quantities, sizes and other requirements is shown on the Drawings. The plan shall have precedence over the plant list.
- C. Deciduous Trees. Provide trees of height and caliper listed or shown and with branching configurations recommended by ANSI Z60.1 for type and species required. Provide single stem trees except where special forms are shown or listed.
- D. Deciduous Shrubs. Provide shrubs of the height shown or listed and with not less than minimum number of canes required by ANSI Z60.1 for type and height of shrub required.
- E. Ground Cover. Provide plants established and well rooted in removable containers or integral peat pots and with not less than minimum number and length of runners required by ANSI Z60.1 for the pot size required.
- F. Seed.
 - 1. Seed shall be at least 95% pure and shall have a minimum germination rate of 85%. All seed shall be furnished in bags or containers clearly labeled to show the name and address of the supplier, the seed name, lot number, net weight, the percent of week seed content and the guaranteed percentage of purity and germination. Seed and seed labels shall conform to all current state and federal regulations and will be subject to the testing provisions of the Association of Official Seed Analysis.
 - 2. All seed mixes shall be free from such noxious weeds as Canadian Thistle, Coarse Fescue, European Bindweed, Johnson Grass and Leafy Spurge. The landscape contractor shall furnish to the Engineer a signed statement certifying that the seed furnished is from a lot that has been tested by a recognized laboratory. Seed which has become wet, moldy or in any other way damaged in transit or storage, will not be accepted.
 - 3. Bluegrass Seed. Bluegrass seed shall be "Quicklawn" mix or approved equal by John Ericson, Ericson Enterprises, 481 Grand Valley Drive, Grand Junction, Colorado 81514, (303) 434-3339.
- G. Sod. Provide strongly-rooted sod, not less than two years old and free of weeds and undesirable native grasses. Provide only sod capable of growth and development when planted (viable, not dormant). Provide sod composed principally of the

following: 90% Kentucky Bluegrass (*Poa pratensis*).

2.5 Miscellaneous Landscape Materials.

- A. Mulch. Mulch all planted areas with shredded bark or approved equal.
- B. Stakes and Guys. Provide six-foot steel drive-in "T" posts. No. 125 for all tree staking. Provide wire ties and guys of two-strand, twisted, pliable galvanized iron wire not lighter than 12 gauge with zinc-coated turnbuckles. Provide not less than ½-inch hose, cut to required lengths, to protect tree trunks from damage by wires.
- C. Fiber Mulch. Mulch shall be "Conweb Hydro-Mulch" 2000 (Conweb Corporation, Fibers Division, Box 43237, St. Paul, MN 55164) or suitable approved substitute.

3.1 METHODS AND PROCEDURES

3.2 Inspection. Installer must examine subgrade, verify elevations, observe conditions under which work is to be performed, and notify contractor of unsatisfactory conditions have been corrected in a manner acceptable to installer.

3.3 Preparation.

- A. Layout. Layout individual trees and shrub locations by size and areas for multiple plantings. Stake locations and outline areas and secure Architect's acceptance before start of planting work. Make minor adjustments as may be requested. Prior to the excavation of planting areas or plant pits or placing tree stakes, the Contractor shall ascertain the location of all utility lines, electric cable, sprinkling system conduits so that proper precautions maybe taken not to disturb or damage any subsurface improvements.
- B. Preparation For Planting Beds.
 - 1. Loosen subgrade of planting bed areas to a minimum depth of eight inches using a cultimulcher or similar equipment. Remove stone over 1½ inches in any dimension, and stick, stones, rubbish and other extraneous matter.
 - 2. Spread planting soil mixture to a 4-inch depth required to meet lines, grades and elevations shown, after light rolling and natural settlement. Place approximately one-half of total amount of planting soil required. Work into top of loosened subgrade to crate a transition layer, then place remainder of the planting soil.
- C. Excavation For Trees and Shrubs.
 - 1. Excavate pits, beds and trenches with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.
 - 2. For balled and burlapped (B&B) trees and shrubs, make excavation at least

half again as wide as the ball diameter and equal to the ball depth, plus following allowance for setting of ball on a layer of compacted backfill.

3. Allow for six-inch setting layer of planting soil mix.
4. For container grown stock, excavate as specified for balled and burlapped stock, adjusted to size of container width and depth.

D. Preparation For Planting Lawns.

1. Grade lawn areas to smooth, even surface with loose, uniformly fine texture. Roll and rake and remove ridges and fill depressions as required to meet finish grades., Limit fine grading to areas which can be planted immediately after grading.
2. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.
3. Restore lawn areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.
4. Preparation of Unchanged Grades. Where lawns are to be planted in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil for lawn planting as follows:

Till to a depth of not less than six inches, apply soil amendments and initial fertilizers as specified; remove high areas and fill depressions; till soils to a homogeneous mixture of fine texture free of lumps, cods, stones, roots and other extraneous matter.

3.4 Planting.

A. Planting Trees and Shrubs.

1. Set B&B stock on layer of compacted planting soil mixture, plumb and in center of pit or trench with top of ball at same elevation as adjacent finished landscape grades. Remove burlap from sides of balls; retain on bottoms. When set, place additional backfill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets.
2. When excavation is approximately 2/3 full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill.
3. Set container grown stock as specified for balled and burlapped stock, except cut cans on two sides with an approved can cutter; remove bottoms or wooden bases after partial backfilling so as not to damage root balls.

4. Dish top of backfill to create a plant saucer with a four-inch lip.
 5. Mulch around all plants with a two-inch layer of shredded bark. The boundaries of the mulched areas shall be the rim of the planting saucer or in shrub beds, the edge of the planting bed.
 6. Staking and Guying. Stake and guy trees immediately after planting, as indicated by planting detail on Drawings.
 7. Prune, thin out and shape trees and shrubs in accordance with standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by the Architect, do not cut tree leaders, and remove only injured or dead branches from flowing trees, if any. Prune shrubs to retain natural character and accomplish their use in landscape design.
- B. Sodding New Lawns.
1. Lay sod within 24 hours from time of stripping. Do not plant dormant sod or if ground is frozen.
 2. Lay sod to form a solid mass with tightly-fitted joints. Butt ends and sides of sod strips; do not overlap. Stagger strips to offset joints in adjacent courses. Work from boards to avoid damage to subgrade or sod. Tamp or roll lightly to ensure contact with subgrade. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering or adjacent grass.
 3. Secure sod on slopes with wood pegs to prevent slippage. Water sod thoroughly with a fine spray immediately after planting.
- C. Seeding.
1. Seeding rate: Bluegrass Seed Mix, 6000 lbs/1000 sq.ft.
 2. Application. Seed shall be broadcast and uniformly raked to incorporate into the soil. Seeded areas shall be lightly mulched with clean straw.
 3. Watering of Seeded Areas. Immediately after seeding and mulching of bluegrass areas, the Contractor shall water the seeded areas lightly and sufficiently to a depth of two inches, but with care so that erosion takes place and no gullies are formed. Damage and erosion from over-watering shall be repaired by or paid for by the Contractor.
- D. Hydroseeding.
1. Seed. All seed shall be delivered to the site tagged and labeled in accordance with the Colorado Agricultural Code and shall be acceptable to the County Agricultural Commissioner.

Seed shall be of a quality which as a minimum pure live seed content of 70% (% purity x \$ germination), and weed seed shall not exceed 0.5% of the aggregate of pure live seed and other materials or a as standard for specific seed. The germination rate shall be 85%.

2. Fertilizer. A commercial fertilizer shall be ammonium phosphate and contain a minimum of 60 lbs. Actual available nitrogen, 50 lbs. actual available phosphoric acid and 25 lbs. actual available potash, uniform in composition, dry solvable, pelleted or granular.

All fertilizer shall be delivered in unbroken and unopened containers, labeled in accordance with applicable State regulations and bearing the warranty of the producer for grade finished.

3. Mulch. (Wood Cellulose) shall be manufactured from Aspen, Alder or Hemlock (no waste paper, dairy waste fiber, ground straw, rice hulls, etc., can be used - only "virgin wood fiber" , i.e. "Conweb or Silva Fiber".

The mulch shall be colored with a non-toxic water soluble green dye to provide a proper visual gauge for metering of material over ground surfaces. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with fertilizer, seed, water, and other approved additives, the fibers in the material will become uniformly suspended to form a homogeneous slurry;; and that when hydraulically sprayed on the ground, the material will form a blotter-like ground cover impregnated uniformly with seed; and which, after application, will allow the absorption of moisture and allow the rainfall to percolate to the underlying soil.

Cellulose shall be certified to indicate that laboratory and field testing of the product has been accomplished and that it meets all of the foregoing requirements based on testing. Weight specifications of this material from suppliers and for all application shall refer only to air dry weight of the fiber material.

Absolute air dry weight is based on the normal; standards of the *Technical Association of The Pulp and Paper Industry* for wood cellulose and is considered equivalent to 10% moisture.

4. Water. Water shall be clean, potable and added to the slurry mixture in sufficient amount to spread uniformly and required quantity of hydro-mulch solids (approximately 3000 - 4000 gallons per acre).
5. Organic Seeding Additive. use "Ecology Control M-Binder" as per manufacturer's recommendations (apply at rate of 120 lbs/acre).
6. Seeding Requirements.
 - a. Application of Seed: The Contractor shall obtain approval prior to application of the hydro-mulch seed.

- b. Seedbed Preparation: The area to be seeded shall have a firm seedbed which has been previously roughened by scarifying with the use of harrowing, cat tracks or other methods. Work to a depth of two inches to three inches. No implement shall be used that will create an excessive amount of down-movement of soil or clods on sloping areas.

Seedbed preparation shall be suspended when soil moisture conditions are not suitable for the preparation of a satisfactory seedbed. This will be determined by the Project Inspector.

- c. Fertilizing: The fertilizer shall be mixed and applied hydraulically in the form of a slurry. It shall be applied uniformly over the seedbed (i.e., 20-20-9 at 300 lbs.).
- d. Seeding: Seed shall be distributed uniformly over the seedbed. The seed shall be added to the slurry mixture just before it is to be applied hydraulically to the seedbed and it shall not remain in the seeder longer than one hour. Seed source: Mile High Seed Company, 520 South 9th Street, P.O. Box 1988, Grand Junction, CO 81502) unless otherwise approved.

Seed

Wester Wheat Grass (50% split or as Slender Wheat Grass available)	50%
Green Needle Grass	6¼%
Candy or Upland Bluegrass	3-1/8%
Hard Fescue	9-3/8%
Creeping Red Fescue	9-3/8%
Kentucky Bluegrass "Troy"	3-1/8%
Mt. Sage (10% purity with 70% germination)	6¼%
Lupine	
Globe Mallow	
Scarlet Gilia (wildflower mix may vary)	
Phlox	
Aspen Daisy	<u>6¼%</u>
	1/5 lbs. PLS/1000

Contractor shall commence seeding immediately upon completion of grading and seedbed preparation. Additional spot seeding may be needed if area is disturbed.

All seeding shall be completed by July 1 (spring seeding) or October 15 (fall seeding) or as otherwise approved.

- e. Mulching: The wood fiber mulch shall be applied uniformly with a hydraulic seeder at the rate of 2000 lbs/acre.
- f. Equipment: Hydroseeder - Hydraulic equipment used for the application of the fertilizer, seed and slurry of prepared wood pump shall be of the type as approved by the Owner. This equipment shall have a built-in agitation system and operating capacity sufficient to agitate, suspend and homogeneously mix a slurry containing up to 40 lbs. of fiber plus combined total of 70 lbs. fertilizer solids for each 100 gallons of water. The slurry distribution lines shall be large enough to prevent sloppage. This discharge line shall be equipped with a set of hydraulic spray nozzles which will provide a continuous non-fluctuating discharge and delivery of the slurry in the prescribed quantities uniformly without misses, waste or erosion. The slurry tank shall have a minimum capacity of 500 gallons and shall be mounted on a traveling unit which will place the slurry tank and spray nozzles within sufficient proximity to the areas to be seeded so as to provide uniform distribution. The Owner may authorize equipment with smaller uniform distribution. The Owner may authorize equipment with smaller tank capacity provided that the equipment has the necessary agitation system and sufficient pump capacity to spray the slurry in a uniform coat.

3.5 Maintenance.

- A. Begin maintenance immediately after planting. Maintain trees, shrubs and other plants until final acceptance but in no case less than 90 days after substantial completion of planting except as provided below for seeded areas. Maintain trees, shrubs and other plants by pruning, cultivating and weeding as required for healthy growth. Restore planting saucers. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required. Restore or replace damaged wrappings. Spray as required to keep trees and shrubs free of insect and disease.
- B. At the completion of the maintenance period, the Contractor shall:
 - a. All plants that die or are in a badly impaired condition shall be removed and replaced.
 - b. Replacement stock shall be subject to all requirements specified for the original material.

- c. Replacement stock shall be planted in accordance with the standard specifications. Maintenance requirements shall be specified below.
- d. Acceptability of the plant material furnished and planted shall be determined after all replacement plant material is planted. The Contractor shall as necessary, employ all possible means to preserve the plants in a healthy and vigorous growing condition to ensure their successful establishment.

3.6 Clean-Up and Protection. During landscape work, keep pavement clean and work areas in an orderly condition.

3.7 Inspection and Acceptance.

- A. When landscape work is completed, including maintenance, Engineer will, upon request, make an inspection to determine acceptability. Landscape work may be inspected for acceptance in parts agreeable to Engineer, provided work offered for inspection is complete, including maintenance.
- B. Where inspected landscape work does not comply with requirements, replace rejected work and continue specified maintenance until re-inspected by Engineer and found to be acceptable. Remove all rejected plants and materials promptly from project site.

End of Section

**SECTION 3100
CAST-IN-PLACE CONCRETE**

1.00 GENERAL

1.01 Scope. Work to be completed under this section shall include all labor, equipment, plant and materials necessary to furnish and install all poured-in-place concrete, together with all miscellaneous and appurtenant items, as shown on the Drawings and as specified herein.

1.2 Related Work Specified Elsewhere.

Section 2110 - Excavation and Embankment
Section 2120 - Excavation and Backfill For Structures
Section 2140 - Embedment and Base Course Aggregate
Section 2520 - Concrete Curb & Gutter, Sidewalk and Curbwalk

1.3 Reference Standards. Except as modified or supplemented herein, all Work shall conform to the following standards. Refer to standards for detailed requirements.

ACI 318 - Building Code Requirement for Reinforced Concrete
ACI 301 - Specifications for Structural Concrete for Buildings
ACI 347 - Recommended Practice for Concrete Framework
ACI 305 - Recommended Practice for Hot Weather Concreting
ACI 306 - Recommended Practice for Cold Weather Concreting

Publication SP-2, ACI Manual for Concrete Inspection

ASTM A 615 - Standard Specifications for Deformed and Plain Billet
Steel Bars for Concrete Reinforcement

ASTM A 185 - Specifications for Welded Steel Fabric for Concrete
Reinforcement

1.4 Submittals.

- A. Lab Design Mix. Prior to the start of Work, Contractor to submit a statement of the proportions for the concrete mixture. Statement to include:
1. Location & identification of aggregate source.
 2. Batch quantities for one (1) cubic yard of concrete, including:
 - a. Weight of fine aggregate in a saturated surface dry condition.
 - b. Weight of coarse aggregate in a saturated surface dry condition.
 - c. Weight or number of 94 pound bags of cement.
 - d. Weight or gallons of water.
 - e. Amount and description (including manufacturer, specific product name, and number) of all admixtures.
 3. Test results on trial batch concrete made from the proposed mix design, including:

- a. Cement factor in bags per cubic yard based on yield tests.
 - b. Water-cement ratio.
 - c. Percent of entrained air.
 - d. Consistency in inches of slump.
 - e. At least three 7-day compressive strength tests.
4. Brand, type and place of manufacture of cement.
 5. Aggregate test results for grading, deleterious substances and physical properties using test procedures developed by AASHTO.
- B. Reinforcing Steel. Product data sheet and statement of manufacturer's compliance with applicable standards.

1.5 Record of the Work. Contractor to keep a record of time, date and location of each concrete pour and submit these records to the Engineer.

1.6 Notice of Intention to Pour. Contractor shall notify the Engineer at least 48 hours before an intended cast-in-place concrete pour. No structural cast-in-place concrete shall be poured until all reinforcing, forms and foundation soils have been inspected by the Engineer.

1.7 Protection of the Work. Contractor to be responsible for protection of all Work prior to acceptance. In place concrete shall not be subjected to loadings or stress prematurely.

1.8 Storage of Materials. Cement and aggregate shall be stored in such a manner as to prevent deterioration or intrusion of foreign matter. Any material which has deteriorated or which has been damaged shall not be used for concrete.

All reinforcing steel shall be stored in a dry location and protected from excessive accumulation of rust or scale.

2.1 MATERIALS

2.2 Cement. All cement shall be Portland Cement Type II conforming to "Specifications for Portland Cement" (ASTM C 150-62). Type III cement may not be used except upon written approval of the Engineer. The same brand cement for all exposed cast-in-place concrete shall be used.

2.3 Stone Aggregate. Fine and course aggregate shall conform to "Specifications for Concrete Aggregates" (ASTM C33-61T). Fine aggregates shall be clean, hard, natural and free from all foreign matter. Course aggregate shall be sound, crushed rock or gravel, free from adherent coating, organic water or injurious amounts of flat or friable pieces. The aggregate shall comply with Concrete Class BZ, Reference Specification.

2.4 Water. Water used in mixing shall be potable, cleaned and free from deleterious amounts of oil, acids, alkalis and organic material.

2.5 Admixtures. "Protex" as manufactured by Protex Industries, Inc. and conforming to Specifications of Air-Entraining Admixtures for Concrete (ASTM C260) is an approved air-entraining admixture. Other admixtures for retarding or accelerating concrete may be used in strict accordance with manufacturer's recommendations and ASTM Specifications upon approval of the Engineer.

2.6 Form Material. For unexposed concrete surfaces, forms may be undressed lumber free from excessive knots. For exposed surfaces, use wood or metal forms as required to give finish as specified.

2.7 Reinforcing Steel. Reinforcing steel shall be deformed bars conforming to "Standard Specifications for Deformed and Plain Billet Steel Bars for Concrete Reinforcement" (ASTM A615) and shall be Grade 60 for #5 bars and larger and Grade 40 or 60 for bars smaller than #5.

2.8 Welded Wire Fabric. Welded wire fabric shall conform to "Specifications for Welded Steel Fabric for Concrete Reinforcement" (ASTM A185) and shall have a minimum wire yield strength of 60,000 psi.

3.1 METHODS AND PROCEDURES

3.2 Concrete Mix.

- A. Proportions. Concrete is to be proportioned according to laboratory designed mixes using the type of aggregate specified and producing the minimum of twenty-eight (28) day ultimate compressive strength of 3,750 psi for all concrete Work. All concrete shall be made with stone aggregate unless specifically noted, and no concrete shall have a 28 day compressive strength of less than 3,750 psi.
- B. Cement and Water Content. The minimum quantity of cement used per cubic yard of concrete shall be 580 pounds. Water content shall not exceed 0.48 pounds water/pounds cement.
- C. Air Entrainment. An air-entraining agent shall be added to all stone concrete so as to entrain 5%-8% by volume. Air-entraining agents shall be in strict accordance with the recommendations of the manufacturer and the testing laboratory for the design mix to assure strength requirements are being fully met or exceeded.
- D. Mixing of Materials. The concrete shall be mixed until there is a uniform distribution of the materials and shall be discharged completely before the mixer is recharged. For job-mixed concrete, the mixer shall be rotated at the speed recommended by the manufacturer.

For stone concrete, mixing shall continue for at least one minute after all materials are in the mixer. Ready mixed concrete shall be mixed and delivered in accordance with "Standard Specifications for Ready Mixed Concrete" (ASTM C94-69).

Sufficient time shall be allowed for proper mixing on the concrete to provide uniformity throughout the batch. Long delays in concrete placement shall be avoided and any concrete which has not been placed within one (1) hour after water has been added to the mix shall be rejected. Over wet mixes shall be rejected and shall not be corrected by the addition of either aggregate or cement to the mixer. Mix not less than ten minutes in transit mix trucks after addition of the mixing water.

- E. Consistency. Slumps shall be minimum, consistent with placing requirements. Slump test shall be made in accordance with "Slump Test for Consistency of Portland Cement Concrete" (ASTM C143-58). Unless written approval is obtained from the Project Engineer or the Town, the maximum slump shall be three (3" ±1") inches. No water shall be added on site unless authorized by the project engineer.

3.3 Concrete Forms.

- A. Forms shall conform to the shape, lines, grades and dimensions of the concrete as detailed on the Drawings. All forms for exposed finished surfaces shall be built with the material needed to produce the form, texture and design specified in Concrete Finishes of this section.
- B. Design of Forms. Forms shall be sufficiently tight to prevent leakage of mortar and shall be properly braced or tied together so as to maintain the desired position. The form work shall be designed for the loads outlined in Part 3, Section 102 of "Recommended Practice for Concrete Form Work" (ACI 347-78). The forms shall be oiled for ease of removal of forms after setting of concrete.
- C. Form Ties and Incidentals. Form ties shall be bolts and rods (adjustable for tightening) arranged so that no metal is within 3'4" of surface after removal of forms. Ordinary wire ties will be allowed with the specific approval of the Engineer. No ties through exposed concrete will be allowed. Set forms for all required anchors, bolt inserts, slots, sleeves, supports, etc., furnished under portions of this Specification and installed under this section.
- D. Removal of Forms. Forms shall not be disturbed until concrete has hardened sufficiently to permit their removal with safety. The removal of the forms shall be carried out in such a manner as to insure the safety of the structure. Unless otherwise permitted by the Engineer, forms shall not be removed until 24 hours after pouring.

3.4 Construction and Expansion Joints. Expansion and control joints shall be constructed in accordance with plan details. Unless otherwise indicated on the Drawings, install one inch (1") thick asphalt impregnated fiberboard expansion joint filler (ASTM D1752) wherever concrete slabs abut buildings or footings or as shown on the plan details. All expansion joint filler shall extend the full depth of the slab.

3.5 Concrete Placement.

- A. Preparation for Placing. Before placing concrete, all equipment for mixing and transporting concrete shall be cleaned and all debris and ice shall be removed from places to be occupied by concrete. Forms shall be properly treated and all reinforcement cleaned of ice and other coatings. Water shall be removed from place of deposit before concrete is placed.
- B. Conveying. Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent the separation or loss of the materials. Equipment for chuting, pumping, or pneumatically conveying concrete shall be of such size and design as to insure a practically continuous flow of concrete at the delivery and without separation of the materials.
- C. Other Trades. Install by way of example, anchor bolts, reinforcing steel, pipe and conduit openings and sleeves, bearing plates, and knockouts as provided by other trades and as required by other trades. Provide minimum 7 days notice to Engineer, Owner, or other trades prior to requiring materials or detailing information. Installation to meet location, dimension and alignment requirements of other trades.

- D. Depositing. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. The concreting shall be carried on at such a rate that the concrete is at all times plastic and flows readily into the space between the bars. No concrete that has been partially hardened or been contaminated by foreign matter shall be deposited on the Work, nor shall re-tempered concrete be used. When concreting is once started, it shall be carried on as a continuous operation until the placing of the panel or section is completed. Place concrete in approximately horizontal layers avoiding displacement of reinforcement above fresh concrete and formation of seams and planes of weakness in sections. When construction joints are necessary, they shall be located as specified in this section under Construction Joints. For bonding fresh concrete, roughen and clean exposed surface and brush with neat cement grout. Place new concrete before grout takes initial set.
- E. Compaction. Place concrete in layers not over 24" deep; compact each layer by mechanical internal vibrating equipment supplemented by hand spading, rodding, tamping, as directed. Vibrators shall not be used to transport concrete inside forms. Limit vibration duration to the time necessary to produce satisfactory consolidation without causing objectionable segregation. Do not insert vibrator into lower courses that have begun to set.
- F. Weather Conditions. Unless adequate protection is provided and the Engineer's approval is obtained, concrete shall not be placed during rain, sleet, or snow. When the mean temperature falls below 40°F for 3 successive days, concreting shall conform to "Recommended Practice for Cold Weather Conditions: (ACI 306 R-78). Concrete placed in hot weather shall meet the standards of "Recommended Practice for Hot Weather Concreting (ACI 305R-77). Concrete is not to be placed under water. A suitable means shall be provided for lowering the water level below surfaces upon which concrete is to be placed. This may require excavating approximately 12 inches below the bottom of the concrete surface and refilling with gravel and compacting. The groundwater shall not be allowed to rise to the bottom of the concrete until 24 hours after the concrete has been completed. Water shall not be allowed to fall upon or run across the concrete during this period.
- G. Protection and Curing. Concrete protection and curing shall be in conformance with ACI 308-71. Immediately after placing or finishing, concrete surfaces not covered by forms shall be protected from loss of surface moisture. All concrete shall be kept in a moist condition for at least five (5) days after placement. Curing compounds may be used upon approval of the Engineer.

3.6 Slabs on Grade. All slabs on grade shall be poured directly on the vapor barrier and prepared gravel subgrade where shown on the Drawings. Construction joints shall be placed such that no section of slab is greater than 25 feet on a side. Finishes, Expansion & Control Joints & Protection shall be as specified under other sections of this section.

Minimum six inch (6") Class 6 aggregate base course shall be installed under the entire slab unless otherwise directed by the Engineer. The grading requirements as per Section 2140 for the aggregate course shall apply.

3.7 Concrete Finishes.

- A. Patching. Patching shall be done on all concrete surfaces immediately after stripping forms; all exposed surfaces shall have fins and other projections carefully removed, offsets leveled, and voids saturated with water and patched to a true and even surface with a wood float. Patch all holes left by the removal of the form ties or bolts. Patching material shall be a stiff mixture of sand and cement, the color of which matches the concrete being patched. Any major area of faulty or honey-combed concrete shall be completely removed and patched at the direction of the Engineer.
- B. Floor slabs. All concrete slabs shall be screened to levels or grades indicated and float finished monolithically completely free from humps or pits. Slabs shall not show surface deviation in excess of one quarter inch ($\frac{1}{4}$ ") when tested with a 10 ft. straight-edge. Before the finish has set, the surface cement film shall be removed with a fine brush in order to have a fine-grained, smooth but sanded texture.
- C. Rubbed finish. All exposed concrete surfaces shall have a rubbed finish. After removal of forms, rubbing of all exterior surfaces shall be started as soon as its condition will permit. Immediately before starting this Work, the concrete shall be kept thoroughly saturated with water. Sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing to thoroughly set. Surfaces to be finished shall be rubbed with a medium course carborundum stone, using a small amount of mortar on its face. The mortar shall be composed of cement and fine sand mixed in the same proportions as the concrete being finished. Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids filled and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place.

After all concrete above the surface being treated has been cast, the final finish shall be obtained by rubbing with a fine carborundum stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform color.

After the final rubbing is completed and the surface has dried, it shall be rubbed with burlap to remove loose powder and objectionable marks.

- D. Chamfer. All exterior corners shall receive $\frac{3}{4}$ " chamfer.

3.8 Reinforcing.

- A. Placing Reinforcement. Reinforcing steel, at the time concrete is placed, shall be free from scale, rust or other coatings that will destroy or reduce bond. Reinforcement shall be accurately placed as shown on the Drawings and shall be adequately secured in position by concrete or metal chairs and spacers.

Reinforcing shall be furnished in the full lengths indicated on the Drawings unless otherwise authorized by the Engineer. Splicing of bars, except where shown on the Drawings or specified, shall not be permitted without written approval by the Engineer. Reinforcement placed in any member shall be inspected before any concrete is placed and the Engineer shall be notified 24 hours in advance before any concrete placement.

The placing, fastening, splicing and supporting of reinforcing steel and welded wire fabric shall be in accordance with the Drawings and the latest edition of the CRSI

"Recommended Practice for Placing Reinforcing Bars" and in accordance with ACI 318-77. Bars shall be placed around all corners to splice steel in adjacent walls, footers and slabs (such detailing may not be shown on Drawings).

- B. Concrete Protection & Reinforcement. Where not otherwise indicated on the Drawings, the minimum thickness of concrete over the reinforcement shall be as follows:
1. Concrete deposited against earth - 3"
 2. Slabs and walls not exposed to weather or earth - 3/4"
 3. All other concrete placed in forms:

For bars larger than #5 - 2"
For bars #5 or smaller - 1½"
- C. Bearing Plates, anchor bolts, etc. Place all bearing plates, anchor bolts, reinforcing rods and other structural items furnished by other trades. Contractor to provide 7-day notice to all such trades prior to affected pour. Installation to be within tolerances required by other trades.

4.1 FIELD QUALITY CONTROL

4.2 Concrete Tests. 6" x 12" cylinders shall be taken at the point of placing in the forms, shall be job cured and tested in accordance with ASTM Standards by the Engineer. For each strength of concrete used, one set of four (4) cylinders for each day's pour, but not less than one (1) set of cylinders for each 100 cubic yards poured shall be taken. Two (2) cylinders at seven (7) days and two (2) cylinders at twenty-eight (28) days shall be tested. In addition, when in the opinion of the Engineer there is a possibility of the surrounding air temperature falling below 40° F, additional specimens to be cured under job conditions may be required.

4.3 Enforcement of Strength Requirements. Should the strengths shown by the test specimens fall below the specified values, the Engineer shall have the right to require changes in proportions to apply on the remainder of the Work.

If concrete fails to meet the strength requirements of this specification, the Engineer may order the Contractor to have a testing laboratory, acceptable to the Engineer, take and test core samples of questionable concrete. The Engineer may order all low-strength concrete removed and replaced if core strengths are below specified strengths. All costs connected with concrete coring and removal and replacement of low-strength concrete shall be borne by the Contractor.

Contractor shall repair all core holes at his expense.

4.4 Slump Tests. Project Engineer to conduct slump tests on each day's pour and on individual trucks whenever concrete consistency varies. Test failure shall be grounds for rejection of individual or batch loads.

4.5 Air Content. The Project Engineer to conduct air tests on each day's pour and on individual trucks as determined by the Town. Test failure shall be grounds for rejection of entire batch until satisfactory tests are obtained.

End of Section

SECTION 3200

MASONRY

1.1 GENERAL

1.2 Scope. Work to be completed under this section shall include all labor, equipment, plant, and materials necessary to furnish and install all masonry units, together with all miscellaneous and appurtenant items required for installation and/or furnished by other trades, as shown on the Plans and as specified herein.

1.3 Related Work in this Manual.

Section 3100 - Cast-In-Place Concrete

1.4 Related Work Specified Elsewhere.

Section 05100 - Structural Metal Framing

Section 05500 - Metal Fabrications

Section 10100 - Toilet Accessories

Section 15050 - Plumbing

Section 16000 - Electrical

1.5 Reference Standards.

ASTM C476 - Standard Specification for Mortar and Grout for Reinforced Masonry

ASTM C404 - Standard Specification for Aggregates for Masonry Grout

ASTM C144 - Standard Specification for Aggregates for Masonry Mortar

ASTM C55 - Standard Specification for Concrete Building Brick

International Masonry Industry, All-weather Council, "Recommended Practices and Guide Specification for Cold Weather Masonry Construction".

1.6 Submittals. Descriptive literature and catalogue cuts on masonry units, reinforcing steel and insulation.

1.7 Protection of Work. Contractor responsible for protection of all work prior to acceptance. Exposed insulation or cells shall be covered to prevent moisture or dirt intrusion.

1.8 Storage of Materials. Materials shall be stored in a dry place and in a manner to prevent damage or intrusion of foreign matter. During freezing weather, all masonry units shall be protected with tarpaulin or other suitable material. Concrete masonry units shall be stored under covers that will permit circulation of air and prevent excessive moisture absorption. Cement, lime and air-settling mortars shall be stored in watertight sheds with elevated floors. Reinforcement shall be protected from the elements; immediately before placing, reinforcement shall be free from loose rust, ice or other foreign coatings that will destroy or reduce the bond. Concrete masonry units shall be protected against wetting prior to use. Deliver packaged material in original manufacturer's containers. Materials showing evidence of water or other damage are subject to rejection.

2.1 MATERIALS

2.2 Concrete Masonry Units (CMU's). Units shall conform to ASTM C90 specifications. All units shall be Type I. Units below grade or exposed to weather shall be Grade N. Other units may be Grade S. Crushing strength, $f'm = 1350$ psi.

Units shall be in modular sizes with standard 8" width or 4" width as required. Corner units shall have square external corners. Jamb units at windows, bond beam units and other special units shall match the approved samples for the type of construction and locations designated. Units shall not contain iron spots or other substances that will strain plaster or paint.

2.3 Joint Reinforcement. Steel reinforcement for use in horizontal bed joints of concrete masonry units and other locations as hereinafter specified shall be prefabricated truss design type formed of zinc-coated cold drawn steel wire conforming to ASTM A82 and A116 of Class 3 coating. Side wire shall be formed of 9 gauge rod; cross rods shall be of 9 gauge, smooth or deformed wire, butt welded to side wires in the same plan at contact points. Special formed pieces shall be provided at corners and wall intersections. Reinforcing shall be of proper widths for the wall thicknesses shown. Reinforcing shall be Standard Type Fur-O-Wall, Rewal or approved equal. Unless otherwise noted on the plans, reinforcement in masonry walls shall be installed in the first and second bed joints above lintels, below sill at openings and below bond beams around the entire top of the perimeter walls of the building. Elsewhere, reinforcing shall be installed in bed joints at 16" vertical intervals. Side rods shall be lapped horizontally a minimum of 6". Joint reinforcement embedded in horizontal mortar joints shall have not less than 5/8" mortar coverage from the exposed face.

2.4 Reinforcing Steel. See Section 3100, Part 2.07.

2.5 Mortar and Grout. Shall conform to the property requirements of ASTM C476. Proportion mix to meet strength and other requirements.

2.6 Portland Cement. See Section 3100, Part 2.01.

2.7 Loose Fill Insulation. Zonolite, Permalite or approved equal water repellent masonry fill insulation.

2.8 Masonry Cement. Cement shall conform to ASTM Specification C91. Cement shall be gray.

2.9 Lime. Hydrated lime shall be Type S conforming to ASTM Specification C207. Quicklime shall conform to ASTM Specification C5; it shall be slaked in accordance with the manufacturer's directions.

2.10 Lime Putty. Putty shall be a stiff mixture of lime and water. Keep putty moist until used. Putty made from quicklime shall be slaked and allowed to soak at least 24 hours before using. Putty made from Type S hydrated lime may be used immediately after mixing.

2.11 Sand. Sand shall conform to ASTM Specification C144 except that sand for mortar in 1/4 inch wide joints shall pass a No. 16 sieve.

2.12 Mixing Water. Water shall be clean and potable.

2.13 Coarse Aggregate for Masonry Grout. Aggregate shall conform to ASTM Specification C404.

3.1 METHODS AND PROCEDURES

3.2 Mixing Mortar. Mix all cementitious materials and sand in a mechanical batch mixer for a minimum of 5 minutes. Adjust the consistency of the mortar to the satisfaction of the mason, but add only as much water as is compatible with convenience in using the mortar. If the mortar begins to stiffen from evaporation or from absorption of a part of the mixing water, re-temper the mortar immediately by adding water and remix the mortar. All mortar shall be used within 2 1/2 hours of the initial mixing. It shall not be used after it has begun to set.

3.3 Other Trades. Other trades shall be consulted and provisions made such that the installation of their work is permitted in a manner to avoid butting and patching. Install, by way of example, anchor bolts, bearing plates, pipe and conduit openings and sleeves, HVAC openings and other knockouts required by other trades. Provide minimum 7-day notice to Owner, Engineer and other trades prior to requiring materials or detailing information. Build in work specified under other sections, as necessary and as the work progresses in accordance with requirements or other trades. Masonry contractor not responsible for installation of materials running within walls such as concealed conduit and piping.

3.4 Laying Masonry Units. All units shall be set plumb and true to line. All units shall be laid with level horizontal joints. Units shall be laid in "running bond" unless otherwise shown.

All interior masonry partitions unless otherwise shown shall terminate 1/2 inch from structural ceilings and a 1/2-inch thick by 8-inch wide expansion joint material installed thereon.

Where electric conduit, outlet and switch boxes occur, units shall be ground and cut before building-in-service. Work shall be coordinated with electrical subcontractor. Cutting of all units exposed in finished work shall be done with an approved type of power saw. Work must also be coordinated with plumbing subcontractor where plumbing occurs in masonry partitions.

Masonry units shall be reinforced horizontally with continuous joint reinforcement placed not to exceed 16" on center vertically in exterior walls and in non-load bearing partitions.

Bond each course at corners in a masonry bond and at intersections with metal ties, anchors or joint reinforcement spaced as above.

Partitions of all units that abut exterior walls, columns and other partitions shall be bonded in or be anchored thereto once every 16 inches in height. Where anchors are used they shall be 1/8 x 1 1/4-inch zinc coated steel anchors with ends turned up 2 inches and extending 4 inches into wall and not less than 8 inches onto partitions; or anchors may be of type to fit the slots in concrete.

Interior joints of all masonry construction shall be "flush". Exterior joints of all masonry construction shall be "concave".

3.5 Special Requirements. Masonry shall not be laid when the temperature of the outside air is below 40°F., unless suitable means as approved by the Engineer are provided to heat materials, protect work from cold and frost and ensure that mortar will harden without freezing. (No anti-freeze ingredient shall be used in the mortar).

The facing material shall be protected against staining and tops of walls kept covered with non-staining waterproof coverings when work is not in progress. When work is resumed, top surface of work shall be cleaned of all loose mortar and in drying weather thoroughly wet except for concrete masonry units.

Where fresh masonry joins masonry that is partially set or totally set, clean the exposed surface of the set masonry and wet it lightly so as to obtain the best possible bond with the new work. Remove all loose brick and mortar. If it is necessary to "stop off" a horizontal run of masonry, this shall be permitted only with the Engineer's approval. (Toothing will not be permitted).

All reinforced hollow unit masonry shall be built to preserve the unobstructed vertical continuity of the cells to be filled. Walls and webs forming such cells to be filled shall be full bedded in mortar to prevent leakage of grout. All head (or end) joints shall be solidly filled with mortar for a distance of the longitudinal face shells. Bond shall be provided by lapping units in successive vertical courses or by equivalent mechanical anchorage.

Vertical cells to be filled shall have vertical alignment sufficient to maintain a clear, unobstructed continuous vertical cell measuring not less than 2 inches by 3 inches.

All cells containing reinforcement shall be filled solidly with grout. Grout shall be poured in lifts of 8 feet maximum height. All grout shall be consolidated at time of pouring by puddling or vibrating and then reconsolidated by again puddling later, before plasticity is lost.

When total grout pour exceeds 8 feet in height, the grout shall be placed in 4 foot lifts and special inspection during grout shall be required. Minimum cell dimension shall be 3 inches.

When the grouting is stopped for one hour or longer, horizontal construction joints shall be formed by stopping the pour of grout 1½ inches below the top of the uppermost unit.

Steel in lintels shall be set in beds of mortar. Spaces around jambs and heads of metal door bucks and frames shall be filled solidly with mortar.

Bond beams or concrete caps along the top of the walls shall be provided with the necessary and required bearing plates, anchor bolts, expansion joint filler, etc. and welds and connections of the pre-cast concrete components to the walls shall be made by the contractor under this section.

3.6 Insulation. Loose fill insulation shall be poured directly from the bag. block joints at columns or other vertical members shall be mortared in to prevent leakage. All block throughout the entire job is to be filled except interior partitions.

4.1 FIELD QUALITY CONTROL

4.2 General. All mortar smears and mortar chucks shall be cleaned from all exposed surfaces or surfaces to receive paint. Point all joints as directed by Engineer removing joint material sufficient to allow uniform joint after repair. Receive approval of finished wall.

End of Section

SECTION 4100

WIRE FENCING

1.1 GENERAL

1.2 Scope. Work to be completed under this Section shall include all labor, equipment, plant and materials necessary to furnish and install all wire fencing with access gate, together with all miscellaneous and appurtenant items, as shown on the Drawings and as specified herein.

1.3 Related Work Specified Elsewhere.

Section 2110 - Excavation and Embankment Section
2120 - Excavation and Backfill for Structures Section
3100 - Cast-in-Place Concrete

1.4 Reference Standards.

Colorado State Department of Highways Standard Specifications for Road and Bridge Construction and M-Standards.

1.5 Submittals. Catalog cuts on materials and dimensional data.

2.1 MATERIALS

2.2 Barbed Wire. Conform to Section 710.01

2.3 Fence Posts. Steel conforming to Section 710.07

2.4 Gate. Galvanized panel gate conforming to M-607=A

2.5 Concrete. Minimum 2500 psi.

3.1 METHODS AND PROCEDURES

3.2 Installation. Conform to M-607-A and applicable portions of Section 607

4.00 QUALITY CONTROL

4.01. General. All posts shall be plumb and in straight line. Gate shall be set plumb and shall operate freely. Wire to be taut throughout.

End of Section

**SECTION 4200
UNDERGROUND SPRINKLER SYSTEM**

GENERAL

1.1 Scope. Work to be performed under this section shall include all labor, materials, and equipment required to complete underground sprinkler system.

1.2 Related Work Specified Elsewhere.

Section 2730 - Revegetation - Seeding, Sodding & Hydroseeding

Section 2740 - Trees, Plants and Ground Cover

1.3 Quality Assurance. Installer shall have satisfactorily installed acceptable underground sprinkler systems on at least three other comparable projects.

1.4 Submittals.

A. Shop Drawings

B. Design: Any deviations in layout (equipment usage or trenching) from the proposed sprinkler design must be approved by the Engineer prior to construction. Submit three (3) copies of any design deviation for approval by Engineer before commencing any Work. Design shall be based on head, valve, and piping locations provided as shown. Sleeving to accommodate sprinkler pipe shall be installed prior to paving operation as set forth herein and as indicated on the Drawings. Zones and stationing shall conform to those indicated on the Drawings. Contractor shall determine water pressure at supply line for system pressure availability. Minimum water coverage for planted area shall be 85%.

C. Operation and Maintenance Date: Submit written operating instruction including winterization procedures. Submit a controller programming schedule indicating length of time each zone is to be operated. Coordinate controller/ watering operations with Owner's maintenance personnel.

D. Maintenance Materials: In addition to installed systems, provide Owner with:

- i) Two sprinkler heads of each size and type.
- ii) Two valve keys for operating manual valves (two drain valve keys two gate valve keys).
- iii. Two keys for each type of valve cover.
- iv. Two wrenches for removing and installing each type of head.

1.5 Delivery, Storage and Handling. Prevent damage to system components during loading, transporting and unloading. Deliver all components in original containers and store in a clean, dry location.

1.6 Warranty. Warrant irrigation system for a period of one (1) year after completion and acceptance of all work against material defects and craftsmanship. The warranty shall be for 100% of the installed price. This warranty does not cover any defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents which are beyond the irrigation system installer's control.

1.7 Record Drawings. A contract set of drawings for all phases of the work shall be maintained at the site, with all changes or deviations from the original drawings marked thereon in contrasting color. This shall be a separate set of drawings, not used for construction purposes, which will be kept up to date as the job progresses and be made available to the Engineer for inspection at all times. the sprinkler contractor shall revise his drawings to indicate all changes made during installation. Upon completion of the work, three sets of revised prints shall be delivered to the Owner.

2.1 MATERIALS

2.2 Pipe and Pipe Fittings.

- A. Pressure Pipe: PVC Class 200 for all pressure pipe.
- B. Conduit Pipe (downstream from circuit valves): Conform to Commercial Standard 80 NSF Polyethylene Pipe.
- C. Pipe Fittings: For PVC plastic pipe, ASTM D2466 socket fittings with ASTM A 2564 solvent cement.
- D. Sleeving: Class 160 PVC with primed and solvent (gray blue) welded joints.

2.3 Valves and Valve Boxes.

- A. Valves: Electric automatic valves.
- B. Strainers: Y strainers on each valve.
- C. Backflow Preventor: Provide anti-siphon device to meet local code.
- D. Valve Box: Plastic
- E. Valve Cover and Frame: Plastic with provision for locking.

2.4 Sprinkler Heads. Manufacturer's standard unit designed to provide uniform coverage over entire area of spray shown on drawings at available water pressure, as follows:

- A. Pop-up Spray (PUSp): Fixed pattern with screw-type flow adjustment.
- B. Flush Surface (FLSrf): Fixed pattern with screw-type flow adjustment.
- C. Shrubbery (Shub): Fixed pattern with screw-type flow adjustment.

2.5 Drainage Backfill. Cleaned gravel or crushed stone, graded from 3" maximum to 3/4" minimum.

- A. General: Furnish a low voltage system manufactured expressly for control of automatic circuit valves of landscape irrigation systems. Provide unit capacity to suit number of circuits as indicated. Wall-mount station controller.

- B. Transformer: To convert building service voltage to control voltage of 24 volts.
- C. Circuit Control: Each circuit variable from approximately 5 to 60 minutes. Include switch for manual or automatic operation of each circuit.
- D. Timing Device: Adjustable, 24 hour and 7 to 14 day, clocks to operate any time of day and skip any day in a 7 day or 14 day period. Allow for manual or semi-automatic operation without disturbing present automatic operation.
- E. Wire: Size must meet local codes and be in accordance with manufacturer's recommendations.

3.1 METHODS AND PROCEDURES

3.2 Inspection. Installer must examine the areas and conditions under which landscape irrigation system is to be installed and notify the General Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

3.3 Trenching and Backfill.

- A. Excavation: All pipe lines shall be installed in open cut trenches (machine trenched where accessible, otherwise manually excavated). The width of the trench in the pipe will be placed shall be sufficient to allow thorough tamping of suitable backfill material under and over the pipe. Boring will be permitted only where the pipe must pass under an existing obstruction which cannot be removed. In backfilling the bore, the final density of the backfill must match that of the surrounding soil. All other under pavement pipe laying shall be installed in sleeving material prior to placement of flatwork or other obstructions. Any trench deeper than 6' shall be adequately shored and/or braced for safety considerations. Trenches shall be dug to depths outlined under pipe and wire depth and shall be compacted by tamping to a minimum density of 95% Standard Proctor. No after-settling shall occur when finish grade has been re-established. (Verify established finished grades in planter areas before proceeding with the pipe installation).

The Contractor shall be responsible for investigating the type of soil and conditions in which these lines are to be installed and shall allow for same in his proposal. No extra will be allowed due to difficulty in trenching.

- B. Backfilling: Puddling or jetting compaction will not be allowed. Hand or machine tamp trenches are required for compaction.

Excavated trenching material will generally be considered satisfactory for backfill purposes. All backfill material shall be free from rubbish, vegetative matter, frozen materials, or stones larger than 2" in maximum dimension. Any material not suitable for backfill shall be hauled away.

Backfill shall not be done in freezing weather except with written approval from the Engineer.

C. Pipe and Wiring Depth:

1. Mainline Pressure Piping: 36" from top of pipe.
2. Lateral Lines: 15" from top of pipe.
3. Control Wiring: 36" from finish grade along mainline pipe.

3.4 Installation.

- A. General: Unless otherwise indicated, comply with requirements of the Uniform Plumbing Code.
- B. Backflow Preventor: Provide unions on upstream or downstream sides. Install minimum 6" above highest ground level sprinkler head.
- C. Circuit Valves: Install in valve box, arranged for easy adjustment and removal. Provide union on downstream side.

Adjust automatic control valves to provide flow rate of rated operating pressure required for each sprinkler circuit.

- D. Piping: Lay pipe on solid subbase, uniformly sloped without humps or depressions.

For circuit piping, slope to drain valve at least 1/2" in 10' of run.

Install PVC pipe in dry weather when temperature is above 40°F in strict accordance with manufacturer's instructions. Allow joints to cure at least 24 hours at temperatures above 40 degrees F before testing, unless otherwise recommended by manufacturer.

- E. Drain Pockets: Excavate to size indicated. Backfill with acceptable drain material to 12" below grade. Cover drain material with a sheet of 30 lb. asphalt saturated felt and backfill remainder with excavated material.

- F. Sprinkler Heads: Flush circuit lines with full head of water and install heads after hydrostatic test is completed.

Install lawn heads at manufacturer's recommended heights.

Install shrubbery heads at heights indicated.

Locate part-circle heads to maintain a minimum distance of 4" from walls and 2" from other boundaries, unless otherwise indicated.

- G. Sleeves Under Pavement: Install 3" PVC for sleeving under all paved areas in which the irrigation system crosses.

4.1 QUALITY CONTROL

- A. General: Notify Owner in writing when testing will be conducted. Conduct test in the presence of Owner.

B. Hydrostatic Test: Test water piping and valves, before backfilling trenches, to a hydrostatic pressure of not less than 100 psi for 3 hours, unless otherwise indicated. Piping may be tested in sections to expedite the work. Remove and repair piping, connections, valves which do not pass the hydrostatic testing.

C. Operational Testing: Perform operational testing after hydrostatic testing.

Demonstrate to the Owner that the system meets coverage requirements and that automatic controls function properly.

Coverage requirements are based on operations of one circuit at a time.

End of Section

SECTION 4300

FOUNTAIN

1.1 GENERAL

1.2 Scope. Work to be performed under this section shall include all labor, equipment, materials and miscellaneous items necessary to install all working components of the fountain.

1.3 Related Work Specified Elsewhere in this Manual.

Section 3100 - Cast-in-Place Concrete.

Section 2130 - Trenching, Backfilling and Compaction

1.4 Related Work Specified Elsewhere.

Section 16000 - Electrical

Section 15050 - Plumbing

1.5 Delivery, Storage and Handling. Deliver all material to be used in original, unopened packages. Do not open packages except as required for inspection for shipping damages. Store in areas least subject to traffic or falling objects. Keep material away from and free of moisture.

1.6 Warranty. Warrant fountain equipment warranted by equipment manufacturer and installer per manufacturer standards for a minimum of one year.

1.7 Submittals.

A. Shop Drawings.

Submit shop drawings for the working components of the fountain.

2.1 MATERIALS

2.2 Provide the following components.

- A. Pump - Centrifugal pump - Gould 3 H.P. Model #3756 or approved equal.
- B. Control Panel - Furnace NEMA 3 Model #87 DF 36 ADDA with magnetic starter or approved equal.
- C. Ball Valves - Three 1½" and one 2" ball valves.
- D. Pressure Gauge - 2½", 0-150 psi pressure gauge.
- E. Foot Valve - 4" valve, Simmons.
- F. Sensor Float - Sensor float, Electrol Systems, Model #WADB normally closed or approved equal.
- G. Float Valve - 3/4" float valve.

- H. Curb Stop - 3/4" curb stop.
- I. Overflow Drain - Overflow drain, Kim Model #R15 or approved equal.
- J. Nozzles - Three (3) geyser nozzles, Kim Model #N152.
- K. Fountain Lights - Three (3) free-standing fountain lights, Kim Model #F220/RG - Lamp R/FL clear.
- L. Submersible Junction Box - Junction Box, Kim Model #JP7 or approved equal.
- M. Piping - Schedule 40 galvanized pipe unless otherwise noted.
- N. Metal Grate - Neenah R4991-G Type A.

3.1 Execution.

3.2 Placing Fittings. Prior to commencing with concrete work, Contractor shall provide and install all pipe and fittings as shown on Drawings. Secure as necessary.

3.3 Sleeving. All pipe passing through or under concrete shall be sleeved in PVC. Pack as necessary.

3.4 Working Components. Contractor shall provide and install all working components of the fountain as shown on Drawings. Install as per manufacturer's recommendations.

3.5 Electrical Service. Provide electrical service to pump vault room as required. Perform all grounding required, including GFI protection system, in accordance with state and local codes.

3.6 Demonstration. Contractor shall demonstrate flow rate of the fountain to the Architect. Adjust as necessary.

End of Section

SECTION 4400 LIGHTING

1.1 GENERAL

1.2 Scope. Provide lighting in accordance with the Contract Documents.

1.3 Submittals.

A. Shop Drawings: Provide shop drawings as specified of the following items:

1. Each lighting fixture.
2. All poles.

2.1 PRODUCTS

2.2 Exterior Lighting Fixtures.

A. General

1. The Contractor shall provide a complete lighting system using the luminaries detailed in the plans or approved substitutes. Luminaries shall bear the UL label. All metal parts shall be continuously grounded. At the time of final inspection, the lighting system shall be clean and in "first-class" condition. Repair or replace damaged luminaries at the Architect's discretion.
2. Exterior lighting fixtures, raceways, equipment, etc. shall be weatherproof and suitable for temperatures down to -20°F.

B. Luminaire (Type "A1")

1. General: The luminaire shall consist of three basic elements; enclosure, ballast/support assembly and refractor assembly. The elements shall be designed for expedient field assembly and maintenance with common tools and shall be individually and securely packaged such that they are resistant to rough handling in transit.
2. Prismatic Refractor: The refractor shall consist of one piece of Borosilicate glass so as to provide lamp obscuration, and precise control of cutoff and light distribution (see photometric specification for details). The total assembly shall be assembled and held in position by means of a fabricated coated steel support assembly. The refractor assembly shall attach to the ballast/support assembly by means of a fitter base.
3. Enclosure: The enclosure shall be 14" seamless, smoked UV stabilized, polycarbonate cube with a minimum wall thickness of 0.100 to 0.125" uniform. The enclosure shall be designed so that it can be securely attached to the ballast/support assembly.
4. Optical Assembly: The optical system shall consist of the refractor assembly described above. In addition to servicing the light control function, the

refractor itself shall serve as an intrinsic visual element of the luminaire design.

5. Ballast/Support Assembly: The ballast/support assembly shall consist of a cast aluminum support bowl and neck welded to a cast aluminum slipfitter designed to accommodate either a 2-3/8" O.D. or 3" O.D. x 4" high pole tenon. Recessed allen head set screws, oriented 120° apart, shall be included to securely fasten the assembly to the pole tenon. The cast aluminum slipfitter shall have a 4" O.D. and shall be designed for aesthetically clean integration with a 4" O.D. pole.

The support bowl shall contain a cast aluminum clamping ring working in conjunction with a gasketed supporting surface within the bowl to provide a secure, weatherproof, bug-resistant seal when assembled to the enclosure. The clamping mechanism shall be operated by means of recessed allen head screws located at 180° extending through the support bowl into the clamping ring.

The support bowl shall also contain the ballast and socket. The ballasts components shall be mounted within the support bowl and shall be concealed by means of a two-piece fabricated aluminum housing, painted a natural aluminum color for appearance. The lamp socket shall be affixed to the assembly.

6. Photometric Performance: The lighting system when installed shall meet the requirements specified herein. Individual luminaries comprising the system shall perform in accordance with the candlepower table referenced below. Also, the individual luminaries are to specifically meet the following critical performance criteria.

<u>Angle</u>	<u>Candlepower</u>	<u>Angle</u>	<u>Candlepower</u>
0°	209	50°	200
5°	191	55°	238
10°	200	60°	298
15°	191	65°	334
20°	155	70°	343
25°	128	75°	325
30°	113	80°	277
35°	113	85°	218
40°	131	90°	140
45°	167	85°	218
50°	200		
55°	238	90°	140
60°	298		

7. Electrical: The luminaire shall be UL listed and carry a label suitable for outdoor wet locations.

The luminaire ballast support assembly shall be prewired with three Type SFF-2 silicon insulated stranded wires rated for 150°C. Leads shall be

brought out through the slipfitter with at least 12" extending to facilitate line connection.

8. Finish: The luminaire shall be finished with a premium, abrasion and fade-resistant, electrostatically applied, oven cured, polyester powder coating. The color of the powder coating shall be bronze. All hardware shall be stainless steel or coated for corrosion resistance.
- C. Lamps: Lamps shall be of the size and type indicated on the plans and the luminaire schedule. Lamp codes listed are ANSI.
 - D. Ballasts: High intensity discharge ballasts shall be high power factor, constant wattage autotransformer type suitable for -20°F. HPS ballasts with $\pm 5\%$ line voltage regulation shall provide lamp wattage within the ANSI C78.1354 trapezoidal limitations. Ballasts shall be manufactured by Universal or an approved equivalent (General Electric or Advance).
 - E. Poles and Standards:
 1. General: Contractor shall provide extruded aluminum poles as herein specified and as detailed on the plans.
 2. Pole: Square straight extruded aluminum poles shall be anodized in dark bronze to match the luminaire. Pole shall contain a hand hole at the base, with an accessible ground lug capable of accepting up to #4 AWG stranded wire. Pole shall be furnished complete with base, anchor bolts, template and any other hardware necessary for the interface of the pole/luminaire or pole/base. Pole shall have two single weatherproof receptacles, one at the top of the pole, the other directly above the hand hole shall be mounted flush in the pole (see plans for mounting detail).

3.1 EXECUTION

3.2 Exterior Lighting.

- A. Concrete base shall be by General Contractor. The electrical contractor shall be responsible for the coordination of conduit and anchor bolts associated with the bases. An anchor bolt template shall be furnished to the Architect within 30 days of the signing of the contract. Provide conduit in and out of the base to a point 5'0" beyond the base.
- B. The entire assembly (base, pole, brackets and luminaries) shall be designed to withstand 100 MPH winds.

End of Section