DESIGN CRITERIA & CONSTRUCTION REGULATIONS

Town of Johnstown

APRIL 2004

BY:

TST, INC. CONSULTING ENGINEERS



FORWARD

PURPOSE OF THIS MANUAL

The Town of Johnstown has prepared this manual to provide guidance to engineers and contractors for the acceptable design and installation of principle public infrastructure. The criteria and standards included in this manual shall be considered minimum requirements for infrastructure improvements. The Town reserves the right to require more stringent criteria or standards when conditions warrant and when in the best interests of the citizens of the Town. The Town may mandate supplemental information from other generally accepted sources such as the Colorado Department of Transportation, Urban Drainage and Flood Control District, or the City of Greeley.

STATUS OF THE TOWN

Construction of public improvements or private utilities within the public right-of-way shall be defined as one of the following; 1) public improvements designed and constructed by others and dedicated to the Town, 2) private utilities or public utilities not dedicated to the Town, or 3) public improvements designed and constructed for the Town by a contractor. The first designation will be defined by a contractual relationship between the Town and the developer (refer to the Public Improvements Development Agreement). The Town shall not presume any relationship with the design engineer, other consultants, or the contractor. The developer shall be solely responsible for the performance of his consultants and contractors. The second designation will be defined by the work permit issued by the Town or by a separate agreement. The third designation will be defined by appropriate professional design services contracts and construction contracts.

<u>AUTHORITY</u>

The authority of the Town to mandate standards for the design and construction of public infrastructure is from Section ______ of the Johnstown Municipal Code. Further reference is made to the Annexation Agreement, Water and Sewer Agreement and the Public Improvements Development Agreement associated with each proposed development. Finally, these standards shall apply to any work to be performed within the public right-of-way as exercise of the police powers of the Town of Johnstown as described in the Colorado Revised Statues.

SUBMITTAL REQUIREMENT

Reference is made to the Town of Johnstown Municipal Code and the Public Improvements Development Agreement regarding the submittal of required engineering designs, technical documents, and associated development documents.

REVIEW PROCESS

The Town Engineer shall be principally responsible for the review and acceptance of technical documents submitted in support of public infrastructure improvements. Documents will be reviewed for general conformance with the criteria and standards identified in this manual. Review and acceptance of the documents shall not relieve the applicant, design engineer, or contractor of ultimate responsibility for total compliance.

CONSTRUCTION INSPECTION

The Town shall periodically inspect all public improvements work or any other work within the public right-of-way. Inspection will be performed for general conformance to the standards presented in this manual and with the drawings accepted by the Town. The contractor shall keep a copy of this manual and the approved construction plans (bearing the acceptance signature of the Town as well as the seal of the design engineer) on the site at all times.

PERMITS AND FEES

From time to time the Town may adopt ordinances regarding construction related permits. Such permits may include, but not be limited to, grading permits, street cut permits, utility connection permits, etc... Inquiry should be made with the Town regarding any pertinent permits. Permits required by County, State, or Federal agencies shall be the sole responsibility of the contractor.

PROTECTION OF THE PUBLIC AND PUBLIC INFRASTRUCTURE

The design and construction of new infrastructure and/or modification of existing infrastructure shall be performed in a manner that does not interfere with the safety, health, and welfare of the public. Adequate precautions shall be taken to safeguard the public from physical hazards and contaminations. The Town of Johnstown, by acceptance of designs or inspection of construction, shall not be responsible for any unsafe conditions. Further, the design and construction of improvements within the Town shall protect existing infrastructure from damage or interruption of service. No water valve shall be operated by anyone other than the designated Town representative. No work shall be performed within the right-of-way of any existing street without a traffic control plan accepted by the Town. No. existing street pavement or sidewalk shall be cut without the written approval of the Town.

CONSTRUCTION SITES

Work hours within the limits of the Town shall be from 7:00 AM to 5:00 PM, Monday through Friday, and 8:00 AM to 4:00 PM on Saturday except for public holidays observed by the Town of Johnstown. Weekend or holiday work shall only be allowed by prior written permission of the Town, but shall not be unreasonably disallowed. Construction sites shall be kept clear of debris and trash and a regular program of trash pickup and removal shall be implemented. Mud, soil, or other debris shall be cleared from public streets and sidewalks every day, more if mandated by the Town Inspector to alleviate dust or hazard. At all times the contractor shall keep a list of emergency phone numbers including police, fire department, ambulance, Johnstown Water and Sewer Department, and other area utility providers. Finally, the Town may allow the contractor to the existing potable water system for construction water. Any connection to the Town system or use of the Town water shall be by prior arrangement with the Water Department. Connection to the Town's water system or use of Town water without prior arrangement may result in criminal prosecution.

AS-BUILT AND RECORD DOCUMENTS

This section addresses the As-Built Drawings and Record Documents for the construction of all commercial and residential building projects as well as miscellaneous appurtenances within the Town of Johnstown.

As-Built and Record Drawings shall be maintained and kept in the contractor's field office and also kept separately from documents used for construction. The contractor shall provide file and/or racks for storage of documents as well as provide storage space for samples. Identify file documents and samples in accordance with the specification's section numbers. Maintain documents and samples in a clean, dry legible condition and in good order. Do not use As-Built and Record Drawings for construction purposes. Documents shall be made available for inspection by the Town, upon request.

When recording documents label each drawing "AS-BUILT RECORD DRAWING" in neat large printed letters. All as-built record information shall be recorded concurrently with construction progress. Backfill of work will not be allowed until all as-built information has been verified and recorded. When labeling project records mark legibly with a dark ink or pencil. Water based ink or ink that is subject to smearing shall not be allowed.

When recording drawings to show actual as-built construction include field dimensions, elevations, details, changes made by a Town approved modification, details not on the original drawings, horizontal and vertical locations of underground utilities and appurtenances referenced to a minimum of two permanent surface improvements and the depths of various elements in relation to project datum.

Submit as-built drawings to the project engineer to review and prepare final As-Built Record Drawings. When submitting final As-Built Record Drawings accompany the submittal to the Project Engineer with a transmittal letter in duplicate containing the date, project title and number, the contractors name, address, telephone number, the index containing title and number of each Record Document and the signature of the contractor or his/her authorized representative. All As-Built Record Drawings submitted to the Town for approval shall be on 24" x 36" blueline or blackline form.

Final acceptance of the utility lines will not be given until the As-Built Record Drawings have been submitted to and accepted by the Town.

The two (2) year warranty period will not begin until the Town gives initial acceptance. No certificates of occupancy will be issued for structures connecting to water and sanitary sewer until the Town gives initial acceptance of the As-Built Record Drawings. The site developer will be responsible for utility locates until the Town gives final acceptance of As-Built Record Drawings.

When project filings are approved by the Town to be completed in phases only paper copies of As-Built will be required at the completion of the phase. Mylars, disks and paper copies will be required at the end of the filing for all completed phases.

DESIGN CRITERIA & CONSTRUCTION REGULATIONS MANUAL

TABLE OF CONTENTS

PART I: STORM DRAINAGE CRITERIA & DETAILS

- SECTION 1: DRAINAGE POLICY
- SECTION 2: SUBMITTAL REQUIREMENTS
- SECTION 3: HYDROLOGY STANDARDS
- SECTION 4: INLETS
- SECTION 5: STORM SEWERS
- SECTION 6: STREETS
- SECTION 7: CULVERTS
- SECTION 8: OPEN CHANNELS
- SECTION 9: DETENTION
- SECTION 10: FLOODPLAIN ISSUES
- SECTION 11: EROSION CONTROL
- SECTION 12: CONSTRUCTION SPECIFICATIONS
- SECTION 13: STORM DRAINAGE & EROSION CONTROL DETAILS

PART II: STREET DESIGN, CONSTRUCTION STANDARDS & DETAILS

SECTION 1: STREET DESIGN AND CONSTRUCTION POLICIES

- SECTION 2: DESIGN CRITERIA
- SECTION 3: PAVEMENT DESIGN
- SECTION 4: STREET CUTS
- SECTION 5: TESTING
- SECTION 6: INSPECTION
- SECTION 7: CONSTRUCTION SPECIFICATIONS
- SECTION 8: STREET DETAILS

PART III: WATER SYSTEM DESIGN, SPECIFICATIONS & DETAILS

- SECTION 1: TOWN POLICY
- SECTION 2: DESIGN CRITERIA & HYDRAULIC ANALYSIS PARAMETERS
- SECTION 3: WATER DISTRIBUTION FACILITIES
- SECTION 4: NONPOTABLE IRRIGATION SYSTEM
- SECTION 4: WATER SYSTEM CONSTRUCTION SPECIFICATIONS
- SECTION 5: WATER DISTRIBUTION SYSTEM DETAILS

PART IV: SANITARY SEWER SYSTEM DESIGN & SPECIFICATIONS

SECTION 1: DESIGN CRITERIA FOR SANITARY SEWER SYSTEM

SECTION 2: TESTING SANITARY SEWER SEWER COLLECTION SYSTEM

SECTION 3: AS-BUILT AND RECORD DOCUMENTS

SECTION 4: MANHOLES

SECTION 5: GRAVITY SANITARY SEWER COLLECTION SYSTEM

SECTION 6: SANITARY SEWER SERVICE LINES

SECTION 7: SANITARY SEWER SYSTEM DETAILS

PART V: GENERAL SPECIFICATIONS & STANDARD DETAILS

- SECTION 1: CONSTRUCTION SPECIFICATIONS
- SECTION 2: MISCELLANEOUS DETAILS

<u>PART I</u>

STORM DRAINAGE CRITERIA

SECTION 1: DRAINAGE POLICY

1.1 Statement Of Policy	STORM-1
1.2 Town Jurisdiction	STORM-1
1.3 Design Criteria & Water Quality	STORM-2

SECTION 2: SUBMITTAL REQUIREMENTS

2.1 Preliminary Drainage Report	STORM-3
2.1.1 Description Of Site	STORM-3
2.1.2 Description Of Basin & Sub-basins	STORM-4
2.1.3 Drainage Design Criteria	STORM-4
2.1.4 Drainage Facility Design	STORM-4
2.1.5 Drainage Plan	STORM-5
2.2 Final Drainage Report	STORM-5
2.2.1 Additional Information	STORM-6
2.2.2 Final Drainage Design Requirements	STORM-6
HISTORIC AND DEVELOPED RUNOFF TABLE	STORM-7
STREET CAPACITY TABLE	STORM-7
INLET DESIGN TABLE	STORM-8
STORM SEWER/CULVERT DESIGN TABLE	STORM-8
SWALE/DITCH DESIGN TABLE	STORM-8
RIPRAP DESIGN TABLE	STORM-9
DETENTION POND TABLE	STORM-9
2.2.3 Drainage Plan	STORM-9

SECTION 3: HYDROLOGY STANDARDS

3.1 Analytical Methods	STORM-10
3.1.1 Applicability Of Methods	STORM-10
3.1.2 Engineering Judgement	STORM-11
3.2 Hydrologic Data Requirements	STORM-11
3.2.1 Rainfall Intensity	STORM-11
TIME-INTENSITY FREQUENCY CURVES	STORM-12
3.2.2 Design Storm	STORM-13
TABLE OF DESIGN STORM FREQUENCIES	STORM-13
3.2.3 Offsite Flows	STORM-13

SECTION 4: INLETS

4.1 Design	STORM-13
4.1.1 Inlet Operation: Sump & Continuous Grade Conditions	STORM-13
4.1.2 Allowable Ponding Depth In Streets	STORM-14

SECTION 5: STORM SEWERS

5.1 Design	STORM-14
5.1.1 Hydraulic Evaluation	STORM-14
5.1.2 Alignment	STORM-14
5.2 Storm Sewer Pipe	STORM-15
5.3 Storm Manholes	STORM-15

SECTION 6: STREETS

6.1 Design	STORM-15
6.1.1 Drainage At Intersections	STORM-15
6.1.2 Allowable Street Capacities	STORM-16
6.1.3 Allowable Cross Street Flow	STORM-16

SECTION 7: CULVERTS

7.1 Design	STORM-16
7.1.1 Hydraulic Analysis	STORM-16

SECTION 8: OPEN CHANNELS

8.1 Design	STORM-16
8.1.1 Unlined Channels	STORM-17
8.1.2 Lined Channels	STORM-17
8.1.3 Channel Section Criteria	STORM-17

SECTION 9: DETENTION

9.1 Storage Requirements & Release Rates	STORM-17
9.1.1 Outlet Structures	STORM-17

SECTION 10: FLOODPLAIN ISSUES

10.1 Town Jurisdiction	STORM-18
10.1.1 Storm Drainage & Floodplains	STORM-18

SECTION 11: EROSION CONTROL

11.1 Requirementsstorm	Л-18
------------------------	------

SECTION 12: CONSTRUCTION SPECIFICATIONS

SECTION 01070 – ABBREVIATIONS	STORM-19
SECTION 02271 – RIPRAP	
1.1 Description	STORM-20
1.2 Quality Assurance	STORM-20
TEST DESIGNATION REQUIREMENTS TABLE	STORM-20
2.1 Riprap Materials	STORM-20
CLASSIFICATION & GRADATION OF RIPRAP TABLE	STORM-21
GRADATION FOR BEDDING MATERIALS TABLE	STORM-22
3.1 Preparation	STORM-22
3.2 Riprap Placement	STORM-22
3.3 Thickness Tolerance	STORM-23
SECTION 02601 – MANHOLES	
1.1 Description	STORM-24
1.2 Quality Assurance	STORM-24
1.3 Product Delivery, Storage and Handling	STORM-24
1.4 Alternatives	STORM-24
2.1 Concrete	STORM-24
2.2 Pre-cast Concrete	STORM-25
2.3 Manhole Gaskets	STORM-25
2.4 Pipe Penetration Gaskets	STORM-25
2.5 Ring and Cover	STORM-25
2.6 Steps	STORM-26
3.1 Inspection	STORM-26
3.2 Mannue Size	STORM-26
3.5 Installation of Pre-cast Manhole Sections	STORM-26
3.5 Eield Quality Control	STORM-27
3.5 Field Quality Control	510RM-28
SECTION 02612 – REINFORCED CONCRETE PIPE	070 51 / 00
1.1 Description	STORM-29
1.2 Quality Assurance	STORM-29
2.1 Pipe and Eittinge	STORM-29
2.1 File and Fillings	STORM-29
3 1 Description	STORM-30
3.2 Installation	STORM-30 STORM-30
1 1 Description	STORM-31
1.2 Product Delivery Storage and Handling	
2 1 Polyethylene (PE) Storm Sewer Pipe	STORM-31
2.2 Non-Pressure Joints	STORM-31
2.3 Pressure Joints	STORM-32
2.4 Joints to Other Pipe Materials	STORM-32
3.1 Inspection	STORM-32
3.2 Installation	STORM-32

SECTION 13: STORM DRAINAGE & EROSION CONTROL DETAILS

TYPE 'R' INLET DETAIL NO. 1 TYPE 'R' INLET DETAIL NO. 2 TYPE 'R' INLET DETAIL NO. 3 TYPE 'R' INLET DETAIL NO. 4 RIPRAP DETAIL SILT FENCE DETAIL STRAW BALE DIKE GENERAL INSTALLATION INLET FILTER DETAIL TEMPORARY VEHICLE TRACKING CONTROL PAD SIDEWALK CULVERT DETAIL OUTLET STRUCTURE DETAILS STANDARD MANHOLE DETAIL FLAT TOP MANHOLE DETAIL

<u>PART I</u>

STORM DRAINAGE CRITERIA

SECTION 1: DRAINAGE POLICY

1.1 Statement Of Policy

The purpose of the Storm Drainage Report and design shall be to prevent loss or damage of property due to increased storm water runoff from proposed development. The scope of such reports and designs shall consider both property within the development and property adjacent to and downstream of the development.

Whenever possible master drainage studies should be referenced for proposed developments located within the basin boundaries of such studies. Release rates and regional drainage information from master drainage studies should be analyzed to assist in the storm drainage design for proposed developments. This information is particularly helpful in identifying drainage-related constraints for areas within the master drainage study boundaries. It will be the policy of the Town of Johnstown that sufficient data be collected to analyze drainage effects by a proposed development in the absence of a master drainage study.

Utilization of existing irrigation ditches as conveyance elements in the drainage design will not be allowed in general. Some exceptions may occur but only at the discretion of the Town and with the express written permission of the Ditch Company. In no event shall discharge of developed runoff be allowed into an irrigation ditch that would carry the runoff into another local basin. In evaluating offsite runoff that contributes to the site, the Engineer shall consider the effects of manmade structures or grading that have un-naturally modified the historic runoff path. Runoff from property that has been un-naturally diverted or retained shall be considered, ignoring the manmade obstruction.

In the case of a naturally formed sump the Engineer shall show that the sump can contain the 100yr event developed runoff from the entire contributing basin with a reasonable amount of excess capacity to account for a partially filled sump prior to the 100-yr event. Water quality and the effect of the sump on surrounding development (current or future) shall also be considered. The design must show that the sump will not create a nuisance caused by increased runoff volumes caused by development. If these conditions can not be met to the satisfaction of the Town, the Town may require that a conveyance be installed to drain the sump. In the case of a manmade impediment, the design shall eliminate the sump and convey the runoff to the nearest major basin drainageway.

1.2 Town Jurisdiction

The Johnstown Waste Water Department (JWWD) has undertaken responsibility for storm drainage within their service area. All development within the District shall, at a minimum, comply with the Storm Drainage Design Criteria published by the (JWWD). The Town of Johnstown reserves the right to require more stringent design and/or construction standards if in the best interests of the public. The criteria set forth in PART I shall apply to development in the Town of Johnstown.

The Design Criteria and Construction Standards set forth in this section are considered minimum requirements. The Town may, at its discretion, require additional information and conditions, in some cases making requirements more "strict" to best serve the interests of the public and the Town. These criteria and standards are general in nature and the Town reserves the right to alter or add to them based on site-specific issues.

1.3 Design Criteria & Water Quality

Design criteria in Part I is to provide the people of the Town of Johnstown and the general public with safe, economical and technically proficient drainage facilities.

The Engineer is to use published material by a generally accepted authoritative source such as the Urban Drainage and Flood Control District. The material used must be referenced and applicable parts copied as part of the submittal information. Rational method hydrologic analysis is acceptable in most cases. The Engineer may choose to utilize a computer generated storm water hydrology model as long as it can be demonstrated to the satisfaction of the Town that the modeling methodology is applicable to the conditions.

Approval of the final storm drainage report and construction plan will be required prior to approval of the final construction plans and recording of the final plat. The drainage system shall be designed to consider the drainage basin as a whole and shall accommodate not only runoff from the development area but also, where applicable, the system shall be designed to accommodate the runoff from those areas adjacent to and upstream from the development itself, as well as its effects on property downstream.

The design and operation of a proposed development shall ensure the following:

- A. Historic flow patterns and runoff amounts will be maintained in such a manner that will reasonably preserve the natural character of the area and prevent property damage of the type generally attributed to runoff rate and velocity increases, diversions, and/or concentration of storm runoff;
- B. The development will not impede the flow of natural watercourses;
- C. All low points within the proposed development site will have adequate facilities to intercept and convey the 100-yr event developed runoff as well as provide emergency conveyances to direct runoff to downstream facilities in the event of plugging or larger event storms;
- D. Any drainage system proposed as part of any development proposal is based on consideration of the drainage basin as a whole and is capable of accommodating not only runoff from the proposed development, but also, where applicable, the historic runoff from areas adjacent to and "upstream" from the development proposal;
- E. Provision exists in the design or operation of any proposed drainage facilities to ensure suitable provisions for maintenance. The Owner/Homeowners Association shall be responsible for maintaining all storm drainage facilities unless a written agreement is made between the Developer and the Town;

F. All development shall meet the requirements of storm water quality dictated by the Colorado Department of Health and the EPA's NPDES Permit. Appropriate erosion and sediment control devices shall be incorporated in the design and construction.

SECTION 2: SUBMITTAL REQUIREMENTS

2.1 Preliminary Drainage Report

The purpose of the preliminary drainage report is to identify and define conceptual solutions to existing problems or problems that will occur as a result of the proposed development. The preliminary drainage assessment shall be in accordance with the following outline and contain the applicable information listed. Failure to comply with the provisions of this section may result in the report being rejected for review.

2.1.1 Description Of Site

A general legal description for the proposed development shall be stated in the introduction. The general location of the proposed development with respect to adjacent public or private roads shall be described. All existing land uses adjacent to the proposed development shall be described. A general location map shall be provided in sufficient detail to depict general drainage patterns and identify drainage flows entering and leaving the proposed development. USGS maps are acceptable for this map. The map shall be at a scale of 1-inch equal's 1000 feet to 1-inch equal's 8000 feet. The map shall identify any existing improvements (i.e., development, irrigation ditches, existing detention facilities, culverts, and storm sewers) that will influence or be influenced by the proposed development.

The general description of the proposed development property shall include at a minimum:

- A. Area in acres.
- B. Township, Range, Section, ¹/₄ section
- C. Local streets, within and adjacent to the subdivision
- D. Existing and proposed ground cover (type of trees, shrubs, vegetation).
- E. General topography.
- F. General soil conditions.
- G. Irrigation ditches or laterals.
- H. Existing and proposed drainage ways.

2.1.2 Description Of Basin And Sub-basins

A. Reference any major drainage way planning study, such as master drainage basin planning studies, flood hazard delineation reports, and flood insurance studies or maps, if available.

- B. The "Storm Water Master Plan For Town Of Johnstown", completed by The Engineering Company, April 2, 2001, is a Master Drainage Plan that analyzes six existing major drainage basins surrounding the Johnstown area. This study should be referenced in submittals to the Town for developments that fall inside these Basin areas.
- C. A discussion of major basin drainage characteristics.
- D. Identification of all nearby irrigation ditches, laterals, streams, rivers, or wetlands, which will influence or be influenced by the local drainage.
- E. A discussion of the historic drainage pattern of the proposed development property.
- F. A discussion of off-site drainage flow patterns and impact on the proposed development.

2.1.3 Drainage Design Criteria

- A. Calculate peak runoff for the 2 –yr, 10-yr, and 100 yr recurrence intervals.
- B. Discuss runoff calculation method used and explain any assumptions used within the chosen method (runoff coefficients, times of concentration, curve numbers, etc...).
- C. Calculate preliminary detention facility storage requirements and release rates.

2.1.4 Drainage Facility Design

- A. A discussion of compliance with off-site runoff considerations;
- B. A discussion of anticipated and proposed drainage patterns;
- C. A discussion of the tables, charts, figures or drawings presented in the report;
- D. A presentation of existing and proposed hydrologic conditions with approximate flow rates entering and exiting the proposed development with all necessary preliminary calculations;
- E. A presentation of approach to accommodate drainage impacts on existing or proposed improvements and facilities;
- F. A presentation of proposed drainage facilities with respect to alignment, material, and structure type including preliminary detention pond sizing. Sizing inlets and conveyance elements is not required with the preliminary drainage report;
- G. A discussion of long-term maintenance and access relative to the preliminary design.
- H. All criteria, master plans, and technical information used in support of the preliminary drainage design concept shall be referenced.
- I. All calculations shall be included in organized appendixes at the end of the report. Provide separate appendixes for undeveloped/historic hydrology, developed hydrology, preliminary detention pond sizing, etc...

2.1.5 Drainage Plan

A preliminary drainage plan of the proposed development at a scale of no more than 1 inch equals 200 feet on a standard 24" x 36" sheet shall be included to better identify existing and proposed conditions on or adjacent to the proposed development. Large offsite basins may be delineated on 8 $\frac{1}{2}$ x 11 or 11x 17 sheets and included in the appropriate appendix of the report. The preliminary drainage plan shall include:

- A. Existing contours (2' contour interval minimum), streets, roads, ditches, fence lines, streams, rivers, buildings, trees, utilities, wetlands, etc...
- B. Proposed spot elevations on streets and across lots, or proposed contours.
- C. Proposed streets and lots.
- D. Existing and proposed basin delineation showing basin delineators and basin areas.
- E. Design points at which runoff shall be determined (inlets, culverts, low points, critical intersections, channel confluences, discharge points, etc...).
- F. Location and magnitude of offsite runoff entering the site.
- G. Location and magnitude of runoff leaving the site.
- H. Location of potential detention facility with approximate active volume and release rate.
- I. Approximate location of storm inlets, storm sewers, and drainage swales.
- J. Existing 100-year flood plains.

2.2 Final Drainage Report

The purpose of the final drainage report is to update the concepts and to present the design details for the drainage facilities presented in the preliminary drainage report.

The final drainage report shall be submitted with the final plat application submittal. The drainage report shall be prepared by or under the supervision of a registered professional engineer licensed in Colorado. The final report shall be properly certified and signed by such Professional Engineer. If the Final Plat is to be presented in sections, filings, or phases, a general drainage plan for the entire development shall be presented with the first section and appropriate development stages for the drainage system for each section shall be indicated. In the event that a development master plan or a preliminary drainage report for an entire development are available, the final report for any portion there of shall include the design of any necessary temporary facilities. The approved final drainage report must be able to function as a stand alone document and show that even the temporary facilities can function adequately in perpetuity.

Where a development is traversed by a water course, drainage way or stream, there shall be provided a perpetual drainage easement conforming substantially with the lines of such watercourse, and of such width as necessary and adequate to carry off the predictable volume of

storm water drainage from a one hundred (100) year frequency storm as determined by the Engineer or as determined by a basin master plan.

2.2.1 Additional Information

The final drainage report shall contain all components of the preliminary drainage report plus additional necessary information relating to design of facilities associated with the proposed development. Such additional information shall include the following:

- A. All criteria, master plans, and technical information used for report preparation and design shall be referenced;
- B. A discussion of previous drainage studies (i.e., drainage reports, project master plans) for or adjacent to the proposed development in question that influence or are influenced by the drainage design and how the previous studies will affect drainage design for the site;
- C. A discussion of the proposed drainage interception and conveyance facilities. A description of street capacity calculations, inlet design, storm sewer/culvert designs, swale/channel designs, and riprap design shall be included. The methods of evaluation and assumed design constrains shall be provided;
- D. A discussion of proposed methods to control erosion and/or contain sediments on site. The discussion should include descriptions of proposed structural methods, vegetative methods, temporary facilities, and permanent measures;
- E. There are a multitude of Storm Drainage evaluation programs available. It is not the intent of the Town of Johnstown to dictate the methods with which storm drainage is evaluated and designed. The engineer who signs and stamps the Final Drainage Report needs to have a thorough understanding of the program they are using and what the output represents. There are however basic design information that we need to be able to extract from a Drainage Report to complete a review and determine that the results are acceptable to the Town of Johnstown. Tables included in the following section (2.2.2 Final Drainage Design Requirements) are examples of what the Town of Johnstown will require from a Final Drainage Report. We realize that certain developments and site conditions may require additions or modifications to these tables, and we will deal with these on a case-by-case basis.

2.2.2 Final Drainage Design Requirements

- A. Any information pertaining to changes from the preliminary design need to be presented in the final report.
- B. Supporting calculations for identification of design rainfall, runoff calculation method, design storm recurrent intervals, and detention discharge and storage calculation method;
- C. Hydraulic criteria and supporting calculations for the design of streets, swales, channels, inlets, storm sewers, riprap, drop structures, etc...
- D. Tables shall be prepared to summarize the following information:

							PEAK DISCHAR	GE
				RUNOFF	CURVE	Q	Q	Q
	SUB	DESIGN	AREA	COEFF.	NUMBER	2-yr	10-vr	100-vr
BASIN	BASIN	POINT	(Ac.)	с	CN	(cfs)	(cfs)	(cfs)
н	H1	1	10.95	0.20	1.00	1.3	32.9	31.1
	H2	2	18.01	0.20	1.00	1.3	39.0	36.8
	H3	3	2.44	0.25	1.00	1.3	13.5	12.5
OS	OSA	А	5.25	0.25	1.00	1.3	25.6	23.7
	OSB	В	0.19	0.20	1.00	1.3	23.6	22.3
	OSC	С	0.10	0.20	1.00	1.3	22.4	21.1

1. Historic and Developed runoff at design points. Attenuate as applicable.

2. Street capacities for the major and minor storm events.

BASIN	DESIGN	CONTRIBUTING	STREET SLOPE (%)	CAPACITY REDUCTION FACTOR	ALLOWABLE CAPACITY Qa(2-vr) (cfs)	ALLOWABLE CAPACITY Qa(100-vr) (cfs)	PEAK DISCHARGE Q(2-vr) (cfs)	PEAK DISCHARGE Q(100-vr) (cfs)
А	8	A7,A8	0.5	0.65	24.4	24.4	24.4	23.8
	10	A9,A10	0.7	0.80	34.7	34.7	34.7	29.6
	13*	A2,A7,A8,A9,A10,OSG	1.3	0.80	46.7	46.7	46.7	84.5
В	26	B2,B3	0.7	0.80	33.3	33.3	33.3	11.4
	28	B4,B5	0.9	0.80	37.7	37.7	37.7	8.5

					PONDING	STREET	ALLOWABLE	100-vr	INTERCEPTED	PASSED	
	DESIGN	INLET	INLET		DEPTH	SLOPE	CAPACITY	FLOW	INLET	INLET	LENGTH
BASIN	POINT	NUMBER	TYPE	CONDITION	(ft)	(%)	(cfs)	(cfs)	(cfs)	(cfs)	(ft)
А	8	6A & 6B	TYPE "R"	ON GRADE	N/A	1.5	N/A	28.6	16.8	11.8	15.0
	10	7A & 7B	TYPE "R"	ON GRADE	N/A	1.3	N/A	37.1	22.0	15.1	15.0
	13	8A & 8B	TYPE "R"	SUMP	1.07	N/A	76.5	48.8	48.8	0.0	15.0
В	28	3A & 3B	TYPE "R"	SUMP	0.71	N/A	34.0	19.8	19.8	0.0	10.0
С	33	4A & 4B	TYPE "R"	SUMP	0.71	N/A	34.0	14.6	14.6	0.0	10.0

3. Inlet design including inlet condition, type, and size.

4. Storm sewer/culvert design.

	FROM	то	DESIGN FLOW	PIPE	PIPE DIAMETER	PIPE
LINE	(UPSTREAM)	(DOWNSTREAM)	(cfs)	(%)	(in.)	MATERIAL
ST-1	POND A	ROAD A	26.0	2.0	30	CMP
ST-2	ROAD A	POND A	9.0	2.4	24	RCP
ST-4	INLET 1A	INLET 2A	14.6	1.5	24	RCP
	INLET 2A	MH 2A	48.8	0.5	29x45	ELLIP. RCP
	MH 2A	MH 1A	51.0	0.8	36	RCP
	MH 1A	POND A	69.1	1.0	42	RCP
ST-13	INLET C	IRRIGATION DITCH	11.0	2.5	24	ADS

5. Swale/ditch designs.

		DESIGN							
	DESIGN	FLOW	SIDE	воттом		NORMAL		FLOW	
	SLOPE	Q(100-yr)	SLOPE	WIDTH	MANNING'S	DEPTH	FREEBOARD	VELOCITY	MISC.
LOCATION	(%)	(cfs)	(XH:1V)	(ft)	"n"	(ft)	(ft)	(fps)	
BASIN C - ST-8 OUTLET	0.50	39.20	4.0	0.00	0.035	1.87	2.83	2.8	
BASIN K - DP 24 OUTLET	25.00	18.64	4.0	24.69	0.027	0.05		14.9	Riprap
BASIN M1 - DP 25 OUTLET	0.56	14.06	4.0	0.00	0.035	1.24	1.38	2.3	

6. Riprap design.

LOCATION &	100-vr DESIGN FLOW	100-vr VELOCITY	PIPE SIZE	DEPTH AT OUTLET	RIPRAP DEPTH	RIPRAP	RIPRAP
DESCRIPTION	(cts)	(fps)	(in.)	(ft.)	(in.)	SIZE	(vd^3)
LINE ST-13 OUTLET	11.0	5.9	24	2.0	18.0	CLASS 9	2
LINE ST-14 OUTLET	9.6	3.1	24	2.0	18.0	CLASS 12	2
LINE ST-2 OUTLET	9.0	4.7	24	6.8	18.0	CLASS 9	2

7. Detention pond design.

A table shall be prepared that will include all information that is required for the Drainage Plan:

	POND	ACTIVE	OUTLET	WATER SURFACE ELEV.		RELEASE RATE	
LOCATION &	CAPACITY	CAPACITY	ELEVATION	10-yr	100-yr	10-yr	100-yr
DESCRIPTION	(ac-ft)	(ac-ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)
POND 1	11.0	5.9	4935.00	4940.00	4942.50	10.5	65.3
POND 2	4.3	4.3	4938.50	4941.00	4944.30	16.7	38.5
POND 3	2.5	2.5	4939.25	4942.30	4945.00	4.9	12.6

Well organized technical appendixes shall show calculations for historic and developed hydrology, street capacity calculations, inlet calculations, storm sewer/culvert capacity calculations (including 100-yr hydraulic grade lines), swale/channel capacity calculations, riprap design, and detention volume requirements.

2.2.3 Drainage Plan

A final drainage plan of the proposed development at a scale similar to the overall utility plan in the final plat package shall be included. The drainage plan shall show the following information in addition to the information required on the preliminary drainage plan:

- A. Existing and proposed contours at two (2) feet maximum intervals;
- B. Property lines and easements;
- C. Streets, curb, gutter, and sidewalk and gutter flowline;

- D. Existing drainage facilities and structures, including irrigation ditches, roadside ditches, drainage ways, gutter flow directions, and culverts. All pertinent information such as material, size, shape, slope, and locations shall also be included;
- E. Overall drainage area boundary and drainage sub-area boundaries relating to the proposed development (both historic and developed);
- F. Proposed gutter type (i.e., vertical or drive-over curb and gutter) and cross-pans;
- G. Proposed storm sewer and open drainage ways, including inlets, manholes, culverts, and other appurtenances. Inlets, storm sewers, culverts, and other proposed facilities shall be labeled in a manner consistent with the labeling in the drainage report and the construction plans;
- H. Proposed outfall point and flow for runoff from the developed area and facilities to convey flows to the final outfall point without damage to downstream properties;
- I. Path(s) chosen for computation of time concentration;
- J. Details of detention storage facilities and outlet works, including pond capacity, active capacity, outlet elevation, 100-year/10-year water surface elevation, and 100-year/10-year release rate.
- K. Location and elevation of all defined flood plains affecting the proposed development;
- L. Location of all existing and proposed utilities affected by or affecting the drainage design;
- M. Typical cross sections of open channels, natural drainageways, and roadside ditches showing the 2-year water surface and the 100-year water surface.

SECTION 3: HYDROLOGY STANDARDS

3.1 Analytical Methods

The Engineer is to use published material by a generally accepted authoritative source such as Urban Drainage and Flood Control District, or other publication applicable to the project. The material used must be referenced and applicable parts copied as part of the submittal information. The Rational method and the Colorado Urban Hydrograph Procedure (CUHP) are reliable methods used in the Denver region. Rainfall time intensity frequency (IDF) curves are included with this criteria manual.

3.1.1 Applicability Of Methods

The Rational method is recommended for overland flow from tributary basins generally less than 200 acres in area. Representation of areas above 200 acres by the Rational method is not recommended, primarily because runoff magnitudes become inaccurate. When the Rational method is used it is important to attenuate runoff at design points. Attenuation should be achieved by applying the highest time of concentration of the contributing sub-basins to the total area

contributing to the design point. It is also important to remember to calculate composite runoff coefficients when attenuating runoff so that an accurate representation of the ground conditions is used. Calculation of composite runoff coefficients and attenuation should be included in the hydrology appendix of the report. Methods such as CUHP, SWMM, and SCS methods are better suited to represent areas larger than 200 acres. SCS methods have been shown to be accurate, particularly for undeveloped ground. SCS methods are not always applicable for developed conditions so the Engineer will be expected to demonstrate that the curve numbers selected do accurately reflect the proposed ground conditions. The hydrologic method selected by the Engineer needs to be reasonable for the undeveloped land use. Undeveloped runoff rates in the Johnstown area tend to fall between 0.50 cfs/Ac. and 1.0 cfs/Ac. depending on the basin size and slope. Soils tend to be silty for most of the Johnstown area and it is important to not overestimate the undeveloped runoff rates that will be used for detention pond release rates. Other methods of determining rainfall runoff not mentioned here will be considered by the Town on a case by case basis.

3.1.2 Engineering Judgment

For many new development sites there may be specific constraints (topographic, space allocation, economic etc.) that lead to new innovative methods of draining runoff. In addition certain assumptions are often used within the framework of existing methods of calculating runoff. In both cases engineering judgment must be used. All of the assumptions, underlying principles and sources of information used in a drainage system design must be explained and documented within the final drainage report.

3.2 Hydrologic Data Requirements

Hydrologic data is the primary information needed to complete a drainage system and report. Regardless of what methodology is used to compute peak runoff, the following requirements apply to all hydrologic data.

3.2.1 Rainfall Intensity

Rainfall data should be current and appropriately selected by geographic region. Rainfall time intensity frequency (IDF) curves for the Johnstown area are included on the following page with this criteria manual. IDF curves were determined from rainfall intensity data shown in the "Storm Water Master Plan For Town Of Johnstown", by The Engineering Company, April 2, 2001. The Engineer shall use appropriate NOAA Rainfall Atlas information, or may use the Depth-Duration-Frequency data included in the Urban Drainage and Flood Control District's design manual, to generate necessary rainfall information.



TIME - INTENISTY - FREQUENCY CURVES

3.2.2 Design Storm

The storm frequencies to be used in the design of storm sewer/culvert systems, inlet evaluations, and street capacity evaluations shall be obtained from the Design Storm Frequency Table listed below.

TABLE OF DESIGN STORM FREQUENCIES					
Land Use Design Storm Period					
Residential	2 years and 100 years				
Open Space	2 years and 100 years				
Commercial	2 years and 100 years				
Public Buildings	2 years and 100 years				
Industrial	2 years and 100 years				

3.2.3 Offsite Flows

All offsite flow over and across a proposed development needs to be analyzed on a per basin basis. The runoff for all such basins must be calculated using a method acceptable to the Town of Firestone. All the data calculated must be incorporated into the whole drainage system and the increased runoff onsite accounted for in the final drainage report. If a proposed development is discharging offsite the downstream property must not be adversely affected.

SECTION 4: INLETS

<u>4.1 Design</u>

All storm drainage curb inlets must be CDOT Type 'R'. Storm drainage inlets in sump conditions shall be designed to accept and convey the 100-year storm. In no case shall a 100-year design storm frequency cause inundation above allowable ponding depths to any structure or pose a hazard. Area inlet shall be allowed in the street. Area inlets may be allowed in open space areas and parking lots. The design of any inlet in a sump shall also consider how runoff would overflow in the event of 100% inlet plugging. The site grading should accommodate some passage for flows in excess of the 100-yr event storm or a plugged inlet. Several methods of determining inlet capacity are available to the Engineer. Regardless of the method, the design should include some oversizing to account for partially plugged inlets.

4.1.1 Inlet Operation: Sump & Continuous Grade Conditions

Two conditions occur when inlets are utilized to drain storm runoff, a sump condition or an on grade (continuous grade) condition. An inlet operating in a sump condition is recommended. On grade inlets operate inefficiently and usually cost more. The use of on grade inlets should be limited to only those cases where providing a sump is not practical. If an on grade inlet needs to be more than ten feet in length the Town may require the design to be modified to create a sump.

4.1.2 Allowable Ponding Depth In Streets

For the 2-yr event storm, a maximum depth at the gutter flowline of 0.5 feet is allowable. The allowable ponding depth for the 100-yr event is 1.5 feet. For inlets designed to operate in conjunction with a storm sewer system under a surcharged condition the above mentioned allowable depths refer to the combined ponding depth for inlets and the storm sewer surcharge depth. (Example: A particular sump inlet at EI= 4950.0 requires 0.65' of ponding depth to accept the 100-yr runoff. The receiving storm sewer is surcharged 0.45' over the inlet flowline. Therefore the actual 100-yr water surface elevation over the inlet is at EI=4951.1, 0.40' less than the maximum allowable elevation.) The depth of ponding water occurring at inlets caused by the hydraulic design of storm sewer piping and backwater effects cannot exceed the allowable depths mentioned above.

SECTION 5: STORM SEWERS

<u>5.1 Design</u>

Storm sewers shall generally be designed to convey 100-yr storm event runoff. Storm sewers shall generally be located in the public Right-of-Way. Storm sewers located outside of the Right-of-Way shall be located in minimum 20 foot exclusive easements granted to the Town of Firestone. Under no circumstances shall a proposed design include installation of trees, shrubs, flower beds, or other landscaping features over storm sewer lines. Likewise, trails shall not be designed over storm sewers (crossings are permitted).

5.1.1 Hydraulic Evaluation

All storm sewer designs shall include a hydraulic evaluation for each segment of the system. the hydraulic grade line (HGL) shall be calculated and shown on the storm sewer construction plan and profile sheet(s). The hydraulic evaluation shall consider the 100-yr water surface of the downstream receiving body (storm sewer, detention pond, drainage swale, stream, etc...). The design shall not allow a surcharge above any manhole rim. Surcharges at inlets shall be considered when performing inlet design/inlet ponding depth calculations. Several methods of evaluating storm sewers are available to the Engineer. The storm sewer appendix should include all appropriate design assumptions (Q, pipe size/material, slope, length, roughness, downstream hydraulic surface, etc...). Labels of storm inlets, manholes, and reaches shall be consistent with those used on the drainage plan and on the construction plans.

5.1.2 Alignment

Storm sewer alignment changes (horizontal and vertical) shall only occur at manholes. Storm sewers located in the public Right-of-Way shall only be located under the proposed street asphalt. A minimum clear distance of five feet shall be maintained between the storm sewer and the gutter flowline. Storm sewers shall also maintain a minimum ten feet of horizontal separation with all other utilities. Storm sewers located outside of the Right-of-Way in easements shall be centered in twenty foot minimum width easements. For wider easements, the storm sewer centerline must remain at least ten feet from the edge of the easement. Storm sewers shall never have reverse grades or level spots. Minimum slope of any storm sewer shall be 0.20% although 0.50% should be the target minimum slope and may be required by the

Town if nuisance flows are estimated to be substantial (>1 cfs). Storm sewer joints shall be concrete encased ten feet on either side of any waterline that crosses underneath. A minimum vertical clearance of 18" shall be provided between the storm sewer and any other utility crossing.

5.2 Storm Sewer Pipe

Storm sewers located within the public Right-of-Way, under private streets, or under parking lots shall be reinforced concrete pipe (RCP) of adequate strength class and bury depth. Storm sewers, or portions of storm sewers, located in open space areas may be smooth interior walled high density polyethylene pipe (HDPE). No storm sewer or portion thereof shall be polyvinyl chloride (PVC) pipe. Other pipe materials will be considered by the Town on a case by case basis. All pipe outlets shall include either a headwall or flared end section with grates. Any pipe that is under a surcharge condition shall have appropriate water tight joints. These are to be specified on the storm sewer construction plan and profile sheet(s). The Engineer shall be responsible for ensuring that the pipe joint specified will adequately perform under the design hydraulic condition.

5.3 Storm Manholes

For storm sewer pipe sizes up to and including 24" inside diameter the minimum manhole inside diameter shall be 48" and the manholes shall be spaced no more than 400 feet apart. For storm sewer pipe sizes larger than 24" up to and including 42" inside diameter the minimum manhole inside diameter shall be 60" and the manholes shall be spaced no more than 500 feet apart. Storm sewers larger than 42" inside diameter shall require either 72" inside diameter manholes, rectangular vaults, or vertical offset tees. Spacing of any of these larger structures shall not exceed 750 feet. If elliptical pipe is to be used the horizontal pipe dimension shall be used to determine minimum manhole sizing. Manhole bases may be placed on the same grade as the storm sewer with no additional drop provided. Manhole rims shall generally be set flush with finished ground except that some conditions may warrant they be buried (across farm fields).

SECTION 6: STREETS

<u>6.1 Design</u>

Streets are typically an integral part of the storm drainage system. Conveyance of storm runoff in streets shall be limited to certain depth and encroachment criteria. Consideration shall also be given to the flow characteristics of runoff in streets. For example, the Engineer will need to consider such items as street slopes and the change in flow direction. If a significant amount of runoff is to be conveyed down a long and steep street it is not likely that the runoff will easily be able to turn 90° at a cross street.

6.1.1 Drainage At Intersections

Because of the intersecting grades and congregation of inlets and crosspans etc., intersections are often problematic drainage areas. When a major arterial intersects a local street the grade of the major arterial must be continued through the intersection as much as possible while not interfering with drainage.

6.1.2 Allowable Street Capacities

Minor storm street encroachment for residential streets shall allow no curb topping. Collector and arterial streets shall have at least one lane width open. Major storm street encroachment for residential and collector streets shall allow a maximum flow depth of six (6) inches over the crown. For arterial streets the flow depth at the crown shall not exceed six (6) inches and the gutter flow depth shall not exceed eighteen (18) inches. Allowable street capacities must be calculated and shown in tabular form in the final drainage report.

6.1.3 Allowable Cross Street Flow

If the constraints of a proposed development, from the standpoint of drainage, create a situation where runoff must cross the crown of a street, the following criteria must be met. For minor storm flows across a local or collector street a maximum depth of (6) inches is allowable. No cross street flow is allowable for arterials during a minor storm event. Major storm cross street flows for local and collector streets may have a maximum depth of (18) inches above gutter flowline. The allowable cross street flow across arterials during a major storm is (6) inches or less over the crown. Whenever possible, design of a drainage system shall avoid cross street flows as much as possible. Allowable cross street flows must be shown in tabular form in the final drainage report.

SECTION 7: CULVERTS

<u>7.1 Design</u>

All culverts under major arterials must be designed to convey the 100-yr event. Culverts under local and collector streets must be designed to convey the 10-yr event. These culverts must also be designed with an overflow capacity for the major storm.

7.1.1 Hydraulic Analysis

All culverts that are part of the proposed drainage system whether inlet or outlet control must be designed so that no damage results during the 100-yr event. The minimum velocity for flow through a culvert shall be 2 ft/s. The minimum effective diameter of any culvert shall be (12) inches. All tailwater and headwater conditions must be designed to be controllable and specific calculations shown in the final drainage report. The hydraulic grade line must be analyzed to ensure that ponding depths (in the case of inlet control) do not inundate structures and adhere to allowable street capacities when applicable. In the case of culverts under outlet control, proper erosion control measures must be applied.

SECTION 8: OPEN CHANNELS

<u>8.1 Design</u>

Open channels should be designed such that the flow is not at critical depth or super critical. Channels must be designed to carry the 100-yr event. Irrigation ditches shall not be used as discharge points for the minor or major storms, except where said discharge is in conformance with an approved master drainage study or variance.

8.1.1 Unlined Channels

Unlined channels should be used when there are no constraints on the hydraulic design, from topography or space limitations. The maximum channel depth of flow shall be 4 feet. The critical depth shall be determined for the major and minor events to ensure that supercritical flow conditions do not occur. The minimum amount of freeboard shall be 1 foot or 1/3 of the design flow. Channel slopes shall be constructed so that flow velocities do not exceed 7.5 ft/s during the major storm or less than 2 ft/s for the minor storm. Unlined channels with longitudinal slopes less than 2% shall have trickle channels.

8.1.2 Lined Channels

If conditions for unlined channels cannot be met, channels shall be lined. If supercritical flow conditions are unavoidable, all concrete channel sections must continuously be reinforced, longitudinally and laterally. A minimum of 1 foot of freeboard or 1/3 of the design flow is required. All lined channels must be protected from uplift forces by drain piping, weep holes or appropriate footings. If a lined channel with a supercritical flow condition discharges into unlined channel, an energy dissipation structure must be constructed at such junction.

8.1.3 Channel Section Criteria

Side slopes for unlined channels can be a maximum of 4:1. When concrete trickle pans are used the minimum width shall be 3 feet, and minimum thickness (6) inches. Overflow swales shall be designed in accordance with Section 8.1.1 of this manual. Freeboard is not required for overflow swales, which are designed only to operate under inlet clogging conditions. Design calculations (in tabular form) must be shown as well as cross-sections in the final drainage report.

SECTION 9: DETENTION

9.1 Storage Requirements & Release Rates

All storm water detention facilities shall be designed to detain the storm water runoff from the fully developed site from a 100-year storm and release the flow at a rate not to exceed to the 100-yr historic rate of runoff at the pond outlet point. In addition, the detention pond outlet structure must detain the 5-yr developed site runoff and release it at the 5-yr historic rate at the pond outlet point. More restrictive release rates may be required by the Town for any given site if it is determined by the Town that the more restrictive rate is in the best interests of the public. Active storage capacities, 5-yr and 100-yr release rates, and 5-yr and 100-yr water surface elevations must be shown on the drainage plan for all proposed detention ponds onsite.

9.1.1 Outlet Structures

Outlet structures must be designed to release detained runoff at the 100-yr historic rate. Outlet structures must also take into account low flow or "nuisance flow" conditions. Such conditions can create maintenance hazards and property damage. A minimum of 1 foot of freeboard is required above the 100-yr water surface elevation.

SECTION 10: FLOODPLAIN ISSUES

10.1 Town Jurisdiction

If a development or portion of a proposed development is located in a flood hazard area, all applicable regulations of the Town shall be met. All federal and state regulations shall also be met prior to the regulations of the Town. All applicable information must be shown on the final drainage plan regarding existing and proposed (if applicable) flood areas.

10.1.1 Storm Drainage And Floodplains

Drainage areas shall be left in a natural state unless approved by the Town and no encroachment shall be made on the natural channel. A plan to prevent water pollution shall be submitted and adhered to wherever any modification of topography is required during construction.

SECTION 11: EROSION CONTROL

11.1 Requirements

Erosion control measures must be addressed for potential erosion caused by runoff, drainage system discharge or wind. Proposed locations where erosion control structures are constructed must be shown on an erosion control plan (which can be shown on the grading plan). In addition the size, type and dimension of all rip rap pads must be labeled.

END OF SECTION

SECTION 01070

ABBREVIATIONS

PART 1 - GENERAL

Wherever used in these specifications the following abbreviations shall have the meanings indicated:

- AASHTO American Association of State Highway & Transportation Officials
- ADS Advanced Drainage Systems Pipe
- A/SC American Institute of Steel Construction
- AISI American Iron and Steel Institute
- ANSI American National Standards Institute
- ASTM American Society for Testing and Materials
- AWS American Welding Society
- AWWA American Water Works Association
- CFS Cubic Feet per Second
- CRSI Concrete Reinforcing Steel Institute
- MSL Mean Sea Level
- PVC Poly Vinyl Chloride Pipe
- *RCP* Reinforced Concrete Pipe
- UBC Uniform Building Code

END OF SECTION

SECTION 02271

RIPRAP

PART 1 – GENERAL

1.1 Description

A. This section covers the construction of riprap on earth slopes, within channel drop structures and at culvert outfalls at the locations indicated on the Drawings and as specified herein.

1.2 Quality Assurance

- A. Stone shall be hard, durable, angular in shape, and free from cracks, overburden, shale and organic matter.
- B. Stone shall be capable of passing specific gravity, soundness and abrasion tests in accordance with the Urban Drainage and Flood Control District's (DRCOG) "Drainage Criteria Manual," as follows:

TEST DESIGNATION REQUIREMENTS						
Specific Gravity (Saturated Surface - Dry Basis)	10 greater than 2.20					
Soundness (Sodium Sulfate Method)	19 less than 6 percent					
Abrasion (Using Los Angeles Machine Grading A)	21 less than 6 percent of weight after 500 revolutions					

PART 2 - PRODUCTS

2.1 Riprap Materials

- A. Stone: gray rhyolite or approved equal.
- B. Quality:
 - 1. Sound, durable, hard, resistant to abrasion and free from lamination, weak cleavage planes, and undesirable effects of weathering.
 - 2. Rounded stone not acceptable.
 - 3. Do not use flat or elongated shapes with thickness less than 1/3 the length.

CLAS	CLASSIFICATION & GRADATION OF ORDINARY RIPRAP						
Riprap Designation	% Smaller than Given Size by Weight	Intermediate Rock Dimension (Inches)	^d 50* (Inches)				
Type VL	70-100 50-70 35-50 2-10	12 9 6 2	6**				
Type L	70-100 50-70 35-50 2-10	15 12 9 3	9**				
Туре М	70-100 50-70 35-50 2-10	21 18 12 4	12				
Туре Н	100 50-70 35-50 2-10	30 24 18 6	18				
Туре VH	100 50-70 35-50 2-10	42 33 24 9	24				

C. The size requirements for riprap gradations are as follows:

^d50 = mean particle size Bury types VL and L with native topsoil and revegetate to protect from vandalism. **

Size of stone, length, and total thickness of riprap shall be as noted on the drawings. 1.

D. All riprap shall be placed on a minimum 4" thick layer of bedding material, which meets one of the following gradations:

	GRADATION FOR BEDDING MATERIAL						
	% by Weight passing Square Mesh Sieves						
Sieve Size	Type I (CDOH concrete sand specification (AASHTO M6) Section 703.01	Type II (CDOH Class A, Section 703.09)					
3"	-	90-100					
11⁄2"	-	-					
³ /4"	-	20-90					
_"	100	-					
#4	95-100	0-20					
#16	45-80	-					
#50	10-30	-					
#100	2-10	-					
#200	0-2	0-3					

PART 3 - EXECUTION

3.1 Preparation

A. Shape and compact slopes and channel bed prior to placement of riprap and bedding.

3.2 Riprap Placement

- A. Place in a manner to provide a solid mass of rock within the limits shown on the drawings.
 - 1. Fill spaces between larger stones with smaller stone of suitable size, so placed as to conform to the slope required.
- B. Material may be machine-placed with sufficient hand work to accomplish requirements of this Section. However, bulldozing of stone from the upper banks will not be permitted.
- C. Material shall be placed in a manner such that filter blanket (if used) is not torn or ripped loose from staples. Minimal disturbance of bedding material layer shall be allowed.
- D. Grouted riprap shall be used when conditions warrant. All grouted riprap blankets shall have adequate weep holes provided.

3.3 Thickness Tolerance

A. Plus or minus 10%.

END OF SECTION

SECTION 02601

MANHOLES

PART 1 - GENERAL

1.1 Description

A. This section covers manholes, including ring and covers, steps, grade rings, fittings, and other appurtenances.

1.2 Quality Assurance

A. Manhole inverts shall not deviate from elevations shown on the Drawings by more than (±) 0.03 ft.

1.3 Product Delivery, Storage and Handling

A. Do not deliver precast concrete sections to job until concrete has attained at least 80 percent of specified strength.

1.4 Alternatives

A. Manhole bases may be either monolithically precast or cast-in-place.

PART 2 - PRODUCTS

2.1 Concrete

- A. Cast-in-Place:
 - 1. Meet the Requirements of Section 3300 Cast-in-Place Concrete (Appendix V).
 - 2. Strength: 4000 psi at 28 days.
 - 3. Cement: Type II.

B. Mortar:

- 1. One part Portland Cement, ASTM C150, Type II.
- 2. Three parts sand, ASTM C144.
- 3. ¹/₂ part hydrated lime, ASTM C207, Type S.
- C. Grout (Non-Shrink):
 - 1. Pre-mixed: Master Builders "Masterflow 713," Sonneborn "Ferrolith G-D.S. Redi-Mixed," or equal.

- 2. Job Mixed:
 - a. One part Portland Cement, ASTM C150, Type II.
 - b. One part sand, ASTM C144.
 - c. One part shrinkage correcting aggregate, Master Builders "Embco Aggregate," "Sonneborn "Ferrolith G-D.S.," or equal.

2.2 Pre-cast Concrete

- A. Bases, Barrels, Cones and Flat Tops:
 - 1. Cast base and first barrel section monolithic.
 - 2. Meet Requirements of: ASTM C478.
 - 3. Cement: Type II.
 - 4. Invert: Cast-in-place concrete as specified in paragraph 2.1.A above.
 - 5. Provide horseshoe shaped openings for manholes to be installed in existing lines.

2.3 Manhole Gaskets

- A. Meet Requirements of: F.S. SS-S-00210, Type I, Rope Form.
- B. Diameter:
 - 1. 48 inch manholes: $1\frac{1}{2}$ inch.
 - 2. 60 inch manholes: 1 3/4 inch.
 - 3. 72 inch manholes: 2 inch.
- C. Approved Manufacturers:
 - 1. K.T. Snyder Co., "Ram-Nek" or "Rubr'-Nek."
 - 2. Hamilton-Kent Mfg. Co., "Kent Seal."
 - 3. Or approved equal.

2.4 Pipe Penetration Gaskets

- A. Approved Manufacturers:
 - 1. Dukor Co., Ko-N-Seal.
 - 2. Press Seal Gasket Corp., PS-10.
 - 3. A-lok Corp., A-lok.
 - 4. Interpace Corp., Lock joint flexible manholes sleeve.
 - 5. Or approved equal.

2.5 Ring and Cover

A. Material: Gray Iron meeting requirements of ASTM A48.
B. Construction:

- 1. Size: Min. Clear opening 24-inch diameter.
- 2. Weight: Heavy-duty 400 pounds minimum.
- 3. Bearing surfaces: machined.
- 4. Lid pattern: checkered top or indented top.
- 5. Pick hole: concealed.

2.6 Steps

- A. Materials: Polypropylene plastic coated steel.
- B. Construction:
 - 1. Reinforcing rod: $\frac{1}{2}$ inch dia.
 - 2. Length: 10 inches, designed for 6-inch protrusion from manhole wall.
 - 3. Width: 12 inches.
 - 4. Tread: notched ridge with retainer lugs on each end.

PART 3 - EXECUTION

3.1 Inspection

A. Examine each pre-cast section, ring and cover and appurtenance for cracks and other defects. Remove all defective materials from the site.

3.2 Manhole Size

A. Unless otherwise directed by the Town, use the following manhole diameters in conjunction with the appropriate line sizes:

Pipe Size	MH Diameter		
(in)	(in)		
≤ 24"	48"		
24" – 42"	60"		
≥ 48"	72"		

B. Use eccentric cones where manhole depth is 60 inches or greater on 48 inch manholes and 72 inches or greater on 60 inch manholes. Use flat top manholes when manhole depth is less than the above and on all 72 inch manholes.

3.3 Installation of Pre-cast Manhole Sections

A. Connect all pipes to pre-cast manhole sections using pipe penetration gaskets.

- B. If inverts are not constructed by pre-caster and wherever grade and alignment permit, lay the main sewer continuously through the manhole and split the pipe after construction of the invert. Where this is not possible, terminate pipe flush with interior manhole wall and construct transition smooth and of proper radius for uninterrupted flow. In no case shall the invert flow section through the manhole be greater than that of the outgoing pipe. Finish invert with a steel trowel prior to adding riser section to the base.
- C. Set each manhole riser section plumb. Use sections of various heights to bring ring and cover to grade. Join manhole sections using mortar or pre-formed flexible plastic gaskets. The last barrel section prior to placement of the eccentric cone or the flat top slab shall be the manufacturer's shortest, but in no case greater than 24 inches in height. All joint surfaces shall be clean, dry and warm during installation. Where mortar joints are used, set each section in a one inch minimum full bed of mortar. If flexible gaskets are used, prime entire joint on both barrel sections prior to placement of gasket material.
- D. Install ring and covers on one or a maximum of two pre-cast adjusting rings of varying heights, not to exceed 8 inches in height each. On buried manholes the total allowable height of adjusting rings and the ring and cover shall be one inch less than the manufacturer's shortest pre-cast barrel section. Set rings in a full bed of mortar and encase in mortar around the entire perimeter. Unless otherwise indicated, set the top of the rings 24 inches below finished grade in farmed fields, 6 inches below finish grade in gravel roadways and such that no part of the ring or cover will project above a point 1/4 inch below the finish surface of pavement in paved areas subject to cleaning by snowplows.
- E. Fill all lifting holes and other imperfections with mortar. Neatly point inside of joints no matter what joint material is used.

3.4 Construction of Cast-in-Place Bases

- A. Set stubs and mains before concrete is placed and recheck for alignment and grade before concrete has set. Where grade and alignment permit, lay the main sewer continuously through manholes and split the pipe after construction of the base. Where this is not possible, terminate the pipe flush with the interior manhole wall and construct transitions smooth and of proper radius for uninterrupted flow. In no case shall the invert flow section be larger than that of the outgoing pipe. Shape the base with a wood float and finish with a steel trowel. Allow the base to set a minimum of 24 hours before continuing construction.
- B. When thermoplastic pipe is used, connections to the manhole base shall be made using approved manhole couplings cast into the base or a minimum of three pipe gaskets spaced two inches apart on the end of each pipe and cast into the base.
- C. If the pipe connection is to a pre-cast section, use pipe penetration gaskets as specified above.
- D. Install pre-cast manholes risers, cones, and tops and the ring and covers as specified in paragraphs 3.2. C through 3.2.E above.

3.5 Field Quality Control

A. Inspect each manhole for and repair all visible leaks and damp spots.

END OF SECTION

SECTION 02612

REINFORCED CONCRETE PIPE

PART 1 - GENERAL

1.1 Description

A. This section covers reinforced concrete culvert, storm drain and sewer pipe with O-ring rubber gasketed joints. Furnish pipe complete with all jointing materials and other necessary appurtenances.

1.2 Quality Assurance

- A. Source quality control:
 - 1. Acceptance of pipe shall be based on the results of the manufacturer's material tests and inspection of pipe for defects and imperfections.
 - 2. Conduct crushing tests on a minimum of two cores or four cylinders from each day's production and every time the concrete mix is changed.
 - Conduct absorption tests on cores taken from the first three lengths of pipe produced of each size and class and thereafter from one percent of the pipe produced.

1.3 Product Delivery, Storage And Handling

- A. Do not bump or drop pipe and fittings during handling.
- B. Do not drag the spigot ring on the ground or allow it to come in contact with gravel, crushed stone, rocks or other hard objects.
- C. Do not permit hooks to come in contact with joint surfaces.
- D. Ship rubber gaskets in cartons and store in a clean area away from grease, oil, ozone producing electric motors, excessive heat, and the direct rays of the sun.

PART 2 - PRODUCTS

2.1 Pipe and Fittings

- A. Conformance: ASTM C76.
- B. Strength class: as required by conditions.
- C. Cement: Type II.

2.2 Joints

- A. Type: ASTM C443, Rubber Gasket.
- B. Gasket material: Neoprene or other synthetic rubber.
- C. Mortar or sealant will be acceptable in lieu of gasketed joints when hydraulic considerations permit.

PART 3 - EXECUTION

3.1 Description

- A. Examine pipe upon delivery and do not use individual sections with any defect including the following:
 - 1. Fractures or cracks passing through the wall.
 - 2. Defects that indicate imperfect proportioning, mixing, and molding.
 - 3. Surface defects indicating honey-combed or open texture.
 - 4. Damaged or cracked ends where such damage would prevent making a satisfactory joint.
 - 5. Any continuous crack having a surface width of 0.01 in. or more extending for a length of 12 in. or more regardless of position in pipe wall.
- B. Mark rejected pipe with a yellow crayon and remove from the site.
- C. Examine gaskets prior to installation and do not use gaskets which show surface checking, weathering, or other signs of deterioration.

3.2 Installation

- A. Install pipe in accordance with the requirements of the Section 02221 of Part V.
- B. Jointing pipe:
 - 1. Joint pipe in accordance with manufacturer's recommendations.
 - 2. Wipe mating surfaces clean and keep foreign materials from interfering with proper joint assembly.
 - 3. Apply lubricant recommended by pipe manufacturer to mating surface and gasket.
 - 4. Position the gasket on the spigot and complete the joint.
 - 5. Check the position of the gasket with a feeler gage after the joint is completed and the pipe is in position.
 - 6. Paint the interior joint space on all pipe 24 inches in diameter and larger with Portland Cement mortar after the pipe is in place.

END OF SECTION

SECTION 02623

CORRUGATED POLYETHYLENE PIPE

PART 1 – GENERAL

1.1 Description

- A. This section covers smooth interior, corrugated polyethylene storm sewer pipe and fittings to be furnished complete with all jointing materials.
- B. Polyethylene pipe shall not be used within street right-of-ways.

1.2 Product Delivery, Storage, and Handling

- A. Do not damage the pipe by impact, bending, compression, or abrasion during handling and storage.
- B. Store pipe on a flat surface, which provides even support for the barrel.
- C. Do not stack pipe higher than the manufacturer's recommended height.
- D. Ship rubber gaskets in cartons and store in a clean area away from grease, oil, ozoneproducing electric motors, heat, and the direct rays of the sun.
- E. Do not use hooks, bare cables, or other devices that may damage the pipe when handling.

PART 2 - PRODUCTS

2.1 Polyethylene (PE) Storm Sewer Pipe

- A. Conform to the following standards:
 - 1. All pipe shall have exterior corrugations and smooth wall interiors. Exterior corrugations may be either annular or helical.
 - 2. All pipe and fittings shall be made of virgin PE compounds which meet or exceed ASTM D1248 Type III, Category 4, Grade P33, Class C requirements.

2.2 Non-Pressure Joints

- A. Non-pressure joints may be used only when the hydraulic grade line is within the inside diameter of the pipe.
- B. The fitting shall be secure enough to withstand stresses from handling and backfilling without failing.
- C. The joint shall be sealed sufficiently to prevent infiltration of ground water and/or silt.

2.3 Pressure Joints

- A. When hydraulic conditions within the pipe produce an internal pressure on the full diameter of the inside of the pipe, a pressure joint shall be used.
- B. The joint shall have a pressure rating at least equal to the internal pressure of the pipe during the major storm, or worst case, event.
- C. The joint shall be sealed sufficiently to prevent "jetting" or leaking at the joint.

2.4 Joints to Other Pipe Materials

A. PE pipe shall not be jointed to other pipe materials. Connections to other pipe materials shall be done only at manholes, inlets, or other accessible facility.

PART 3 - EXECUTION

3.1 Inspection

- A. Examine pipe and fittings and do not use individual sections containing:
 - 1. Cracks.
 - 2. Dents.
 - 3. Abrasions.
 - 4. Other defects.
- B. Mark rejected pipe and remove from site.

3.2 Installation

- A. Install pipe in accordance with Section 02221 of Part V.
- B. Jointing the pipe:
 - 1. The various manufacturers of PE pipe have differing methods of jointing the pipe that depends on pressure condition and pipe diameter. For this reason, the Contractor is to joint the pipe per the manufacturers recommendations to satisfy the conditions of paragraphs 2.2 and 2.3 of this section.

END OF SECTION







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<u>PART II</u>

STREET DESIGN & CONSTRUCTION STANDARDS

SECTION 1: STREET DESIGN & CONSTRUCTION POLICIES

1.1 Statement Of Policy	STREET-1
1.2 Developer's Responsibility	STREET-1
1.3 General	STREET-1

SECTION 2: DESIGN CRITERIA

2.2 JOHNSTOWN STREET DESIGN CRITERIA TABLE STREET-3 2.3 Sight Distance STREET-4 SIGHT DISTANCE TABLE STREET-4 2.4 Vertical Alignment STREET-4
2.3 Sight Distance STREET-4 SIGHT DISTANCE TABLE STREET-4 2.4 Vertical Alignment STREET-4
SIGHT DISTANCE TABLE
2.4 Vertical Alignmentstreet-4
FIGURE E1 – CREST VERTICAL CURVESSTREET-5
FIGURE E2 – SAG VERTICAL CURVESSTREET-6
2.5 Intersections street-7
2.6 Curb, Gutter & Sidewalkstreet-7
2.7 Auxiliary Lanes
2.8 On-street Parking & Drivewaysstreet-8
2.9 Medians & Street Lightsstreet-8

SECTION 3: PAVEMENT DESIGN

3.1 Geotechnical Study	STREET-8
3.2 Minimum Pavement Sections	STREET-9

SECTION 4: STREET CUTS

4.1 Procedure	STREET-9
4.2 Requirements	STREET-9
4.3 Backfill	STREET-10
4.4 Gravel Surface	STREET-10
4.5 Bituminous Surface	STREET-10
4.6 Portland Cement Concrete Pavement	STREET-10
4.7 Bituminous Pavement With Concrete Base	STREET-11

SECTION 5: TESTING

5.1 Material Testing	STREET-12
5.2 Developer's Responsibility	STREET-12

SECTION 6: INSPECTION

6.1 Procedure	STREET-12
6.2 Contractors Responsibility	STREET-12

SECTION 7: CONSTRUCTION SPECIFICATIONS

HOT MIX ASPHALT PAVEMENT	
1.1 Description	STREET-13
TEST PROCEDURE DEFINITIONS TABLE	STREET-13
1.2 Materials	STREET-13
AGGREGATE TEST PROPERTY TABLE	STREET-13
GRADATION RANGE TABLE	STREET-14
MINIMUM VMA% TABLE	STREET-15
PROPERTIES OF PERFORMANCE GRADED BINDERS	STREET-16
2.1 Mix Design and Plant Produced Mixture Requirements	STREET-17
SUPERPAVE MIXTURE PROPERTIES	STREET-18
2.2 Mixture Design Submittals	STREET-18
3.1 Equipment	STREET-19
3.2 Manufacture	STREET-21
MIXTURE DISCHARGE TEMPERATURES TABLE	STREET-21
4.1 Tack Coat	STREET-22
5.1 Placement	STREET-22
MINIMUM AIR AND SURFACE TEMPERATURE	
LIMITATIONS FOR MIX PLACEMENT TABLE	STREET-23
6.1 Longitudinal Joints	STREET-24
6.2 Transverse Joints	STREET-24
7.1 Segregation	STREET-25
7.2 Compaction	STREET-25
7.3 Production Tolerances	STREET-26
JOB MIX FORMULA TOLERANCES TABLE	STREET-27
8.1 Sub-grade Preparation	STREET-27
9.1 Soil Sterilization	STREET-28
SECTION 02514 – SIGNING, STRIPING AND STREET MARKING	
1.1 Description	STREET-29
1.2 Quality Assurance	STREET-29
	STREET-29
2.1 Lane Striping Material	STREET-29
2.2 Thermoplastic Pavement Marking Material	STREET-30
3.1 Traffic Control Signs	STREET-30
3.2 Epoxy Lane Striping	STREET-30
	STREET-30
3.4 Preformed Thermoplastic Pavement Marking	STREET-31
1 1 Work Included	
1.2 Testing and Inspection	SIREE1-32
1.2 resuing and inspection	SIREET-32
1.0 SUDITINUUS	STREET-33
1.4 JOD CONDITIONS	STREET-33
2.1 Ayyreyale	STREET-34
3.1 Subylaut	SIREE1-34
5.2 INStallation	SIREE1-35

SECTION 8: STREET DETAILS

STREET CUT UTILITY TRENCH DETAIL MAJOR ARTERIAL STREETS MINOR ARTERIAL STREET SECTION COLLECTOR STREET SECTION **RURAL STREETS** CUL-DE-SAC CROSS PAN DETAIL CURB, GUTTER AND SIDEWALK DETAIL HANDICAPPED RAMP DETAIL (DRIVEOVER – DRIVEOVER) HANDICAPPED RAMP DETAIL (VERTICAL – DRIVEOVER) HANDICAPPED RAMP DETAIL (VERTICAL – VERTICAL) MIDBLOCK HANDICAPPED RAMP DETAIL SIGN POST DETAIL – RURAL STREETS SIGN POST DETAIL – RESIDENTIAL STREET SIGN DETAIL CONCRETE JOINT DETAIL SURVEY MONUMENT IN PAVEMENT

<u>PART II</u>

STREET DESIGN & CONSTRUCTION POLICIES

SECTION 1: STREET DESIGN & CONSTRUCTION POLICIES

1.1 Statement Of Policy

The criteria set forth in this section shall be considered minimum standards. The Town reserves the right to alter these standards for a given site when the change will best serve the interests of the public and the Town. All work shall be performed according to the following requirements. All standards are subject to interpretation by the Town.

1.2 Developer's Responsibility

It is the policy of the Town that developers shall be responsible for arterial road improvements adjacent to proposed sites. These responsibilities include (but are not limited to) dedication of future right-of-way and landscape tracts along major arterials bordering their site, paving and construction material testing costs, striping and signing. When required by the Town, the developer shall extend roadways to property lines for access by adjacent properties.

1.3 General

- A. It will be the policy of the Town to design roads on section lines as arterial streets.
- B. Collector streets are defined as having projected traffic volumes of 2500 vehicles per day or more.
- C. The Developer's engineer shall consider existing and future traffic flows when designing streets.
- D. All street construction shall conform to Town of Johnstown standards and specifications. Any construction occurring two years after the plan approval shall require re-examination of the plans by the Town who may require that they be made to conform to standards and specifications current at that time.
- E. Street paving shall not start until the soils report and pavement designs are approved by the Town, and subgrade compaction tests and proofrolls have been passed.
- F. When an existing asphalt street must be cut, the street must be restored to a condition equal to or better than its original condition. The Town shall document the existing street condition before any cuts are made. Patching shall be done in conformance with the Town of Johnstown Standards. The finished patch shall blend smoothly into the existing surface. All large patches shall be paved with an asphalt lay-down machine. In streets where more than one cut is made, an overlay of the entire street width, including the patched area may be required. The Town shall make the determination of need for a complete overlay.

- G. Prior to the commencement of any construction, the Contractor shall contact all utilities to coordinate schedules.
- H. Prior to the commencement of any construction, the Contractor shall give the Town Clerk a minimum of 24 hours advance notice.

SECTION 2: DESIGN CRITERIA

2.1 Points Of Conflict

The spacing of intersections between arterials, collectors and residential streets is critical to maintaining safe driving conditions. Intersections of collector streets with arterial streets should be located at approximately 1/3-mile intervals. Intersections of residential streets with arterial streets should be located at approximately 1/4 mile intervals. Intersections of streets with arterial streets should be in line with streets intersecting on the opposite side. Streets intersecting on opposite sides of a residential or collector street should be directly across from each other or offset a minimum of 200 feet. Residential streets shall be designed to provide adequate circulation between collector streets. Intersections of arterials and residential streets should be minimized as much as possible.

Design Element	Major Arterial	Minor Arterial	Rural Arterial	Major Residential Collector	Minor Residential Collector	Local Street	Low Volume Local Street	Rural Local Street	Alleys
Right of Way Width	120	120	80	80	09	60	54	60	20
Roadway Width (Pavement Width)	74	70	30-36	40	36	32	28	24	18
Total Through Lanes	9	4	2	2	2	2	2	2	N/A
Travel Lanes	12	12	12	12	12	12	10	12	N/A
Paved Shoulder (each side)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unpaved Shoulder (each side)	N/A	V/N	2-2	V/N	V/N	N/A	N/A	N/A	N/A
Bike Lane Width	4	4	Shldr.	4	N/A	N/A	N/A	N/A	N/A
Planted Raised Median (including curb and 1' gutter pan)	18	14	N/A	16 (flush)	A/A	N/A	N/A	N/A	N/A
Curb & Gutter				6" Barrie	r with 2' Gut	ter			
Parking Lane	N/P	N/P	N/P	N/P	9	4	4	N/P	N/P
Plant Strip (each side) (1)	13	10	25-22	15	7	12	11	14	N/A
Sidewalk Width	10	10	None	5	5	5	5	N/A	N/A
Landscape/Buffer Easement (each side - outside of Right of Way)	30	30	0£	9	9	9	9	N/A	N/A
Flow Line Curb Radius - Arterial	50	50	50	30	30	25	25	25	N/A
Flow Line Curb Radius - Collector	30	30	30	25	25	20	20	20	15
Flow Line Curb Radius - Local	25	25	25	20	20	15	15	15	15
Design Speed	50 mph	45 mph	40 mph	35 mph	35 mph	25 mph	25 mph	25 mph	15 mph
Typical Posted Speed Limit	45 mph	40 mph	40 mph	35 mph	35 mph	25 mph	25 mph	25 mph	15 mph
Minimum Degree of Curve	6	8.8	8.8	14.3	14.3	32.7	32.7	32.7	
Curve Radius	955	775	650	475	475	175	175	175	60
Cross Slope w/o Super Elevation				Maximum 4	⊧% - Minimur	n 2%			
Super Elevation Maximum	4% required	Reverse Crown 2%	Normal Crown	Normal crown	Normal crown	Normal crown	Normal crown	Normal crown	N/A
Maximum Street Grade	5%	5%	2%	%9	%9	6%	6%	6%	N/A
Minimum Street Grade	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Maximum Grade at Intersection	2% for 300	3% for 300	3% for 300	4% for 150	4% for 150	4% for 150	4% for 150	4% for 150	4% for 150
	D = D	Detached		N/P = Not	Permitted		N/A = Not	Applicable	

2.2 JOHNSTOWN STREET DESIGN CRITERIA TABLE

NOTE: (1) Includes curb, gutter and sidewalk (may meander).

2.3 Horizontal Alignment

		HORIZONT	AL ALIGNME	NT		
Street Type	Design Speed*	Minimum Tangent Between Curves or at Intersections	Minimum Corner Sight Distance (1)	Minimum stopping Sight Distance (2)	Minimum Super- Elevation Allowed (3)	Minimum Grade (4)
Local/Residential	25 mph	100 ft.	300 ft.	200 ft.	0	0.75%
Minor Collector	35 mph	150 ft.	400 ft.	275 ft.	0	0.75%
Major Collector	35 mph	150 ft.	400 ft.	275 ft.	0	0.75%
Arterial Major/Minor	45-50 mph	200 ft.	500 ft.	350 ft.	0.04 ft./ft.	0.75%

Horizontal alignments of streets shall be based upon the following table:

20 mph in School Zones

- (1) Corner sight distance measured from a point on the minor road, parallel to the roadway, 15 feet from the edge of the major road pavement, and from an eye height of 3.50 feet on the minor road to a height of object of 4.25 feet on the major road.
- (2) Stopping sight distance measured from the driver's eye, 3.50 feet above the pavement to the top of an object six inches high on the pavement anywhere on road.
- (3) On arterial streets with full super-elevation, the minimum centerline radius shall become 830 feet. Maximum change in cross slope shall be 1% in 25 feet.
- (4) Minimum grade shall apply to gutter flowline grade.
- * Lower design speeds may be used when existing conditions will not allow for 30 mph design speed for Residential or 40 mph design speed for Collectors and Industrial/Commercial if approved in writing by the Town prior to preliminary submittal.

2.4 Vertical Alignment

A. Figures E1 and E2 give minimum length of crest and sag vertical curves for various algebraic differences in grade. Streets designed in the Town of Johnstown shall meet or exceed these minimums.





- B. Connection with existing streets shall be smooth transitions and existing grades shall be shown for at least 150 feet on all sides of the connection. The grade and ground lines of all streets that dead-end, except cul-de-sacs, shall be confined for 500 feet beyond the proposed construction. The grade and ground lines of all arterials shall be designed to continue 1000 feet beyond the end of proposed construction.
- C. Minimum length of vertical curves should be in accordance with Figures E1 and E2. The higher classified street at an intersection shall govern the through grade.
- D. For crest curves the street centerline and curb and gutter shall be constructed with vertical curves in accordance with Figure E1.
- E. For sag curves the street centerline should include a curve with minimum length as shown on Figure E2, for grade changes exceeding 0.75%. Curb and gutter should be constructed with no vertical curve in these areas. For grade changes larger than 0.75%, both street centerline and the curb and gutter shall be constructed with vertical curves in accordance with Figure E2. No single point grade break shall exceed 0.75%.
- F. The Design Engineer shall show centerline profiles (on utility drawings) through intersections and details at any mid-block crosspans to provide smooth riding transitions.
- G. The Design Engineer shall provide cross-sections to the construction limits at 100-foot intervals on arterial streets showing existing and proposed construction.
- H. Crown or cross slopes shall be no more than 4% or less than 2% measured from the crown to the lip of the gutter.

2.5 Intersections

A. Approach grades at all intersections should not exceed 2.0%. The distance of approach grades shall be as follows:

1.	Collectors intersecting arterials	125 feet
2.	Collectors intersecting collectors	50 feet
`		FO f = +

- 3. Residential intersecting collectors 50 feet
- 4. Residential intersecting residential 50 feet
- B. Angle of intersection should be perpendicular but in no case more than 10°.

2.6 Curb, Gutter & Sidewalk

- A. All streets shall have concrete curb and gutter.
- B. Arterial streets shall have vertical curb and gutter. Collector and residential streets may use either vertical curb and gutter or drive over curb and gutter.
- C. All streets shall have sidewalks. The minimum width of sidewalks shall be 4 feet for residential and collector streets and 5 feet for arterial streets.

- D. Arterial streets shall have detached sidewalks. Sidewalks shall adjoin the curb and gutter at all intersections.
- E. Collector streets may have either attached or detached sidewalks.
- F. Cross-pans shall be a minimum of 6 feet wide and (6") inch deep. Mid-block cross-pans shall be a minimum of 12 feet wide and (6") inches in depth.
- G. Minimum grade on cross-pans at flowline shall be 0.6%.
- H. Approaches to cross-pans should be in accordance with Part II, sections 2.2 and 2.3 of this manual.

2.7 Auxiliary Lanes

The necessity for auxiliary lanes bordering or within a new subdivision shall be determined by a traffic study. A registered professional transportation engineer must either prepare the report or have stamped the report. Background traffic from adjoining developments (if any) must be considered to anticipate future street system use.

2.8 On-street Parking & Driveways

All on street parking shall be in accordance with the cross section details shown at the end of Part II of this manual.

2.9 Medians & Street Lights

All medians shall be designed so that there is no interference with traffic flow. The nose of medians shall be a minimum of 10 feet behind the flowline of the intersected street. The minimum radius shall be 2 feet to flowline. Only outfall curb & gutter should be used to construct all medians unless otherwise approved by the Town engineer.

Streetlight design, type and location shall be the discretion of the Town of Johnstown. The Town may require alternative style lights at major intersections and along collector or arterial streets.

SECTION 3: PAVEMENT DESIGN

3.1 Geotechnical Study

The Town requires a geotechnical soil analysis for all proposed developments. A registered professional geotechnical engineer must either prepare or stamp the report. The report should address subsurface soil conditions and classification, groundwater conditions, physical properties of the soils onsite, recommendations for basement, floor slab and footing requirements, analysis procedures, pavement sections (for each roadway classification) and any special earthwork or drainage specifications to be used onsite. Tests should be conducted on representative samples for the following properties; water content, dry density, swell-consolidation, unconfined compressive strength, grain size, plasticity index, R-value and water-soluble sulfate content.

3.2 Minimum Pavement Sections

Pavement design and materials shall be based on the soils properties onsite and AASHTO procedures and guidelines. The geotechnical report must include minimum pavement thickness for all the streets within the proposed development and adjacent arterial roadway improvements.

SECTION 4: STREET CUTS

4.1 Procedures

- A. Obtain a Right-Of-Way Work Permit from Town Clerk's office.
- B. Notify Town Clerk not less than 24 hours or more than 48 hours prior to the start of work.
- C. Erect traffic control prior to commencement of work.

4.2 Requirements

- A. Excavated material shall be stored in neat compact piles.
- B. Private driveways should be kept open whenever possible. <u>Contractor shall notify the affected driveway owner 24 hours prior to commencing construction.</u> If they must be closed, then closing should be as short and convenient a time as possible.
- C. No more than 200' of trench shall be open at one time.
- D. When traffic or conditions warrant, the Town may specify work hours. General work hours are 7:00 AM to 5:00 PM Monday through Friday and 8:00 AM to 4:00 PM on Saturday Weekend or holiday work shall only be allowed by prior written permission from the Town.
- E. Two opposing lanes of traffic shall be maintained at all times unless approved on the permit by the Town Engineer.
- F. All street cuts shall be surfaced with an acceptable permanent pavement or a temporary hot or cold mix paving material immediately after completion of the flow-fill operation and prior to the opening to traffic by the end of the work day. See Part V, Section 02575.
- G. The Contractor is responsible for maintaining the temporary patches deemed necessary by the Town.
- H. All asphalt or concrete removals shall be saw-cut or cut using an adequate cutting wheel on a grader or other heavy piece of equipment.
- I. All asphalt and concrete cuts shall extend a minimum of twelve (12) beyond the trench limits.

4.3 Backfill

- A. The Town shall, at its sole discretion, require FLOWABLE FILL in lieu of COMPACTED BACKFILL on a case-by-case basis.
- B. Upon approval of the backfill, the surface shall be restored.

4.4 Gravel Surface

Alleys or streets which presently exist as gravel surfaces shall be replaced with CDOT Class 6 aggregate base course material one (1) inch greater in depth than what presently exists (minimum of 4") and to the line and grade of the existing gravel surface.

4.5 Bituminous Surface

- A. Subgrade and base material must be compacted to at least 95% of maximum density within $\pm 2\%$ of optimum moisture content as determined by ASTM D 698-78.
- B. Edges shall be saw cut straight with vertical faces. Existing asphalt shall be milled back eighteen (18) inches at the vertical face and tack coated prior to paving to form a weather tight seal.
- C. Tack coat existing asphalt/concrete edges.
- D. Asphalt pavement shall have a minimum full depth thickness of six (6) inches.
- E. The final lift of asphalt pavement shall not be placed in a lift greater than three (3) inches compacted, or less than two and one-half $(2\frac{1}{2})$ inches compacted.
- F. Asphalt content $5.8\% \pm 0.5\%$.
- G. Asphalt mix pavement temperature shall be between 234° and 325° F when placed and compacted.
- H. All asphalt pavements shall be compacted to at least 95% density as determined in accordance with ASTM D 2041-78, D 2726-83 and D 2950-82.
- I. Following placement of the asphalt surface, the joints where the new asphalt abuts the old shall be sealed with a fog or painted coat of bitumen cement.
- J. The permit holder who cuts the street shall be responsible for the workmanship and materials of such cut for a period of two (2) years.

4.6 Portland Cement Concrete Pavement

- A. Subgrade and base material must be compacted to at least 95% of maximum density within \pm 2% optimum moisture content as determined by ASTM D 698-78.
- B. Edges to be saw cut back a minimum of twelve (12) inches from the excavation with a full depth cut.

- C. Concrete pavement shall be replaced to the existing depth, or a minimum of six (6) inches, whichever is greater. Concrete shall be dowelled into adjacent concrete with a minimum of 4 equally spaced, 18 inch #4 deformed bars driven in a minimum of 8 inches. Bars shall be free of rust, dirt and oil.
- D. Minimum mix design of six (6) sacks of cement per cubic yard with an air content of 5% 8% by volume and shall have a minimum 28-day strength of 4000 psi.
- E. Concrete shall be protected from weather and rapid loss of moisture.
- F. Concrete shall be protected from vehicular traffic for a period not less than seven (7) days (two days with high/early concrete).
- G. Joints shall be cleaned and sealed with hot poured elastic type joint filler or an approved equal.
- H. Concrete patches shall be a minimum full lane in width and a minimum length of three (3) feet.

4.7 Bituminous Pavement With Concrete Base

- A. Subgrade and base material must be compacted to at least 95% of maximum density within $\pm 2\%$ of optimum moisture content as determined by ASTM D 698.
- B. Edges shall be cut back a minimum of twelve (12) inches from the excavation. Edges shall be straight with vertical faces. Existing asphalt shall be milled back eighteen (18) inches and tack coated prior to paving to form a weather tight seal.
- C. Tack coat existing asphalt/concrete edges.
- D. Asphalt pavement shall be the greater of six (6) inches or the existing pavement.
- E. The final lift of asphalt pavement shall not be placed in lifts greater than two and one-half (2¹/₂) inches compacted.
- F. Asphalt content $5.8\% \pm 0.5\%$.
- G. Asphalt mix pavement temperature shall be between 234° and 325° F when compacted.
- H. All asphalt pavements shall be compacted to at least 95% density as determined in accordance with ASTM D 2041-78, D 2726-83 and D 2950-82.
- I. Following placement of the asphalt surface, the joints where the new asphalt abuts the old shall be sealed with a fog or painted coat of bitumen cement.
- J. The concrete pavement shall be 1" greater than the existing thickness.
- K. The finished bituminous wearing surface shall not be placed on top of the concrete base for a period of two (2) days or until the compressive strength of the concrete is 2000 psi.

L. The permit holder who cuts the street shall be responsible for the workmanship and materials of such cut for a period of two (2) years.

SECTION 5: TESTING

5.1 Material Testing

All materials used for infrastructure construction onsite are subject to testing at the discretion of the Town. In the case of testing failures, the specific material and corresponding structure will be removed and replaced. All testing must be done based on ASTM or AASHTO standards.

5.2 Developer's Responsibility

The developer is responsible for all costs associated with the testing of materials and the scheduling of such testing.

SECTION 6: INSPECTION

6.1 Procedures

Inspection will be completed by the Town for all proposed developments under construction. If a problem involving materials or workmanship is encountered the Town reserves the right to request testing be conducted. Prior to placement of any curb, gutter, sidewalk or pavement, the subgrade shall be properly compacted, tested and then proofrolled. Proofrolls shall be performed in the presence of the Town Inspector and/or Town Representative.

6.2 Contractor's Responsibility

The contractor shall be responsible for the workmanship and materials for a period of two (2) years from the issuance of final acceptance unless specifically identified in this Section.

END OF SECTION

SECTION 7: HOT MIX ASPHALT PAVEMENT

1.1 Description

These specifications include general requirements applicable to all types of plant mixed hot mix asphalt pavements (HMAP). This work consists of one or more courses of asphalt mixture constructed on a prepared foundation in accordance with specifications. The design intent is to provide pavement with adequate thickness and quality to provide a serviceable life of 20 years. It is also the intent to provide construction in accordance with these specifications with a high standard of practice. This item shall include all labor, equipment, and materials to manufacture, place and compact asphalt cement concrete for pavement purposes.

TEST PROCEDURE DEFINITIONS		
CP - ##	Colorado Department of Transportation Testing Procedure	
ASTM	American Society for Testing & Materials	
AASHTO	American Association of State Highway & Transportation Officials	
CP-L ####	Colorado Department of Transportation Lab Procedure	

1.2 Materials

The hot mix asphalt shall be composed of a mixture of aggregate, filler, hydrated lime and asphalt cement. Some mixes may require polymer modified asphalt cement. Some mixes may allow up to 20% reclaimed asphalt pavement (RAP).

A. Aggregates

1. Aggregates for HMAP shall be of uniform quality, composed of clean, hard, durable particles of crushed stone, crushed gravel, or crushed slag. Excess of fine material shall be wasted before crushing. The material shall not contain clay balls, vegetable matter, or other deleterious substances and shall meet the following requirements:

Aggregate Test Property	Coarse: Retained on #4	Fine: Passing the #4
Fine Aggregate Angularity, CP-L 5113 Method A		
Traffic Level 1 & 2	-	40%
Traffic Level 3 to 5	-	45%
Two Fractured Faces, CP-45		
Top and Middle Lifts	80%	-
Bottom Lifts	70%	-
LA Abrasion, AASHTO T 96	45%	-
Flat and Elongated (Ratio 5:1) %, AASHTO M 283	10%	-
Adherent Coating (Dry Sieving) ASTM D 5711	0.5%	-
Sand Equivalent. AASHTO-T 176	-	45%
- 2. <u>Reclaimed Asphalt Pavement material (RAP) shall be used only where</u> <u>specifically allowed and shall be of uniform quality and gradation with a</u> <u>maximum size no greater than the nominal aggregate size of the mix.</u> <u>Mixes shall not contain more than 20 percent RAP.</u>
- 3. The HMAP gradation for the Proposed Design Job Mix gradation shall be wholly within the control point gradation range set forth in the following Table. The allowable job mix gradation for production shall be the design job mix gradation with the tolerances of section 7.3 applied. The Proposed Design Job Mix and the final allowable job mix gradation for production shall report all sieve sizes listed in the following table:

GRADATION RANGE

(Percent by Weight Passing Square Mesh Sieves, AASHTO T 11 & T 27)

Mixture	***SX (1/2" nominal)		SX (1/2" nominal) S (3/4" nominal)		SG (1" nominal)	
Grading	Control	Restricted	Control	Restricted	Control	Restricted
Sieve	Points	*Zone	Points	Zone	Points	Zone
Size						
1 1⁄2"					100	
1"			100		90-100	
3/4"	100		90-100		0	
1/2"	90-100		0		0	
3/8"	0		0		0	
#4	0		0		0	39.5
#8	28-58	39.1	23-49	34.6	19-45	26.8-30.8
#16	0	25.6-31.6	0	22.3-28.3	0	18.1-24.1
#30	@	19.1-23.1	0	16.7-20.7	0	13.6-17.6
#50	0	15.5	0	13.7	0	11.4
*#200	2.0-8.0		2.0-7.0		1.0-7.0	

*The restricted zone is a guideline only. It is recommended that mix design gradations go above the restricted zone boundaries, on the "fine" side.

**These limits shall include the weight of lime at 1.0%.

***Limited to top mat on local/residential streets.

@These sieve sizes used only to determine the final allowable Job Mix Formula (JMF) in accordance with 7.3.

VMA shall be based on tests of the Bulk Specific Gravity of the Compacted Mix (CP-L 5103) and Aggregate (T 84 & T 85), and calculated according to CP-48. All mixes shall meet the minimum VMA specified in the table on the following page:

MINIMUM VMA, %

Nominal Maximum		Air Voids **	
Particle Size *	3.5%	4.0%	4.5%
1"	12.5	13.0	13.5
3⁄4"	13.5	14.0	14.5
1/2"	14.5	15.0	15.5

*Nominal Maximum Particle Size is defined as one sieve size larger than the first sieve to retain more than 10%, but shall not exceed the 100% passing size. The Nominal Maximum Particle Size can vary during mix production even when the 100% passing size is constant.

**Minimum VMA criteria apply to the mix design only. The minimum VMA criteria shall be linearly interpolated based on actual air voids. See Section 7.3 for tolerances.

- B. Performance Graded Asphalt Binders (Asphalt Cement)
 - 1. The CONTRACTOR shall provide to the TOWN acceptable 'Certifications of Compliance' of each applicable asphalt cement grade from the supplier. Upon nonconformance with the specifications, the asphalt cement may be rejected as directed by the TOWN. When production begins, the CONTRACTOR shall, upon request, provide to the TOWN a sufficient amount to conduct the required tests. Larger aggregate mix designs require more material for testing, and in no case less than one gallon of each specified asphalt cement. Larger mixes (1" or larger) require at least two gallons. Additionally, when requested, the CONTRACTOR shall provide the refinery test results that pertain to the asphalt binders used during production
 - 2. Asphalt Cement binder shall meet the requirements of the Superpave Performance Graded Binders (PG) as presented in the Table on the following page:

Property	PG 58-28	PG 64-22	PG 76-28
Traffic Level: Recommended Usage	1 and 2	2 through 5	3 through 5
Flash Point Temperature, °C, AASHTO T 48	230 Min.	230 Min.	230 Min.
Viscosity at 135 °C. Pas, ASTM D 4402	3 Max.	3 Max.	3 Max.
Dynamic Shear, Temperature [°] C, where [°] C/Sin δ @ 10 rad/sec. ≥ 1.00 Kpa, AASHTO TP 5	58 °C	64 °C	76 °C
Rolling Thin Film Oven Re	sidue Properties	, AASHTO T 240	
Mass Loss, %, AASHTO T 240	1.00 Max.	1.00 Max.	1.00 Max.
Dynamic Shear, Temperature $^{\circ}$ C, where $^{\circ}$ G/Sin δ @ 10 rad/sec. \geq 2.20 Kpa, AASHTO TP 5	58 °C	64 °C	76 °C
Elastic Recovery1, 25 °C, % Min.*	N/A	N/A	50 Min.
Pressure Aging Vessel Residue Proper	ties, Aging Temp	perature 100 °C AA	SHTO PP1
Dynamic Shear, Temperature [°] C, where [°] G/Sin δ @ 10 rad/sec. ≤ 5,000 Kpa, AASHTO TP 5	19 °C	25 °C	28 °C
Creep Stiffness, @ 60 sec. Test Temperature in °C, AASHTO TP 1	-18 °C	-12 °C	-18 °C
S, Mpa, AASHTO TP1	300 Max	300 Max	300 Max
m-value, AASHTO TP1	.300 Min.	.300 Min.	.300 Min.
**Direct Tension Temperature in ^o C, @ 1.0 mm/min., Where Failure Strain > 1.0%, AASHTO TP3	-18 °C	-12 °C	-18 °C

PROPERTIES OF PERFORMANCE GRADED BINDERS

*Elastic Recovery by Task Force 31, Appendix B Method

**Direct tension measurements are required when needed to show conformance to AASHTO MP.1.

- A. Additives Hydrated Lime
 - 1. Lime shall be added at the rate of 1% by dry weight of the aggregate and shall be included in the amount of material passing the No. 200 sieve. Hydrated lime for aggregate pretreatment shall conform to the requirements of ASTM C 207, Type N. In addition, the residue retained on a 200-mesh sieve shall not exceed 10% when determined in accordance with ASTM C 110. Drying of the test residue in an atmosphere free from carbon dioxide will not be required.
- B. Tack Coat
 - 1. The emulsified asphalt, for Tack Coat shall be CSS-1h or SS-1h and conform to AASHTO M208 or M140, respectively.

2.1 Mix Design and Plant Produced Mixture Requirements

The mix design materials shall be those listed in Section 1.2 and used for the project. No substitutions are allowed during production.

- A. Grading SG (1-inch nominal aggregate) shall only be designed using the 150 mm Superpave molds. Hveem Stability and Lottmans are not required for Grading SG mixtures. Grading S an SX shall be designed using 100 mm Superpave molds when using the Superpave design method.
 - 1. Marshall Mixture Design Method

Note: Only Superpave methods will be allowed starting March 2004.

- 2. Superpave Mixture Design Method
 - a. <u>The CONTRACTOR shall submit a Proposed Design Job Mix for</u> <u>each mixture required by the Contract.</u> The design shall be determined using Colorado Procedure CP-L 5115 for the Superpave Method of Mixture Design. Guidance is provided in "Superpave Level 1 Mix Design" SP-2 published by the Asphalt Institute. Mix designs shall meet the requirements on the following page:

SUPERPAVE MIXTURE PROPERTIES

Traffic Level	0	1 & 2 & 3	4 & 5
Traffic Loading, Total 18 kip ESALs Over Design Life (Usually 20 Years)	Non Vehicular or Paths	1) < 300,000 2) 300,000 to <1.0 Million 3) 1.0 to < 3.0 Million	4) 3.0 to 10.0 Million 5) > 10.0 Million
Initial gyrations, N _{initial} Air Voids, (For Information Only)	6	7	8
N _{initial} Air Voids, (For Information Only)	>8.5	>9.5	>11.0
Design gyrations, N _{design} (Air Void:3.5% to 4.5%) (See Note 1,2)	50	75	100
Hveem Stability CP- L 5106 (Grading S & SX only) (See Note 1,2)	N/A	28 Min.	30 Min.
Voids Filled with Asphalt, MS-2	70-80	65-78	65-75
Lottman, Tensile Strength Ratio, % Retained, CP-L 5109, Method B	80 Min.	80 Min.	80 Min.
Lottman, CP-L 5109 Dry Tensile Strength, psi	30 Min.	30 Min.	30 Min.
VMA %. CP-48 (See Notes 1,2)	Minimum VMA criteria applies to the mix design only (see table <i>STREET-14</i>). The minimum VMA criteria shall be linearly interpolated based on actual air voids.		

Note 1: Maximum Theoretical Specific Gravity of mix by CP-51. Note 2: Refer to Section 7.3 for production tolerances.

2.2 Mixture Design Submittals

- A. General Requirements
 - 1. <u>The CONTRACTOR shall submit all mixture designs, Certificates of</u> <u>Compliance, and laboratory data to the TOWN for approval at least 7</u> <u>calendar days before construction is to begin. The mix design (Proposed</u> <u>Design Job Mix) must be approved by the TOWN prior to the start of</u> <u>construction.</u>

- 2. Mixture Designs shall be performed in a materials laboratory under the direct supervision of and shall be stamped and signed by a Professional Engineer licensed in Colorado and practicing in this field. In addition, the CONTRACTOR shall submit, as part of the mixture design, laboratory data documents to verify the following:
- Source of materials.
- Gradation, specific gravity, source and description of individual aggregates and the final blend.
- Aggregate physical properties.
- Proposed Design Job Mix: aggregate and additive blending, final gradation shown on 0.45 power graph, optimum asphalt content.
- Mixing and compaction temperatures used.
- Mixture properties determined at a minimum of four asphalt contents and interpolated at optimum and graphs showing mixture properties versus asphalt content.
- 3. The TOWN reserves the right to verify the CONTRACTOR'S mix design for each hot asphalt pavement grading utilizing materials actually produced and stockpiled. If requested, the CONTRACTOR shall provide a sufficient quantity of each aggregate, mineral filler, RAP, and additive for the required laboratory tests, if required by the TOWN. The TOWN may request a Certificate of Conformance or Certificate of Compliance at any time on any material used.
- B. Pre-paving Meeting
 - 1. TOWN may require a pre-paving meeting of all parties involved in supply, haul, laydown inspection, quality control and quality acceptance of HMAP. Areas of responsibility and contact names and numbers should be shared.

3.1 Equipment

- A. Mixing Plant
 - 1. The mixing plant shall be capable of producing a uniform material, have adequate capacity, and be maintained in good mechanical condition. Defective parts shall be replaced or repaired immediately if they adversely affect the proper functioning of the plant or plant units, or adversely affect the quality of the HMAP.
 - 2. Dust, smoke, or other contaminants shall be controlled at the plant site to meet all air quality requirements in the "Colorado Air Quality Control Act," Title 25, Article 7, CRS and regulations promulgated thereunder.
 - 3. Acceptable safety equipment, approved by the TOWN, shall be provided by the CONTRACTOR to accommodate sampling of the mat in a minimum of 3 different areas and testing.

B. Hauling Equipment

- 1. Trucks used for hauling HMAP material shall have tight, clean, smooth beds thinly coated with a minimum amount of paraffin oil, lime solution, or other approved release agent. Petroleum distillates such as kerosene or fuel oil will not be permitted. Each truck shall have a cover of canvas or other suitable material to protect the mixture from the weather and excessive temperature loss or cooled layers of mix in truck.
- C. Bituminous Pavers
 - 1. Self-propelled pavers shall be provided for full lane width paving, and shall be equipped with a screed assembly, heated if necessary, capable of spreading and finishing the HMAP material in full lane widths applicable to the typical section and thickness shown in the Contract. Pavers used for shoulders, patching and similar construction, not requiring fine grade control, shall be capable of spreading and finishing courses of HMAP material in widths shown in the Contract.
 - 2. The paver's receiving hopper shall have sufficient capacity for a uniform spreading operation and shall have an automatic distribution system that will place and spread the mixture uniformly in front of the screed.
 - 3. The paver shall be capable of operating at forward speeds consistent with uniform and continuous laying of the mixture. Stop and go operations of the paver shall be avoided. The screed or strike-off assembly shall produce the specified finished surface without tearing, shoving, or gouging the mixture. Self-propelled pavers shall be equipped with automatic screed controls with sensors capable of sensing grade from an outside reference line, and maintaining the screed at the specified longitudinal grade and transverse slope. The sensor shall be constructed to operate from either or both sides of the paver and shall be capable of working with the following devices when they are required for the situation:
 - Ski-type device at least 30 feet in length
 - Short ski or short shoe
 - Adequate length of control line and stakes, if no other type of geometric control is present.
 - 4. The controls shall be capable of maintaining the screed at the specified transverse slope within plus or minus 0.1 percent. Automatic mode should be used where possible. If the automatic controls fail or malfunction, the equipment may be operated manually for the remainder of the normal working day, provided specified results are obtained.
 - 5. If the CONTRACTOR fails to obtain and maintain the specified surface tolerances, the paving operations shall be suspended until satisfactory corrections, repairs, or equipment replacements are made.
 - 6. Placement of HMAP on a waterproof bridge deck shall be accomplished with equipment that will not damage the membrane or protective covering.

3.2 Manufacture

- A. Preparation of Aggregates
 - 1. Heating and drying of the aggregates shall be accomplished without damaging the aggregate. Hydrated lime shall be added to achieve complete and uniform coating of the aggregate, in accordance with one of the methods on the following page:
 - Lime Slurry Added to Aggregate: The hydrated lime shall be added to the aggregate in the form of a slurry and then thoroughly mixed in an approved pug mill. The slurry shall contain a minimum of 70 percent water by weight.
 - Dry Lime Added to Wet Aggregate: The dry hydrated lime shall be added to wet aggregate (a minimum of three percent above saturated surface dry) and then thoroughly mixed in an approved pug mill.
 - 2. The lime-aggregate mixture may be fed directly into the hot plant after mixing or it may be stockpiled for not more than 90 days before introduction into the plant for mixing with the asphalt cement. The hydrated lime may be added to different sized aggregates and stockpiled by adding 75 percent of the lime to the aggregate passing No. 4 sieve and 25 percent to the aggregate retained on the No. 4 sieve.
- B. Mixing
 - 1. The dried aggregates and asphalt cement shall be combined in the mixer in the quantities required to meet the design job mix. The materials shall be mixed until the aggregate is completely and uniformly coated, and the asphalt cement is uniformly distributed throughout the aggregate Baghouse fines shall be fed back to the mixing plant in a uniform and continuous manner to maintain uniformity in the mixture. The Baghouse, fines feeder, auger, and related equipment, shall be in recommendation. If the TOWN determines that non-uniform operation of the equipment is detrimental to the mixture, it may suspend all paving operations until the CONTRACTOR takes appropriate action.
 - 2. The minimum temperature of the mixture when discharged from the mixer shall be as shown in the following table:

Asphalt Grade	Minimum Discharge Temperature	Maximum Discharge Temperature
PG 58-28	275 °F	305 °F
PG 64-22	290 °F	320 °F
PG 76-28	320 °F	350 °F

MIXTURE DISCHARGE TEMPERATURES

- 3. HMAP mix shall be produced at the lowest temperature within the specified temperature range that produces a workable mix and provides for uniform coating of aggregates (95 percent minimum in accordance with AASHTO T 195), and that allows the required compaction to be achieved.
- 4. HMAP mix may be stored provided that any and all characteristics of the mixture are not altered by such storage. If storing or holding of the mixture causes segregation, excessive heat loss, or adversely affects the quality of the finished product, corrective action shall be taken. Unsuitable mixture shall be disposed of at the CONTRACTOR'S expense.
- 5. When placing hot bituminous mixture over bridge decks covered by waterproofing membrane, the minimum temperature of the mixture, when rolling operations begin, shall be 250 degrees Fahrenheit. The job mix temperature may be increased up to 30 degrees Fahrenheit to obtain this temperature.

4.1 Tack Coat

- A. Prior to placement of HMAP, a tack coat shall be applied to all existing concrete and asphalt surfaces. The emulsified asphalt shall be diluted 1:1 with water and applied at 0.10 + or – 0.01 gallons per square yard of diluted material. The TOWN may direct other application rates to match the age of condition of the surface.
- B. The surface to receive the tack coat shall be dry and cleaned by sweeping, or another approved method, until dust, debris, and foreign matter are removed. The tack coat shall then be applied uniformly by squeegee, brooms, or distributor. Prior to paving, all water must have evaporated from the tack coat. Contaminated areas shall be cleaned and tack coat shall be reapplied.

5.1 Placement

A. Hot Mix asphalt shall be placed only on approved, properly, constructed surfaces that are free from loose material, water, frost, snow, or ice. The hot mix asphalt and tack coat shall be placed in accordance with the temperature limitations of the table on the following page and only when weather conditions permit the pavement to be properly placed and finished as determined by the TOWN. Placement temperature as stated shall be increased by 5 degrees Fahrenheit for each 10 miles per hour wind velocity to a maximum increased minimum placement temperature of 70 degrees Fahrenheit.

MINIMUM AIR AND SURFACE TEMPERATURES LIMITATIONS FOR MIX PLACEMENT

Compaction	Top Layer of Pavement*		Lower Layers *	
Thickness	PG 58-28 PG 64-22	PG 76-28	PG 58-28 PG 64-22	PG 76-28
<2 inches (not recommended)	60 °F	75 °F	N/A	N/A
2 inches to <3 inches	50 °F	65 °F	40 °F	50 °F
3 inches or more - SG mix only	50 °F	50 °F	40 °F	40 °F

*Air temperature is taken in the shade. Surface temperature is taken on the subgrade or base. The TOWN may not waive the above temperature limitations for PG 76-28.

- A. The mixture shall not be placed at a temperature lower than 245 degrees Fahrenheit for mixes containing PG 58-28 or PG 64-22 asphalt, and 290 degrees Fahrenheit for mixes containing polymer modified asphalt. Mix which is too cold or damaged by weather, will be rejected.
- B. The mixture shall be laid upon an approved surface, spread and struck off to obtain the required grade and elevation after compaction. The minimum lift thickness shall be at least three times (preferably four times) the nominal particle size. The mixture should be placed approximately 25 percent thicker than the existing surrounding mat thickness to account for compaction. Raking is discouraged and will not be allowed except to correct major problems of grade and elevation. Casting or raking that causes any segregation will not be permitted.
- C. On areas where the use of mechanical spreading and finishing equipment is impracticable, the mixture shall be carefully dumped, spread, raked, screened, and luted by hand tools to the required compacted thickness plus 25 percent. Carefully move or minimally work the HMAP mix with the use of rakes, lutes, or shovels to avoid segregation. Mixtures made with modified asphalt cement require more rapid completion of handwork areas than for normal mixtures. Hauling and placement sequences shall be coordinated so that the paver is in constant motion. Excessive starting and stopping shall not be allowed. A construction joint shall be placed any time the paver stops, and the screed drops enough to cause a surface dip in violation of section 7.3, Surface Tolerances; or the mat temperature falls below that allowed in section 7.2, Compaction. Bituminous pavers shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable. Echelon paving will be permitted.

6.1 Longitudinal Joints

- A. The longitudinal joints in both a new pavement and an overlay pavement layer shall offset the joint in the layer immediately below by a minimum of 6 inches. The joints in any pavement layer shall not fall in a wheel track or path. The joints in the top layer of new pavement, not built on top of an existing pavement, shall be located on lane lines, or as shown on the plans. Longitudinal joints shall be minimized, where feasible, with wide paving pulls or echelon paving. Joints shall not cross any centerline, lane line, or edge line unless approved by the TOWN. The CONTRACTOR shall submit, prior to paving, a joint plan and pavement marking plan showing locations and the methods to establish a field control line. The TOWN must approve such plans prior to paving. The CONTRACTOR shall use a continuous string line to delineate longitudinal joints during paving as shown on the joint plan. All string lines shall be removed at the end of each day's paving.
- B. The free edge of the paved pass shall be laid as straight as possible, to the satisfaction of the TOWN. This joint, if cold, shall be tack coated prior to placement of adjacent paving.
- C. The new compacted mat shall overlap the previously placed mat no more than 1.5 inches. Excess overlap or thickness shall not be raked or cast onto the new mat, but shall be wasted by pulling back and removing. The hot edge shall be blocked or bumped in a smooth line consistent with the previous longitudinal edge. Minor raking will not be allowed to correct major grade problems or provide mix around manholes and meter covers. The longitudinal joint shall be rolled from the hot side and overlap the joint by approximately 6 inches on the cold side.

6.2 Transverse Joints

- A. The CONTRACTOR shall submit, prior to paving, a joint plan showing locations and the methods to be used to construct transverse joints. The TOWN must approve such plans prior to paving. Placing of the HMAP shall be continuous with a minimum of transverse joints, and rollers shall not pass over the unprotected end of a freshly laid mixture. Transverse joints shall be formed by cutting back on the previous run to expose the full depth of course. Tack coat material shall be applied to contact surfaces of all joints just before additional mixture is placed against the previously compacted material.
- B. The end of transverse joints shall be located so they will be constructed with a full head of mix in front of the screed. When butt joints are constructed, runoff boards shall be used to support the roller on the downstream side of the joint. All tapered sections, rounded edges and segregated areas shall be removed to achieve a vertical face at the butt joint before paving is restarted.
- C. When a tapered joint is required for traffic access, the ramp shall be removed back to a full depth from the segregated section before paving is restarted.

D. When restarting paving operations, the paver screed shall be placed on the starter block on the completed side of the transverse joint. The starter block should be approximately 25% of the thickness of the existing completed mat, so that adequate grade and compaction can be achieved on starting the paving operation. The screed should be nulled (angle removed) when on starting blocks and an up angle of attack set. Proper head mix should be introduced into the paver prior to starting. The new compacted (downstream) side of the joint may be up to 3/16 inches higher than the old (upstream) side. Raking of this joint shall not be allowed except to correct major grade problems. The surface tolerance at the transverse joint must be verified with a 10-foot straight edge before the paver is more than 100 feet from the joint.

7.1 Segregation

- A. The asphalt mixture shall be transported and placed on the roadway without segregation. All segregated areas shall be removed immediately and replaced with specification material before the initial rolling. If more than 50 square feet of segregated pavement is removed and replaced in any continuous 500 linear feet of paver width laydown, operations shall be discontinued until the source of the segregation has been determined and corrected.
- B. The TOWN will visually determine areas that are segregated, and may also use density and gradation measures to help in this determination. The TOWN will visually determine the extent of the segregation. The CONTRACTOR will not be allowed additional compensation for correction of segregated areas.

7.2 Compaction

- A. The temperature of the mixture immediately behind the screed shall be at least 245 degrees Fahrenheit for PG 58-28 or PG 64-22 binder and 290 degrees Fahrenheit for PG 76-28 binder. The breakdown compaction shall be completed before the mixture temperature drops 20 degrees Fahrenheit.
- B. The HMAP shall be compacted by rolling. The number, weight, and type of rollers furnished shall be sufficient to obtain the required density and surface texture while the mixture is in a workable condition. Compaction shall begin immediately after the mixture is placed and be continued until the required density is obtained. Final compaction shall be obtained using steel wheel rollers.
- C. If the required density is not achieved and the surface temperature falls below 185 degrees Fahrenheit, or there is obvious surface distress or breakage, no further compaction effort will be permitted unless approved by the TOWN. Price Reduction criteria in Section 76-28 asphalt cements shall be 235 degrees Fahrenheit. These minimum compaction temperatures may be adjusted according to the asphalt cement supplier recommendations. Adjusted minimum compaction temperatures must be shown on the approved mix design or on other asphalt cement supplier documents, to be available on the job site. Pavement operations shall be suspended when density requirements are not met, and the problem shall be resolved prior to continuing paving operations.

- D. All roller marks shall be removed with the finish rolling. Use of vibratory rollers with the vibrator on will not be permitted on bridge decks.
- E. The CONTRACTOR shall establish a rolling pattern or procedure during the beginning of paving operations, which will achieve the required compaction and surface tolerances. This procedure may be re-evaluated by the CONTRACTOR and TOWN throughout the paving operations.
- F. All HMAP paving shall be compacted to between 92.0 and 96.0 percent of Maximum Theoretical (Rice) Density, (CP-51: Maximum Specific Gravity of Bituminous Paving Mixtures). The average (mean) of the 3 most recent production CP-51 Rice values shall be used in calculating Relative Compaction according to CP-44.
- G. The CONTRACTOR shall core the pavement, as required by the TOWN, for field density tests in accordance with Colorado Procedure 44, Method B (AASHTO T 230), or for field calibration of nuclear density equipment in accordance with the Appendix of Colorado Procedure 81 (ASTM D 2950). At a minimum, cores for nuclear density equipment calibration shall be taken at the beginning of placement of each pavement layer or change of mixture materials or gradation. Untested areas during placement will also require cores to be taken to verify compaction.
- H. Along forms, curbs, headers, walls, and all other places not accessible to the rollers, the mixture shall be thoroughly compacted with mechanical tampers.
- I. Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective, shall be immediately removed and replaced with fresh hot mixture and compacted to conform with the surrounding area.

7.3 Production Tolerances

- A. The variation between any two contracts with the surface shall not exceed 3/16 inch in 10 feet for full lane width paving. For patching surface tolerances the variation shall not exceed 1/2" in 10 feet. Irregularities exceeding the specified tolerance shall be corrected at the CONTRACTOR'S expense. Transverse measurements for variations shall exclude breaks in the crown sections.
- B. Production test results that deviate from the design job mix by more than shown in the table on the following page are subject to conformity with job specific plans and specifications:

JOB MIX FORMULA TOLERANCES

Item	
Passing No. 3/8" and Larger ¹	±6%
Passing No. 4 and No. 8	± 5%
Passing No. 30 to No. 50	± 4%
Passing No. 200 ²	± 2%
Air Voids	± 1.2%
VMA	± 1.2%
Hveem Stability	See footnote #3
Asphalt Content	± 0.3%
Asphalt Content, Mixes with >10% RAP	± 0.4%

- 1. There is 1.0 percent tolerance for the maximum sieve size.
- 2. Mixes with passing No. 200 sieve material produced over 7.0 percent are allowed only when the above Air Voids and VMA tolerances are still met.
- 3. Hveem Stability must meet the minimum value specified in Superpave Mixture Properties Table.
- C. When disagreements concerning determination of specification compliance occur, only valid tests from both the AGENCY and CONTRACTOR will be considered. The AGENCY shall determine validity. Generally, valid tests are those in which sampling and testing have been performed according to referenced procedures and the results are within stated precision statements. When disagreements occur with asphalt content and gradation tests results, solvent extracted aggregate testing shall take precedence over burnoff oven extracted aggregate, which shall take precedence over cold feed belt testing.

8.1 Sub-grade Preparation(See Site Specific Geotechnical Report)

- A. General:
 - 1. Natural soils shall be stripped of organic matter, scarified, moisture treated and compacted by the Contractor prior to asphalt placement.
 - 2. The top one (1) foot of the sub-grade shall be moisture treated to between optimum and two (2) percent above optimum moisture content. The testing agent retained by the Contractor/Developer will perform the necessary tests to determine compliance with this provision.
 - 3. Soils shall be compacted to at least 95 percent of maximum standard Proctor dry density when tested in accordance with AASHTO T 99, Method A.
 - 4. Moisture treatment and compaction requirements shall also apply where additional fill is required to bring the subgrade to the required elevation.
 - 5. The subgrade shall be in a moist condition at the time the asphalt is placed.
 - 6. Asphalt shall not be placed on any portion of the subgrade which has not been tested for correct grade and cross-section.
 - 7. The subgrade shall be cleared of any loose material which may have fallen upon it.

- 8. All soft and unyielding material and other portions of the subgrade which will not compact readily when rolled or tamped shall be removed as directed and replaced with suitable granular material, placed and compacted as specified.
- 9. Proofroll inspections are required for all Town roadways prior to the placement of asphalt.
 - a. Valid for 24 hours unless precipitation renders the inspection invalid.
 - b. Must be performed in the presence of a Town Inspector, Town Superintendent or Town Engineer.
 - c. Must be performed with a tandem axle truck that meets one of the following conditions: 1) a minimum 3,000 gallon water truck fully loaded, or 2) a rear end dump truck having a minimum bed capacity of 8 cubic yards fully loaded.

9.1 Soil Sterilization

- A. Prior to paving, an approved herbicide shall be applied at the rates and methods recommended by the manufacturer.
- B. Treatment shall be made at a temperature acceptable to the manufacturer.
- C. The Contractor shall comply with all Colorado statutes and all local ordinances or codes pertaining to the use and application of fungicides, insecticides, herbicides, or other agricultural chemicals.
- D. The Contractor will be held responsible for any damage to plant growth outside the designated treatment areas, where such damage is attributable to carelessness or improper application of the herbicide. Care shall be exercised to prevent powder spray or vapor drift which may damage crops, gardens, shrubs, or trees in the vicinity of the areas being treated.
- E. Herbicides shall not be used where they may contaminate water used for irrigation or drinking purposes.

END OF SECTION

SECTION 02514

SIGNING, STRIPING, AND STREET MARKING

PART 1 - GENERAL

1.1 Description

This section covers materials and methods to be used for the installation of traffic control signs, lane striping, and street markings.

1.2 Quality Assurance

- A. All traffic control signs shall conform to the requirements of the Manual on Uniform Traffic Control Devices (MUTCD) with regard to sign type, size, location, and mounting specifications.
 - 1. All signs and posts will be supplied by the Town of Johnstown at the contractors cost.
- B. All striping and pavement markings shall comply with the MUTCD and Section 627 of the CDOT Construction Specifications.
 - 1. Striping shall be aligned with and parallel to the roadway. Alignment shall not vary more than 2" in 100' of roadway.

1.3 Submittals

- A. Provide a CDOT Certificate of Compliance (COC) of the epoxy striping material.
- B. Provide manufacturers certification that all of the thermoplastic marking material meets the requirements of AASHTO M 249 specification.

PART 2 - MATERIALS

2.1 Lane Striping Material

- A. Permanent Epoxy Striping Material
 - 1. Comply with CDOT Section 713.17.
 - 2. Permanent striping must be installed prior to Final Acceptance.
- B. Temporary Striping Material
 - 1. Comply with CDOT Section 708.05.
 - 2. Temporary striping may not be in service for more than 9 months.

2.2 Thermoplastic Pavement Marking Material

- A. Thermoplastic Marking Material
 - 1. Comply with CDOT Section 713.12.
 - 2. Use for STOP bars and cross walks only.
- B. Preformed Thermoplastic Material
 - 1. Comply with CDOT Section 713.14.
 - 2. Use for all symbols, numbers, and letters.

PART 3 - EXECUTION

3.1 Traffic Control Signs

- A. Signs shall be installed in the locations represented on the Drawings and in conformance with the MUTCD. Details for the orientation of the sign with respect to the edge of asphalt and the minimum height of the sign are included in the Drawings as well as in the MUTCD.
- B. Posts shall be buried at minimum of 2' and shall be concrete encased below grade. Posts shall be installed vertical both parallel to and perpendicular to the roadway. Post holes shall be at least twice the diameter of the posts to provide adequate concrete anchorage.

3.2 Epoxy Lane Striping

- A. Do not stripe until the final asphalt lift has cooled for at least 72 hours.
- B. Pavement surface shall be clean and free of soil or other debris that will prevent permanent adhesion of the epoxy to the pavement. Contractor shall use compressed air or high pressure water to remove any debris. If water is used the pavement surface shall be allowed to completely dry prior to applying the epoxy material.
- C. Application methods shall comply with CDOT Section 627.05. Only an experienced applicator shall operate the equipment.
- D. Striping width shall be in conformance with the dimensions shown on the Drawings. Epoxy striping shall be applied to achieve a 90 mil thickness. Application rate shall be between 100 s.f./gal (min.) and 110 s.f./gal (max.). Ambient air temperature and pavement surface temperature shall be a minimum of 50° F for application.

3.3 Thermoplastic Pavement Marking

A. Do not apply until the final asphalt lift has cooled for at least 72 hours.

- B. Pavement surface shall be clean and free of soil or other debris that will prevent permanent adhesion of the material to the pavement. Contractor shall use compressed air or high pressure water to remove any debris. If water is used the pavement surface shall be allowed to completely dry prior to applying the material.
- C. Application methods shall comply with CDOT Section 627.06. Only an experienced applicator shall operate the equipment.
- D. Application width shall be in conformance with the dimensions shown on the Drawings. Material shall be applied to achieve a 3/32" minimum thickness at the edges and 1/8" minimum thickness in the middle. Ambient air temperature and pavement surface temperature shall be a minimum of 50° F for application.

3.4 Preformed Thermoplastic Pavement Marking

- A. Do not apply until the final asphalt lift has cooled for at least 72 hours.
- B. Pavement surface shall be clean and free of soil or other debris that will prevent permanent adhesion of the material to the pavement. Contractor shall use compressed air or high pressure water to remove any debris. If water is used the pavement surface shall be allowed to completely dry prior to applying the material.
- C. Application methods shall comply with CDOT Section 627.09. Only an experienced applicator shall operate the equipment.
- D. Application temperatures and heating methods recommended by the manufacturer shall be followed.

END OF SECTION

SECTION 02235

AGGREGATE BASE COURSE

PART 1 - GENERAL

1.1 Work Included

- A. Furnish and install aggregate base course consisting of one (1) or more courses of crushed aggregate on prepared subgrade.
- B. Related work specified elsewhere:
 - 1. Section 02220, Structure Excavation, Fills, and Embankment.
 - 2. Hot Mix Asphalt Pavement
- C. Applicable Publications:
 - 1. The term "State Specifications" in this Section refers to State Department of Highways, Division of Highways, State of Colorado "Standard Specifications for Road and Bridge Construction", 1991. Measurement and Payment sections of "State Specifications" do not apply.

1.2 Testing and Inspection

- A. Field Compaction Control:
 - 1. One (1) compaction test shall be performed for each 2,500 square yards of aggregate placed.
 - 2. ASTM D2922 (AASHTO T238): Tests for Density of Soil and Soil-Aggregate in Place by Nuclear Methods.
 - 3. ASTM D1556 (AASHTO T191): Tests for Density for Soil in Place by the Sand Cone Method.
 - 4. ASTM D2167 (AASHTO T205): Tests for Density of Soil in Place by the Rubber Balloon Method.
 - 5. Compaction shall be to the following minimum densities, reference ASTM D698 or AASHTO T99, unless otherwise indicated:
 - a. Subgrade: 95%.
 - b. Aggregate Base Course: 95%.
 - 6. Moisture Content:
 - a. All compacted backfill shall be within 2% (±) of the optimum moisture content of the soil as determined by ASTM D698.
 - b. Water shall be added to the material, or the material shall be harrowed, disced, bladed or otherwise worked to insure a uniform moisture content, as specified.

- B. Thickness: In-place compacted thickness will not be acceptable if exceeding following allowable variation from required thickness:
 - 1. Aggregate Base Course: No limit on greater thickness, but no more than 0.25" less than the thickness specified.
- C. Surface Smoothness: Test finished surface of aggregate base course for smoothness using 10' straight edge applied parallel with, and at right angles to, centerline of paved area. Surfaces will not be acceptable if exceeding the following tolerances for smoothness.
 - 1. Aggregate Base Course: 0.25".
- D. Proof rolling is required as specified above.

1.3 Submittals

- A. Submit test results for each source of material.
 - 1. Provide for the following:
 - a. Gradation.
 - b. Los Angeles wear test.
 - c. Aggregate quality.
 - d. Liquid limits.
 - e. Plasticity index.
 - 2. Perform soil compaction tests, ASTM D698 or AASHTO T99, Standard Method of Test for Moisture Density Relations of Soils using a 5.5 lb. Rammer and a 12" drop.
 - a. Use method A, B, C or D as appropriate, based on soil condition and judgement of the testing laboratory.
 - b. Sample tests will be representative of materials to be placed.
 - c. Determine and provide maximum density curve for each type of material encountered or utilized.
 - d. Include Atterberg Limits, gradation and specific gravity.
 - 3. Provide a density test of a typical sample.
 - 4. Test results will be basis for field quality control.

1.4 Job Conditions

- A. Drainage and Ground Water:
 - 1. Maintain excavations free from water during construction.
 - 2. Remove water encountered during construction to the extent necessary to provide a firm subgrade and remove standing water.
 - 3. Divert surface runoff or use other means necessary to accomplish the above.

- B. Weather:
 - 1. Do not construct aggregate base course during freezing weather.
 - 2. Do not place on frozen surfaces.
 - 3. Do not place frozen materials, snow or ice in aggregate base course.
 - 4. Do not deposit, tamp, roll or otherwise mechanically compact in water.
- C. Scarify surface, reshape and compact to required density, completed or partially completed areas of work disturbed by subsequent construction operations or by adverse weather.

PART 2 - PRODUCTS

2.1 Aggregate

- A. Crushed stone or crushed gravel conforming to Section 703.03 of "State Specifications".
- B. Gradation: Class 6 of Section 703.03 of "State Specifications" with an "R" value between 70 and 77.

PART 3 - EXECUTION

3.1 Subgrade(See Site Specific Goetechnical Report)

- A. Scarify to a depth of 6" and compact. Not required if existing subgrade has been recycled.
- B. Remove exposed cobbles, stones or boulders greater than 6" in size that create an irregular surface at subgrade.
- C. Compact and consolidate subgrades such that they are free from mud and sufficiently stable to remain firm, dense and intact.
- D. Level and roll subgrade so that aggregate base course will be compact and bond well with the subgrade.
- E. Proof rolling is required for subgrade for areas to receive aggregate base course. Proof rolling shall be done after the specified compaction has been obtained. Areas found to be weak and those areas which fail a proof roll shall be ripped, scarified, wetted or dried as necessary and recompacted to the required density and moisture. Repeat proof rolling testing until all areas to be paved have passed the proof rolling tests.

3.2 Installation

- A. Maximum compacted thickness of one (1) layer not to exceed 6".
- B. Proof rolling is required for aggregate base course to receive pavement. Proof roll with a heavy rubber tired roller. Proof rolling shall be done after the specified compaction has been obtained. Areas found to be weak and those areas which fail a proof roll shall be ripped, scarified, wetted or dried as necessary and recompacted to the required density and moisture. The operating weight of the roller shall be not less than 12 tons per wheel. Tires shall be inflated to a minimum pressure of 70 lbs. per square inch and a maximum pressure of 90 lbs. per square inch. Repeat proof rolling testing until all areas to be paved have passed the proof rolling tests.

END OF SECTION





























SIGN POST DETAIL RURAL STREETS










PART III

WATER SYSTEM SPECIFICATION AND DETAILS

SECTION 1: TOWN POLICY

1.1 Developer's Responsibility	WATER-1
1.2 Town Jurisdiction	WATER-1

SECTION 2: DESIGN CRITERIA & HYDRAULIC ANALYSIS PARAMETERS

2.1 Water Supply	WATER-1
2.2 Demand	WATER-1
2.3 Analysis	WATER-1

SECTION 3: WATER DISTRIBUTION SYSTEM

3.1 Definitions	WATER-2
3.1.1 Town Utility System	WATER-5
3.1.2 Source Facilities	WATER 5
5.1.5 Oustomer Oystem	WATER-5
3.2 Service Line Requirements	WATER-5
3.2.1 Water Lines	WATER-6
3.2.2 Valves	WATER-6
3.2.3 Fire Safety Requirements	WATER-6
3.3 Installation Requirements	WATER-7
3.4 Inspection & Quality Control	WATER-8

SECTION 4: NONPOTABLE IRRIGATION SYSTEMS

4.1 Section intentionally left blank war	ATER-9
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SECTION 5: WATER SYSTEM CONSTRUCTION SPECIFICATIONS

SECTION 01060 – REGULATORY REQUIREMENTS	WATER-11
SECTION 01070 – ABBREVIATIONS	WATER-13
SECTION 01656 - DISINFECTION OF DOMESTIC WATER LINES	WATER-14
SECTION 01666 – TESTING PIPING SYSTEM	WATER-17
SECTION 02615 – DUCTILE IRON PIPE	WATER-20
SECTION 02622 – PLASTIC PIPE	WATER-26
SECTION 02641 – VALVES	WATER-28
SECTION 02644 – HYDRANTS	WATER-32
SECTION 02710 - WATER DISTRIBUTION & TRANSMISSION LINES	WATER-34

SECTION 5: WATER DISTRIBUTION SYSTEM DETAILS

UTILITY ENCASEMENT DETAIL DITCH CROSSING DETAIL DITCH CROSSING ENCASEMENT DETAIL CONCRETE ENCASEMENT AIR AND VACUUM VALVE DETAIL 2" BLOWOFF INSTALLATION CONDUIT CROSSING DETAIL FIRE HYDRANT DETAIL GATE VALVE DETAIL 1¹/₂" AND 2" METER DETAIL METER NOTES STANDARD RESIDENTIAL METER SETTING PIPE BEDDING DETAIL THRUST RESTRAINT DETAIL VALVE OPERATOR DETAIL WATER SERVICE DETAIL WATER AND SEWER SERVICE LOCATIONS

<u>PART III</u>

WATER SYSTEM SPECIFICATION AND DETAILS

SECTION 1: TOWN POLICY

1.1 Developer's Responsibility

It shall be the policy of the Town to require the developer and/or the developer's engineer to consult with the appropriate Fire Protection District to review any special conditions that exist or that should be addressed in the design of the Town's distribution system in the development.

1.2 Town Jurisdiction

The design criteria and construction specifications set forth in Part III are considered minimum requirements. The Town reserves the right to alter or add to the criteria and/or specifications based on site-specific conditions.

SECTION 2: DESIGN CRITERIA & HYDRAULIC ANALYSIS PARAMETERS

2.1 Water Supply

Potable water is supplied by the Town of Johnstown.

2.2 Demand

Potable water system domestic demand criteria for the Town of Johnstown is as follows:

Average Day Demand	= 150 gal/day/cap. (assume 3.0 people per dwelling unit)
Maximum Day Demand	= 2 x Avg. Day Demand
Peak Hour Demand	= 1.5 x Max. Day Demand

2.3 Analysis

The following two conditions <u>must</u> be checked for the water distribution system, and documented in a hydraulic study of the proposed system:

- A. At peak hour demand the minimum residual pressure in the system must be 40 psi.
- B. For the maximum day demand + ISO fire flow the minimum residual pressure in the system must be 20 psi.

SECTION 3: WATER DISTRIBUTION SYSTEM

3.1 Definitions

Unless defined otherwise herein, all terms contained in this regulation shall have the meaning assigned to such terms by the Rules and Regulations of the Town.

"Auxiliary Water Supply" Any water supplies on or available to the premises other than the Town's approved public potable water supply. These auxiliary waters may include any natural source(s) such as a well, spring, river, stream, etc., or "used waters" or "industrial fluids". These waters may be polluted or contaminated or may be objectionable and constitute an unacceptable water source over which the Town does not have sanitary control.

"Backflow Preventer" A device or means designed to prevent backflow or back-siphonage.

"Air Gap" The unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank, plumbing fixture, or other device and the flood level rim of said vessel. An approved air-gap shall be at least double the diameter of the supply pipe, measured vertically, above the top of the rim of the vessel. and, in no case less than one inch. When an air-gap is used at the service connection to prevent the contamination or pollution of the water system, an emergency by-pass shall be installed around the air-gap system and an approved reduced pressure principle device shall be installed in the by-pass system.

"Reduced Pressure Principle Device" An assembly of two independently operating approved check valves with an automatically operating differential relief valve between the two check valves, tightly closing shut-off-valves on either side of the check valves plus properly located test cocks for the testing of the check and relief valves. The entire assembly shall meet the design and performance specifications and approval of a recognized and Town approved testing agency for backflow prevention assemblies. The device shall operate to maintain the pressure in the zone between the two check valves at a level less than the pressure on the public water supply side of the device. At cessation of normal flow the pressure between the two check valves, the differential relief valve shall operate to maintain the reduced pressure in the zone between the check valves, the differential relief valve shall operate to maintain the reduced pressure in the zone between the check valves, the differential relief valve shall operate to maintain the reduced pressure in the zone between the check valves by discharging to the atmosphere. When the inlet pressure is two pounds per square inch or less, the relief valve shall open to the atmosphere. To be approved, these devices must be readily accessible for inline maintenance and testing and be installed in a location where no part of the device will be submerged.

"Double Check Valve Assembly" An assembly of two independently operating approved check valves with tightly closing shut-off valves on each side of the check valves plus properly located test cocks for testing of each check valve. The entire assembly shall meet the design and performance specifications and approval of a recognized and Town-approved testing establishment for backflow prevention devices. To be approved, these devices must be readily accessible for in-line maintenance and testing.

"Back Pressure" means backflow caused by a pump, elevated tank, boiler or other means that could create pressure within the system greater than supply pressure.

"Backsiphonage" means the flow of water or other liquids, mixtures or substances into the distribution pipes of a water system from any source other than its intended source caused by the sudden reduction of pressure in the water system.

"Certified Inspector and/or Tester" means a person who has passed a State-approved and/or sponsored testing and/or inspection course and who is listed by the State as a certified inspector and/or tester.

"Check Valve" means a self-closing device, which is designed to permit the flow of fluids in one direction and to close if there is a reversal of flow.

"Colorado Department of Health Cross-Connection Control Manual" A manual that has been published by the State addressing cross-connection control practices which will be used as a guidance document for the agency in implementing a Cross-Connection Control Program.

"Contamination" means an impairment of the quality of the potable water by sage, industrial fluids or water liquids, compound or other materials to a degree that creates an actual hazard to the public health through poisoning or through the spread of disease.

"Critical Level" means the critical level C-L or C/L marking on a backflow prevention device or vacuum breaker which is a point conforming to approved standards and established by the testing laboratory (usually stamped on the device by the manufacturer), which determines the minimum elevation above the flood-level rim of the fixture or receptacle served at which the device may be installed. When a backflow prevention device does not bear a critical level marking, the bottom of the vacuum breaker, combination valve, or the bottom of any such approved device shall constitute the critical level.

"Cross-Connection" shall mean any unprotected, actual, or potential connection or structural arrangement between the Town's water system, or a consumer's potable water system and any other source, or system, through which it is possible to introduce into any part of the potable system any substance, other than the intended potable water, with which the system is supplied. By-pass arrangements, jumper connections, removable sections, swivel or changeover devices and other temporary, or permanent, devices through which, or because of the "backflow" can or may occur, are considered to be cross-connections.

"Cross-Connections - Controlled" A connection between a potable water system and a nonpotable water system with an approved backflow prevention device properly installed that will continuously afford the protection commensurate with the degree of hazard.

"Flood-Level Rim" means the edge of the receptacle from which water overflows.

"Hazard, Degree Of" The term is derived from an evaluation of the potential risk to public health and the adverse effect of the hazard upon the water system.

"Hazard - Health" Any condition, device, or practice in the water system and its operation which could create, or in the judgment of the Town may create a danger to health hazard is a structural defect, including a cross-connections, in a water system.

"Hazard - Pollutional" An actual or potential threat to the physical properties of the water system or to the potability of the Town's or the consumer's potable water system but which would constitute a nuisance or be aesthetically objectionable or could cause damage to the system or its appurtenances, but would not be dangerous.

"Hazard - System" An actual or potential threat of severe damage to the physical properties of the water system or the consumer's potable water system or of a pollution of contamination, which would have a protracted affect on the quality of the potable water in the system.

"Industrial Fluids System" Any system containing a fluid or solution that may be chemically, biologically or otherwise contaminated or polluted in a form or concentration such as would constitute a health, system, pollution or plumbing hazard if introduced into an approved water supply. This may include, but not be limited to: polluted or contaminated waters; all types process waters and "use waters" originating from the water system which may have deteriorated in sanitary quality; chemicals in fluid form; plating acids and alkalis, circulated cooling waters connected to an open cooling tower and/or cooling towers that are chemically or biologically treated or stabilized with toxic substances; contaminated natural waters such as from wells, springs, streams, rivers, irrigation canals or systems, etc.,; oils, gases, glycerin, paraffin, caustic and acid solutions and other liquid and gaseous fluids used in industrial or other purposes or for firefighting purposes.

"Non-Potable Water/Raw Water" means water that is not safe for human consumption or that is a questionable potability.

"Pollution" means the presence of any foreign substance (organic, inorganic, radiological or biological) in the water that may degrade the water quality so as to constitute a hazard or impair its usefulness.

"Potable Water" means water free from impurities in amounts sufficient to cause disease or harmful physiological effects. The bacteriological, chemical and radiological quality shall conform to State of Colorado Drinking Water Regulations.

"Reclaimed Water" means water treated at a waste water facility and is not safe for human consumption.

"Submerged Inlet" means a water pipe or extension there to from a public water supply terminating in a tank, vessel, fixture or appliance that may contain water of questionable quality, waste or other contaminant and which is unprotected against backflow.

"Vacuum" means any pressure less than that exerted by the atmosphere.

"Vacuum Breaker, Atmospheric Non-pressure Type" means a vacuum breaker designed so as not to be subject to static line pressure or installed where it would be under pressure for not more than twelve hours in any twenty-four hour period.

"Vacuum Breaker, Pressure Type" means a vacuum breaker designed so as not to be subjected to static line pressure.

"Water-Service Connection" means the terminal end of a service connection from the water system; i.e., where the Town loses jurisdiction and sanitary control over the water at its point of delivery to the customer's water system. If a meter is installed at the end of the service connection, then the service connection shall mean the downstream end of the meter. There shall be no unprotected takeoffs from the service line ahead of any meter backflow prevention device located at the point of delivery to the customer's water system. Service Connection shall also include water service connection from a fire hydrant and all other temporary or emergency water service connections from the water system.

3.1.1 Town Utility System

The utility system shall consist of the Town's water distribution system; and shall include all those facilities of the water system under the complete control of the Town up to the point where the customer's system begins. The Town's distribution system shall include the network of conduits used for the delivery of water from the source to the customer's system to the curb stop. From the curb stop to the building is the owner's responsibility.

3.1.2 Source Facilities

Source facilities are owned and operated by the Town of Johnstown. The source facilities shall include all components of the facilities utilized in the production, treatment, storage, and delivery of water to the distribution systems.

3.1.3 Customer System

The customer system shall include those parts of the facilities beyond the termination of the distribution system, which are utilized in conveying Town delivered domestic water to points of use.

3.2 Service Line Requirements

- A. It shall be the builders'/contractors' responsibility to protect the meter from freezing or other physical damage during construction and acceptance by the owner, it shall be the owner's responsibility to protect the meter from freezing or other physical damage.
- B. Licenses and Permits Required: All water service installations shall be done by a contractor who has an individual working for him that possesses a current master plumber's card and that individual shall personally accomplish or directly supervise the installation work.
- C. A connection permit shall be secured from the Town a minimum of three (3) days prior to construction, at which time the contractor shall familiarize himself with the standards and specifications, select and obtain approval of the appropriate standard water service installation for the building or facility, submit an appropriate set of mechanical plans, inform the Town Clerk of the intended schedule for construction, and present the appropriate trade card.
- D. Where a street cut is required for water service, the contractor shall rebuild the road base in accordance with Part II, Section 4 of the Johnstown Design Criteria & Construction Regulations.
- E. All permits, fees, and licenses shall be paid for by the contractor, plumber or other doing work in the Town prior to the start of construction.

3.2.1 Water Lines

- A. Water lines may be either ductile iron pipe (DIP) or polyvinyl chloride (PVC) pipe. Refer to specification Section 02615 and 02622 for pipe requirements.
- B. Standard distribution lines shall have an inside diameter of 8 inches.
- C. Distribution lines may need to be larger than 8 inch to provide fire flows or adequate pressures.
- D. Distribution lines shall be located within street R.O.W. under the pavement. A minimum horizontal separation between the water line and any other utility in the street shall be 10 feet. The water line shall also not be closer than 5 feet to the flowline of the curb and gutter
- E. When conditions require that a waterline be installed outside of a street R.O.W., the waterline is to be centered in a minimum 20-foot wide exclusive easement. Waterlines outside of street R.O.W. should be avoided and the Town reserves the right to not allow them when another option is available.
- F. All water lines shall have tracer wire attached to the pipe. Tracer wire shall be extended to the surface at all hydrants within an enclosed riser behind each hydrant. Tracer wire shall be continuity tested and approved prior to street subgrade preparation.

3.2.2 Valves

- A. The distribution system shall be valved such that future repairs or maintenance may be isolated with disruption of service to as few customers as possible.
- B. Minimum valving of the distribution system would involve a gate valve on each line at "tees" and crosses.
- C. Appurtenant valves such as air relief/vacuum relief valves, check valves, pressure reducing valves, etc. shall meet the requirements of specification Section 02641. The necessity and location of these valves will be evaluated on a site-by-site basis.

3.2.3 Fire Safety Requirements

- A. All subdivisions shall be required to provide minimum fire protection as required by the appropriate fire protection district.
- B. Fire hydrants shall be spaced no more than 500 feet for residential and 300 feet for commercial or as directed by the Fire District.
- C. Minimum fire line water line size shall be six (6) inches.
- D. Fire hydrants that have two and one-half (2-1/2) inch outlets shall have the National Standard Thread. Four and one-half (4-1/2).

- E. Minimum residual pressure of 20 psi during max day + fire flow at the fire hydrants will be required to provide minimum fire protection.
- F. Fire hydrants shall be located on dedicated street rights-of-way and be accessible to the standard fire pumper.
- G. No surface features or utilities shall be installed within 5-feet of a fire hydrant.

3.3 Service Installation Requirements

- A. Water service lines shall be located so as to take the shortest, most direct route (preferably perpendicular to the main) from the water main to the building. The service line shall be located such that the meter pit is not under any paved driveway or service road. All water service lines shall have a minimum cover of five (5) feet. No service lines shall be laid parallel to or within three (3) feet of any bearing wall, which might be thereby weakened. The water service shall be laid at uniform grade and in straight alignment.
- B. All meters 1" and smaller shall be installed by a Town representative. All meters 1-1/2" and larger shall be installed by the contractor at the direction of the Town Representative.
- C. Service Line and Control Valves: The water service line shall be soft Type K copper. The service line shall have a control valve located at the property line with easy access to the Town and said valve shall be located on an appropriate improvements survey, a copy of which shall be forwarded to the Town. Two splices in the service line are allowed every 100 feet. No soldered joints will be allowed underground. Pack joints or approved equal shall be the only acceptable joints. No joints are allowed between the main and the curbstop.
- D. Pressure Reducing Valves: Individual pressure reducing valves shall be installed. On all new construction, the pressure-reducing valve shall be upstream from the meter.
- E. Excavation: All excavations required for the installation of water service shall be open trench work unless otherwise approved by the Town. Pipe laying and backfill shall be performed in the manner described in this manual. All excavations for water service installation shall be adequately guarded with barricades and lights so as to protect the public from hazard. Streets, sidewalks, parkways, and other public or private property disturbing the course of the work shall be restored in a manner satisfactory to the Town.
- F. Tapping the Main: The Maintenance Supervisor of the Town, or his designated representative, is the sole individual authorized to supervise or make taps onto the Town's water mains. The applicants of the building water service permit shall notify the Maintenance Supervisor and Town Inspector when the service is ready for inspection and connection to the main.
- G. Surface Restoration: Paving, curb and gutters, sidewalk, improved services, or other street improvements removed, damaged, or destroyed during construction shall be replaced to the same elevation and alignment with the same type and dimensions as units removed and shall be equal to and consistent with the undisturbed portions of the

improvements existing prior to trench excavation. Debris shall be removed from the site of the work at the expense of the contractor.

- H. Maintenance of Backfill and Surface Warranty: All backfill shall be maintained in a satisfactory condition and all places showing signs of settlement shall be filled and maintained during construction and for a period of one year following the completion of construction except that the warranty period for settlement in asphalt surface streets shall be two years. When the Town notifies the applicant that any backfill is hazardous, he shall correct such hazardous condition at once.
- I. Street Cut Permits: Street cuts permits, and accompanying obligations, are solely the responsibilities of the applicant.

3.4 Inspection & Quality Control

- A. All work shall be inspected by the Town's representative who shall have the authority to halt construction when, in his opinion, the Town's Rules and Regulations, these specifications or proper construction practices is not being adhered to. Whenever any such violation occurs, the Town's representative shall, in writing, order further construction to cease until all deficiencies are corrected.
- B. Except as otherwise provided, no pipe shall be covered without observation by a representative of the Town. Anyone making any installation without such observation shall be required to remove all topsoil or any other covering placed over this facility to be inspected at his own expense.
- C. The Town water system shall be protected from cross-connection and backflow contamination or pollution. The contractor shall isolate within its customers' internal distribution system(s) or its customers' private water system(s) such contaminants or pollutants, which could backflow or backsiphon into the water system.
- D. The contractor shall provide for the maintenance of a continuing program of crossconnection control which will systematically and effectively prevent cross-connections, actual or potential, between its customers' in-plant potable water system(s) and nonpotable water systems, plumbing fixtures and industrial piping systems.
- E. All water service line construction shall be done in accordance with these specifications and all other Rules and Regulations of the Town. The scope of these specifications shall include all new water service line installations from the Town mains to the associated plumbing of the building or any other facility requiring water use.

SECTION 4: NONPOTABLE IRRIGATION SYSTEM

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WATER SYSTEM CONSTRUCTION SPECIFICATIONS

Section 01060 - Regulatory Requirements

Section 01071 - Abbreviations

Section 01656 - Disinfection of Domestic Water Lines

Section 01666 - Testing Piping System

Section 02615 - Ductile Iron Pipe

Section 02622 - Plastic Pipe

Section 02641 - Valves

Section 02644 - Hydrants

Section 02710 - Water Distribution and Transmission Lines

Refer to Part V for other applicable specifications.

WATER DISTRIBUTION SYSTEM

SECTION 01060

REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.1 General

A. All public works construction within the boundaries of the Town of Johnstown shall be performed in accordance with the requirements of these specifications.

1.2 Approved Plans

A. Public works construction shall be done in accordance with engineered construction drawings for the work prepared by an engineer registered in the State of Colorado and accepted by the Town.

1.3 Notice Before Beginning Work

- A. The contractor shall notify the Town Clerk at least 24 hours before beginning any construction. If for any reason work should stop on a project during any stage of construction for a period of more than forty eight (48) hours, it shall be the responsibility of the contractor to notify the Town at least forty eight (48) hours to any resumption of work on the project. The contractor may work extended shifts, double shifts, or hours other than the normal workday of Town personnel only with written permission form the Town, except in the event of an emergency.
- B. When Inspectors are required to work overtime, it shall be at the contractor's expense.

1.4 Inspection

A. All work shall be inspected by a representative of the Town who shall have the authority to halt construction when, in his opinion, these specifications or standard construction practices are not being followed. Whenever any portion of these specifications is violated the Town, by written notice, shall order further construction to cease until all deficiencies are corrected. If deficiencies are not corrected; performance shall be required of the contractor's surety.

1.5 Warranty and Acceptance

- A. The contractor shall warrant all work to be free of defects in workmanship or materials for a period of two (2) years from the date of completion of all construction. If work meets these Specifications, a letter of initial acceptance shall be given at the time of completion. A final acceptance letter shall be given upon final inspection at the end of the warranty period. All defective work shall be corrected by the contractor before final acceptance.
- B. The determination of the necessity for the contractor to repair or replace the work in whole or in part during the warranty period shall rest entirely with the Town whose decision in the matter shall be final and obligatory upon the Contractor.
- C. Corrections of defective work shall be warranted for two years unless otherwise specified by a Town Representative.

SECTION 01070

ABBREVIATIONS

PART 1 - GENERAL

- 1.1 Wherever used in these specifications the following abbreviations shall have the meanings indicated
 - YACHT American Association of State Highway & Transportation Officials
 - APWA American Public Works Association
 - ASTM American Society for Testing and Materials
 - AWWAAmerican Water Works Association
 - DIP Ductile Iron Pipe
 - ISO Insurance Services Office
 - MSS Manufacturer's Standardization Society of the Valves and Fittings
 - NFPA National Fire Protection Association
 - PVC Poly Vinyl Chloride Pipe

SECTION 01656

DISINFECTION OF DOMESTIC WATER LINES

PART 1 - GENERAL

1.1 Description

- A. This section covers disinfection of potable water distribution and transmission lines.
- B. The developer shall employ and pay for a water quality lab to perform all of the testing required by this section. The Developer shall be responsible for all costs associated with water quality testing.
- C. The Contractor shall contact both the Town and the Town's water quality lab to arrange for testing at least 48 hours prior to testing.

1.2 Submittals

A. Certification: Submit manufacturer's certification that materials conform to specified requirements.

1.3 Product Delivery, Storage and Handling

A. Exercise extreme care in handling of hypochlorites, as they may be dangerous to health.

PART 2 - PRODUCTS

2.1 Materials

A. Hypochlorites: Reference AWWA C651-86

PART 3 - EXECUTION

3.1 General

- A. Flush and satisfactorily disinfect new water lines prior to placing in service in accordance with AWWA C651-86.
- B. Clean and swab the interior of the pipe, fittings, valves, or appurtenances with a 5 percent (50,000 ppm) hypochlorite disinfecting solution if dirt, trench water, or other contaminants enter the pipe or will not be removed by flushing operations.
- C. Manipulate valves to prevent the disinfection solution from flowing back into the line supplying the water or into adjacent parts of the inservice distribution system.
- D. Operate valves and appurtenances while the lines are filled with chlorinated water.

3.2 Flushing

- A. Preliminary flushing: Flush pipelines at a minimum velocity of 2.5 ft/sec to remove foreign material prior to disinfection.
 - 1. Do not use preliminary flushing if the tablet method of disinfection is approved by Engineer.
- B. Final flushing: Flush chlorinated water from the lines after chlorination until the chlorine concentration is no higher than that prevailing in the system, or less than 1 mg/l, whichever is higher.

3.3 Methods

- A. In general, apply chlorine using the continuous feed method.
 - 1. Slug method may be used on large diameter pipe where continuous feed is not practical.
 - 2. Tablet method may be used on a short extensions up to 2500 feet of water lines 20 inch and smaller.
- B. Continuous Feed Method
 - 1. Introduce chlorinated water into the lines at a constant rate so that the chlorine concentration in the water lines is maintained at a minimum of 50-mg/l available chlorine.
 - 2. Fill the entire main with the chlorine solution.
 - 3. Retain the chlorinated water in the main for at least 24 hours at which time the treated water shall contain no less than 25 mg/l chlorine throughout the length of the main.
- C. Slug Method
 - 1. Introduce chlorinated water into the lines at a constant rate so that the chlorine concentration in the water lines is maintained at a minimum of 300-mg/l available chlorine.
 - 2. Apply for a sufficient period of time to develop a solid column of chlorinated water that will expose all interior surfaces for a period of at least 3 hours.
 - 3. Measure chlorine residual at the upstream end of the line.
- D. Tablet Method
 - 1. Do not use if trench water or foreign material has entered the line or if the water temperature is below 5° C (41° F).
 - 2. Use only when scrupulous cleanliness has been exercised due to the fact that preliminary flushing is not possible with this method.
 - 3. Place tablets in each section of pipe, hydrants, hydrant leads, and other appurtenances in sufficient number to produce a minimum chlorine concentration of 50 mg/l. Reference table 4, AWWA C651-86.

- 4. Attach tablets, except in hydrants and joints, with an adhesive on the tablet except on the broad side next to the pipe surface.
- 5. Introduce water into the lines at a velocity less than 1 ft/sec.
- 6. Retain the water in the lines a minimum of 24 hours at which time the treated water shall contain no less than 25 mg/l chlorine throughout the main.

3.4 Bacteriologic Tests

- A. Collect samples from the end of the pipeline after final flushing and prior to placing water lines in service and test for bacteriologic quality to show the absence of coliform organism.
 - 1. Collect samples in sterile bottles from a corporation stop with a copper tube gooseneck assemble installed in the main.
 - 2. Do not collect samples from a hydrant or hose.
- B. The number and frequency of samples shall conform to the requirements of the public health authority.
 - 1. In no case shall the number be less than one (1) sample for lines with chlorinated supplies and two (2) samples collected 24 hours apart for unchlorinated supplies.

3.5 Repetition Of Procedure

A. Repeat disinfection until satisfactory samples have been obtained if the initial disinfection or subsequent disinfections fail to produce satisfactory samples.

SECTION 01666

TESTING PIPING SYSTEM

PART 1 - GENERAL

1.1 General

- A. Description: This section covers the hydrostatic testing of water distribution and transmission lines.
- B. Conduct pressure test and leakage test concurrently.
- C. Do not test until at least 7 days have elapsed after the 1st concrete thrust restraint has been cast.
 - 1. 36 hours minimum shall elapse if high-early-strength cement is used.
- D. Conduct tests in increments not to exceed 2 miles of pipe as construction progresses.
- E. No allowance shall be made for pressure reductions accomplished by means of pressure reducing valves or other mechanical means.
- F. Prior to tests Contractor and Engineer shall inspect valves within the test section to make sure they are fully open.
 - 1. Hydrants: Test with the hydrant main valve closed and the auxiliary line valve open.

1.2 Pressure Test

- A. Preparation:
 - 1. Slowly fill pipe with water.
 - 2. Remove all air.
 - a. Install corporation cocks at high points to evacuate the air if permanent air vents are not located there.
 - 3. Leave pipe filled with water at working pressure for a minimum of 24 hours prior to the hydrostatic pressure test.
- B. Test Pressure:
 - 1. For steel pipe, ductile iron pipe and PVC pipe, use a test pressure of 1¹/₂ times the working pressure measured at the lowest elevation of the pipeline test section or the working pressure plus 50 psi, whichever is greater.
 - 2. Maintain the test pressure within \pm 5 psig of the test pressure for at least 2 hours.

1.3 Leakage Test

- A. Definition: Leakage is the quantity of water that must be added to the pipeline to maintain pressure within 5 psi of the specified test pressure after the air has been expelled and the pipe is filled with water.
- B. Maximum allowable leakage:
 - 1. For ductile iron pipe and PVC pipe:

L	=	<u>ND (P^{1/2}) H</u>
		7400

where:

1	=	Maximum	allowable	leakane	in dallo	ne
L	-	IVIAXIIIIUIII	allowable	leanaye	iii yaiiu	115

- N = Number of joints in the length of pipeline tested.
- D = Nominal pipe diameter in inches.
- P = Average test pressure during the leakage test in psig.
- H = Number of test hours.

GALLONS (G) OF ALLOWABLE LEAKAGE PER 100 COUPLINGS PER HOUR*									
Average Te	Average Test Pressure at Lowest Point in Line - psi								
Pipe									
Diameter	50	75	100	125	150	175	200	225	250
Inches									
4	0.71	0.87	1.00	1.12	1.23	1.32	1.42	1.51	1.58
6	1.06	1.29	1.51	1.68	1.84	1.98	2.12	2.25	2.37
8	1.42	1.72	2.00	2.24	2.45	2.64	2.84	3.00	3.16
10	1.77	2.15	2.50	2.79	3.07	3.40	3.54	3.75	3.95
12	2.12	2.58	3.00	3.35	3.68	3.96	4.24	4.52	4.74
14	2.48	3.01	3.50	3.91	4.28	4.62	4.96	5.26	5.50
16	2.83	3.44	4.01	4.47	4.89	5.27	5.68	6.00	6.32
18	3.18	3.87	4.52	5.02	5.52	5.93	6.37	6.75	7.11
20	3.54	4.30	5.00	5.58	6.12	6.58	7.08	7.51	7.90
21	3.73	4.54	5.24	5.88	6.40	6.92	7.42	7.86	8.28
24	4.24	5.16	6.00	6.69	7.34	7.91	8.50	9.01	9.47
27	4.77	5.83	6.74	7.56	8.23	8.90	9.54	10.12	10.66
30	5.30	6.45	7.51	8.37	9.18	9.88	10.62	11.26	11.84
33	5.83	7.13	8.24	9.25	10.06	10.88	11.67	12.36	13.02
36	6.37	7.75	9.01	10.07	11.02	11.88	12.74	13.50	14.22
39	6.88	8.42	9.74	10.83	11.90	12.96	13.79	14.61	15.40
42	7.42	9.08	10.48	11.78	12.82	13.85	14.86	15.74	16.58

• The data are based on 150 psi and represent a leakage of approximately 30 gpd per mile of pipe per inches of pipe diameter for pipe in 13-foot lengths.

2. When testing against closed metal-sealed valves, an additional leakage per closed valve of 0.0078 gal/hour/inch of nominal valve size will be allowed.

1.4 Acceptance

- A. Acceptance shall be on the basis of maximum allowable leakage.
- B. Locate and repair defective materials and joints if the tests disclose leakage greater than that specified.
- C. Repeat tests until the leakage is within the permitted allowance.

SECTION 02615

DUCTILE IRON PIPE

PART 1 - GENERAL

1.1 Description

A. This section covers ductile iron pipe fittings, flanges, specials, and other accessories.

1.2 Product Delivery, Storage and Handling

A. Handling:

- 1. Use slings, pipe tongs or skids.
- 2. Do not drop pipe or fittings including dropping on old automobile tire or other cushions.
- 3. Do not skid or roll pipe into pipe already on the ground.
- 4. Do not damage coating or lining.
- 5. Do not use hooks.
- B. Storage:
 - 1. Maintain lubricant in a sanitary condition during storage.
 - 2. Store rubber gaskets in a cool, dark location away from grease, oil, and ozone producing electric motors and the direct rays of the sun.
 - 3. Do not exceed maximum stacking heights listed in AWWA C600, Tables 1 and 2.

1.3 Alternatives

A. Grooved end couplings may be used in lieu of flanged joints. Where flanged couplings adapters are indicated harnessed mechanical couplings shall be used.

PART 2 - PRODUCTS

2.1 Pipe

- A. Pipe:
 - 1. Standard: ANSI 21.51 (AWWA C151).
- B. Flanged pipe (vaults only, not allowed for direct bury):
 - 1. Standard: ANSI 21.15 (AWWA C151), flat faced.

2.2 Fittings

- A. Flanges, mechanical joint, push-on:
 - 1. Standard: ANSI A21.10 (AWWA C110).
 - 2. Material: Ductile Iron.
 - 4. Pressure rating: 250 psi, 12 in. & smaller; 150 psi, over 12 in.
- B. Threaded:
 - 1. Standard: ANSI B16.4, ANSI B16.14.
 - 2. Pressure rating: 175 psi.

2.3 Joints

- A. Mechanical and push-on:
 - 1. Standard: ANSI A21.11 (AWWA C111)
 - 2. Gaskets: Synthetic Rubber.
 - 3. Lubricant: Furnished by pipe manufacturer.
 - 4. Provide joint retainer gland on all exposed mechanical joints unless tie rods are indicated on the Drawings.
- B. Flanged:
 - 1. Standard: ANSI A21.15.
 - 2. Flanges: ANSI B16.1.
 - 3. Drilling: 125 LB., unless otherwise indicated.

2.4 Couplings

- A. Mechanical couplings:
 - 1. Type: Mechanical compression sleeve.
 - 2. Omit pipe stop unless indicated otherwise on the Drawings.
 - 3. Gaskets: Synthetic Rubber.
 - 4. Dresser Style 38, Smith-Blair Type 411 Baker Series 400, or equal.
- B. Flanged coupling adapters:
 - 1. 3 in. through 12 in.: Dresser Style 127; Smith-Blair Type 912; or equal with locking pins unless otherwise required.
 - 2. Over 12 in: Dresser Style 128; Smith-Blair Type 913, or equal.
 - 3. Gaskets: Synthetic Rubber.
- C. Transition couplings:
 - 1. Dresser Style 162, or equal.

- D. Wall castings:
 - 1. Mechanical Joint with waterstop and tapped holes.
 - 2. Plug all holes with plastic plugs.
- E. Grooved end couplings:
 - 1. Pipe ends: Rigid Groove sizes 2 in. through 24 in. Shouldered for sizes over 24 in.
 - 2. Couplings: Victaulic Style 31, 3 in. through 24 in. Victaulic Style 41, over 24 in.

2.5 Pipe Lining

- A. Cement mortar:
 - 1. Standard: ANSI A21.4.
 - 2. Thickness: Standard.
- B. Polyethylene:
 - 1. Standard: ASTM D1248, Class C, fused on.
 - 2. Thickness: 20 mil.

2.6 Pipe Coatings

- A. Underground or submerged locations (PE sock will be required on all DIP unless specifically waived by the Town):
 - 1. Type: Bituminous.
 - 2. Thickness: Approximately 1. mil.
- B. Exposed Locations:
 - 1. Pipe: Primer; Tnemec "77 Chem-Prime, Mobil "13-R-50 Chromox Q.D.," or approved equal.
 - 2. Flange faces: Rust-Oleum "R-9." Houghton "Rust Veto 344," or approved equal.

2.7 Accessories

- A. Tie rods:
 - 1. Rods: ASTM A307.
 - 2. Steel pipe: ASTM A120, stand weight.
 - 3. Washers: ANSI B27.2, plain steel.
- B. Cable bond connectors:
 - 1. Capacity: 500 amps.
 - 2. Bond: Cadweld brazing cartridges.

- C. Polyethylene tubing:
 - 1. Standard: ANSI 21.5 (AWWA C105)
 - 2. Method: A.

PART 3 - EXECUTION

3.1 Inspection

- A. Examine pipe and fittings and do not use individual section's containing:
 - 1. Cracks.
 - 2. Flaws.
 - 3. Broken or loose lining.
 - 4. Other defects.
- B. Mark defective pipe and remove from the site.
- C. Cutting the Pipe
 - 1. Cut pipe smooth, straight, and at right angles to the pipe axis.
 - 2. Do not damage the pipe and or cement lining.
 - 3. Use a saw, abrasive wheel, or oxyacetylene torch for ductile iron pipe.
 - 4. Do not use an oxyacetylene torch for cutting holes for saddles.
 - 5. Grind cut ends and rough edges smooth.
 - 6. Bevel the cut end for push-on joints.
- D. Polyethylene Encasement:
 - 1. Install polyethylene encasement on ductile iron pipe where required by ANSI/AWWA C105/A21.5-82.
 - 2. Cut polyethylene tube to a length approximately 2 feet longer than that of the pipe section.
 - 3. Slip the tube around the pipe, centering it to provide a 1-foot overlap on each adjacent pipe section, and bunching it according fashion lengthwise until it clears the pipe ends.
 - 4. A shallow bell hoe must be made at joints to facilitate installation of the polyethylene tube.
 - 5. After assembling the pipe joint, make the overlap of the polyethylene tube.
 - 6. Pull the bunched polyethylene from the preceding length of pipe, slip it over the end of the new length of pipe, and secure in place.
 - 7. Then slip the end of the polyethylene from the new pipe section over the end of the first wrap until it overlaps the joint at the end of the preceding length of pipe.
 - 8. Secure the overlap in place.
 - 9. Take up the slack width to make a snug, but not tight, fit along the barrel of the pipe, securing the fold at quarter points.

3.3 Joint Installation

A. General:

- 1. Use push-on or mechanical joints in underground locations, unless otherwise required.
- 2. Use flanged joints at other locations unless otherwise required.
- 3. All joints shall be watertight and free from leaks.
- 4. Repair each leak discovered immediately.
- 5. Block, anchor, or harness all mechanical couplings, and push-on or mechanical joints.
- 6. Do not deflect joints beyond the maximum values specified in AWWA C-600, Tables 5 and 6.
- B. Push-on joints:
 - 1. Clean the inside of the bell and the outside of the spigot to remove dirt, oil, excess coating and other foreign matter.
 - 2. Insert the gasket.
 - 3. Apply a thin film of lubricant to either the inside surface of the gasket, the spigot end of the pipe or both.
 - 4. Do not permit the joint surfaces to come in contact with the ground.
 - 5. Assure that pipe is marked with a depth mark before assembly to assure the spigot end is inserted the full depth of the joint.
 - 6. Complete the joint making certain the spigot is inserted to the depth mark.
- C. Mechanical joints:
 - 1. Remove all dirt, oil, grit, excess coating and other foreign matter from the inside of the bell and the outside of the spigot.
 - 2. Apply a thin film of lubricant to the inside of the bell, the outside of the spigot and the gasket.
 - 3. Tighten nuts alternately on opposite sides of the pipe of produce equal pressure on all parts of the gland.
 - 4. Use a torque-limiting wrench and do not exceed the maximum torque value listed in AWWA C600 Table 4.
 - 5. Holes in mechanical joint bells shall straddle the top (or side for vertical piping) centerline.
- D. Flanged joints:
 - 1. Extend pipe completely through screwed-on flanges.
 - 2. Machine finish the pipe end and flange face in a single operation.
 - 3. Eliminate any restraints on the pipe that would prevent uniform gasket compression or cause unnecessary stress in the flanges.
 - 4. Do not assemble mechanical connections until all flanged joints affected thereby have been tightened.
 - 5. Alternately tighten bolts spaced on opposite sides of the pipe to assure uniform gasket compression.

- 6. Holes in flanges shall straddle the top (or side for vertical piping) centerline.
- E. Mechanical couplings:
 - 1.
 - Clean and smooth pipe ends. Allow ¼ inch minimum to one-inch maximum space between pipe ends. 2.

SECTION 02622

PLASTIC PIPE

PART 1 - GENERAL

1.1 Description

A. This section covers plastic pressure and non-pressure pipe and fittings to be furnished complete with all jointing materials.

1.2 Product Delivery, Storage and Handling

- A. Do not damage the pipe by impact, bending, compression or abrasion during handling and storage.
- B. Store pipe on a flat surface that provides even support for the barrel with bell ends overhanging.
- C. Do not stack pipe higher than 5 feet.
- D. Do not store pipe and fittings in direct sunlight for periods in excess of two weeks.
- E. Ship rubber gaskets in cartons and store in a clean area away from grease, oil, ozone producing electric motors, heat and the direct rays of the sun.
- F. Use only nylon protected slings or hands to handle pipe. Do not use hooks or bare cables.

PART 2 - PRODUCTS

2.1 Plastic Pressure Pipe (4" and Larger)

- A. Conform to: AWWA C900 and C905.
 - 1. Pressure Class: 150 psi, DR 18.
 - 2. Joints: Gasket bell end or gasket couplings.

2.2 Plastic Pressure Pipe (3 in. and smaller)

- A. Conform to: ASTM D2241.
 - 1. Pressure Class: 125 psi, SDR 32.5.
 - 2. Joints: Gasket bell end, or gasket couplings.

PART 3 - EXECUTION

3.1 Inspection

- A. Examine pipe and fittings and do not use individual sections containing:
 - 1. Cracks.
 - 2. Dents.
 - 3. Abrasions.
 - 4. Other defects.
- B. Mark rejected pipe and remove from the site.

3.2 Installation

- A. Install pipe in accordance with Section 02710.
- B. Cutting the Pipe:
 - 1. Cut pipe square with saw or pipe cutter designed specifically for the material.
 - 2. Bevel the end in accordance with the manufacturer's recommendations.
 - 3. Remove burrs and wipe off all dust and dirt from the jointing surfaces.
- C. Jointing the Pipe:
 - 1. Remove all dirt and foreign material from the pipe ends, gasket and gasket groove.
 - 2. Apply lubricant furnished by the pipe manufacturer to the spigot end of the pipe.
 - 3. Insert the spigot to the reference mark.
 - 4. Do not disturb previously installed joints during jointing operations.
- D. Install tracer wire or metallic tape in trench with PVC pipe not under a paved street. If tracer wire is not attached to the pipe it shall be buried directly above the pipe with a minimum of two feet of cover.
 - 1. Tracer wire is to be stored in an enclosed wire behind each fire hydrant.
 - 2. All tracer wire is to be continuity tested at the completion of waterline installation.

3.3 Field Quality Control

A. Leakage Tests: Refer to Section 01666 for pressure pipelines.

SECTION 02641

VALVES

PART 1 - GENERAL

1.1 Description

A. This section covers valves, valve operators, valve boxes, and appurtenances used for the water distribution system.

1.2 Product Delivery, Storage and Handling

- A. Take precautions so as not to damage materials during delivery or storage.
- B. Store valves off the ground and away from materials that could contaminate potable water systems.
- C. Take precautions to keep joints and internal parts clean.

PART 2 - PRODUCTS

2.1 Gate Valves

- A. Conformance: AWWA C500.
 - 1. Type: double discs, parallel seats, resilient seats.
 - 2. Stem seal: O-ring.
 - 3. Direction of opening: open left.
 - 4. Valve ends: conform to the type of pipe material used.
 - 5. Operator: Underground 2" nut; Vault Handwheel.

2.2 Butterfly Valves

- A. Conformance: AWWA C504.
 - 1. Type: conform to the type of pipe material used flanged valves shall be short body, with resilient seats.
 - 2. Type of shaft seal: O-ring seals.
 - 3. Type of operator: Underground 2" nut; vault-handwheel.
 - 4. Direction of opening: open left.
 - 5. Operator torque: reference AWWA C504, Appendix A, design the required operator torque to the higher valve given by the following two formulas:
 - a. To = (Tb + Ts + Th).
 - b. To = (1.2 Tb + Td).

2.3 Valve Boxes

- A. Materials and construction:
 - 1. Type: Cast iron or ductile iron, extension sleeve type.
 - 2. Shaft size: 5 1/4 inch minimum.
 - 3. Thickness: 3/16-inch minimum at any point.
 - 4. Furnish with suitable cast iron bases and covers.
 - 5. Cast appropriate name designation of service in cover.
 - 6. Coating: Dip in bituminous varnish.

2.4 Air Relief/Vacuum Valves

- A. Materials and construction:
 - 1. Type: Integral type assembly that functions both as an air release and vacuum valve.
 - 2. Rating: working pressure of 150 psi and a minimum hydrostatic test pressure of 250 psi.
 - 3. Outlet capacity: 30 cubic feet of free air per second.
 - 4. Connections:
 - a. Inlet: 2 inches, screwed (AWWA C800).
 - b. Outlet: Protect to minimize entry of debris and dirt.
 - 5. Body: cast iron or ductile iron.
 - 6. Working parts and seats: brass, stainless steel, or non-corroding material.
 - 7. Float: non-corroding, stainless steel.
 - 8. Watertight at 200 psi.
- B. Acceptable manufacturers:
 - 1. Crispin Universal Air Valve, by Multiplex Manufacturing.
 - 2. Apco Combination Air Release Valve, by Valve and Primer Corporation.
 - 3. Approved equal.

2.5 Pressure Relief Valve

- A. Materials and construction:
 - 1. Type: Integral type assembly to open cover and allow outside water pressure to enter empty tank.
 - 2. Body: Iron.
 - 3. Dimensions: 4" diameter 10" body length.
 - 4. Open at head of 9" of water.
- B. Acceptable manufacturers:
 - 1. Clow F-1492 by Clow Corporation.
 - 2. Or equal.

2.6 Check Valves

- A. Acceptable check valves and their manufacturers are:
 - 1. Watts
 - 2. Febco
 - 3. Mueller, "Detector Gravity".
 - 4. Furnish adjustable stem and operating handwheel.
- B. All check valves shall be rated at a working pressure of 150 psi.

2.7 Curb Stops

- A. All curb stops shall have compression connections at both ends.
- B. The top threads for all curb stops shall be Minneapolis type.
- C. Curb stops shall be used for taps which are 2 inches and smaller.
- D. Acceptable curb stop manufacturers are:
 - 1. Mueller;
 - 2. Ford;
 - 3. A.Y. McDonald;
 - 4. Approved equal.

2.8 Tapping Saddles

- A. All tapping saddles shall have a bonze body, with bronze double flat straps and bronze nuts.
 - 1. Outlet threads on tapping saddles shall be "cc" type only.
- B. Acceptable manufacturers of taping saddles are:
 - 1. Mueller;
 - 2. Ford;
 - 3. Approved equal.

PART 3 - EXECUTION

3.1 Valve Boxes

- A. Install valve boxes on buried valves.
- B. Install so that no stress is transmitted to valve.
- C. Set plumb and directly over the valve with the top between 1/4 inch and 1/2 inch below finished grade. Install 8" thick concrete collar with valve box lid.

D. Install extended stems on valves where operating nut is more than 4 feet below finished grade.

3.2 Air Relief/Vacuum Valves

A. Install at high points where required.
SECTION 02644

HYDRANTS

PART 1 - GENERAL

1.1 Description

A. This section covers dry-barrel fire hydrants intended for use in public water supply systems where freezing temperatures occur.

1.2 Product Delivery, Storage and Handling

- A. Handle, store and protect in a manner to prevent damage to materials, coatings, and finishes.
- B. Do not drop or dump materials into trench.
- C. Keep fittings and joints free from dirt.

PART 2 - PRODUCTS

2.1 General

- A. Conformance: AWWA C502.
- B. Acceptable manufacturers:
 - 1. Mueller, No. A24015.
 - 2. Mueller, No. A-423
 - 3. Waterous Pacer, WB-100
 - 4. Or approved equal.

2.2 Materials and Construction

- A. Type: dry barrel with breakaway traffic flange.
- B. Outlet size: $2-2\frac{1}{2}$ inch hose nozzles and $1-4\frac{1}{2}$ inch pumper nozzle.
- C. Outlet threads: Conformity with NFPA No. 194.
- D. Hydrant size: 5¹/₄ inch.
- E. Shoe inlet size: 6 inch, mechanical joint with retainer gland.
- F. Bury: 5¹/₂ feet.
- G. Operation: open left.

- H. Color: red.
- I. Operating nut: 1¹/₂" inch pentagon.

PART 3 - EXECUTION

3.1 Installation

- A. Set Plumb.
- B. Set Traffic Flange 0.1 feet to 0.2 feet Above Finished Grade.
- C. Reference The Details in this manual.

3.2 Operation

- A. Hydrants Shall Be Fully Closed Or Fully Open.
- B. Do Not Operate Hydrants Partially Open.
- C. <u>Once in service, only the Town or the Fire District shall operate hydrants unless express</u> permission is otherwise granted (i.e...issuance of a town hydrant meter).

END OF SECTION

SECTION 02710

WATER DISTRIBUTION AND TRANSMISSION LINES

PART 1 - GENERAL

1.1 Description

A. This section covers the installation of water distribution and transmission lines.

1.2 Quality Assurance

- A. Do not deviate from alignment more than 0.5 feet.
- B. Do not deviate from grade more than 0.3 feet where the pipeline is laid to grade.
 - 1. Measure at the pipe invert for grade, not at the top of pipe.

1.3 Job Conditions

- A. Prevent foreign material from entering the pipe.
- B. Do not place debris, tools, clothing, or other material in the pipe.
- C. Close the open ends of pipe with a blocked, watertight plug when pipe laying is not in progress to prevent the entrance of water, debris, and animals into the pipe.
 - 1. Do not remove the plug, if water is present in the trench, until the trench is pumped dry.
- D. Use effective measures to prevent uplifting or floating of the pipeline prior to completion of backfilling operations.
- E. Do not lay pipe under the following conditions:
 - 1. In water.
 - 2. Unsuitable weather conditions.
 - 3. Unsuitable trench conditions.

PART 2 - PRODUCTS (NOT USED) SEE SECTIONS 02615, 02622 and 02641.

PART 3 - EXECUTION

3.1 Preparation

- A. Perform trenching, backfilling and compaction in accordance with Section 02221.
- B. Connections: Where connections are to be made to existing pipes or appurtenances, the exact location of which cannot be determined without exposing the existing pipe or appurtenance, excavate and expose the existing improvement before installing any pipe.
 - 1. The Town will examine the existing pipe or appurtenance and specify any necessary adjustments in line or grade of the proposed pipe to accomplish the connection.

3.2 Pipe Installation

- A. Pipe laying:
 - 1. Lay pipe with the bells pointing the direction the Work is progressing.
 - a. On down slopes of 10 percent or more:
 - 1) Hold the last pipe laid in place by some means, such as a winch, while joining the next pipe to it to prevent moving or reverse the direction of pipe laying.
 - 2) Take effective measures to prevent opening of joints during bedding and backfilling operations.
 - 2. Complete the joint in accordance with the applicable pipe material specification and adjust the pipe to the correct line and grade as each length of pipe is placed in the trench.
 - a. Make adjustments in line and grade by scraping away or filing pipe bedding under the entire length of the pipe, except at bells, and not by wedging, blocking, or mounding up the pipe or bells.
 - 3. Secure the pipe in place with the specified bedding tamped under and around the pipe except at the joints.
 - a. Do not disturb the pipe after the jointing has been completed.
 - 4. Install the pipeline so that a positive or negative grade is maintained between high and low points.
 - a. Record the location of high and low points so they may be readily located if permanent air vents or blow-offs are not provided.
 - 5. Provide a minimum depth of cover from finished grade to top of pipe of 5 feet.
 - 6. Maximum depth of cover shall be 6 feet unless approved by the Town.
- B. Connections to existing pipelines:
 - 1. Make each connection at a time authorized by Owner, which will least interfere with service.
 - 2. Use suitable fittings for the conditions encountered.
 - 3. Dewater and dispose of water from dewatered lines.
 - 4. Use effective measures to prevent contamination to existing potable water lines.

- a. Do not permit trench water, mud or other contaminating substances to enter pipelines.
- 5. Swab the interior of new pipe, fittings, and valves installed in existing pipelines with a solution of 5 percent (50,000 ppm) chlorine solution prior to installation.
- 6. <u>Only the Town shall operate existing valves, hydrants, blow-offs, curb stops, and other control units unless written permission from the Town is given in advance.</u>
- C. Encasements:
 - 1. Provide concrete encasement where indicated on the Drawings or required by these Specifications.
 - 2. Sewerline Crossings.
 - a. Where watermains cross sewer lines, and the sewer is above the watermain or less than 18 inches clear distance vertically below the watermain, construct the crossing by one of the following methods:
 - 1) Install one length of ductile iron pipe in the sewer line centered on the intersection with the watermain. Ductile iron pipe shall be the same size as sewer line, or nearest size larger, then sewer line. Use approved adapters for joints between the ductile iron pipe and the sewer line or encase the joints in a concrete collar.
 - 2) Encase the sewer pipe with reinforced concrete at least 6 inches thick at all locations within 10 feet either side of the watermain. See the encasement detail in this Appendix.
 - b. Provide suitable backfill or other structural protection to preclude settling or failure of higher pipe.

3.3 Anchorage and Blocking

- A. Provide concrete thrust blocks and megalug restraint only, for preventing pipe movement at push-on or mechanical joint plugs, tees, crosses, bends deflecting 11¹/₄ degrees or more, reducers and valves installed in piping subjected to internal hydrostatic pressure in excess of 13 psi.
 - 1. Tie concrete anchors to fittings, reducers, and valves by 2 "U" shaped No. 5 rebar.
 - a. Bend ends of rebar 90 degrees out, length 3 inches.
 - b. Rebar embedment: one-half pipe O.D. plus 6 inches.
- B. Provide a concrete thrust block under flanged valves that have valve boxes.
- C. Extend concrete from the fitting or valve to solid undisturbed earth.
 - 1. Construct so joints and drain holes are clear and accessible.

RESULTANT THRUST IN POUNDS AT FITTINGS WITH 100 PSI WATER PRESSURE					
Diameter	221/2°	45°	671/2°	90°	Tees or
Inches	Bend	Bend	Bend	Bend	Dead Ends
4"	660	1,320	1,900	2,440	1,720
6"	1,470	2,910	4,200	5,370	3,800
8"	2,550	5,040	7,300	9,300	6,580
10"	3,640	7,190	10,400	13,270	9,380
12"	5,170	10,240	14,800	18,860	13,330
14"	6,000	11,750	17,100	21,800	15,400
16"	7,800	15,350	22,300	28,400	20,000
18"	9,900	19,400	28,200	36,000	25,450
20"	12,200	24,000	34,800	44,400	31,400
24	17,600	34,600	50,100	64,000	45,200
30"	27,400	54,000	78,300	100,000	70,700
36"	39,500	77,600	113,000	144,000	101,800
42"	54,000	106,000	153,500	196,000	138,500
48"	70,500	138,000	200,000	262000	181,000
54"	8,9000	175000	254,000	323,000	229,000
60"	110,000	216,000	314,000	400,000	282,700
66"	133,000	262,000	380,000	484,000	342,000
72"	158,000	311,000	450,000	575,000	407,000
78"	185,500	365,000	530,000	675,000	477,800
84"	216,000	424000	615,000	784,000	554,200
90"	247,000	486,000	70,5000	900,000	636,200
96"	281,000	553,000	800,000	1,020,000	723,800
108"	358,000	701,000	1,019,000	1,298,000	916,000
120"	442,000	865,000	1,258,000	1,600,000	131,000
132"	535,000	1,050,000	1,522,000	1,940,000	1,368,000
144"	636,000	1,248,000	1,810,000	2,305,000	1,628,600
156"	747,000	1,461,000	2,040,000	2,705,000	1,911,300
168"	868,000	1,700,000	2,466,000	3,141,000	2,216,700
180"	995,000	1,950,000	2,830,000	3,600,000	2,544,700
192"	1,131,000	2,220,000	3,220,000	4,100,000	2,865,200
204"	1,279,000	2,505,000	3,640,000	4,630,000	3,268,500
216"	1,430,000	2,805,000	4,075,000	5,190,000	3,644,300
228"	1,595,000	3,125,000	4,540,000	5,770,000	4,082,800
240"	1,770,000	3,465,000	5,040,000	6,410,000	4,523,900
Table from "Welded Steel Water Pipe Manual", 1970, page 33					
(Table above indicates values for different fittings).					
Values: $4^{"}$ $10^{"}$ = Dressure coloulated at and an O.D. of alass 100 A.C. Disc.					

Values: 4" - 12" =Pressure calculated at seal on O.D. of class 100 A.C. Pipe,
reference Johns-Mansville Installation Manual; page 55.14" - 240" =Pressure calculated on Pipe I.D.

Specifier - Safe Bearings Load: the following values are the ultimate bearing capacity of the soils divided by two for a safety factor.

SAFE BEARING LOADS			
Soil	Safe Bearing Load Lb. per Sq. Ft.		
Muck, peat, etc. *	0		
Soft clay	1,000		
Sand	2,000		
Sand and gravel	3,000		
Sand and gravel cemented with clay	4,000		
Hard shale	10,000		

D. Minimum bearing surface area is shown on the thrust restraint detail in this manual.

3.4 Installation of Pipeline Appurtenances

- A. Install valves, meters, hydrants, and other equipment appurtenants to the water distribution and transmission lines at the locations shown on the Drawings or as designated by the Town to accommodate field conditions.
 - 1. Record measurements of actual location of appurtenant equipment prior to backfill.

3.5 Protection of Metal Surfaces

- A. Apply two coats of coal tar paint to ferrous metal rods, rebar, clamps, bolts, nuts and other accessories subject to submergence or contact with earth or fill material and not incised in concrete.
 - 1. Apply first coat to dry, clean surface.
 - 2. Allow first coat to dry before applying second coat.
- B. Loose polyethylene encasement:
 - 1. Standard: AWWA C105.
 - 2. Methods, any of the following:
 - a. A or B (tube type encasement involving advancing a bunched length of material around each length of newly laid pipe).
 - b. C (sheet encasement wrapped around newly laid pipe to produce an overlapping seam at top of pipe).
 - 3. Repair rips, punctures or other damage with adhesive tape or with a short length of polyethylene encasement wrapped around pipe and secured in place.
 - 4. Maintain a sealed encasement with the polyethylene taped to the pipe at exist lines at the end of the encasement section.
 - 5. Use loose polyethylene encasement at the following locations:
 - a. Valves and fittings with flanges or mechanical joints.
 - b. Bolted fittings, such as couplings.
 - c. Tie rods and joint harnesses.













-FINAL STREET GRADE NIΜ CONFLICTING UTILITY RESTRAIN 5'-0" RESTRAIN 0.D. JOINTS JOINTS 45° ELBOWS (TYPICAL) ._6" NΙΜ O.D. + 2'-0" MIN.

NOTES:

- 1. RESTRAIN ALL JOINTS WITH MEGALUG RESTRAINT.
- 2. ALL EXPOSED METAL SURFACES SHALL BE POLY-WRAPPED.



CONDUIT CROSSING DETAIL









- 3 Curb Stop
- (4) Meter Unit
- 5 Check Valve
- (6) Type "K" Copper Tubing
- (7) 72" Conc. Manhole
- (8) Pressure Reducing
- (9) Strainer
- 1. Manhole Base Beams Required For Driveways, Or Parking Area When Approved.
- 2. A 72" Ø Manhole Pit Will Accomodate 1-1/2" & 2" Meters w/ Custom Setter.
- 3. Joints Inside Meter Vault Shall Be Either Threaded Or Soldered w/95-5 Timantimony
- 4. No Concrete To Be Laid In Floor Of
- Flanged w/ Brass Companion Flanges.
- 6. No Connections Or Changes In Pipe Diameter Shall Be Made In The Meter Pit Or In The Distance Of Five Feet Beyond The Meter Pit On The
- 7. Ladder Rungs Shall Be On The Opposite Side Of Bypass.
- 8. Bypass Shall Not Be Installed For Use With An Irrigation System.
- 9. For Building Service Check Valve To Be Located in the Building. For Irrigation Service -Check Valve To Be Located Outside Of Meter Pit.

GENERAL METER NOTES

- 1. Location Of The Meter To Be Established By The Development Engineer And Approved By The Town.
- 2. All Settings Must Be Inspected By The Town's Representative.
- 3. If The Street Or Ground Is Not To Final Grade At The Time Of Installation Of The Meter, The Owner Must Raise Or Lower The Meter Vault When The Final Grade Is Established.
- 4. Leaded Joints And Galvanized Piping Shall Not Be Allowed Inside The Meter Vaults.
- 5. A Bypass Is To Be Installed On 1-1/2" And Larger Meters Unless Otherwise Specified.
- 6. The Service Line Through And On Both Sides Of The Meter Pit Must Be Of The Same Material.
- 7. No Connections Shall Be Made In The Meter Pit. Sprinkler Connections Must Be Made More Than Five (5) Feet From The Meter Pit On The Downstream Side.
- 8. GATE VALVES:
 - A. All Gate Valves Under 3" For Use W/Copper Pipe Shall Be All Bronze, w/Non-rising Stems And Solid Wedge Disc, Manufactured In Accordance With A.S.T.M. Spec. B62 And Federal Spec. W.W.-V-54 Class A, 125psi W.S.P., 200psi W.O.G. Or Curb Stops In Accordance With AWWA C800 And MS-23 Of The Material Specifications.
 - B. All Gate Valves 3" And Larger Shall Conform With Town Of Johnstown Standard Specifications.
- 9. All Dresser (Or Approved Equal) Couplings Shall Have The Pipe Stop Removed.
- 10. Meters 1-1/2" And Larger To Be Installed By The Contractor With The Town's Supervision. Meters 1" And Smaller Will Be Installed By The Town.

TOWN OF JOHNSTOWN









POLYETHYLENE -BEARING BOND BREAKER SURFACE М BEDDING MATERIAL UNDISTURBED SOIL

TYPICAL BEND





MINIMUM BEARING SURFACE AREA (SQ. FT.)					
PIPE		BEN	IDS		TEE OR
SIZE	11¼°	22½°	45°	90°	END
6"	1.0	1.5	2.5	4.5	3.5
8"	1.5	2.5	4.5	8.0	5.5
12"	3.0	4.5	9.0	16.5	12.0

GENERAL NOTES:

- 1. BEARING SURFACE AREAS SHOWN IN CHART ARE MINIMUM.
- 2. ALL FITTINGS TO BE WRAPPED WITH POLYETHYLENE.
- 3. PIPE INSTALLED UNDER CONDITIONS DIFFERENT FROM THOSE NORMALLY ENCOUNTERED SHALL REQUIRE THRUST BLOCKS DESIGNED FOR THOSE PARTICULAR CONDITIONS.
- 4. THRUST BLOCKS ON PIPE LARGER THAN 12" SHALL BE DESIGNED FOR CONDITIONS EXISTING AT THE INSTALLATION SITE.
- 5. REFER TO SECTION 03300 FOR CONCRETE REQUIREMENTS.













PART IV

SANITARY SEWER SYSTEM DESIGN & SPECIFICATIONS

SECTION 1: DESIGN CRITERIA FOR SANITARY SEWER SYSTEM

1.1	General	SEWER-1
1.2	Definitions and Abbreviations	SEWER-1
1.3	System Requirements	SEWER-1
1.4	Hydraulic Design	SEWER-2
1.5	Phasing	SEWER-2
1.6	Collection Main Slope and Size	SEWER-3
	APPLICABLE MINIMUM GRADES TABLE	SEWER-3
1.7	Location of Collection Mains	SEWER-3
1.8	Easements	SEWER-4
1.9	Manhole Size and Location	SEWER-5
	APPLICABLE STANDARD MANHOLE DIAMETER TABLE	SEWER-5
1.10	Manhole Inverts	SEWER-6
1.11	Pipe Material	SEWER-6
1.12	Depth of Bury	SEWER-6
1.13	Sanitary Sewer Services	SEWER-7
1.14	Relation to Water Mains and Sewer Pipes	SEWER-7
1.15	Other Utility Crossings	SEWER-8

SECTION 2: TESTING SANITARY SEWER COLLECTION SYSTEM

2.1	Scope	SEWER-8
2.2	Quality Assurance	SEWER-8
2.3	General	SEWER-9
2.4	Alignment Test	SEWER-9
2.5	Pipe Deflection Test	SEWER-9
	PIPE DEFLECTION TABLE	SEWER-10
2.6	Air Testing Sanitary Sewer Mains	SEWER-10
2.7	Vacuum Testing Manholes	SEWER-13
	MANHOLE TEST TIME TABLE	SEWER-13
2.8	Televising Sanitary Sewer Main	SEWER-14

SECTION 3: AS-BUILT AND RECORD DOCUMENTS

3.1	Scope	SEWER-15
3.2	Maintenance of Documents and Samples	SEWER-15
3.3	Recording	SEWER-15
3.4	Submission	SEWER-15

SECTION 4: MANHOLES

4.1	Scope	SEWER-16
4.2	Quality Assurance	SEWER-16
4.3	Product Delivery, Storage and Handling	SEWER-17
4.4	Precast Concrete Manholes	SEWER-17
4.5	Cast-In-Place Manholes	SEWER-17
4.6	Mortar	SEWER-18
4.7	Grout	SEWER-18
4.8	Ring and Cover	SEWER-18
4.9	Steps	SEWER-19
4.10	Preformed Plastic Gaskets	SEWER-19
4.11	Inspection	SEWER-19
4.12	Preparation	SEWER-19
4.13	Manhole Construction	SEWER-19

SECTION 5: GRAVITY SANITARY SEWER COLLECTION SYSTEM

5.1	Scope	SEWER-21
5.2	Quality Assurance	SEWER-22
5.3	Job Conditions	SEWER-22
5.4	Manholes	SEWER-23
5.5	Pipe	SEWER-23
5.6	Sanitary Sewer Service Lines	SEWER-24
5.7	Inspection	SEWER-24
5.8	Preparation	SEWER-24
5.9	Connections to Existing System	SEWER-25
5.10	Pipe Installation	SEWER-25
5.11	Manhole Installation	SEWER-26
5.12	Sanitary Sewer Service Connections	SEWER-26
5.13	Field Quality Control	SEWER-26

SECTION 6: SANITARY SEWER SERVICE LINES

6.1	Scope	SEWER-26
6.2	Quality Assurance	SEWER-26
6.3	Job Conditions	SEWER-26
6.4	Pipe	SEWER-26
6.5	Flexible Couplings	SEWER-27
6.6	General	SEWER-27
6.7	Trenching, Backfilling and Compaction	SEWER-27
6.8	Taps	SEWER-27
6.9	Service Lines	SEWER-28

SECTION 7: SANITARY SEWER SYSTEM DETAILS

STANDARD MANHOLE DETAIL SHALLOW MANHOLE DETAIL INSIDE/DROP MANHOLE SEWER SERVICE ALTERNATIVE CONNECTION UNDERDRAIN/MANHOLE CONNECTION DETAIL

PART IV

SANITARY SEWER SYSTEM DESIGN & SPECIFICATIONS

SECTION 1. DESIGN CRITERIA FOR SANITARY SEWER SYSTEM

1.1 General

The purpose of this section is to provide information for the design and layout of a sanitary sewer collection system acceptable to the Johnstown Waste Water Department (JWWD). All sanitary sewer system design shall be in accordance with the requirements of this section and the Town of Johnstown Standard Construction Specifications for Sanitary Sewer Construction.

1.2 Definitions and Abbreviations

- A. Collection Mains
 - 1. A sanitary sewer collection main is defined as a system that gathers flows directly from individual building services and transports the material to an interceptor or main sewer.
- B. Interceptor Sewer
 - 1. An interceptor, or main, sanitary sewer carries flows from the collections sewers to a point of treatment or disposal of the wastewater.
- C. Sanitary Sewer Services
 - 1. All pipe and fittings used to convey sanitary sewage from the plumbing system in a building to a collection main.

D. Abbreviations

- 1. cfs cubic feet per second
- 2. fps feet per second
- 3. gpcd gallons per capita per day
- 4. gpd gallons per day

1.3 System Requirements

- A. Design Flow
 - 1. The sanitary sewer collection system design shall include consideration for providing service for the entire area tributary to the outfall point. Sanitary sewer flow information for the existing collection system may only be obtained from the Town. Estimates for sanitary sewer flows shall use the following guidelines:
 - a. Residential sewage contribution shall be based on 100-gpcd average flows.

- b. Minimum residential population density shall be figured on a basis of 2.5 persons per house, six (6) houses per acre and, 70% of total land area developed as residential, unless detailed analysis of the proposed service area indicates differently.
- c. Estimates shall include allowances for a maximum infiltration of 100 gallons per day per inch diameter per mile of pipe.
- d. Commercial and industrial sewage contribution estimates shall be submitted to the Sewer Department for review prior to design acceptance

1.4 Hydraulic Design

- A. Sanitary sewer grades shall be designed to produce flow characteristics as close to optimum as is physically and economically feasible.
 - 1. The size of pipe required shall be computed by Manning's Equation.

Where: Q=Flow n=Manning's Coefficient of Coefficient, 0.013 A=Area of Flow (ft²) R=Hydraulic Radius (A/P) Where P =Wetted Perimeter S=Slope of pipe (ft/ft)

2. All sanitary sewer collection pipes shall be designed to flow maximum half full (d/D=0.5) at design flows.

Where: d=Depth of Flow D=Diameter of Pipe

The design depth of flow should be greater than two-inches (2") where practical.

3. Optimum velocities are four (4) to five (5) feet per second (fps) at design flow. The minimum and maximum velocity at the design flow rate shall be two (2) fps and fifteen (15) fps respectively unless prior written acceptance is to received from the Water and Sewer District.

1.5 Phasing

- A. Sanitary sewer phasing, if proposed, must meet the following conditions for acceptance:
 - 1. Shown on the master utility plan.
 - 2. Terminal manhole shall be located at either the phase line or subsequent next manhole in the adjoining phase.
 - 3. A stub out for future phasing may be made by providing a block out in the terminal manhole for future lines. The inverts in the terminal manhole shall be called out for all pipes entering and exiting the manhole.

1.6 Collection Main Slope and Size

- A. In addition to the criteria stated in Section 1.4, Hydraulic Design, the following shall apply to sanitary sewers:
 - 1. Sanitary Sewer mains shall be eight-inch (8") diameter or larger. Service connections are four-inch (4") diameter or larger.
 - 2. Table 1.6-1 displays the applicable minimum grades per pipe diameter. These minimum grades may be used provided Section 1.4 criteria are met.

Sewer Diameter	<u>Minimum Grade (%)</u>
4 inch	2.00
6 inch	0.60
8 inch	0.40
10 inch	0.28
12 inch	0.22
15 inch	0.15
18 inch	0.12
21-inch	JWWD
	acceptance
*Subject to Section 1.4. Hydraulic Design	-

TABLE 1.6-1 APPLICABLE MINIMUM GRADES

- 3. The maximum grade for any sanitary sewer line shall be 5.00% unless prior acceptance is obtained from the JWWD.
- 4. If the JWWD requires the Developer to install a collection main larger than needed to adequately serve the development, the Town may reimburse the Developer for the extra materials cost and depth of excavation above what is required for the development. Extra material costs shall include on the difference between the size of pipe and manholes. Extra depth costs shall include only the extra depth of excavation required to install the pipe in excess of what would have been required for the development. Material prices must be verified from supplier's invoices and the extra depth costs must be shown on the Contractor's bid sheet. All prices must be accepted by the Town prior to start of construction.

1.7 Location of Collection Mains

- A. Sanitary sewer mains shall be extended to the greater distance of either the far or upstream edge of the end service lot or property, regardless of where the tap is made, or to the edge of the platted subdivision. The Town may grant exception to this requirement if development of adjacent property is infeasible and/or unforeseeable.
- B. The centerline of sanitary sewer mains shall not be placed closer than eight feet (8') to the face of an existing or future curb, gutter, or walk without written acceptance by the Town.

- C. All sewer mains shall terminate at a manhole.
- D. A stub out of future extensions shall consist of a block out for future pipes in the terminal manhole. The stub out shall consist of a block out for future pipes in the terminal manhole. The invert elevations shall be shown for pipes entering and exiting the manhole.
- E. Sewer lines shall be straight not curved between manholes, both in line and grade.
- F. Clean outs on sewer main lines shall be prohibited.

1.8 Easements

- A. When the Sewer Department determines it is not feasible for an installation in a dedicated street right-of-way, the installation shall be made in an easement. The conditions for allowance of such an exception shall be determined for each individual case. The minimum easement width acceptable by the Sewer Department is as follows:
 - 1. For a dedicated sanitary sewer easement, the width shall be twenty feet (20') or twice the depth to the invert of the water pipe, whichever is greater, and shall be for the exclusive use of Town of Johnstown water mains. These easements shall be labeled on the construction and plat documents as "EXCLUSIVE SEWER LINE EASEMENT."
 - 2. For a combined sanitary sewer and water easement, the total width shall be twice the maximum depth to the invert of the sanitary sewer line plus twice the maximum depth to the invert to the water pipe or thirty feet (30'), whichever is greater.
 - 3. The easement width will be required to be wider than the minimum widths previously stated if the line depth would require additional width to be able to safely excavate around the pipe without the use of a trench box.
 - 4. The sanitary sewer line shall be located a minimum ten feet (10') from the edge of the easement, or equal to the depth to the pipe invert, which ever is greater.
- B. The Sewer Department shall have the exclusive utility use of the exclusive sanitary sewer and sanitary sewer easements except for angled utility crossings. The Sewer Department shall review for acceptance all utility crossing methods prior to construction.
- C. All easement documents shall be recorded prior to construction drawing acceptance.
- D. The easement shall be COMPLETELY CLEAR OF landscaping greater than three feet (3') tall (mature growth), permanent structures, and storm water detention ponds.

1.9 Manhole Size and Location

A. Table 1.9-1 displays the applicable diameter of standard manholes per pipe diameter.

TABLE 1.9-1 APPLICABLE STANDARD MANHOLE DIAMETER

Sewer Pipe Diameter	Manhole Diameter
8 inch to 15 inch	48 inch
15 inch to 36 inch	60 inch
48 inch and larger	Sewer Dept Acceptance

- B. Manholes shall be provided at every change in direction, grade, or connection with other sewer mains.
- C. Maximum manhole spacing shall be 450 feet (450') for lines ten-inches (10") or smaller, or 550 feet (550') for lines twelve-inches (12") or larger.
- D. The center of any manhole shall not be placed closer than eight feet (8') to the face of an existing or future curb, gutter, or sidewalk.
- E. A minimum ten feet (10') horizontal separation shall be maintained from the center of the sanitary sewer manhole and any other utility.
- F. Manholes outside of road right-of-ways should be located in areas that are not subject to flooding from surface runoff. No manholes shall be located in areas where ponding or storm detention basins are to be used.
 - 1. If the possibility of surface runoff cannot be avoided a solid manhole cover, with an integral O-ring type gasket that can be bolted closed must be used.
 - 2. All manholes that are to be designed and constructed with a watertight, bolted type cover, the manhole ring shall be bolted to the manhole cone, and all manhole joints and grade rings shall be sealed from the outside with an approved seal wrap.
- G. There shall be no more than three (3) lines designed to discharge into any one manhole. This includes service lines.
- H. Rim and invert elevations of all lines (including services) entering and exiting a manhole shall be shown on the project plans in the profile view.
- I. Manholes shall be located in areas that allow direct access by Town maintenance vehicles (up to 35 tons) via all weather roads. An all-weather road design shall be submitted by a qualified Geotechnical Engineer to the Town for acceptance prior to construction drawing approval.
- J. The Design Engineer shall determine if conditions require a protective coating to protect the manhole from corrosion.

1.10 Manhole Inverts

- A. Inverts of a straight channel sanitary sewer manhole, without laterals, may be set by using the same grade as the main provided that the upstream and downstream grades are the same and the manhole is constructed by laying pipe through the manhole and removing the upper half of the pipe. Refer to Standard Details for this type of manhole construction.
- B. If the conditions in 1.10.A cannot be maintained, the minimum elevation drop across a straight channel manhole shall be one-tenth-of-a-foot (0.1').
- C. Where a sanitary sewer of the same size changes direction by 30° or more, the inlet and outlet flowline elevations shall have at least two tenths-of-a-foot (0.2') difference across the manhole.
- D. When a tree invert is constructed with the inlet(s) and outlet being the same size, the inverts coming into the manhole must be at least two tenths-of-a-foot (0.2') higher than the outlet invert.
- E. Where a smaller sewer joins a larger on a straight channel, the smaller sewer crown elevation shall match the crown elevation of the larger line. This includes service lines.
- F. Where a sanitary sewer lateral main connects to a sanitary trunk sewer with a diameter of ten inches (10") or more, the crown elevation of the lateral main shall match the crown elevation of the trunk sanitary sewer line.
- G. Inside drop manholes shall be provided for a sewer entering a manhole with an elevation twenty four-inches (24") or more above the manhole invert.
 - 1. Drop inlet pipes equal to or greater than 10 inches shall require a 60-inch diameter manhole.
- H. Where the invert elevation difference is less than two feet (2') but greater than six-inches (6"), the invert shall be filleted, as shown on Standard Details, to prevent solids deposition.

1.11 Pipe Material

A. Standard residential development shall use polyvinyl chloride (PVC) SDR 35 pipe suitable for sanitary sewer flows. The Design Engineer shall specify acceptable pipe material for commercial or industrial applications for corrosive or solvent-entrained wastewater and any other conditions that require a non-SDR35 PVC pipe. The Town shall approve use and length of the specified pipe.

1.12 Depth of Bury

- A. Sewer mains shall have a minimum cover of four feet (4') to the finished ground surface.
- B. Where minimum cover provides less than nine feet (9') of elevation difference between the finished lot grade at building line and the top of the sewer main, the plans and the plat shall indicate that the lot is served by a "shallow sewer" and appropriate elevation information shall be given.

1.13 Sanitary Sewer Services

- A. Each structure and each subdivided lot shall be served by separate service lines. No compound services are allowed.
- B. All lots shall have separate sewer services without crossing any adjacent properties.
- C. Service lines shall be designed with a minimum fall as shown in Table 1.6-1.
- D. Service lines shall have a maximum velocity of ten feet per second (10 fps).
- E. The service line shall flow maximum half full at peak design flow.
- F. The minimum allowable service line size is four-inches (4").
- G. Sanitary sewer services shall be located ten feet (10') down grade, or down stream, of the water service wherever feasible. Certain cul-de-sacs may have the sewer service line located further than ten feet (10') off the water service t allow the sewer service not to be located under a driveway.
- H. Service lines may not be installed in trenches with other conduits. A service line shall be separated from other conduits a minimum of ten feet (10') horizontally.
- I. Clean-outs shall be located at all points of deflection (i.e. bends) and every 100 feet (100') in a service line with the following exception:
 - 1. No clean out shall be located within a public right-of-way.
- J. Each lot or separate building site shall have tees or tapping saddles for service connections.
 - 1. Service tees or tapping saddles on the main shall have a minimum five feet (5') separation.
- K. Riser connections shall be prohibited.
- L. All service lines greater than six-inch (6") diameter shall be connected at a manhole. This service connection shall channel the flow through the manhole bench to the invert unless the difference in invert elevations is greater than twenty-four inches (24"). See Section 4.10.07.

1.14 Relation to Water Mains and Sewer Pipes

A. Sanitary sewer services and collection mains shall be located horizontally a minimum of ten feet (10') centerline to centerline of existing or proposed water or storm lines.

- B. Where sanitary sewer lines cross water mains, the sanitary sewer pipe shall have a minimum eighteen-inches (18") clear distance vertically below the water main. If this clear distance is not feasible or the sanitary sewer line is above the water line, the crossing must be designed and constructed, using pipe encasement on the sanitary sewer main, to protect the water main. Refer to Standard Details for construction.
- C. Storm sewers shall have the same restrictions as water mains.

1.15 Other Utility Crossings

- A. The minimum horizontal separation shall be ten feet (10') when parallel in the public right-ofway. The same restrictions as sanitary sewer shall apply.
- B. Right angle crossings are permitted under the sanitary sewer pipe with a two-foot (2') vertical clearance.
 - 1. Tunneling or boring is preferable but if open cut is the only solution, the trench shall be as narrow as possible and backfill shall be flowfill from the top of the lower pipe up to the spring line of the sanitary sewer pipe.
- C. For crossings above the sanitary sewer pipe, the utility crossing shall have a minimum eighteen-inches of vertical clearance and be installed in High Density Polyethylene pipe (HDPE), Standard Dimension Ratio (SDR) 11 from edge to edge of the easement or right-of way or ten feet (10') either side of the sanitary sewer line, which ever is greater.
- D. Sanitary sewer crossings of open irrigation ditches shall be detailed, have four feet (5') minimum cover, and be approved by the ditch company. See Standard Details for typical pipe crossing requirements.

SECTION 2: TESTING SANITARY SEWER COLLECTION SYSTEM

2.1 Scope

- A. This section addresses the testing of sanitary sewer collection mains, manholes, and appurtenances.
 - 1. All sanitary sewer pipelines shall be air tested per these specifications.
 - 2. All sanitary sewer manholes shall be vacuum tested per these specifications.
 - 3. All sanitary sewer collection systems shall be video inspected per these specifications.

2.2 Quality Assurance

- A. Standards (as applicable).
 - 1. ASTM C1244, Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum), latest revision.
 - 2. ASTM F1417, Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air, latest revision.

2.3 General

- A. Testing shall be conducted when:
 - 1. Backfill and compaction has been completed but before street improvements are installed.
 - 2. Main and manholes have been thoroughly cleaned of all foreign material.
- B. The Contractor shall furnish all equipment, labor, and incidentals necessary to perform tests.
 - 1. The maximum allowable pressure gauge shall be 0.1 psi.
- C. The Town shall witness tests and record times, leakage readings, and pressure over the test period.
 - 1. Contractor shall provide the Town a minimum 48 hours advance notice of any tests.
- D. All tests shall occur after completion of backfilling and compaction but prior to paving unless otherwise stated in these specifications.

2.4 Alignment Test

- A. Video each section of sanitary sewer between manholes to determine whether any displacement of pipe has occurred.
 - 1. Videoing shall be done after pipe trench is compacted and brought to grade or pavement subgrade and submitted to the Town.
 - 2. "Full moon" shall be visible for grand alignment.
 - 3. No less than "half moon" shall be visible for horizontal alignment.
 - 4. Repair poor alignment, displaced pipe, or other defects discovered.

2.5 Pipe Deflection Test

- A. Each section of sanitary sewer shall be tested for deflection by an independent testing firm as hired by the Contractor prior to Town acceptance and as deemed necessary within the warranty/construction period by the Town.
 - 1. The maximum allowable deflection for Town acceptance is 5% of the base internal diameter.
 - 2. The maximum allowable deflection at the end of the warranty period shall be 7.5% of the base internal diameter.

3. Mandrel outside diameters in inches is as follows:

<u>Pipe Size</u>	Base I.D.	5% Deflection	7.5% Deflection
		Mandrel	Mandrel
6	5.742	5.455	5.311
8	7.665	7.282	7.090
10	9.563	9.085	8.846
12	11.361	10.793	10.509
15	13.898	13.203	12.856
18	16.976	16.127	15.703
21	20.004	19.004	18.504
24	22.480	21.356	20.794
27	25.327	24.061	23.427

4. Sections of the pipe that fail the deflection test shall have the defects repaired and the test repeated.

2.6 Air Testing Sanitary Sewer Mains

- A. Conduct tests in conformance with ASTMF1417, Time Pressure Drop Method, and these specifications.
- B. Preparation for tests:
 - 1. Flush and clean the sewer line prior to testing in order to wet the pipe surfaces and produce more consistent results.
 - 2. Provide a relief valve on the pressuring equipment to avoid over-pressurizing and damaging an otherwise acceptable line.
 - a. Set relief valve at 5 psi.
 - 3. Plug and brace all openings in the main sanitary sewer line and the upper connections.
 - a. Check all pipe plugs with a soap solution to detect any air leakage.
 - b. If leaks are found, release the air pressure, eliminate the leaks and start the test procedures over again.
- C. Test Procedure
 - 1. Add air until the internal pressure of the sewer line is raised to approximately 40psi gage.
 - a. Maintain the air pressure between 3.5 psig and 4.5 psig until the air temperature in the pipe is stabilized with the pipe/ground temperature.
 - 2. Disconnect the air supply and reduce the air pressure to 3.5 psig before starting the test.
 - a. If the groundwater is higher than the top of the pipe, the test pressure shall be adjusted to account for the high groundwater. The test pressure shall be increased by 0.43 psi per foot of ground water up to five feet (5') of ground water. For ground water over five feet (5') in depth, an infiltration test shall be conducted in place of the air test. Contact the JWWD for infiltration testing procedure and criteria.
3. Determine the time required for the air pressure to drop from 3.5 psig to 2.5 psig. a. The time elapsed shall not be less than:

Where:

- T = Shortest time (s) allowed for the air pressure to drop 1.0 pisg
- K = 0.000419 DL but not less than 1.0
- Q = leak rate in cubic feet/minute/square feet of internal surface = 0.0015 CFM/SF
- D = measured average inside diameter of pipe (in)
- L = length of test section (ft)
- b. Example calculation for an 8-inch diameter sanitary sewer pipe with a test section 400 feet long:

 $T = 0.085 \left[\frac{8in(0.00419)(8in)(400ft)}{0.0015CFM/SF}\right]$

T = 608 seconds or 10 minutes 08 seconds (10:08)

c. The following table contains the test durations for pipe diameters between four (4") and fifteen (15") inches, for pipe lengths up to 500 feet. The test durations for pipe larger than fifteen-inches (15") shall be calculated using the formula given above.

Pipe Diameter	Pipe Length (feet)						
	0-150	200	250	300	350	400	500
4"	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6"	5:40	5:40	5:40	5:40	5:40	5:42	7.07
8"	7:34	7:34	7:34	7:36	8:52	10:08	12:38
10"	9:26	9:26	9:53	11:52	13:51	15:49	19:45
12"	11:20	11:24	14:15	17:05	19:56	22:47	28:26
15"	14:10	17:48	22:15	26:42	31:09	35:36	44:26

Specified Test Duration for Length of Pipe Indicated (duration indicated in min:sec)

4. If lateral or service lines are included in the test, their length may be ignored for computing required test time if the test time requirements are met. If the test section fails, time shall be recomputed to include all the lateral lengths using the following formula:

$$T = 0.085 \left[\frac{D_1^2 L_1 + D_2^2 L_2 + \dots + D_n^2 L_n}{D_1 L_1 + D_2 L_2 + \dots + D_n L_n} \right] \frac{K}{Q}$$

where:

	Т	=	shortest time (s) allowed for the air pressure to drop
	K .	=	0.000419 $(D_1L_1 + D_2L_2 + + D_nL_n)$ but not less than
	Q	=	leak rate in cubic feet/minute/square feet of internal surface = 0.0015 CFM/SF
۰.	D_1, D_2 , etc. L_1, L_2 , etc.	H	measured average inside diameter of pipe (in) length of test section (ft)

- a. If the recomputed test time is short enough to allow the section tested to pass, then the test section meets the requirements of this specification.
- 5. Sections of the pipe that fail the air test shall have the defects repaired and the test repeated.

2.7 Vacuum Testing Manholes

- A. Manholes shall be tested before the ring and cover and grade adjustment rings are installed, and after backfill and compaction is complete.
- B. Conduct tests in conformance with ASTM C1244 and these specifications.
- C. Preparation for tests:
 - 1. All lift holes, joints, and other imperfections shall be filled with an approved nonshrink grout, to provide a smooth finish appearance.
 - 2. All pipes entering the manhole shall be temporarily plugged, taking care to securely brace the pipes and plugs to prevent them from being drawn into the manholes.
- D. Test Procedure:
 - 1. The test shall be placed at the top of the manhole in accordance with the manufacturer's recommendation.
 - 2. A vacuum of 10-inches mercury shall be drawn in the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off.
 - a. The time shall be measured for the vacuum to drop to 9-inches mercury.
 - 3. The manhole shall pass if the time for the vacuum reading to drop from 10-inches mercury to 9-inches mercury meets or exceeds the values indicated in the following table.

	Diameter (in)		
Depth ¹ (ft)	48	60	72
	Time (s)		
8	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	67
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121

Minimum Test Times for Various Manhole Diameters

¹Round actual depth of manhole to next depth up (ex. 11 foot deep manhole, use depth of 10 feet).

4. If the manhole fails any test, necessary repairs shall be made by an approved method and the manhole shall be retested until a satisfactory test is obtained.

2.8 Televising Sanitary Sewer Main

- A. All sanitary sewer lines shall be televised three (3) months prior to the end of the warranty period or as deemed necessary within the warranty/construction period by the Town. The televising shall be made by the Contractor or a Sub-consultant to the contractor and the recording shall be submitted to the Town for acceptance.
 - 1. The recording shall be made using a color camera, self-propelled or other having sufficient light to show detail of problem areas and joints.
 - 2. Camera shall have a swivel head capable of looking up each service connection.
 - 3. Camera speed shall not exceed three feet (3') per second.
 - 4. If problem areas or concerns are seen by operator, then the camera shall be backed up and an extended look at the area will be recorded.
 - 5. All recordings will have location (i.e. manhole # to manhole #), time, date, and footage displayed.
- B. The warranty period for the sanitary sewer collection system WILL continue to be in effect for the time specified in Town of Johnstown Water and Sewer Construction Specifications, latest edition, or until the JWWD has received and approved the video recordings, which ever is longer.

END OF SECTION

SECTION 3: AS-BUILT AND RECORD DOCUMENTS

<u>3.1 Scope</u>

A. This section addresses the As-Built Drawings and Record Documents for the construction of sanitary sewer collection mains, sanitary sewer facilities, and miscellaneous appurtenances.

3.2 Maintenance of Documents and Samples

- A. Store documents in Contractor's field office apart from documents used for construction.
 - 1. Provide files and racks for storage of documents.
 - 2. Provide storage space for samples.
- B. File documents and samples in accordance with the specification's section numbers.
- C. Maintain documents and samples in a clean, dry legible condition and in good order. Do not use as-built and record documents for construction purposes.
- D. Documents shall be made available for inspection by the Town upon request.

3.3 Recording

- A. Label each drawing "AS-BUILT RECORD DRAWING" in neat large printed letters.
- B. Record information concurrently with construction progress.
 - 1. Do not backfill Work until required information is recorded.
- C. Marking of Project Records.
 - 1. Legible and with a dark pen or pencil.
 - 2. Ink shall not be water based or subject to easy smearing.
- D. Mark Drawings to record actual construction.
 - 1. Field dimensions, elevations, and details.
 - 2. Changes made by a Town approved modification.
 - 3. Details not on original Drawings.
 - 4. Horizontal and vertical locations of underground utilities and appurtenances, referenced to a minimum of two permanent surface improvements.
 - 5. Depths of various elements in relation to project datum.

3.4 Submission

A. Submit as-built information to the Project Engineer to review and prepare final As-Built Record Drawings.

- B. Accompany the submittal to Project Engineer with a transmittal letter in duplicate containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name, address, and telephone number
 - 4. Index containing title and number of each Record Document
 - 5. Signature of Contractor or his authorized representative
- C. All As-Built Record Drawings submitted to the Town for approval shall be on 24" x 36" blueline or blackline form.
- D. Final acceptance of the utility lines will not be given until the As-Built Record Drawings have been submitted to and accepted by the Town.
 - 1. Warranty period will not begin until the Town gives initial acceptance.
 - 2. No certificate of occupancy will be issued for structures connecting to water and sanitary sewer until the Town gives final acceptance of the As-Built Record Drawings.
 - 3. The site Developer will be responsible for utility locate until the Town gives final acceptance of As-Built Record Drawings.

SECTION 4: MANHOLES

<u>4.1 Scope</u>

- A. This section addresses sanitary sewer manholes, and includes the acceptable products, materials, and construction practices which may be used in the construction and installation of manholes.
- B. Manholes shall be furnished with all accessories, including steps, base, cone section, and ring and cover.
- C. Manholes shall be installed wherever there is a change in size, direction, slope, at junctions, and intervals of not more than four hundred feet (400') for 10-inch and smaller diameter pipe and five hundred feet (500') for pipe diameters greater than 10-inches.

4.2 Quality Assurance

- A. Standards (as applicable)
 - 1. ASTM A185, Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement, latest revision.
 - 2. ASTM A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement, latest revision.
 - 3. ASTM A996, Standard Specification for Rail-Steel and Axel-Steel Deformed Bars for Concrete Reinforcement, latest revision.

- 4. ASTM B108, Standard specification for Aluminum-Alloy Permanent Mold Castings, latest revision.
- 5. ASTM C33, Standard Specification for Concrete Aggregates, latest revision.
- 6. ASTM C144, Standard Specification for Aggregate for Masonry Mortar, latest revision.
- 7. ASTM C150, Standard Specification for Portland Cement, latest revision.
- 8. ASTM C207, Standard Specification for Hydrated Lime for Masonry Purposes, latest revision.
- 9. ASTM C478, Standard Specification for Precast Reinforcement Concrete Manhole Sections, latest revision.
- 10 ASTM C497, Standard Test Method for Concrete Pipe, Manhole Sections, or Tile, latest revision.

4.3 Product Delivery, Storage, and Handling

- A. Manholes shall be handled, stored, and protected in such a manner as to prevent damage to materials.
- B. All joint surfaces shall be free from dirt, oil, and grease at the time of installation.

4.4 Precast Concrete Manholes

- A. Precast manhole bases, risers, and cone sections shall be manufactured in accordance with ASTM C478, and shall be made with Type I/II cement.
 - 1. All cone sections shall be the eccentric type.
- B. Concrete and Reinforcing Materials
 - 1. All reinforcing materials shall conform to ASTM A615, ASTM A617, or ASTM A185.
 - 2. Reference Section 03400, Precast Concrete.

4.5 Cast-In-Place Manholes

- A. Cement used in cast-in-place manholes shall conform to ASTM C150, Type I/II.
- B. All fine and course aggregate shall conform to ASTM C33.
- C. All deformed reinforcing bars shall conform to ASTM A615, or ASTM A996.
 - 1. All bars shall be either Grade 40 or 60.
- D. All welded steel wire fabric shall conform to ASTM A185.
- E. Concrete used in cast-in-place manholes shall have a minimum of six (6) sacks per cubic yard, and develop a minimum compressive strength of 4000 psi after 28 days.
 - 1. Concrete shall have a max allowable water/cement ration of 0.50, by weight.

F. Reference Section 03300, Cast-in-Place Concrete.

4.6 Mortar

- A. Mortar shall be Sand-Cement grout, using the following ratio of ingredients:
 - 1. One part Portland Cement; conforming to ASTM C150, Type I/II.
 - 2. Two parts sand; conforming to ASTM C144.
 - 3. One-half part hydrated lime; conforming to ASTM C207, Type S.

<u>4.7 Grout</u>

- A. Grout shall be one of the following:
 - 1. Pre-mixed, nonmetallic grout; the acceptable types and manufacturers of which are listed below:
 - a. Master Builders; "Embeco Mortar".
 - b. Sonneborn; "Ferrolith G-D.S. Redi-Mixed".
 - c. Or approved equivalent.
 - 2. Job-mixed grout, using the following ratio of ingredients:
 - a. One part Portland Cement; conforming to ASTM C207, Type I/II.
 - b. One part sand; conforming to ASTM C144.
 - c. One part shrinkage correcting aggregate; the acceptable types and manufacturers are:
 - (1) Master Builders; "Embeco Aggregate".
 - (2) Sonneborn; "Ferrolith G-D.S".
 - (3) Or approved equivalent.

4.8 Ring and Cover

- A. All rings shall be maximum eight-inches (8") in height.
- B. Iron ring and covers shall be gray iron conforming to ASTM A48, with a coal-tar epoxy finish.
 - 1. The word "SEWER" shall be cast in the cover.
 - 2. Covers shall be non-perforated.
 - 3. Cover shall be a Denver heavy-duty traffic lid and not rock under traffic.
 - 4. Pick-hole shall be 11/2 inch wide by $\frac{1}{2}$ inch deep.
 - 5. Acceptable rings and covers are:
 - a. Neenah, R-1706.
 - b. Or approved equivalent.

<u>4.9 Steps</u>

- A. Steps in manholes shall not be installed unless prior written approval is received from the Town of Johnstown JWWD.
 - 1. If the JWWD accepts manhole steps to be installed, the steps shall be made a minimum 3/8-inch diameter grade 60 steel-reinforcing rod completely encapsulated in a copolymer polypropylene plastic, conforming to ASTM C478 and ASTM C497.
 - 2. Acceptable steps and their manufacturers are:
 - a. M.A. Industries; PS-2-PFS.
 - b. M.A. Industries; PS-2PF.
 - c. Or approved equivalent.

4.10 Preformed Plastic Gaskets

- A. All preformed plastic gaskets shall conform to Federal specification SS-S-00210 (GSA-FSS). Type I, rope form.
- B. The diameter of the preformed plastic gasket shall be 1.5-inches (1.5").
- C. Acceptable gaskets and their manufacturers are:
 - 1. Hamilton-Kent Manufacturing Co.; Kent Seal.
 - 2. Con Seal; CS-202.
 - 3. Or approved equivalent.

4.11 Inspection

- A. Manholes shall be inspected for cracks, abrasions, or other flaws prior to installation.
 - 1. Damaged or flawed manholes shall be rejected and not used.
 - a. Mark defective manholes and store them on site at a separate location away from the work until after acceptance of the piping system at which time it shall be removed from the site.

4.12 Preparation

A. Reference Part V, Section 02221, Trenching, Backfilling, and Compaction.

4.13 Manhole Construction

- A. Standard manholes shall be installed in accordance with Standard Drawings.
- B. Flat-top manholes shall be installed in accordance with Standard Drawings.
 - 1. Flat-top manholes are required whenever the distance between the finished ground surface and the manhole barrel section does not allow room for a cone section.
 - 2. Access holes for flat-top manholes shall be offset from center.

C. Cast-In-Place Concrete Base

- 1. Invert channels shall be smooth and semi-circular in shape conforming to the inside of the adjacent sanitary sewer pipe section.
- 2. Form inverts directly in the concrete of the base, or for a straight through manhole with no other inlets the channel may be constructed by laying a full section pipe through the manhole and by cutting out the top half of the pipe after the surrounding concrete has hardened.
- 3. Changes in direction of flow shall be made with a smooth curve having as large a radius as the manhole will permit.
- 4. The floor of the manhole outside of the channels shall have a smooth trowel finish and shall slope toward the channels at one-inch (1") per foot.
- 5. Pipe size changes shall be accomplished by matching the pipe crowns and forming the channel to accommodate the pipe size differential.
- 6. Where shown on the approved Construction Drawings, a piece of pipe of the proper size shall be built into the manhole where future laterals may be connected.
 - a. The stub-out shall be sealed with a plug at its outer end and an invert shall be built into each manhole for such lateral connections.
- 7. Manhole bases shall be thoroughly bonded to the barrel of the pipe.
 - a. Provide a rubber gasket on the pipe barrel for PVC pipe.
 - b. All connections with the pipe shall be made without projections or voids.
- 8. Inverts must meet the requirements of the Town.
- D. Drop Manholes
 - 1. Where difference in elevation between the incoming sanitary sewer pipe invert and the outgoing manhole invert is less than twenty-four inches (24"), the channel invert through the manhole shall be formed to make a smooth transition between the incoming and outgoing inverts.
 - 2. Where the difference in elevation is twenty-four inches (24") or more, provide an inside drop pipe for the sanitary sewer entering the manhole.
 - a. The inside drop shall be the same diameter as the incoming pipe diameter.
 - b. Manhole diameter per diameter of inside drop shall be:

Drop Diameter	Manhole Diameter
8-inch and below	5 feet
10-inch to 15-inch	6 feet
18-inch and above	Contact JWWD

- 3. The inside drop shall be manufactured by Reliner or approved equivalent.
- 4. Reference Town of Johnstown Sewer Standard Details.
- E. Manholes shall be constructed at the location and to the elevation indicated on the accepted Construction Drawings, or as stated by Sewer Department to accommodate field conditions.
 - 1. Reference Section 8, Gravity Sanitary Sewer Collection System.

- 2. All buried manhole covers shall be referenced to a minimum of two permanent surface references and recorded on the As-Built Record Drawings.
- F. The manhole shall be set plumb.
 - 1. Precast concrete adjustment rings shall be used to bring the ring and cover to grade.
 - a. The total height from the top of the cone section to the finished grade shall not exceed 16-inches.
 - b. The adjustment rings shall be flush with the inside of the manhole and grouted.
- G. Step Spacing (If Required)
 - 1. Manhole steps shall be placed 12-inches on center.
 - 2. The maximum distance from the cover of the manhole to the top most step shall be 18-inches.
 - 3. The maximum distance from the bench of the manhole to the lowest step shall be 18-inches.
- H. Manhole sections shall be joined to each other using preformed flexible plastic gaskets on <u>both interior and exterior shiplaps</u>. The manhole section shall be joined to the base using a double row of preformed flexible plastic gaskets.
 - 1. All joint surfaces shall be kept clean and dry during installation.
 - 2. Gaskets shall be pliable at the time of installation.
 - 3. Primer shall be used on both section/base surfaces unless directed by the Town.
- I. Adjustment shims, and ring and covers shall be joined to the manhole section and to each other using flexible plastic gaskets.
 - 1. All joint surfaces shall be kept clean, dry, and warm during installation.
 - 2. Manhole sections shall be grouted to ring and covers on the inside.
- J. All lifting holes, joints, and other imperfections shall be filled with an approved non-shrink grout, to provide a smooth finished appearance.

SECTION 5: GRAVITY SANITARY SEWER COLLECTION SYSTEM

<u>5.1 Scope</u>

A. This section addresses the installation of sanitary sewer collection mains and includes the acceptable products, materials, and construction practices which may be used in the installation of sanitary sewer collection systems.

5.2 Quality Assurance

- A. Standards (as applicable).
 - 1. ASTM C1244, Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum), latest revision.
 - 2. ASTM F1417, Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air, latest revision.
- B. Materials
 - 1. All materials used in the construction of gravity sanitary sewer collection systems shall be new.
- C. Horizontal alignment shall remain uniform between consecutive manholes and shall not deviate from the Town accepted construction documents by more than 6-inches (0.5 feet).
- D. Vertical alignment shall remain uniform between consecutive manholes and shall not deviate from the Town accepted construction documents by more than 0.05 feet.
 - 1. The only acceptable methods for the laying of sanitary sewer lines shall be with a laser.

5.3 Job Conditions

- A. Foreign material, including trench water, debris, etc., shall not be permitted to enter the pipe under construction.
- B. Debris or other material shall not be permitted in the pipe.
- C. Water shall be prevented from entering the sanitary sewer pipe that is already in services and has been previously accepted by the Town.
- D. Pipe delivered for construction shall be strung to minimize entrance of foreign material.
- E. All openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped at the close of a day's work or for other reasons, such as rest breaks or meal periods.
- F. Do not place debris, tools, clothing, or other material in the pipe.
- G. Use effective measures to prevent uplifting or floating of the pipeline prior to completion of backfilling operations.
- H. Do not install pipe under the following conditions:
 - 1. When the trench contains water.
 - 2. When weather conditions are unsuitable.

- a. Temperature is less than 10° Fahrenheit.
- b. Snowing
- c. Raining
- d. High winds that in the opinion of the Town impact construction and/or project safety.
- 3. When the trench bottom is unstable.
- I. Protect pipe and appurtenances against dropping and damage.
 - 1. Do not use pipe and appurtenances if they are damaged.
- J. Drainage and groundwater.
 - 1. Contractor shall obtain all necessary permits prior to starting dewatering operations.
 - a. If groundwater will be discharged into an irrigation ditch, pond, stream or waterway, or will drain to an irrigation ditch, pond, stream or waterway, a Colorado Department of Health Dewatering Permit will be required.
 - (1) Permit applications may take up to 30 days to be reviewed by the Colorado Department of Health.
 - (2) Contractor is required to complete and process the Discharge Monitoring Report (DMR) that is typically a part of the Dewatering Permit.
 - b. Upon completion of the work, the Contractor shall be responsible for completing a Colorado Department of Health Discharge Termination Notice.
 - 2. Water that is encountered in the trench shall be removed to the extent necessary to:
 - a. Provide a firm subgrade.
 - b. Permit connections to be made in dry conditions.
 - c. Prevent entrance of water into the pipeline.
 - 3. Surface runoff shall be diverted as necessary to keep excavations and trenches free from water during construction.
 - 4. The excavation or trench shall be kept free from water until the structure, or pipe, to be installed is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.
 - 5. The pipe shall not be used to dewater the trench.

5.4 Manholes

A. Reference Town of Johnstown Sanitary Sewer Construction Specifications, latest edition, Section 4, Manholes.

<u>5.5 Pipe</u>

A. Reference Town of Johnstown Sanitary Sewer Construction Specifications, latest edition, Section 6, Sanitary Sewer Service Lines.

5.6 Sanitary Sewer Service Lines

A. Reference Sanitary Sewer Construction Specifications, latest edition, Section 6, Sanitary Sewer Service Lines.

5.7 Inspection

- A. Pipe barrel and manholes shall be free of dirt or other foreign objects prior to installation.
- B. Pipe and manholes shall be inspected for cracks, dents, abrasions, or other flaws prior to installation.
 - 1. Damaged or flawed pipe or manholes shall be rejected and not used.
 - a. Mark defective pipe and/or manholes and store them on site at a separate location away from the work until after acceptance of the piping system at which time it shall be removed from the site.
- C. Operational Inspection:
 - 1. At the completion of the project and in the presence of the Town, the Contractor shall video all lines to ensure that no debris is left in the lines/manholes and the lines are not plugged.

5.8 Preparation

- A. Trenching, Backfilling, and Compaction
 - 1. Reference Construction Specifications, latest edition, Section 02221, Trenching, Backfilling, and Compaction.
- B. Pipe
 - 1. Reference Sanitary Sewer Construction Specifications, latest edition, Section 6, Polyvinyl Chloride (PVC) Non-Pressure Pipe.
- C. Manholes
 - 1. Reference Sanitary Sewer Construction Specifications, latest edition, Section 4, Manholes.
- D. Existing Utilities
 - 1. The horizontal and vertical location of existing utilities shall be field verified prior to start of construction.
 - a. Any deviation from what is shown on the approved construction drawings shall be reported to the Engineer immediately and documented on the As-Built drawings.

5.9 Connections to Existing System

- A. Connections to existing sanitary sewer collection system shall be made at an existing manhole or by setting a new manhole on the existing line.
 - 1. A watertight plug shall be installed in the new line to prevent any material from entering the existing system until the Town accepts the new system.
- B. At locations where connections to existing sanitary sewer collection mains are to be installed, the Contractor shall locate the existing mains both vertically and horizontally and verify their exact size and material prior to start of construction.
 - 1. The JWWD personnel will examine the existing pipe or manhole. Any necessary adjustments in line, grade, or connection requirements to accomplish the connection shall be reviewed and accepted by the Town prior to making the connection.

5.10 Pipe Installation

- A. Pipe Laying
 - 1. Pipe installation shall begin at the lowest elevation and proceed upstream to the highest, unless prior written approval is obtained from the JWWD.
 - a. Pipe shall be installed so that the bells are pointing uphill.
 - b. Lay pipe true to line and grade.
 - 2. Take effective measures to prevent opening of joints during bedding and backfilling operations.
 - 3. Complete the joint in accordance with the applicable pipe material specification and adjust the pipe to the correct line and grade as each length of pipe is placed in the trench.
 - a. Make adjustments in line and grade by scraping away or filling pipe bedding under the entire length of the pipe, except at bells, and not by wedging, blocking, or mounding up the pipe or bells.
 - 4. Secure the pipe in place with the specified bedding tamped under and around the pipe except at the joints.
 - a. Do not disturb the pipe after the jointing has been completed.
 - b. Do not use mechanical compacting equipment in the zone above the horizontal centerline of the pipe and below a plane one foot (1') above the top of the pipe.
 - 5. Do not walk on small diameter pipe or otherwise disturb pipe after the jointing has been completed.
- B. For water and sanitary sewer pipe crossings see the requirements set forth in Sanitary Sewer Construction Specifications, latest edition, Section 4, Relation to Water Mains and Sewer Pipes.

5.11 Manhole Installation

- A. Reference Sanitary Sewer Construction Specifications, latest edition, Section 4, Manholes.
- B. Manholes shall be installed at the location and to the elevation shown on the approved Construction Drawings, or as approved by Sewer Department to accommodate field conditions.
- C. Measurements of the actual location and elevation of sanitary sewer inverts and rim shall be made for the As-Built Drawings.

5.12 Sanitary Sewer Service Connections

A. Reference Sanitary Sewer Construction Specifications, latest edition, Section 6, Sanitary Sewer Service Lines.

5.13 Field Quality Control

A. Reference Sanitary Sewer Construction Specifications, latest edition, Section 2, Testing Sanitary Sewer Collection System.

SECTION 6: SANITARY SEWER SERVICE LINES

6.1 Scope

A. This section addresses the installation of sanitary sewer service lines plus furnishing and installation of clean-outs and other appurtenances.

6.2 Quality Assurance

- A. Construction Staking
 - 1. Reference Construction Specifications, latest edition, Section 02221, Trenching, Backfilling, and Compaction
- B. Materials
 - 1. All materials used in the construction of gravity sanitary sewer services shall be new.

6.3 Job Conditions

A. Reference Sanitary Sewer Construction Specifications, latest edition, Section 7, Gravity Sanitary Sewer Systems.

<u>6.4 Pipe</u>

A. Reference Sanitary Sewer Construction Specifications, latest edition, Section 4, Pipe Material

6.5 Flexible Couplings

- A. When joining pipes where conditions will not allow joining by use of a bell section, use one of the following adaptors:
 - 1. Can-Tex, C-T Adaptors
 - 2. Fernco, Flexible couplings or reducing couplings
 - 3. Jointers Inc., Calder Coupling
 - 4. Mission, Bushing Adaptors
 - 5. Nashua Pre-cast corp., Flex-O-Joint
 - 6. Or approved equivalent

6.6 General

- A. Only those Contractors licensed and bonded with the Town of Johnstown will be permitted to install sanitary sewer service connections.
- B. Sanitary sewer service connections shall be installed at locations designated on the Town accepted construction drawings.
- C. The Contractor shall mark the location of the sanitary sewer service with a stamped "S", four-inches (4") high, three-inches (3") wide into the face of the curb and gutter.

6.7 Trenching, Backfilling, and Compaction

A. Reference, Construction Specifications, latest edition, Part V, Section 02221, Trenching, Backfilling, and Compaction.

6.8 Taps

- A. Unless prior approval is given by the Town, only Town personnel shall make service taps on mains that have passed final acceptance by the City.
- B. The Contractor shall not make any taps without permission from the Town.
- C. Wyes and bends shall not be permitted for service connections unless previously approved in writing by the Town.
- D. Taps shall not be made within five feet (5') of a manhole.
- E. The flow line of the service connection shall be at or above the spring line of the sanitary sewer collection main and no closer than three feet (3') to the bell or spigot of the pipe.
- F. Reference Standard Drawings.

6.9 Service Lines

- A. All sanitary sewer services shall be extended at a constant grade from the tap on the collection main to the building.
 - 1. Maximum slope of all services shall be 8%.
 - 2. Minimum slope of 4-inch services shall be $\frac{1}{4}$ -inch per foot (2%).
 - 3. Minimum slope of 6-inch services shall be 1/8-inch per foot (1%).
- B. Sanitary sewer service lines shall be uniform in size from the tap to the building.
- C. Sanitary sewer service trenches shall be subject to compaction specifications. Reference Construction Specifications, latest edition, Part V, Section 02221, Trenching, Backfilling, and Compaction.
- D. The end of all sanitary sewer services shall be plugged with an airtight cap or plug.
- E. The end of all sanitary sewer services shall be marked with a 2-inch by 4-inch (2" x 4") wood post.
 - 1. All wooden posts shall extend from the end of the service to a point two feet, minimum, above the ground surface and shall be painted green.
 - 2. Locator balls/rings or adequate steel to be located by a ferrous metal detector shall be placed at the end of the service at an adequate depth to not be disturbed by grading and construction operations.
 - 3. Maintenance of the marker posts shall be responsibility of the Contractor.











<u>PART V</u>

CONSTRUCTION SPECIFICATIONS & STANDARD DETAILS

SECTION 1: CONSTRUCTION SPECIFICATIONS

SECTION 01070 – ABBREVIATIONS SECTION 01340 – SHOP DRAWINGS, SAMPLES AND OPERATION AND MAINTENANCE MANUALS SECTION 01400 – QUALITY CONTROL SECTION 01500 – CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS SECTION 02220 – STRUCTURE EXCAVATION AND BACKFILL SECTION 02221 – TRENCHING, BACKFILLING AND COMPACTING SECTION 02486 – SEEDING SECTION 02575 – PAVING REPAIR AND RESURFACING SECTION 03300 – CAST-IN-PLACE CONCRETE

SECTION 01070

ABBREVIATIONS

PART 1 - GENERAL

CISPI

- 1.1 Wherever used in these specifications the following abbreviations shall have the meanings indicated:
 - AA Aluminum Association AAMA Architectural Aluminum Manufacturers Association AASHTO American Association of State Highway & Transportation Officials AFBMA Antifriction Bearing Manufacturers Association AGMS American Gear Manufacturers Association AIA American Institute of Architects AIMA Acoustical and Insulating Materials Association AISC American Institute of Steel Construction AISI American Iron and Steel Institute ANSI American National Standards Institute ASHRAE American Society of Heating, Refrigeration & Air Conditioning Engineers ASME American Society of Mechanical Engineers ASTM American Society for Testing and Materials AWPI American Wood Preservers Institute AWS American Welding Society AWWA American Water Works Association BHMA Builders Hardware Manufacturers Association BUR Built-up Roofing CFM Cubic feet per minute
 - SPECS-1

Cast Iron Soil Pipe Institute

- CRSI Concrete Reinforcing Steel Institute
- CS Commercial Standard
- DWV Drain, waste and vent
- EEI Edison Electric Institute
- EXH Exhaust
- FM Factory Mutual System
- FRP Fiberglass reinforced plastic
- FS Federal Specifications
- IBBM Iron Body, Bronze Mounted
- IEEE Institute of Electrical and Electronics Engineers
- IFI Industrial Fasteners Institute
- ISA Institute Society of America
- MCC Motor Control Center
- MCIP Motor Control Instrument Panel
- MIL U.S. Military Specifications
- MSL Mean Sea Level
- MSS Manufacturer's Standardization Society of the Valves and Fittings
- NAAMM National Association of Architectural Metal Manufacturers
- NEC National Electric Code
- NEMA National Electrical Manufacturers Association
- NPT National Pipe Thread
- NRS Non-Rising Stem
- NWMA National Woodwork Manufacturers Association
- RIS Redwood Inspection Services
- RPM Revolutions per minute

- SDI Steel Door Institute and Steel Deck Institute, as applicable
- SMACNA Sheet Metal and Air Conditioning Contractors National Association
- SSPC Steel Structures Painting Council
- TCA Tile Council of America
- TFE Teflon
- UBC Uniform Building Code
- UL Underwriters Laboratories
- UPC Uniform Plumbing Code
- WCLIB West Coast Lumber Inspection Bureau
- WWPAWestern Wood Products Association

END OF SECTION

SECTION 01340

SHOP DRAWINGS, SAMPLES AND OPERATION AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 General

- A. This section covers the submittal and review of Shop Drawings, Samples and Operation and Maintenance Manuals.
- B. Submittals may only be required when requesting a variance from the Town's criteria. Consult with the Town to determine what submittals will be necessary.

1.2 Submittal Requirements

- A. Submit Shop Drawings, Samples, Operation and Maintenance Manuals and other submittals as required by individual specification sections or when requested by the Town.
 - 1. The Town will not accept Shop Drawings or other submittals from anyone but the Contractor or the contractor's engineer.
- B. Do not submit operation and maintenance data with Shop Drawings unless so specified or required by the Town to determine if equipment will comply with the requirements of the Town.
- C. Identify in writing all deviations of submittal from the approved drawings.
- D. Unless otherwise specified, make all submittals in groups containing all associated items to insure that information is available for checking each item when it is reviewed. Partial submittals may be rejected as not complying with these specifications.
- E. Submit the information identified by the code symbol in the individual specification sections or if not so identified submit the appropriate information outlined below required to define each item proposed to be furnished. The information to be submitted for each code symbol is defined on the following page:

LEGEND

DATA REFERENCE SYMBOLS AND DESCRIPTIONS

Symbol Description

- A Letters of Certification of Compliance on materials, equipment, etc.
- B Samples
- C Final Certified drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
- D Field erection instructions, assembly drawings and/or diagrams detail reference drawings lists, and lists of erection details.
- E Shop detail drawings showing individual subassemblies and fabricated pieces, with material specifications and other applicable data.
- F Installation instructions, operating and maintenance manuals and all other data pertinent to operating or servicing the complete apparatus. Preventive maintenance instructions and recommended frequency.
- G Schematic diagrams of power, control and piping system.
- H General bulletins and catalog cuts describing complete apparatus including operating principles and fundamentals.
- I Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished.
- J Head capacity curves for pumps. Impeller size furnished and maximum size available shall be noted on these data.
- K Curves and/or data for over-all range of operation from minimum to maximum capacity or load, showing capacity or load, utilities motive medium required, total or incremental differential head, and other pertinent information applicable to the equipment or its component assemblies.
- L Materials of construction of all components.
- M Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
- N Stuffing box sizes; packing sizes, specifications and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment.

- O Bearing manufacturer's standard identification and/or interchangeable number for all antifriction bearings in the equipment proper and its accessory items.
- P Material gradation, design mix, job mix formula and/or material analysis.
- F. Minimum Number Required:
 - 1. Shop Drawings:
 - a. Number Contractor requires plus three (3) copies which will be retained by the Town, five (5) copies minimum.
 - Submit four (4) additional copies for inclusion in Operation and Maintenance manuals where Operation and Maintenance manuals are called for. Where field modifications are made after acceptance, indicate "as constructed" conditions, mark copies "AS CONSTRUCTED", and submit prior to Substantial Completion.
 - 2. Samples: Two (2) unless required otherwise by individual specification sections.
 - 3. Operation and Maintenance Manuals: The number required by Contractor plus four (4) copies to the Town.

1.3 Resubmittal Requirements

- A. Make corrections or changes required by the Town and re-submit as specified in paragraph 1.2 above until acceptable.
- B. Identify in writing, all revisions other than those called for by the Town on previous submissions.

1.4 Shop Drawings

- A. Include the following pertinent information for each submittal.
 - 1. Field dimensions, clearly identified as such.
 - 2. Applicable standards, such as ASTM or Federal Specification numbers.
 - 3. Motors: include horsepower, voltage, temperature rating, service factor, full load current, full load rotative speed, power factor at full load, efficiency at full load, code letter, and design letter.
 - 4. Color charts and similar items.
- B. Manufacturer's standard drawings, schematics and diagrams:
 - 1. Clearly mark each copy to identify pertinent products and models and to describe exactly which parts of the drawings apply to the equipment being furnished.
 - 2. Delete information not applicable to the Work.
- C. Reproductions or copies of portions of Contract Documents are not acceptable as complete fabrication or erection drawings. However, they may be used as a drawing upon which to indicate information on erection or to identify detail drawings.

D. Format:

- 1. Minimum sheet size: $8\frac{1}{2} \times 10^{\circ}$
- 2. Identify each submission with the following:
 - a. Date of submission.
 - b. Project title and number.
 - c. Names of Contractor, Supplier, and Manufacturer.
 - d. Specification section number, intended use of item in the work and equipment designation.
 - e. Identify details by reference to sheet, detail, schedule or room numbers shown in the specifications.
 - f. Deviations from specifications.
 - g. Revisions on resubmittals.
 - h. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the Town.
 - i. Provide a clear space approximately $3\frac{1}{2}$ " x $2\frac{1}{2}$ " for the Town's stamp.

1.5 Samples

A. Samples shall be of sufficient size and quantity to clearly illustrate the functional characteristics of the product, with integrally related parts and attachment devices and the full range of color, texture, and pattern.

1.6 Operation and Maintenance Manuals

- A. Submit operation and maintenance manuals by the time the Work is 50% complete for all equipment so designated in the individual Specification Sections and for which the Shop Drawings have been reviewed and marked "No Exceptions Taken" or "Make Corrections Noted." In addition, submit instruction books and other pertinent information for equipment not so designated which requires special instruction or knowledge for proper operation and maintenance.
- B. Submit operation and maintenance manual for equipment by the time Work is 90% complete.
- C. Do not start or operate equipment until the respective operation and maintenance data has been reviewed, approved and copies made available at the site.
- D. The operation and maintenance manuals shall be in addition to instructions or parts lists packed with or attached to equipment when delivered.
- E. Include as a minimum the following information:
 - 1. Equipment function, normal operating characteristics, and limiting conditions complete motor data, test data and performance curves where applicable.
 - 2. Operating instructions for start-up, routine and normal operations, regulations and control, shutdown, and emergency conditions.

- 3. Lubrication and routine maintenance instructions.
- 4. Guide to "troubleshooting."
- 5. Parts lists, predicted life of parts subject to wear and recommended list of spare parts to be on hand.
- 6. Outline, cross section, and assembly drawings; engineering data; and wiring diagrams.
- 7. Copy of accepted or as constructed Shop Drawings.
- 8. Temperature control diagrams.
- 9. System balancing report including a description of system operation as prepared by the balancing contractor which includes a schedule of inspection and maintenance.
- 10. System Schematic Flow Diagrams.
- F. Format:
 - 1. Submit in a format suitable for binding in a three ring binder or a post binder.
 - 2. Minimum sheet size: $8'' \times 10\frac{1}{2}''$
 - 3. Fold drawings larger than 11" x 17" and insert into individual pockets bound into the manuals.
 - 4. Enclose sheets pages subject to frequent usage by operators in clear plastic.
 - 5. Individually annotate standard drawings which are furnished, describe exactly which parts of the drawing apply to the equipment being furnished.
 - 6. Identify each submission with the following:
 - a. Date of submission
 - b. Project title and number.
 - c. Names of Contractor, Supplier and Manufacturers, include telephone numbers and addresses.
 - d. Names of subcontractors with telephone numbers and addresses, contracted by Contractor for servicing and maintenance of portions of the project.
 - e. Specification section number, intended use of item in the Work, and equipment designation.
 - f. Identify details by reference to sheet detail, schedule or room numbers shown in the Contract Documents.

1.7 Review of Submittals

- A. A minimum of fourteen (14) days will be required for the Town to review each submittal or resubmittal following the receipt of all information required for review of the submittal. The Town will notify Contractor when the review time must be extended in order to correlate the submittal with other forthcoming submittals or for any other reason that prevents the Town's timely review.
- B. The Town will review submittals, affix a stamp, and initials or signature will indicate subsequent action to be taken and will return the submittals to Contractor for distribution. The review actions listed on the Town's stamp are defined on the following page:

- 1. No exception taken Signifies material or equipment represented by the Submittal conforms to the design concept and complies with the information given in the Town's criteria. Contractor is to proceed with fabrication or procurement of the items and with related work.
- 2. Make corrections noted Signifies material or equipment represented by the submittal conforms to the design concept, and complies with the requirements of the Town. Contractor may proceed with the work in accordance with the Town's notations.
- 3. Revise and resubmit Signifies material or equipment represented by the submittal conforms with the basic design concept, however, it does not comply with the requirements of the Town. Contractor is to submit a revised submittal responsive to the notations marked on the returned submittal and to the requirements of the Town.
- 4. Rejected Signifies material or equipment represented by the submittal does not conform to the design concept or comply with the requirements of the Town and is not acceptable. Contractor is to submit material or equipment responsive to the requirements of the Town.
- 5. Submit specified item Signifies material or equipment represented by the submittal is not the item specified by the Town and is not to be incorporated into the work. Contractor is to submit only the material or equipment specified by the Town.

C.	The Town will return the number of copies of submittals specified below depending on the
	action taken:

Action by the Town	No. Retained by the Town	No. Returned to Contractor	No. Required for Resubmittal	
No Exception Taken	3	3	0	
Make Corrections Noted	3	3	0	
Revise and Submit*	1	5	6	
Rejected*	1	5	6	
Submit Specified Item*	1	5	6	
* Only one copy of the submittals returned to the Contractor marked with these actions will be stamped annotated.				

END OF SECTION

SECTION 01400

QUALITY CONTROL

PART 1 - GENERAL

1.1 Description

A. The purpose of this section is to define the responsibilities for project staking and for performing the tests required by these specifications.

1.2 Construction Stake Out

- A. General:
 - 1. Construction stakes shall be provided by qualified, competent personnel for all construction.
 - 2. Design Engineer shall establish all points of intersection for alignment and temporary bench marks for vertical control.
 - 3. The grade and alignment shall be maintained by the use of suitable surveying instruments, or laser equipment operated continuously during construction.
- B. Grade Stakes:
 - 1. Sanitary sewer lines shall be staked as follows: The first hundred feet out of the manhole shall be stationed every 25'. From one hundred feet on, stationing will be every 100'. Cut sheets shall be provided indicating the percent and grade of the sewer line and cuts to the flow line of the sewer line. Sewer services shall be staked as required for each lot at a convenient offset for the Contractor, unless otherwise noted.
 - 2. Water lines shall be staked on the center lines of the water lines, at all fittings and angle points, any other points necessary for establishing the line. Cuts will be established at all main fittings to insure proper depth of the line. Fire hydrants will be staked with 5' offset. Water services will be staked no closer than 10' on the uphill side of the sewer services in the lot, unless otherwise required by field location.
- C. Survey Notes:
 - 1. Enter all survey notes and construction stake out cut notes into bound, hard cover field books.
 - 2. All survey data developed by the Contractor in performing the Work shall be available throughout the construction period.

1.3 Tests and Inspections

- A. The developer shall employ and the developer will pay for the services of a qualified independent testing laboratory to conduct the tests for:
 - 1. Soil compaction control as specified in Section 02221.
 - 2. Cast-in-place concrete as specified in Section 03300.
 - 3. Pavement repair and resurfacing as specified in Section 02575.
 - 4. Bacteriologic Tests as specified in Section 02710 (Appendix III).
 - 5. Bituminous concrete paving as specified in Section 02513 (Appendix II).
- B. The contractor shall conduct the following tests under the observation of and to the satisfaction of the Town:
 - 1. Pipe alignment tests.
 - 2. Sewer infiltration tests.
 - 3. Sewer exfiltration or air tests.
 - 4. Pipe deflection tests.
 - 5. Pressure and leakage tests.

1.4 Requirements for Independent Testing Laboratories

- A. Qualifications: Submit to the Town for prior approval:
 - 1. Name and address of proposed testing laboratory.
 - 2. Qualification of personnel.
 - 3. Description of facilities and equipment.
 - 3. Certificate of calibration of applicable testing equipment made by an accredited calibration agency within 12 months prior to the submittal date.
- B. Test Reports:
 - 1. Instruct the testing laboratory to submit, directly to the Town,
 - two copies of all reports of tests or inspections made showing:
 - a. Project identification.
 - b. Date of test.
 - c. Location of test in the project.
 - d. Applicable specification section and standard for compliance.
 - e. Indication of compliance, irregularities or deficiencies.
 - f. Observations relating to compliance.
 - g. Name and signature of observer.

END OF SECTION

SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.1 Temporary Utilities

A. Temporary utilities for construction shall be the sole responsibility of the Contractor.

1.2 Temporary Controls

- A. Noise Control: Equip construction machinery and vehicles with practical sound and muffling devices and operate in a manner to minimize noise consistent with efficient performance of the work.
- B. Dust Control:
 - 1. Take reasonable measures to prevent unnecessary dust.
 - 2. Moisten dirt roads used for transportation and haul with water or apply a chemical dust suppressant to control dust.
 - 3. Cover dusty material in transit when necessary to prevent blowing.
 - 4. Install silt fence or other barriers to prevent wind blown sediments from leaving the site.
- C. Pollution Control:
 - 1. Prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris and other substances resulting from construction activities.
 - 2. Retain all spent oils, hydraulic fluids and other petroleum fluids in containers for disposal off the site.
 - 3. Do not perform equipment maintenance or fueling within 50 feet of any water course.
- D. Erosion Control:
 - 1. Take such measures as are necessary to prevent erosion of soil on the site and adjacent properties that might result from construction activities.
 - 2. Provide temporary materials such as hay bales, sand bags, plastic sheets, chain link fencing fabric, riprap or culverts to prevent the erosion of banks or excavation where runoff may be increased or concentrated due to construction activities.
 - 3. Adhere to all state and federal requirements regarding erosion and sediment control associated with stormwater runoff.
1.3 Traffic Regulation

- A. Keep traffic areas free of excavated material, construction equipment, pipe, and other materials and equipment unless otherwise stipulated and conduct operations in a manner to avoid unnecessary interference with public and roads.
- B. Furnish properly equipped flagmen where necessary to provide for public safety, or where required by jurisdictional authorities.
- C. Warning Signs and Lights:
 - 1. Provide barricades and warning signs for open excavations, parked equipment, and soil stockpiles.
 - 2. Illuminate by means of warning lights all barricades and obstructions from sunset to sunrise.
 - 3. Comply with "Manual on Uniform Traffic Control Devices", U.S. Dept. of Transportation, or applicable statutory requirements of State Highway Department.
- D. Provide suitable parking areas for the use of all construction workers and others performing work in furnishing services in connection with the Project so as to avoid interference with construction activities.

1.4 Project Identification And Signs

A. Signs advertising the project, contractor, developer, etc. shall meet all pertinent local ordinances.

END OF SECTION

SECTION 02220

STRUCTURE EXCAVATION & BACKFILL

PART 1 - GENERAL

1.1 Description

- A. This section covers excavation, subgrade preparation, backfill for structures, and subgrade preparation and compaction for fills and embankments. It also includes disposition of excess materials, provision for imported materials, sheeting, shoring, pumping and initial site dewatering, and temporary drainage operations.
- B. Contents of this section may be modified to include more stringent requirements based on the soils report for the site.

1.2 Quality Assurance

- A. Soil Compaction Tests:
 - 1. ASTM D698 or AASHTO T99 Standard Method of Test for Moisture Density Relations of Soils Using a 5.5 lb. Rammer and a 12 inch drop.
 - a. Use method A, B, C, Or D, as appropriate, based on soil condition and judgment of the testing laboratory.
 - b. Sample tests will be representative of materials to be placed.
 - c. Determine and provide optimum density curve for each type of material encountered or utilized.
 - d. Include Atterberg Limits, grain size determination and specific gravity.
 - 2. ASTM D2049 Test for Relative Density of Cohesion less soils.
 - 3. Test results will be basis for Field Quality Control.

1.3 Job Conditions

- A. Underground Obstructions:
 - 1. Underground obstructions known to Engineer are shown on Drawings. However, locations shown may prove inaccurate and other obstructions not known to Engineer may be encountered.
 - 2. Notify each utility owner and request utilities be field located by surface reference at least 48 hours prior to trenching or excavation.
 - 3. Expose and verify size, location and elevation of underground utilities and other obstructions where conflicts might exist sufficiently in advance to permit changes in the event of conflict.
 - a. Notify Engineer in case of conflict.
 - b. In case of conflict the proposed Work may be changed by Engineer.
 - 4. Maintain, protect and support by shoring, bracing or other means existing utilities and appurtenances.

- 5. If Contractor elects to remove underground obstructions, the following shall apply:
 - a. Replace all other underground obstructions with new materials.
 - b. Restore to original conditions or better.
- 6. Clean drainage culverts so they are free to sediment after construction.
- B. No blasting will be allowed.
- C. Drainage and Groundwater:
 - 1. Maintain excavations and trench free from water during construction.
 - 2. Remove and dispose of surface and ground water entering excavations, trenches or other parts of the Work.
 - 3. Conduct dewatering operations in addition to good, positive drainage and eliminate standing water. Dewater excavations for concrete structures or pipes extending below ground water level by lowering and maintaining the water level beneath such excavations 24 inches or more.
 - 4. Divert surface runoff and use sumps, gravel blankets, well points, drainage lines or other means necessary to accomplish the above.
 - 5. Keep excavations dry during subgrade preparation and continuously thereafter until the structure is built to the extent that no damage from hydrostatic pressure, floatation or other cause will result.
- D. Sheeting and Shoring:
 - 1. Sheet, shore or brace banks and trenches not cut back to a stable slope as necessary to prevent sliding or caving to protect workmen and the Work.
 - 2. Design and build to withstand loads that might be caused by earth movement and pressure and to be rigid, maintaining its shape and position.
 - 3. Support sheeting in excavation in a manner so as not to concentrate loads or horizontal thrusts on piping.
 - a. Do not brace sheeting against the pipe.
 - 4. Sheeting Removal:
 - a. Do not remove prior to backfilling.
 - b. Use effective methods to protect construction, other structures, utilities and properties during sheeting removal.
 - c. Fill voids left by sheeting removal with dry sand.
- E. Weather:
 - 1. Do not backfill or construct fills or embankments during freezing weather.
 - 2. Do not place backfill, fill or embankment on frozen surfaces.
 - 3. Do not place frozen materials, snow or ice in backfill, fill or embankment.
 - 4. Do not deposit, stamp, roll or otherwise mechanically compact backfill in water.

1.4 Product Delivery, Storage and Handling

- A. Select transportation schedule and truck routes with approval of Owner to keep impacts on public to a minimum.
- B. Do not stockpile excavated materials against existing structures or Work.

C. If any material is stockpiled on the job site it shall be done in an orderly manner and kept a sufficient distance from banks, open trenches or excavations to avoid overloading and to prevent slides or cave-ins.

1.5 Correction Period

- A. Maintain and repair backfill, fill and embankment settlement and make necessary repairs to pavement, sidewalks or other structures which may be damaged as a result of settlement for a period of two (2) years after initial acceptance of the Work by the Town.
- B. Contractor may perform such maintenance and repairs by subcontract.

PART 2 - PRODUCTS

2.1 Fill, Embankment and Backfill Materials

- A. Crushed Gravel Base Course:
 - 1. Select base course meeting Colorado Department of Highways Specification, Class 6.
- B. Structure Backfill:
 - 1. Earth of non-expansive type, granular sand, gravel, small rocks and stone material.
 - 2. Free of organic material, trash, glass, broken concrete, or other deleterious material.
 - 3. Otherwise suitable backfill material containing rocks or stones larger than 6 inches in greatest dimension shall be screened so that backfill contains no stones or rocks of 6-inches or larger in size.
 - 4. Use suitable on-site excavated materials to the greatest extent possible.
 - 5. Import additional material, if required, using an approved pit-run sand and gravel.
- C. Fill and Embankment Materials:
 - 1. Fill and embankment shall be comprised of excavated on-site clay soils and sand & gravels to the greatest extent possible. Approved imported materials may be utilized as necessary.

PART 3 - EXECUTION

3.1 Preparation

A. Clear and strip surface vegetation, sod and organic topsoil for subgrades for areas within site work boundaries as shown on Drawings. The stripped topsoil shall be stockpiled separately and stored for later use in the site Finish grading.

1. Remove topsoil to a depth of 4" or the depth of existing topsoil, whichever is greater.

3.2 Excavation

- A. Provide adequate space and clearances for the Work and for installation and removal of concrete forms.
- B. Do not undercut excavated faces for extended footings.

3.3 Subgrade

- A. Scarify to a depth of six (6) inches and compact.
- B. Do not work on subgrade while ground is frozen or muddy.
- C. Remove exposed cobbles, stones or boulders greater than six (6) inches in size that create an irregular surface at subgrade. Backfill resulting voids with crushed gravel base course compacted to specific density.
- D. Carefully compact near structures to avoid damage.
- E. Compact and consolidate subgrades for structures or trench bottoms such that they are free from mud and sufficiently stable to remain firm, dense and intact under the feet of workmen.
 - 1. Reinforce subgrades with stabilization material that are otherwise solid, but become muddy on top due to construction operations.
 - 2. Finish stabilized subgrade to elevations shown on the Drawings.
- F. Level and compact subgrade so that surface materials will bond well with the first layer of backfill, fill or embankment.

3.5 Backfill, Fill and Embankment

- A. Use material that meets the requirements for structure backfills, fill and embankment material:
 - 1. Do not place rocks or stones in upper 18 inches of fills, or embankments larger than $1\frac{1}{2}$ inch in their greatest dimension.
 - 2. Use of rocks or stones within the allowable size limit in the remainder of fills or embankments is subject to their not interfering with proper compaction.
- B. Place on suitably prepared subgrades.
- C. Spread and compact materials in uniform lifts not exceeding 8 inches in incompact thickness:
 - 1. Spread and level material deposited in piles or windows prior to compaction.
 - 2. Distribute material so as to preclude the formation of lenses of material differing from the surrounding materials.

- D. Place and compact fill to an elevation at least one foot above top of proposed pipe where pipe will pass through backfill or fill prior to beginning trenching.
- E. Fill voids caused by demolition work or excavation or unsuitable material or over excavation with graded gravel in areas where structures, foundations or slabs will be constructed.
- F. Compaction Around Structures:
 - 1. Mechanically compact:
 - a. Use platform type tampers or similar equipment.
 - b. Rolling is permitted provided proper compaction is obtained and adequate measures are taken to prevent damage to structures.
 - 2. Do not compact by flooding or jetting.
 - 3. Do not backfill against new concrete walls less than 14 days after removal of forms:
 - a. Do not exceed ten (10) foot heights with backfill in less than 21 days after removal of forms.
- G. Compaction Equipment for Fills and Embankments:
 - 1. Use equipment suited to the soil being compacted.
 - 2. Sheepfoot Roller: If used provide with cleaner bars to attached as to prevent the accumulation of material between the tamper feet.
 - 3. Rollers: Use rollers so designed that the effective weight can be increased as required to obtain specified compaction.

3.6 Excess Material

A. Excess excavated material and unsuitable excavated material shall be disposed of on Owner's property at his direction.

3.7 Finish Grading

- A. Grade all areas after structures, backfills and embankments have been completed to slopes, contours or elevations indicated on Drawings.
- B. Provide allowance for topsoil placement where required.
- C. Provide effective drainage with slopes of at least one (1) percent unless otherwise indicated.
- D. Replace topsoil to a minimum depth of 4 inches.

3.8 Field Quality Control

- A. Field Compaction Control:
 - 1. Field tests will be conducted to determine compliance of compaction methods with specified density in accordance with:
 - a. ASTM D2922 (AASHTO T238)) Tests for Density of Soil and Soil Aggregate In-Place by Nuclear Methods, or,
 - b. ASTM D1556 (AASHTO T191) Tests for Density of soil In-Place by the Sand Cone Method.
 - c. ASTM D2167 (AASHTO T205) Tests for Density of Soil In-Place by Rubber-Balloon Method.
- B. Compaction shall be to the following minimum densities, reference ASTM D698 or AASHTO T99 unless otherwise indicated:
 - 1. Subgrade:
 - a. Under footings or slabs on grade foundations: 98%.
 - b. All other locations: 95%.
 - 2. Structure Backfill:
 - a. Under footings or foundations: 98%.
 - b. All other locations: 95%.
 - 3. Fills and Embankments:
 - a. Under footings, foundations, roadways or parking areas: 98%.
 - b. Other locations: 95%.
 - c. Dry utility trenches shall be flow filled or backfilled at the Town's discretion.
- C. Moisture Content
 - 1. Compact soils within ± 2 percent of optimum moisture.
 - a. Add water, harrow, disc, blade or otherwise work material as required to insure uniform moisture content and adequate protection.
- D. Soils Engineer:
 - 1. A soils engineer will inspect the natural soil at the bottom of excavations for structures. Provide the Town with 72 hours notice (exclusive of weekends and holidays) when the areas are expected to be ready for such inspections.
 - 2. Do not prepare subgrade or place concrete or asphalt until such inspection has taken place (or waived by the Town) and resulting recommendations of the Town has been carried out.

3.9 Flowable Backfill

- A. Scope:
 - 1. This section specifies requirements for design, materials, production, and placement of low strength, flowable concrete backfill. Flowable backfill is an alternative to conventional, compacted earth backfill. The primary application for this type of backfill is in utility trenches.

- B. Mix Design:
 - 1. A mix design shall be prepared in a testing laboratory by a Colorado Registered Professional Engineer competent in the field of materials engineering. In lieu of a mix design, documentation of field test data may be submitted. Samples of the mix, with its formula, shall be made available to the Town for testing prior to construction. Town reviewed mixes may be considered pre-qualified for subsequent usage. Flowability and strength requirements shall be as follows:
 - a. Slump: 10" minimum
 - b. 28-day strength: 30-90 psi
 - c. 90-day strength: 35-95 psi
- C. Materials and Production:
 - 1. Flowable backfill shall be produced from a job mix formula as specified above.
- D. Placement:
 - Before depositing flowable backfill, debris shall be removed from the space to be occupied by the flowable backfill. Flowable backfill shall be held low enough from the pavement surface to allow adequate trench patching depth per the Street Cut Utility Trench Detail shown in Part II Street Design, Construction Standards and Details. Vibratory or other compaction equipment shall be used only when necessary to fill inaccessible voids.
- E. Excess Excavation:
 - 1. All excess excavation material shall be removed from the job site at the Contractor's expense and shall become the property of the Contractor.
- F. Structure Backfill (Flow-Fill) Requirements for Bridge Abutments and Pipes:

Ingredients	<u>lbs./c.y.</u>	<u>kg/m³</u>
Cement	50	30
Coarse Aggregate (AASHTO No. 57 or 67)	1700	1009
Fine Aggregate (AASHTO M 6)	1845	1095
Water (39 gallons) (147 L)	325(or as needed)	193(or as needed)

G. The amount of water shall be such that the structure backfill (flow-fill) flows into place properly without excessive segregation. Approximately 39 gallons of water per cubic yard (193 L/m³) of structure backfill (flow-fill) is normally needed.

H. The Contractor may use aggregate which does not meet the above specifications of the cement is increased to 100 pounds per cubic yard (lbs/c.y.) (60 kg/m³) and the aggregate conforms to the following gradation:

<u>Sieve Size</u>	<u>%Passing</u>	
1 inch (25.0mm)	100	
No. 200	0-10	

The Contractor may substitute 30 lbs./c.y. (15 kg/m³) of cement and 30 lbs./c.y. (18 kg/m³) of fly ash for 50 lbs/c.y. (30 kg/m³) of cement or may substitute 60 lbs/c.y. (36 kg/m³) of cement and 60 lbs./c.y. (35 kg/m³) of fly ash for 100 lbs/c.y. (60 kg.m³) of cement.

- I. Recycled Broken Glass (Glass Outlet)
 - 1. Aggregate including glass must conform to the required gradations.
 - 2. All containers used to produce the outlet shall be amply prior to processing. Chemical, pharmaceutical, insecticide, pesticide or other glass containers containing or having contained toxic or hazardous substances shall not be allowed and shall be grounds for rejecting the glass outlet.
 - 3. The maximum debris level in the outlet shall be 10%. Debris is defined as any deleterious material, which impact the performance of the flowfill including all non-glass confluents.
- J. The maximum layer thickness for structure backfill (flow-fill) shall be three feet (1 m). Additional layers shall not be placed until the structure backfill (flow-fill) has lost sufficient moisture to be walked on without indenting more than two inches (50mm). Any damage resulting from placing structure backfill (flow-fill) in layers that are too thick from not allowing sufficient time between placements of layers shall be repaired at the Contractors expense.

END OF SECTION

SECTION 02221

TRENCHING, BACKFILLING, AND COMPACTING

PART 1 - GENERAL

1.1 Description

- A. This section covers excavation and trenching, including drainage, preparation of subgrades, pipe bedding, backfilling, compacting, and finish grading for underground pipelines, conduits, cables and appurtenances.
- B. Contents of this section may be modified to include more stringent requirements based on the soils report for the site.

1.2 Job Conditions

- A. Right-of-Way: Haul and stockpile excess material or erect suitable bulkheads to prevent deposition of excavated material where permanent right-of-way or temporary construction easement is not adequate to stockpile all excavated material without depositing it on private property.
- B. Blasting: No blasting or other use of explosives will be permitted.
- C. Drainage and Groundwater:
 - 1. Maintain excavations and trench free from water during construction.
 - 2. Remove water encountered in the trench to the extent necessary to provide a firm subgrade, to permit joints to be made in the dry, and to prevent the entrance of water into the pipeline.
 - 3. Divert surface runoff and use pumps, gravel blankets, well points, drain lines or other means necessary to accomplish the above.
 - 4. Maintain the excavation or trench free from water until the structure, or pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, floatation, or other cause will result.
 - 5. Obtain approval of individual owners and ditch companies for discharge to their property or facilities.
 - 6. Prevent puddling or continuous running water around trees or cultured plants.
- D. Sheeting and Shorings: Use sheeting and shoring where banks are not cut back on a stable slope and as necessary to prevent caving or sliding and to protect workmen, the Work and adjacent structures and facilities.
- E. Sequence of Operation:
 - 1. Install the pipeline within a minimum of 100 linear feet of trench excavation in developed areas and 300 feet in all other locations.

- 2. Backfill the trench within a minimum of 150 linear feet of the pipe installation in developed areas and 200 feet in all other locations.
- 3. Clean up the right-of-way within a minimum of 500 liner feet of trench excavation in developed areas and 1000 feet in all other locations.
- F. Underground Obstructions:
 - 1. Underground obstructions known to Engineer are shown on Drawings. However, locations shown may prove inaccurate and other obstructions not known to Engineer may be encountered. Contractor shall field locate and verify all obstructions whether or not shown on the Drawings.
 - 2. Notify each utility owner and request utilities are field located by surface reference at least 48 hours prior to trenching or excavation.
 - 3. Expose and verify size, location and elevation of underground utilities and other obstruction where conflicts might exist sufficiently in advance to permit changes in the event of conflict.
 - a. Notify Engineer in case of conflict.
 - b. In case of conflict the proposed Work may be changed by Engineer.
 - 4. Maintain, protect and support by shoring, bracing or other means existing utilities and appurtenances.
 - 5. Take such protective measures as the utility may direct where alterations or moving of utilities is required.
 - 6. If Contractor elects to remove underground obstructions, such as sprinklers, drainage culverts, catch basins or other structures, the following shall apply:
 - a. Drainage culverts may be salvaged, stored and reused if not damaged unless otherwise noted on the Drawings.
 - b. Replace all other underground obstructions with new materials.
 - 7. Maintain the flow in field drains at the quantity, quality, and velocity present prior to the temporary removal of the drainpipe, unless otherwise noted on the Drawings.

1.3 Product Delivery, Storage and Handling

- A. Select transportation schedule and truck routes with approval of Owner to minimize impacts to the public.
- B. Do not mix stabilization material or bedding material with topsoil or job-excavated material.

1.4 Maintenance and Correction

- A. Maintain and correct all trench settlement and make necessary repairs to pavement, sidewalks or other structures which may be damaged as a result of backfill or settlement for a period of one (1) year after conditional acceptance by the Town.
- B. Contractor may perform such maintenance and correction by subcontract. If subcontracted submit a copy of any subcontract or authorization as evidence of Contractor's faithful intention to perform necessary corrections during the one-year correction period.

PART 2 - PRODUCTS

2.1 Stabilization Material

- A. Top 6 Inches of Pipe Subgrade: Granular bedding material as specified below.
- B. Subgrade Below Top 6 Inches:
 - 1. Pit-run gravel or crusher-run rock meeting ASTM D448 gradation No. 357 (2" to No. 4 sieve) or
 - 2. Same as top 6 inches except that broken concrete and rock may be included in size permitting compaction specified without discernible voids.

2.2 Bedding Materials

- A. Concrete: Meet requirements of Section 03300 with a minimum 28-day compressive strength of 4000 psi.
- B. Granular Material: Crushed rock or gravel with 100% passing a 1" sieve, 95% passing a ³/₄" sieve and not more than 5% passing No. 4 sieve or well graded crushed, stone or gravel meeting requirements of ASTM D448, gradation 67.
- C. Select Soil: Material free from rocks, clods and stones greater than 1½ inch in any dimension and meeting other requirements of trench backfill material OR granular material.
- D. Barrier Material: Finely divided job excavated material free from stones organic matter and debris meeting a soil classification of GC, SC, CL, or ML-CL.

2.3 Trench Backfill Material

- A. Dry utility trenches shall be flow filled or backfilled at the Town's sole discretion.
- B. Trench backfill may be job-excavated material or select material as specified below.
- C. Job Excavated Material shall be free of frozen material, stumps, roots, brush, other organic matter, cinders or other corrosive material, debris, and rocks or stones greater than the following dimensions:
 - 1. 3 inches in any dimension for material placed within one foot of pavement subgrade or finished surface in unpaved areas.
 - 2. 6 inches in any dimension for the remainder of the trench provided they are distributed in the finer material.

C. Imported Backfill Material: Pit-run gravel or crusher-run rock with the following gradation:

Sieve Size	% Passing
2 inch	100
No. 10	80
No. 200	0 - 15

- 1. Material passing a No. 40 sieve shall have a liquid limit less than 35 and a plastic index less than 6 when tested in accordance with AASHTO T-89 and T-91, respectively.
- D. Highway Right-of-Way: Obtain approval by the agency having jurisdiction over highway maintenance for material placed within the limits of paved surfacing, gravel shoulders, or shoulder slopes.

PART 3 - EXECUTION

3.1 Preparation

- A. Clearing:
 - 1. Remove and disposing of trees, shrubs, bushes, downed trees, upturned stumps, weeds and other vegetation within the limits of clearing.
 - 2. Limit clearing to as narrow a width as practical within the right-of-way or permanent easements.
 - 3. Remove only non-cultured shrubs, bushes and other vegetation within the limits of the temporary easements.
 - 4. Trim trees in lieu of removal when practicable.
 - 5. Apply wound paint to cuts or scarred surfaces of trees or shrubs.
 - 6. Protect root zones of trees and cultivated plants not removed.
- B. Topsoiling:
 - 1. Remove topsoil from all areas to be disturbed by construction.
 - 2. Minimum depth of removal: Equal to depth of existing topsoil or 4 inches whichever is greater.
 - 3. Stockpile topsoil and keep segregated from granular materials and inorganic trench materials and debris.
- C. Sod Removal:
 - 1. In lawn areas, cut and roll back sod before trenching.
 - 2. If sod is to be reused store and protect sod from damage and drying.
 - 3. Do no reuse when stored for more than 48 hours.

- D. Pavement Removal:
 - 1. Remove pavement, drives, curbs, and sidewalks to clean straight lines. Saw cutting is required if a clean straight line cannot be obtained by other methods.
 - 2. On concrete surfacing, if saw cut would fall within 3 feet of a construction joint, cold joint or edge, remove concrete to that location.

3.2 Trenching

- A. Excavate trenches by open cut methods, except where boring or tunneling is indicated in the Contract Documents, required by jurisdictional agencies or desired by Contractor to avoid removal of obstruction.
- B. Do not use mechanical equipment in locations where its operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground. In all such locations, hand-excavating methods shall be used.
- C. Use mechanical equipment so designed and operated that the rough trench excavation bottom elevation can be controlled with uniform trench widths and vertical sidewalls from an elevation one foot above the top of the installed pipe to the bottom of the trench, and trench alignment sufficiently accurate to permit pipe to be aligned properly with adequate clearance between the pipe and sidewalls of the trench. Do not undercut the trench sidewall to obtain clearance.
- D. Excavation in Rock:
 - 1. Over excavate a minimum of six inches below the bottom of the pipe for pipe 24 inches in diameter or less and nine inches for pipe larger than 24 inches, wherever the trench bottom is rock, shale, or other hard or semi-hard material.
 - 2. Backfill over depth with Granular Material.
- E. Preparation of Trench Bottom:
 - 1. Grade trench bottoms uniformly to provide clearance for each section of pipe.
 - 2. Remove loose materials, water and foreign objects.
 - 3. Provide firm subgrade suitable for application of bedding material.
 - 4. Wherever unstable material that in the opinion of the Owner's Representative is incapable of supporting the pipe is encountered in the bottom of the trench, over-excavate such material to a depth suitable for construction of a stable subgrade. Backfill over-depth with Stabilization Material and compact.
- F. Stockpiling Excavated Materials:
 - 1. Pile suitable material for backfilling in an orderly manner a sufficient distance from banks of the trench to avoid overloading and to prevent slides or cave-ins.
 - 2. Remove and dispose of excess excavated materials not suitable or not required for backfilling.
 - 3. Do not stockpile excavated material against existing structures, or appurtenances, trees or cultivated shrubs.

- G. Limiting Trench Widths:
 - 1. Excavate trenches to provide adequate working space and pipe clearances for proper pipe installation, jointing and embedment. Provide a minimum clearance of 6 inches on each side of the pipe for pipe 12 inches in diameter or less, 8 inches for pipe between 14 inches and 30 inches in diameter, and 12 inches for pipe larger than 30 inches in diameter.
 - 2. If PVC pipe is used and maximum cover over the pipe exceeds 17 feet, use granular material compacted to 95% of maximum density to an elevation 1 foot above the top of the pipe.
- H. Over-depth Excavation:
 - 1. Restore over-excavated subgrades to proper elevation with Stabilization Material.

3.3 Pipe Bedding

- A. Bedding Classes: Place pipe bedding in accordance with the details shown in this Appendix. Bedding shall be Class B or better except where other Classes are specifically required. Provide higher-class bedding where maximum trench width is exceeded and the higher class is required to avoid overloading the strength of pipe being placed as determined by ENGINEER.
- B. Placement and Compaction:
 - 1. Distribute and grade bedding material to provide uniform and continuous support beneath the pipe at all points between bell holes or pipe joints.
 - 2. Deposit bedding material and compact uniformly and simultaneously on each side of the pipe to prevent lateral displacement.
 - 3. Compact carefully compacted bedding material to 95% of maximum density.
- C. Ground Water Barriers:
 - 1. To impede passages of water through bedding material, construct a ground water barrier the full trench width, approximately 4 feet long, and from the bottom of all Granular Material to 1 foot above top of pipe.
 - 2. Location:
 - a) Sanitary Sewers: Approximately 10 feet downstream from each manhole.
 - b) All other pipelines: Approximately 500 feet apart.

3.4 Backfilling and Compaction

- A. Sheeting Removal:
 - 1. Do not remove sheeting prior to backfilling.
 - 2. Use effective methods to protect the construction, other structures, utilities and properties during sheeting removal.
 - 3. Fill voids left by sheeting removal with dry sand.

- B. Deposit backfill material in uniform layers not exceeding eight inches in incompact thickness. Increased layer thickness may be acceptable provided it is demonstrated that the specified compacted density will be obtained.
- C. Use methods and equipment appropriate for the backfill material. Do not use equipment or methods that will transmit damaging shocks to the pipe.
 - 1. Do not perform compaction by jetting.
- D. Import material for trench backfill if compaction cannot be obtained with job excavated material.
- E. Backfill in Fields:
 - 1. Do not mechanically compact the top 2 feet of backfill in fields.
 - 2. Estimate the amount of material required to backfill the trench and form sufficient mound so that after normal settlement has occurred, the finished surface will match the existing grade.
- F. Topsoiling: Replace topsoil to the depth of stripping over all areas disturbed by construction operations and which will not receive other surface treatment.
- G. Obtain a site for and dispose of excess excavated materials and material not suitable for backfilling.

3.5 Field Quality Control

- A. Moisture Density Tests: The following tests shall be conducted on representative samples of each type of material encountered or utilized and will be used as a basis for compaction control.
 - 1. ASTM D698 or AASHTO T99 Standard Method of Test for Moisture Density Relations of Soils Using a 5.5 lb Rammer and a 12-inch drop.
 - a. Use method A, B, C or D as appropriate, based on soil condition and judgment of the testing laboratory.
 - b. Determine and provide optimum density curve for each type of material encountered or utilized.
 - c. Include Atterberg Limits, grain size determination and specific gravity.
 - 2. ASTM D2049 Test for Relative Density of Cohesionless Soils.
- B. Compaction Control:
 - 1. Field tests will be conducted to determine compliance of compaction methods with specified density in accordance with one of the following methods:
 - a. ASTM D2922 Tests for Density of Soil and Soil Aggregate In Place by Nuclear Methods.
 - b. ASTM D1556 Tests for Density of Soil In-Place by the Sand Cone Method.
 - c. ASTM D2167 Tests for Density of Soil In-Place by Rubber-Balloon Method.

- 2. Conduct a minimum of 3 tests for every 1000 linear feet of trench at locations and depths designated by ENGINEER. Excavate to designated depths and backfill tests holes in accordance with the backfilling and compacting specifications.
- C. Compaction shall be to the following minimum densities:
 - 1. Subgrade:
 - a. Under footings or foundations: 100%
 - b. All other locations: 95%.
 - 2. Barrier material: 95%
 - 3. Pipe bedding:
 - a. Carefully compacted select soil: 90%.
 - b. Lightly compacted select soil: 80%.
 - c. Compacted granular material: 80% (ASTM D2049).
 - d. Barrier material: 95%.
 - 4. Trench backfill:

b.

- a. State highways
 - 1) 100% for paved areas and shoulder slopes.
 - 2) 95% for all other areas.
 - Paved roadways, sidewalks and other areas to receive pavements
 - 1) Top 4 feet: 95%.
 - 2) Remainder of trench: 90%.
- c. Gravel roadways: 90%.
- d. Sodded or lawn areas: 90% (top two feet only).
- e. Fields and all other areas: 90% or equal to the density of undisturbed adjacent material, whichever is greater unless otherwise indicated.
- f. Under footings, foundations or structures: 100%.
- g. All other locations: 95%.
- 5. Where granular materials are used in lieu of cohesive soils, reduce the above percentages specified in paragraphs 1. and 4. above by 15% to arrive at the relative density and ASTM D2049 shall apply.
- D. Moisture Content: Compact soils within (±)2% of optimum moisture. Add water, harrow, disc, and blade or otherwise work material as required.

END OF SECTION

SECTION 02486

SEEDING

PART 1 - GENERAL

1.1 Description

A. This section covers soil preparation, seeding, fertilizing, mulching, watering and initial care.

1.2 Quality Assurance

- A. Furnish in bags or containers clearly labeled to show the name and address of the supplier, the seed name, the lot number, net weight, the percent of weed seed content and the guaranteed percentage of purity and germination.
 - 1. All seed furnished shall be free from noxious seeds such as Russian or Canadian thistle, European bindweed, Johnson grass and leafy spurge.
 - 2. If seed available on the market does not meet the minimum purity and germination percentages specified, compensate for a lesser percentage of purity or germination by furnishing sufficient additional seed to equal the specified product. Product comparison shall be made on the basis of pure live seed in pounds.
 - 3. Normally, seeding should be accomplished in one or another of two planting seasons within a specified time. Planting seasons are between September 1st and November 1st or April 15 and June 15.
- B. Double amount of seed per acre if seeding is done at times other than the above stated planting seasons.
 - 1. Need not be quadruple if seed and mulch are supplied in single application.

PART 2 - PRODUCTS

2.1 Fertilizer

- A. Commercial Product:
 - 1. Native areas:
 - 2. Available nutrients by weight:
 - a. Nitrogen (N) is 15 lbs/acre.
 - b. Phosphorous $({}_{2}0_{5})$ at 10 lbs/acre.

2.2 Lawn Areas

- A. Available Nutrients by Weight:
 - 1. Nitrogen (N) at 28 lbs/acre.
 - 2. Phosphorous $(P_2 0_5)$ at 20 lbs/acre.

- B. Uniform in Composition, Dry and Free Flowing.
- C. Deliver in Original, Unopened Containers.

2.3 Seed

A. Native Seed: combination of at least two of the following:

	<u>SPECIES</u>	PLS/ACRE
(1)	Crested wheatgrass	11.5
(2)	Indian grass	2.5
(3)	Hard Fescue	1.0
(4)	Alkali sacaton	0.15
(5)	Sainfoin	5.25
(6)	Western wheatgrass	19.8
(7)	Blue gramma	3.0
(8)	Switch grass	5.6

- B. Alternative seed types may be used by Approval only.
- C. All seeding rates are for drilled seeding and must be doubled if broadcast.
- D. Do not use seed that has become wet, moldy, or otherwise damaged in transit or in storage.

2.4 Mulch

- A. Clean Hay or Straw.
- B. Wood Cellulose Fiber.
- C. Soil Retention Blanket:
 - 1. Jute
 - 2. Loosely twisted construction of heavy mesh with a uniform open plain weave of unbleached single jute yarn.
 - 3. Average twist of not less than 1.6 turns per inch.
 - 4. Thickness shall not vary more than one-half its normal diameter.
 - 5. Furnish in approximately 90 pound rolled strips.
 - a. Length: Approximately 75 yards.
 - b. Width: 48 inches, plus or minus one inch.
 - c. 78 warp ends per width of cloth.
 - d. 41 weft ends per yard.
 - e. Weight: Average of 1.22 pounds per linear yard, plus or minus 5 percent.
 - f. Staples: 0.091 inch diameter minimum, "U"-shaped with a 1 inch crown and legs 6 inches in length or "T" shaped, 8 inch minimum length after bending with bar at least 4 inches long having a single wire end bent downward approximately 3/4 inch.

- D. Erosion Control Fabric:
 - 1. Knitted construction of yarn with uniform openings interwoven with strips of biodegradable paper, furnished in rolls with suitable protection for outdoor storage at a construction site.
 - a. Width: 10 feet minimum.
 - b. Length: 360 feet average.
 - c. Approximate weight: 0.2 pounds per square yard.
 - d. Packaging: 4 6 ml opaque polyethylene bag.
 - e. Staples: 1 gage wire, "U" shaped with a 1-inch crown and legs 6 inches in length.

PART 3 - EXECUTION

3.1 Preparation

- A. Till, fertilize, and harrow areas to be seeded:
 - 1. Thoroughly till the soil in areas that previously supported vehicle traffic.
 - 2. Till soil to a depth of 12 inches after areas have been cleared and brought to grade.
- B. Work the soil only when moisture conditions are suitable.
- C. Remove rocks and other objects 2 inches and greater in any dimension.
- D. Smooth, firm and mix fertilizer into top 2 inches of soil by use of a weights harrow prior to seeding.
- E. Correct irregularities in the ground surface resulting from soil preparation operations and slope to drain.

3.2 Seeding

- A. Apply seeding by means of approved mechanical power-drawn drills followed by packer wheels, broadcast-type seeders, or hydraulic type seeders.
- B. Do not drill or sow during windy weather or when ground is frozen or untillable.
- C. Apply water when necessary.
- D. Seeding by mechanical power-drawn drills:
 - 1. Set depth bands to maintain a planting depth of at least 1/4 inch.
 - 2. Set to space rows not more than 7 inches apart.
 - 3. Sow seeds of different sizes from the mixtures from at least two separate hoppers adjusted to provide the proper coverage.

- E. Seeding by broadcast type seeders:
 - 1. "Rake in" or otherwise cover seed with soil to a depth of at least 1/4 inch.
 - 2. Roll to obtain a firm seed bed.
 - 3. Do not use hand method of broadcasting seed except on small areas not accessible to machine method.
- F. Hydraulic seeding:
 - 1. Equipment shall include a pump capable of being operated at 100 gallons per minute at 100 psi.
 - 2. Equipment shall have an acceptable gage and a nozzle adaptable to hydraulic seeding requirements.
 - 3. Storage tanks shall have a means of agitation and a means of estimation of the volume used, or remaining in the tank.

3.3 Mulching

- A. Apply mulch or Soil Retention Blanket on all seeded areas:
 - 1. On slopes flatter than 4:1, mulch may be hay, straw or wood cellulose fiber.
 - a. Spread hay or straw mulch uniformly at rate of 2 tons per acre.
 - b. Immediately following the spreading of hay or straw mulch, anchor the material into the soil a minimum of 3 inches by means of a mulch anchoring machine equipped with large goulter-type discs spaced at approximately 8 inch centers.
 - c. Apply wood cellulose fiber in the manner and at the rate recommended by the manufacturer for the specific fiber used.
- B. Apply Soil Retention Blanket on 4:1 slopes and steeper:
 - 1. Drape blanket loosely over ground surface, smooth but not taut.
 - 2. Fabric shall have close ground contact.
 - 3. Prepare, fertilize and seed prior to installation of Soil Retention Blanket.
 - 4. If the slope is greater than 3:1, fabric shall be applied vertically with paper strips oriented parallel to the slope.
 - 5. Dig a 6 inch deep check slot 1 foot back from the top of slope and at toe of the slope.
 - a. Fold and place fabric in slot, and drive staple in fabric every 9 inches.
 - b. Fill slot with soil and compact.
 - 6. Dig a 4 inch deep check slot perpendicular to the direction of water flow at 50 foot intervals on slopes and ditches more than 100 feet long.
 - a. Drape fabric down into check slot.
 - b. Fill slot with soil and compact.
 - 7. Overlap 4 inches (minimum) when 2 or more lengths of fabric are required to be installed side-by-side to cover an area.
 - a. Secure each length of fabric with staples driven in 3 rows, at each edge and the center with staples placed on 3-foot centers (maximum).

- 8. Overlap 12 inches (minimum) with the upgrade section on top of the lower grade section when fabric lengths are installed end-to-end.
 - a. Secure overlapped ends with staples driven in 3 rows, at each edge and the center with staples places on 9-inch centers (maximum) across the fabric overlap.
- 9. Overlap 12 inches (minimum) where one roll ends and a second roll starts with the upslope piece brought over the buried end of the second roll to form a junction slot.
- 10. Staple:
 - a. 2 foot interval on outside edges and centers of rolls.
 - b. 6-inch interval on check slots and junction slots.
 - c. Use sharp pointed hardened steel 3-inch fence type staples on soil that is extra hard.

3.4 Hydraulic Seeding and Mulching

A. As an option, CONTRACTOR may accomplish seeding, fertilizing and mulching by hydraulic spray application at the direction of the Town. Seed and fertilizer in the amounts per acre designated, and wood cellulose fiber mulch at the rate recommended by the manufacturer for the specific fiber mulch used. Combine with water to provide a slurry. Perform hydraulic application in such a manner that the liquid carrier will uniformly distribute the material over the entire area to be seeded at rates not less than indicated herein. Do not compact. Double the amount of seed per acre if seed and mulch are applied in a single application. Hydro seeding will only be allowed in irrigated areas.

3.5 Watering

- A. After seeding and mulching, wet down seeded area and keep moist during germination.
- B. Avoid allowing standing water, surface wash, or scour.

3.6 Reseeding and Repair

A. Reseed and mulch areas where there is not a satisfactory stand of grass at the end of 5 weeks after seeding.

3.7 Fertilizing

- A. Broadcast fertilizer over the seeded area after the germination of seed:
 - 1. Apply at a rate of 5 lbs. per 1000 sq. ft.
- B. Do not apply fertilizer until at least 6 weeks after seeding operations are complete if seeding is done during the germination season.

3.8 Establishment

- A. Water and care for seeding planted until Final Acceptance.
- B. Field seed shall be established at least 30 days prior to Final Acceptance.

SECTION 02575

PAVING REPAIR AND RESURFACING

PART 1 - GENERAL

1.1 Description

- A. This section covers surface obstructions which CONTRACTOR removes and replaces such as pavement, drives, curbs, gutters, sidewalks, and similar surfaces as required to perform the Work.
 - 1. CONTRACTOR has the option of protecting instead of removing and replacing obstructions that interfere with the Work.

1.2 Quality Assurance

- A. The words "Standard Specifications" as used herein refer to the State Department of Highways, Division of Highways, State of Colorado, "Standard Specifications for Road and Bridge Construction," adopted 1976.
 - 1. Measurement and payment sections of "Standard Specifications" are not applicable to the Work.

PART 2 - PRODUCTS

2.1 Materials

- A. Soil Sterilizing Agent: Reference "Standard Specifications," Section 217.02.
- B. Aggregates for Base Course and Gravel Surface: Reference "Standard Specifications," Section 703.04, Grading "E."
- C. Aggregates for Pavement: Reference "Standard Specifications," Section 703.04, Grading, Class 6.
- D. Filler Material: Reference "Standard Specifications," Section 703.06 and AASHTO M17.
- E. Hydrated Lime: Reference "Standard Specifications," Section 712.03.
- F. Bituminous Materials: Reference "Standard Specifications," Section 702.

Asphalt Cement	Penetration Grade of AC-10, AASHTO M226, 6.0%
	by weight of mix.
Prime Coat	Liquid Asphalt, MC -70, AASHTO M82.
Tack Coat	Emulsified Asphalt, CSS01, AASHTO M140.
	Asphalt Cement Prime Coat Tack Coat

- G. Concrete: Reference Section 03300, "Cast-In-Place Concrete."
- H. Premolded Expansion Joint Fillers: Reference AASHTO M213 (ASTM D1751), 1/2" thickness.

PART 3 - EXECUTION

3.1 Asphalt Concrete Including Base and Gravel Surfacing

- A. Remove, dispose of and restore to original or better condition asphalt concrete pavement, curbs, drives, sidewalks and gravel surfacing.
 - 1. Remove pavement, drive or sidewalk to clean straight lines.
 - a. Saw cutting is required if a clean straight line cannot be obtained by other methods.
 - 2. Subgrade compaction Reference Section 0221, "Trenching, Backfilling and Compaction."
 - 3. Soil Sterilization Sterilize subgrade prior to construction of base course.
 - 4. Base Course Construct in accordance with Section 02513 of Part II.
 - a. Existing asphalt shall be milled 18' back from the vertical edge before patching operation commences to form a weather tight seal.
 - b. Pavement and driveway base course Restore to same thickness as existing, but in no case less than 6 inches.
 - c. Sidewalk base course Restore to same thickness as existing, but in no case less than 4 inches.
 - 5. Primer Coat Tack Coat Apply prior to placement of asphalt concrete in accordance with Section 02513 of Appendix II.
 - 6. Asphalt concrete pavement, drives and sidewalks restore to existing alignment, dimensions and grade.
 - a. Pavement and driveway Restore to same thickness as existing, but in no case less than 2 inches.
 - b. Sidewalk Restore to same thickness as existing but in no case less than 4 inches.
 - 7. Gravel Surfacing Restore to existing alignment and grade.
 - a. Restore to same thickness as existing, but in no case less than 4 inches.
 - b. Perform grading necessary to provide a smooth roadway.

3.2 Concrete Surfacing

- A. Remove, dispose of and restore to original or better condition concrete drives, curbs, gutters, sidewalk and similar structures.
 - 1. Remove concrete to neatly sawed edges or to existing smooth joint lines.
 - a. Saw concrete to a minimum depth of 2 inches.
 - b. If saw cut would fall within 3 feet of construction joint, cold joint, expansion joint, or edge, remove concrete to the joint.
 - 2. Subgrade compaction Reference Section 02221, "Trenching, Backfilling, and Compaction."

- B. Restore to existing alignment, dimensions and grade.
- C. Provide for a diameter lap if existing concrete that is removed contains reinforcing steel. New steel shall be of same diameter and of equal or better quality.
- D. Match existing expansion joints and contraction joints.
- E. Restore all surface improvements to the same thickness as existing, but in no case less than the following:
 - 1. Driveway and slab 6 inches.
 - 2. Patio 4 inches.
 - 3. Gutter 6 inches measured at flowline.
 - 4. Concrete base for bricks 6 inches.
 - 5. Sidewalk 4 inches.
- F. Tool outside edges of sections and joints with a ¹/₄" radius edging tool.
 - 1. Replace W/S curb face marking as necessary.
- G. Curing:
 - 1. Cure faces exposed by form removal immediately after forms are removed.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 Description

A. This Section covers all cast-in-place concrete, including forms, reinforcing steel, finishing, curing and other appurtenant work for use with small projects such as vaults, headwalls, and utility encasements.

1.2 Quality Assurance

- A. Reference Standards:
 - 1. Except as modified or supplemented in these Specifications, all structural concrete shall meet the requirements of the following standards. Refer to the standards for detailed requirements.
 - a. ACI 301 Specification for Structural Concrete for Buildings.
 - b. ACI 347 Recommended Practice for Concrete Formwork (Chapters 1 through 5).
- B. Mix Design:
 - 1. Compressive Strength: 4000 psi at 28 days:
 - a. Minimum number of cylinders passing above requirement shall be 90%.
 - b. Minimum strength of cylinder acceptable, 2800 psi.
 - 2. Cement Content: 6 bags per cubic yard, minimum.
 - 3. Maximum permissible Water cement ratio:
 - a. For 3500-psi strength, non air-entrained, absolute ratio by weight 0.58.
 - b. For 3500-psi strength, air-entrained, absolute ratio by weight 0.46.
 - 4. Slump: 4 inch maximum.
 - 5. Air Content: $5\% \pm 8\%$ for concrete with exposed surfaces or subject to freezing and thawing; not required for other concrete. Low air content may be field adjusted at the Town's discretion.

1.3 Product Delivery, Storage and Handling

- A. Cement: Store in weather-tight enclosures and protect against dampness, contamination and warehouse set. Do not use cement that has become caked or lumpy.
- B. Aggregates:
 - 1. Stock pile to prevent excessive segregation or contamination with other materials or other sizes of aggregates.
 - 2. Use only one supply source for each aggregate stockpile.
 - 3. Do not use the bottom 6 inches of aggregate piles in contact with the ground.

- C. Admixtures:
 - 1. Store to prevent contamination, evaporation, or damage.
 - 2. Protect liquid admixtures from freezing or harmful temperature ranges.
 - 3. Agitate emulsions prior to use.
- D. Mixing and Transporting Ready-Mixed Concrete:
 - 1. The maximum elapsed time from the time water is added to the mix until the concrete is in place shall not exceed 1½ hours when concrete is transported in revolving-drum truck bodies. This includes the time in which air packs are added.
- E. Reinforcing Steel:
 - 1. Deliver to site in bundles marked with metal tags indicating bar size and length.
 - 2. Carefully handle and store on supports, which will keep the steel from coming in contact with the ground.
 - 3. Remove all mud, oil, loose rust or mill scale and other foreign materials prior to placing concrete.
 - 4. Rust or mill scale which is "tight" will be permissible without cleaning or brushing, provided weights, dimensions, cross sectional area, and tensile properties meet the requirements of ASTM A615.

1.4 Job Conditions

- A. Environmental Requirements:
 - 1. Do not place concrete during rain, sleet or snow unless adequate protection is provided.
 - 2. Do not allow rainwater to increase the mixing water or damage the surface finish.
- B. Cold Weather Concreting:
 - 1. Conformance: ACI 306, "Recommended Practice for Cold Weather Concreting."
 - 2. Temperature of concrete when placed shall not be less than the following:

Minimum Concrete Temp. [°] F Air Temp. Sections with Least Dimension				
۴	Under 12"	12" and Over		
30 to 45	60	50		
0 to 30	65	55		
Below 0	70	60		

- 3. When placed, heated concrete shall not be warmer than 80°F.
- 4. Prior to placing concrete, all ice, snow, surface and subsurface frost shall be removed, and the temperature of the surfaces to be in contact with the new concrete shall be raised above 35° F.
- 5. Protect concrete during specified curing period.
- 6. Heated enclosures shall be strong and windproof to insure adequate protection of corners, edges and thin sections.
- 7. Do not permit heating units to locally heat or dry the concrete.
- 8. Do not use combustion heaters during the first 24 hours unless the concrete is protected from exposure to exhaust gases, which contain carbon dioxide.
- C. Hot Weather Concreting:
 - 1. Conformance: ACI 305 "Recommended Practice for Hot Weather Concreting."
 - 2. Take precautions when the ambient air temperature is 90°F or above.
 - 3. Temperature of concrete when placed shall not exceed 85°F.
 - 4. Cool forms and reinforcing to a maximum of 90°F by spraying with water prior to placing concrete.
 - 5. Do not use cement that has reached a temperature of 170°F or more.
 - 6. Prevent plastic shrinkage cracking due to rapid evaporation of moisture.
 - Do not place concrete when the evaporation rate (actual or anticipated) equals or exceeds 0.20 pounds per square foot per hour, as determined by Figure 2.1.4 of ACI 305.
 - 8. Approved set retarding and water reducing admixtures may be used when ambient air temperature is 90°F or above to offset the accelerating effects of high temperature.

PART 2 - PRODUCTS

2.1 Concrete Materials

- A. Cement: ASTM C150, Type I.
- B. Aggregates:
 - 1. Fine aggregate ASTM C33.
 - Coarse aggregate ASTM C33 except air-cooled blast furnace slag is acceptable.
 a. Nominal maximum size as permitted by ACI 318.
- C. Water: Clean and fresh.
- D. Air-Entraining Agent: ASTM C260.
- E. Ready-Mixed Concrete: Mixed and delivered, ASTM C94.
- F. Batching and Mixing Equipment: ACI 304, "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete."

2.2 Form Materials

A. Forms:

- 1. Plywood PSI, waterproof, resin-bonded, exterior type, Douglas fir.
- 2. Lumber straight, uniform width and thickness, free from knots, offsets, holes, dents and other surface defects.
- 3. Designed to produce hardened concrete having the shape, lines and dimensions shown on the Drawings.
- B. Form Oil:
 - 1. Light colored paraffin oil, or other non-staining material. For exposed surfaces not in contact with earth backfill, acceptable chemical release agents are Protex Industries, "Pro-Cote," Symons Corp., "Magic Kote," L & M, "Debond," or equal.
- C. Form Ties:
 - 1. Commercially manufactured permanently embedded type with removable ends for all exposed surfaces.
 - 2. Permanently embedded portion shall terminate not less than one inch from the face of the concrete.

2.3 Reinforcing Materials

- A. Bars: ASTM A615, Grade 60 unless specified otherwise.
- B. Welded Wire Fabric: ASTM A185 or A497.
- C. Fabrication ACI 315 and 318 unless shown otherwise on Drawings.

2.4 Non-Shrink Grout

A. Ferrolith G.D.S. grout by Sonneborn Building Products, Inc., Embeco Grout by Master Builders Co., Vibrofoil by W.R. Grace Co., Construction Materials Division, or equal.

2.5 Curing and Sealing Compounds

- A. ASTM C309, Type 1, Class B.
- B. Use Protec "Triple Seal," Symons Corp., "Cure and Seal," or equal.

PART 3 - EXECUTION

3.1 Erection of Forms

A. Brace or tie to maintain desired position, shape and alignment before, during and after concrete placement.

- B. Construct forms for beams and slabs supported by concrete columns so the column forms can be removed without disturbing the beam or slab supports.
- C. Provide temporary openings at the bottom of columns and wall forms and at other locations where necessary to facilitate cleaning and inspection.
- D. Where concrete is placed against rock, remove loose pieces of rock and clean the exposed surface with a high-pressure air hose.
- E. Place Chamfer strips in forms to bevel salient edges and concrete corners of exposed surfaces except the top edges of walls and slabs that are to be tooled. Unless otherwise noted on the Drawings, bevels shall be ³/₄ inch wide.
- F. Remove mortar or grout from previous concrete and other foreign material from the surfaces. Coat form surfaces with approved coating material before either the reinforcing steel or concrete is placed.
- G. Do not allow form coating to:
 - 1. Stand in puddles in the forms.
 - 2. Come in contact with the reinforcing steel.
 - 3. Come in contact with hardened concrete against which fresh concrete is placed.

3.2 Removal of Forms

- A. Do not remove or disturb forms until the concrete has attained sufficient strength to safely support all dead and live loads.
- B. Remove forms with care to avoid surface gouging, corner or edge breakage, and other damage to the concrete.

3.3 Reinforcing

- A. Installation:
 - 1. Accurately place reinforcing bars and maintain in proper position while concrete is being placed and compacted. Reinforcing bars that are rusty, dirty or oily shall not be used.
- B. Bar Supports:
 - 1. Provide minimum number of supports as required by ACI 315.
 - 2. Do not use pebbles, pieces of broken stone, common or face brick, metal pipe or wood blocks to support reinforcement.
 - 3. On ground, where necessary, supporting solid concrete bricks may be used. Use one-half concrete bricks whenever possible.
 - 4. Use metal, plastic or approved bar chairs, bolsters and spacers over form surface.
 - 5. Where the concrete surface will be exposed to the weather in the finished structure the portions of all accessories within ½ inch of the concrete surface shall be non-corrosive or protected against corrosion.

3.4 Concrete Placement

A. Conveying:

- 1. Convey to the point of final deposit by methods that will prevent the separation or loss of ingredients.
- 2. During and immediately after placement, concrete shall be thoroughly compacted, worked around reinforcements and embedments, and worked into all corners of the forms.

3.5 Expansion and Contraction Joints

- A. Installation:
 - 1. Formed where shown on the Drawings. (See storm detail).
 - 2. Install expansion joints, fillers and waterstops as detailed on the Drawings or in accordance with manufacturer's instructions, in no case less than 400' and at all PCR's.
 - 3. Do not extend reinforcement through expansion joints, except where specifically noted or detailed on the Drawings.

3.6 Construction Joints

- A. Location:
 - 1. Formed where shown on the Drawings.
 - 2. Construct in one continuous concrete placing operation all concrete included between construction joints.
 - 3. Obtain Engineer's approval for location of additional construction joints desired.

3.7 Finishing Formed Surfaces

- A. Rough Form Finish:
 - 1. Rough form finish is unacceptable for surfaces. A smooth finish is required on all cast-in-place or pre-cast, whether it is exposed or not.
 - 2. Patch tie holes with mortar.
 - 3. Repair defects.
 - 4. Smooth form finish is acceptable alternative.
- B. Smooth Form Finish:
 - 1. Provide smooth form finish for surfaces not specified to have grout cleaned finish.
 - 2. Use form facing to produce a smooth, hard, uniform surface.
 - 3. Keep number of seams to a minimum.
 - 4. Patch all tie holes with mortar.
 - 5. Remove all fins.
 - 6. Repair all defects.

- C. Grout Cleaned finish:
 - 1. Provide grout cleaned finish for surfaces so designated on the Drawings and the following surfaces:
 - 2. Complete operations for smooth form finish.
 - 3. Wet surface and apply grout mix of 1 part Portland Cement and 1¹/₂ parts of fine sand.
 - 4. Substitute white Portland Cement for gray as required to match surrounding concrete.
 - 5. Rub surface with cork float or stone to fill air bubbles and holes.
 - 6. Remove excess grout by rubbing with a rubber float, sack or other means.
 - 7. Do not begin cleaning until all contiguous surfaces are completed and accessible.

3.8 Finishing Unformed Surfaces

- A. Slabs, Pavements, Sidewalks, Driveways, Curb and Gutters and Similar Structures:
 - 1. Screen and give an initial float finish as soon as concrete has stiffened sufficiently for proper working.
 - 2. Remove course aggregates disturbed by the initial floating or which cause a surface irregularity and replace with mortar.
 - 3. Initial floating shall produce a surface of uniform texture and appearance.
 - 4. Follow with a second floating at the time of initial set. This floating shall produce a finish of uniform texture and color.
 - 5. In areas where concrete is to remain exposed, follow the second floating with a broomed treatment to the surface to provide a uniform abrasive texture of constant color, except where steel trowel surface is indicated.

3.9 Defective Concrete

A. Repair in accordance with ACE 301, Chapter 9.

3.10 Curing

- A. Keep concrete continuously moist for at least 7 days after placement by use of:
 - 1. Ponding or continuous sprinkling.
 - 2. Wet burlap, wet absorptive mats, or wet sand.
 - 3. Waterproof sheets.
 - 4. Polyethylene film.
 - 5. Membrane curing compound.
 - a. Do not use membrane-curing compounds when the surface is to be painted or other material is to be bonded to the surface.
- B. Maintain concrete within 50° to 70° F range during curing.
- C. Apply curing and sealing compounds in accordance with manufacturer's instructions.

3.11 Field Quality Control

- A. Test Cylinders:
 - 1. Make a set of test cylinders (four 4"x8" or four 6"x12") for each 100 cubic yards placed or portion thereof. More frequent testing may be required where more than one class of concrete is being used.
 - 2. Deliver test cylinders to testing laboratory.
 - 3. Comply with ASTM C912.

END OF SECTION