

**ENGINEERING DESIGN STANDARDS
AND SPECIFICATIONS**

TOWN OF MORRISON

REVISED SEPTEMBER 2024

PART I SUBDIVISION DESIGN STANDARDS

Section 1. Purpose

The character and environment of the Town of Morrison for future years will be greatly affected by the design of future subdivisions and plats to be approved by the Town of Morrison. The planning, layout, and design of a subdivision are of the utmost concern. Lots and blocks should provide desirable settings for the buildings that are to be constructed, make use of natural contours to protect the view, afford privacy for the residents, and provide protection from adverse noise and vehicular traffic. Natural features and vegetation of the area should be preserved as practicable. Schools, parks, churches and other community facilities should be planned as an integral part of the development.

Section 2. Higher Standards

The Town may apply higher or more stringent design standards where appropriate so long as such standards are required by site considerations and are in accordance with generally accepted design and construction practices and in accordance with the purposes and intent of these regulations.

Section 3. Site Considerations

- A. Difficult Sites. Steep land, potential unstable land, areas having potentially inadequate drainage, areas having potential geologic or soils problems or areas having problems of such a nature as to potentially endanger health, life or property as identified by the Town shall not be platted unless studies and reports which provide for the elimination or control of such problems are made by a registered engineer or other person, qualified in the particular field. Such studies must be approved by the Town which shall judge the same by generally accepted principles adapted to the particular circumstances. All development in the subdivision shall be carried out in conformity with the recommendations of the reports as finally approved.
- B. Drainage Areas. Any land subject to flooding by the one hundred (100) year flood, defined within the Town of Morrison Flood Plain Ordinance, shall be delineated on the plat and development shall be prohibited within the floodplain unless adequate provisions are made to eliminate or control flood hazards as they apply to the area being developed and the general vicinity. A registered engineer shall propose the controls which shall be in conformance with the design and construction standards for stormwater and drainage facilities as referenced in this document and approved by the Town. Development shall be carried out in conformity with the plans as finally approved.
- C. Freeway Noise Abatement. Where a residential subdivision borders a freeway or arterial street, subdivision design shall include provisions for reduction of noise. Inclusion of a parallel street, a landscaped buffer area, and lots with increased setbacks are among recommended solutions.

- D. Natural Contours. In all subdivision design, the natural contours of the land should be preserved whenever feasible. Grading, overlot grading, scarring of natural terrain features, and other topographical changes shall be kept to a minimum to preserve drainage patterns. The removal of vegetation is to be minimized as is the impact on the aesthetics of the special terrain in Morrison. Erosion, silting, and fugitive dust during construction and afterward are to be minimized.
- E. Access. Adequate vehicular and pedestrian access shall be provided to all parcels.
- F. Street Alignments. Arterial and collector street alignments shall generally conform to the alignments shown on the Morrison Master Plan Map unless otherwise approved by the Town. All streets shall be aligned to join with planned or existing streets, where desirable.

Section 4. Blocks and Lots

- A. Block Shape. Block lengths and widths shall be suitable for the uses contemplated and shall conform to the minimum lot sizes and dimensions as specified in the Town of Morrison Zoning Ordinance, current version.
- B. Block Length. Blocks shall be at least four hundred feet (400') in length and not more than one thousand three hundred twenty feet (1,320') in length between street intersections, unless adjacent to a freeway, arterial street, or unless topographical conditions justify a deviation from the requirement.
- C. Midblock Crosswalks. Midblock pedestrian crosswalks, not less than twelve feet (12') wide, may be required where deemed essential to provide access to schools, playgrounds, shopping centers, open space areas, or other community facilities.
- D. Access. Each lot shall have vehicular access to a public street. Lot design shall not prohibit surrounding land access to public streets.
- E. Double Frontage Lots. Double frontage shall be prohibited except where essential to provide separation from arterial streets or from incompatible land uses. A planting screen easement of at least fifteen feet (15') in width, across which there shall be no vehicular right of access, may be required along the lot line of lots abutting such traffic artery or other incompatible use.
- F. Side Lot Lines. Side lot lines shall be substantially at right angles or radial to street right-of-way lines.
- G. Lot Shape. The size, shape and orientation of lots shall be appropriate for the location of the subdivision and for the zoning, type of development, and use contemplated.
- H. Lot Depth. The maximum depth of all residential lots shall not exceed two and one-half (2 ½) times the width thereof. For all other lots, the depth shall not exceed three (3) times the width.

- I. No lot shall be divided by a street or alley.
- J. Flag Lots. Flag lots shall not be permitted.
- K. Cross-access Easements. When the proposed land use is commercial or industrial, adequate cross-access easements shall be required for both lots so as to allow for efficient traffic flow and access to loading areas.

Section 5. Design Standards

- A. Roadway. Design standards for roadway improvements shall be in accordance with the "*Jefferson County Roadway Design and Construction Manual*", current version.
- B. Drainage. Design standards for drainage facilities shall be in accordance with the "*Jefferson County Storm Drainage Design and Technical Criteria*", current version.
- C. Water and Sewer. Design methodology and quality standards for water and sewer facilities shall be in accordance with this document.
- D. Other Improvements. Other Improvements shall be constructed according to generally accepted standards as specified by the Town.

PART II DESIGN AND TECHNICAL CRITERIA

Section 1. Streets

- A. References. In this section, all references to the "Manual" shall be to the "Jefferson County Roadway Design and Construction Manual", current version. Any requirements stated specifically in this section shall supersede the Manual.
- B. Design. Street, alley and emergency, pedestrian and bikeway easement right-of-way widths, curves, grades, site distances and minimum design speeds shall be as specified in Manual.
- C. Street Jogs. Street jogs are to be avoided on arterial streets and carefully evaluated on collector streets. Unless otherwise required by the Town, streets with centerline offsets of less than two hundred fifty feet (250') shall not be accepted. Intersections shall approximate right angles as closely as possible.
- D. Topography. Streets shall be designed to bear a logical relationship to the topography.
- E. Through Traffic. Residential streets shall be designed to minimize through traffic movements, minimize excessive vehicular travel, and discourage excessive speeds.
- E. Cul-de-sacs. Cul-de-sacs shall be permitted, provided they are not more than six hundred feet (600') in length and have a turnaround right-of-way of at least ninety feet (90') in diameter. Proposals for Cul-de-sacs up to nine hundred feet (900') in length will be referred to the Fire District for their comments and may be approved if a traffic and safety study indicates that such a cul-de-sac would operate safely and efficiently as determined by the Town. Surface drainage from a cul-de-sac shall be toward the intersections of collector streets. Any variance from this requirement will require a drainage easement over an overland conveyance route.
- F. Dead-end Streets. Dead-end streets, with the exception of cul-de-sacs, shall be prohibited unless they are designed to connect with future streets in adjacent land that has not been platted. In this case, a temporary turnaround easement ninety feet (90') in diameter shall be required.
- G. Access Control Line. Restriction of access may be required when a subdivision or portion thereof adjoins a freeway or arterial street. Where access to adjacent streets must be restricted for traffic safety reasons, an access control line shall be clearly delineated and dimensioned as to length and locations specified by the Town. Such Access Control Lines shall be designated by the letters "A.C.L." and be consecutively numbered. Access rights across such lines shall be dedicated to the Town.
- H. Half Streets. The dedication and construction of half streets may be approved by the Town provided that two-way traffic can be accommodated and maintained on the paved portion of the street.

- I. Intersections. At street intersections, property line corners shall be rounded by an arc, the radius of which shall be at the same radius point as the curb radius or a minimum radius of five feet (5'). Additional right-of-way or easements may be required if necessary to provide adequate clear sight distance or adequate right-of-way for pedestrian ramps.
- J. Street Naming. Where new streets align with streets already named within the Denver metro street system or with an existing street in Morrison, the new street shall use the same name as the Denver metro or Morrison street. Where a street would align with both a Denver metro and Morrison street, the name shall be as approved by the Town's street. Where streets are not aligned with existing Denver or Morrison streets, street names which do not duplicate an existing street name in Morrison, or the Fire District shall be proposed and approved by the Town.
- K. Traffic Efficiency. Local circulation systems and land development patterns shall not detract from the efficiency of bordering major streets. Intersections of collector streets along arterial streets shall be properly placed to facilitate traffic signal progression.
- L. Driveways. Driveways shall be designed to meet the requirements of the Manual.
- M. Public Transit. Appropriate provisions for public transit service shall be established.
- N. Curb Cuts. Curb cuts shall not be approved for off-street truck loading areas that require backing maneuvers onto collector or arterial streets.
- O. High Traffic Driveways. Access locations with high traffic generation potential may be approved for full intersection type with standard corner radii and pedestrian ramps. The on-site connecting roadway must have at least one hundred feet (100') of on-site access control as measured from the flowline of the cross street.
- P. Protective Barriers. Off-street parking and loading areas adjacent to public street right-of-way shall include protective barriers to prevent parked or maneuvering cars from encroaching on the public right-of-way. These barriers shall include:
 - 1. A landscaped area at least ten feet (10') wide as measured from the back of sidewalk to the beginning of pavement, or:
 - 2. A poured-in-place curb that is six inches (6") wide by twelve inches (12") high, with six inches (6") above ground and six inches (6") below ground, located two feet (2') from property line to face of curb.
 - 3. These barriers are required along the total length of parking or loading areas that are adjacent to public street right-of-way except at the approved access locations.

- Q. Pedestrian Ramps. The construction of all new streets and the reconstruction of any existing streets shall include pedestrian ramps at all intersection corners designed in accordance with the "Americans with Disabilities Act Standards for Accessible Design", current version.
- R. Street Lighting. Street lighting shall be designed to provide adequate lighting as determined by the most current edition of the "*American National Standard Practice for Roadway Lighting*", current version.
- S. Minimum Curb Radii. At street intersections, the minimum curb radii shall be per the Manual.
- T. Cut and Fill Slopes. The intersection of cut slopes with the existing ground shall be rounded in earth cuts beginning outside the slope stake and extending down the cut slope. The typical maximum cut and fill slopes for streets shall be three-to-one (3:1). Where cut depth exceeds ten feet (10') and fill height exceeds twenty feet (20'), the maximum slope can be reduced to two-to-one (2:1).
- U. Number of Access Points. Subdivision access shall be by dedicated and constructed streets that connect the subdivision to existing County, State or Town maintained streets at a minimum of two (2) different locations, except those subdivisions that are served by one access street that meet the requirements of a cul-de-sac.
- V. Raised Medians. Raised medians may be required on arterial roadways and may be allowed on local or collector roadways as determined by the Town.
- W. Median Widths. Widths shall be a minimum of sixteen feet (16') measured face of curb to face of curb. If left turn lanes are installed, the median must be not less than four feet (4') measured face of curb to face of curb.
- X. Existing Medians. Cuts in existing medians must be approved by the Town. In new design, openings shall be kept to intervals between three hundred feet (300') and one thousand feet (1,000'), including left turn bays. In no case shall median openings be less than fifty feet (50') nose to nose.
- Y. Access to Highways. Access to State Highways shall be governed by the "*State of Colorado State Highway Access Code*", current version.
- Z. Sidewalks. Sidewalks on arterial streets shall be set back a minimum of five and on-half feet (5.5') from the face of the curb.
- AA. Bikeways. Bikeways shall be required on all arterial streets and may be required on collector streets and in parks and open space. As directed by the Town, bikeways will:
 - 1. Be completely separated from vehicular traffic and contained within an independent street right-of-way or bikeway easement.

2. Consist of bicycle lanes within the roadway adjacent to both outside motor vehicle lanes.
 3. Be shared with normal pedestrian traffic on a sidewalk having a minimum width of eight feet (8').
 4. Other design features of bikeways must be approved by the Town.
- BB. Access Restriction. Restriction of access shall be required when a subdivision or portion thereof adjoins a freeway or arterial street. Marginal access streets, reverse frontage lots with screen planting, deep lots or similar treatment shall be required to reduce the impact of the traffic on residential properties and to avoid interference with the movement of the traffic on thorough-fares.
- CC. Alleys. Alleys, open at both ends, shall be provided in commercial and industrial areas, except that this requirement may be waived where other provisions are made and approved for service access. If alleys are provided, they shall be paved.
- DD. Construction. Construction of streets, curbs, gutters and sidewalks shall be in accordance with the standards herein, the approved plans shall be in accordance with the Manual, and shall meet the specifications of the Manual, as amended, with the following amended definitions:
1. "County" shall mean the Town of Morrison;
 2. "Department of Development and Transportation" shall mean Town of Morrison;
 3. "Engineer" shall mean the Town of Morrison.

Section 2. Drainage

Drainage facilities shall be designed in accordance with the following criteria:

- A. Drainage Design Criteria: In this section, all references to the "Manual" shall be to the "Jefferson County Storm Drainage Design & Technical Criteria", current version. Any requirements stated specifically in this section shall supersede the Manual.
- B. Easements and Right-of-Way: The sub-divider shall dedicate to the Town adequate easements for the purpose of operation, repair, alteration and maintenance of the storm drainage system. These easements shall cover the storm water pipelines, detention area including outlet structure and berm, water quality features, and other parts of the storm drainage system. Private systems may require separate documents conveying the ownership of the system to a third party for maintenance purposes pursuant to subsection C. below, although the ownership of the underlying easement is the Town. All lots upon which drainage easements are located shall,

when conveyed, include covenants running with the land stating that no buildings, fills, excavations, structures, fences, trees, or other situations that could interfere with the flow of water or the operation, repair and maintenance of the storm drainage system shall be constructed within said easement without the express written consent of the Town.

- C. Maintenance Note. All development planning and construction documents shall include the following statement regarding private storm drainage systems:

"The Town of Morrison requires that maintenance access be provided to all storm drainage facilities to assure continuous operational capability of the system. The property Owner shall be responsible for the maintenance of all drainage facilities including inlets, pipes, culverts, channels, ditches, hydraulic structures, and water quality and detention basins located on their land unless modified by the sub-dividers agreement. Should the Owner fail to adequately maintain said facilities, the Town of Morrison shall have the right to enter said land for the purposes of operations and maintenance. All such maintenance costs will be assessed to the property Owner."

- D. Operation and Maintenance. All detention, retention, and water quality facilities shall have a Town-approved Operation and Maintenance Manual that will spell out the responsibilities and scope of maintenance for the facility.

- E. "As-built" Drainage Plan: A professional engineer retained by the developer shall inspect the construction of the improvements for the purpose of determining conformance with the approved Drainage Plan. This inspection shall include verification that the following conform reasonably to the drainage plan:

1. As-built survey by a surveyor licensed in the State of Colorado, of finished floor elevations; sizes, grades, locations, and elevations of drainage structures, channels, pipes, etc.; location of basin boundaries; detention pond volumes; and
2. Facilities appear to be constructed in a workmanlike manner and functional.

Any significant deviations from the approved drainage plan shall be annotated on the "As-built" plans. The "As-built" plans must be on file before a Certificate of Occupancy will be issued. The engineer shall include the following statement on the "As-built" plans:

"I hereby declare that I have performed a field review of the constructed drainage facilities on this plan, the facilities conform reasonably well to the approved drainage plan, appear to have been constructed in a workmanlike manner, and appear to be adequate for the intended purpose"

Registered P.E., State of Colorado No.

Section 3. Water Mains

Water mains shall be designed in accordance with the following criteria.

A. New Development Water Usage Criteria.

1. The following criterion was developed to predict water consumption within specific developments or annexations. This criterion is intended to create input for the computer models when the specific land uses, locations, and use mixes are known. The computer model can then be used to evaluate the impact of new developments and assist the Town to evaluate system improvements required to preserve levels of service.
2. Developers are responsible for designing new facilities located in previously established areas, such that the total demand fire flow does not exceed total available fire flow. This may require the developer to reconstruct existing or install additional lines to serve the project.
3. Developments can be evaluated in detail to determine particular infrastructure requirements. Forecasting the impact of new development will allow the Town to negotiate line extensions and over sizing requirements with the developer to maintain the integrity of the Amended Master Plan. Water usage shall be based on the following criteria:

Single Family

Density	3.5 unit/acre
Occupancy	3.2 residents/unit
Usage	70 gallons/capita/day
Domestic Usage	785 gallon/day/acre
Lawn Area	0.1 acre/lot
Irrigation Application	2.5 acre feet/year/acre*
Irrigation Usage	1360 gallon/day/acre
Total Irrigation Season Usage	2145 gal/day/acre

Multi-Family

Density	6.0 units/acre
Occupancy	2.4 residents/unit
Usage	70 gal/capita/day
Domestic Usage	1010 gallon/day/acre
Lawn Area	0.25 acre/gross acre
Irrigation Application	2.5 acre feet/year/acre*
Irrigation Usage	970 gallon/day/acre
Total Irrigation Season Usage	1980 gal/day/acre

Commercial/Office

Floor Space	10,000 sf/acre
Occupancy	1 worker/300 sf
Usage	30 gpd/worker
Domestic Usage	1000 gallon/day/acre
Lawn Area	0.15 acre/acre
Application	2.5 acre feet/acre*
Irrigation Usage	580 gallon/day/acre
Total Irrigation Season Usage	1580 gal/day/acre

Parks and Open Space

Irrigation	2.5 acre feet/acre/year*
Total Irrigation Season Usage	3880 gal/day/acre

*Based on seven months a year demand

B. Design Flow.

1. The water mains and looping must be designed to provide a minimum residual pressure of twenty pounds per square inch (20 psi) at ground surface, under maximum day demand plus the required ISO fire flow demand, provided the required International Fire Code (IFC), latest version, fire flow is greater than or equal to one thousand two hundred gallons per minute (1,200 gpm) at any one hydrant and one thousand five hundred gallons per minute (1,500 gpm) at any two hydrants.
2. The system must be designed to provide a minimum of forty pounds per square inch (40 psi) during normal system conditions without fire flow.
3. The system must be designed to have a maximum of one hundred pounds per square foot (100 psi). When normal system conditions exceed eighty pounds per square foot (80 psi), individual service pressure reducing valves (PRVs) are required for each service.
4. Water pressure and flow capacity information of the Town's existing and future water system may only be obtained from the Town.
5. The proposed system must be evaluated for impacts on the Town's existing infrastructure.

C. All extensions to the Town's water system mains and new hydrants shall be public.

D. Materials and Installation. All construction shall be in accordance with this document.

E. Location of Water Mains. As a rule, mains should be installed in public street or alley rights-of-way.

1. Placement in Public Street or Alley Right-of-Way

- a. Water lines shall be placed ten feet (10') north of the center line in east/west streets and ten feet (10') west of the center line in north/south streets.
- b. No water main center line may be placed closer than eight feet (8') to the face of an existing or future curb.
- c. All dead-end lines must have a fire hydrant at their end. Dead-end lines shall not exceed six hundred feet (600') in length and shall be avoided if possible.
- d. Water main must be extended to the far edge of the property to be serviced, regardless of where the tap is made, or to edge of the platted subdivision, which is greater.
- e. If it is impossible to place utilities in the public street or alley right-of-way, water line easements will be required.

2. Easements

- a. When practical, new exclusive easements should be granted to the Town of Morrison for its utilities, including water, sanitary sewer, and storm sewer. If exclusive easements to the Town are impractical, provisions for the protection of the water utility must be included in a separate easement document, which easement must be approved by the Town's attorney.
- b. All easements must be a minimum of twenty-five feet (25') wide.
- c. The entire easement shall be placed on one side of a property line.
- d. No vegetative landscaping other than grass may be placed in the easement.
- e. No permanent structure may be place in the easement.
- f. The easement agreement must state that when maintenance or replacement activities require the removal of any temporary structures (including paving and fencing) placed in the easement, the owner will be responsible for the cost of removal and replacement of such structures and shall hold the Town of Morrison harmless for any responsibility associated with the structures.

- g. Water main installation in easements between single family residential lots will only be allowed for the purpose of looping a water main which otherwise would dead-end at the end of a cul-de-sac.
 - h. Service taps will be allowed off of water lines in easements only if free and unobstructed access is permanently guaranteed for water meter reading.
 - i. Water mains placed in easements shall be located ten feet (10') from the northern edge of east/west easements and from the western edge of north/south easements.
- F. Master Plan. If a water main twelve inches (12") or larger in size as schematically located on the Water Utility Master Plan is located within one thousand feet (1,000') of the proposed project, the design engineer for the project must consider the feasibility of placing that water main in the development. If the size of pipe is larger than actually required for the development, the developer may be reimbursed as per an executed oversizing agreement with the Town.
- G. Size. All water mains shall be a minimum of eight inches (8") in diameter. Dead end lines less than two hundred feet (200') long may be six inches (6") in diameter. This will be allowed only when there is no possibility of extending the line in the future and must be approved by the Town.
- H. Depth. The minimum depth of cover for water mains shall be four and one-half feet (4½') below the final grade of the surface. Where final grades have not been established, mains shall be installed to a depth great enough to insure four and one-half feet (4½') of cover below the future grade based on the best information available. Under no condition shall the main have less than four and one-half feet (4½') of cover below the existing grade.
- I. Crossings.
- 1. Water line crossings of sanitary sewers shall be constructed as follows:
 - a. When the main crosses over or under a proposed sanitary sewer, the sewer shall be constructed to have a full length of new pipe, either a poly-wrapped Special Thickness Class 50 ductile iron pipe manufactured in accordance with AWWA C151 or Type PSM SDR 35 PVC sewer pipe manufactured in accordance with ASTM D 3034, centered over the point of crossing.
 - b. When the main crosses over or under an existing sanitary sewer that is constructed of either vitrified clay or concrete pipe, the existing sewer shall be:

- 1) Replaced with a full length of new pipe, either a poly-wrapped Special Thickness Class 50 ductile iron pipe manufactured in accordance with AWWA C151 or Type PSM SDR 35 PVC sewer pipe manufactured in accordance with ASTM D 3034, centered over the point of crossing. Re-connections to the existing sewer pipe shall be made with watertight, flexible couplings approved by the Town, or
 - 2) Protected by placing a Class B concrete cap over the lower main that has a minimum thickness of six inches (6") over the main, for a minimum of five feet (5') outside the limits of trench width in each direction.
2. Water line crossings of storm sewers shall be done in accordance with the construction standards for sanitary sewers, with the following exceptions:
 - a. The minimum horizontal separation shall be five feet (5') outside-of-pipe to outside-of-pipe;
 - b. If it is impossible to obtain eighteen inch (18") vertical clearance, the storm sewer must be pressure class pipe, but it need not be pressure tested;
 - c. If eighteen-inch (18") clearance is obtained, no special pipe materials will be required, regardless of whether the storm sewer is above or below the water main.
 3. Crossings of irrigation ditches, drainage ditches, and flood channels, and natural creeks shall meet the following criteria:
 - a. There shall be a minimum depth of cover of four and one-half feet (4½') from the bottom of the waterway to the top of the water pipe, regardless of whether the waterway is in a culvert or not.
 - b. When water main fittings and bends are used to lower the water main in the area of a waterway crossing, the fittings shall not be located closer than twenty feet (20') from either end of the waterway's banks.
 - c. The waterline shall be encased in reinforced concrete to limits to be determined on a case by case basis by the Town.

J. Corrosion Protection.

1. The Town requires soil resistivity tests and examination of the service history of other installations in the area to determine the type of pipe which can be used.

2. If required, the design engineer shall provide the design and installation of adequate cathodic protection.

K. Transmission Mains.

1. All water mains sixteen inches (16") and larger in diameter shall be classified "transmission mains".
2. All transmission mains shall have air and vacuum release valves installed at all high points on the line. Air and vacuum manholes must be constructed in accordance with the Town standards.
3. All transmission mains must have blow-off assemblies constructed at each low point.
4. All lateral branches shall have a minimum diameter of six inches (6").
5. No direct service line taps shall be made to transmission lines.

L. Valves.

1. On Transmission Mains. Valves on transmission mains must be placed no more than twelve hundred feet (1,200') apart. Where there are connections to transmission mains, all connecting mains must be valved at the connection. Three (3) valves shall be placed at all tee-type connections and four (4) valves at cross-type connections.
2. On All Other Mains. Mains shall be valved so that any main break will put no more than six hundred feet (600') of main and no more than one (1) fire hydrants out of service. Three (3) valves shall be placed at all tee-type connections and four (4) valves at all cross-type connections. All valves shall be located immediately adjacent to the tee or cross. The placement of a valve where vehicles could be parked on top of them on a routine basis should be avoided.
3. Future Connections. When future main extensions are possible, the main which can be extended must be valved so that only one valve will have to be closed when the main is extended. The valve must be restrained so that when the one valve is closed and the line to be extended is exposed to be connected to the new line, the valve will not blow off. Restraint may be made by the use of a swivel tee or cross or the following lengths of pipe installed on the extension side of the valve:

10 inch pipe	-	36 feet
12 inch pipe	-	54 feet
16 inch pipe	-	72 feet

The entire main, previously existing and new, between the closed valve and the next valve shall be flushed, chlorinated and pressure tested. No service taps shall be allowed on a main which can be extended in the future between the single valve to be closed and the dead-end.

M. Hydrants.

1. Hydrants shall be placed within public rights-of-way or within easements.
2. Hydrant spacing shall be determined by the Town and Fire District.
3. A hydrant shall be placed at the northeast corner of any intersection.
4. A hydrant may be used in lieu of a blow-off at the high point of a dead-end line.

N. Fire Sprinkler Service. Fire sprinkler lines shall be installed at right angles to the distribution main or lateral and be extended directly to the property line. No horizontal bends, off-sets or taps are to be installed in these lines. The size of the fire sprinkler lines shall be determined by the Fire District. All fire sprinkler service lines shall be private.

O. Groundwater Barrier. A cut off wall, consisting of an impervious soil (clay) or Class B concrete, shall be installed in the trench, around, under and over a main that:

1. Crosses under an open ditch, channel or stream.
2. Crosses a known location for shallow groundwater.

P. Service Lines. Service lines with appurtenances to convey water from a distribution or lateral main in a street or easement to a structure shall conform to the following minimum standards.

1. The corporation stop, the meter, and that portion of the service pipe between the meter and the corporation stop on the main, shall all be of the same size. This portion of the service line must be installed in public right of way or an easement.
2. Service lines shall be adequate to supply the requirements of the property being served. The minimum size allowed for a water service line is three-quarter inch (¾"). The size of a service line from the Town water main to any unit being served shall be selected such that the following design criteria are not exceeded during total peak demand flow:
 - a. Eighty percent (80%) of the manufacturer's maximum meter capacity.

- b. Service line pipe flow velocity does not exceed fifteen feet per second (15 fps).
 - c. The pressure drop from the Town water main to any unit being served shall not be greater than thirty pounds per square inch (30 psi) and the minimum residual pressure at the foundation at any unit shall not be less than thirty pounds per square inch (30 psi).
3. The water requirements of the property being served shall be defined as "total peak flow". Peak domestic water requirements shall be as calculated per the latest edition of the International Plumbing Code.
4. The irrigation demand flow and continuous load demands (when applicable) shall be added to the peak domestic flow to obtain the total peak demand flow. The service lines and meter shall be designed on the basis of the total peak demand flow. Consideration should be given to metering domestic and irrigation demand flows separately in some instances.
5. Peak demand flows for commercial, industrial, and professional properties are to be approved by the Town prior to sizing their service lines. If these flows are not known during the construction of the service, the developer will be allowed to construct a stub out of up to two inches (2") for commercial and a one inch (1") for residential, with the ultimate size of the rest of the service determined by meter size. If the size of the service is larger or smaller than the stub out, a reducer will be allowed at the tie in point of the service.
6. That portion of the service pipe between the main and the property line shall be one continuous length of Type K copper pipe, installed perpendicular from the main to a meter or curb stop and box at property line.
7. Service lines shall be installed ten feet (10') laterally, on the uphill side from any foreign non-potable conduit and a minimum of five feet (5') from the side property line of the lot being served. Services are not allowed to cross lot lines.
8. When serving lots at the end of a cul-de-sac, the length of service line between the main and the meter at property line shall not exceed fifty feet (50'). Meters and/or curb stops with boxes shall not be installed in driveways or sidewalks. In instances where this requirement cannot be met, the curb stop/meter pit and lid must be of heavy-duty construction as approved by the Town.

Section 4. Sanitary Sewer

Sanitary sewer improvements shall be designed in accordance with the following criteria.

A. Design Flow.

1. No roof drains, foundation drains, surface drainage, cooling water, or any other surface water may be discharged to the sanitary sewer.
2. Sanitary sewers must be designed to carry the peak discharge and to transport suspended material such that deposits in the sewer are precluded. It is essential that the sewer has capacity when flowing full for peak hourly sewage flow and adequate velocity at minimum sewage flows.
3. The following sewage flow parameters shall be used to determine the minimum required sewer capacity:

<u>Residential</u>	<u>Average Daily Contribution (Gallons per day)</u>
Multifamily	(100 g/c/d) x (2 c/u)
Townhouses	(100 g/c/d) x (2 c/u)
Apartments	(100 g/c/d) x (2 c/u)
Duplex	(100 g/c/d) x (2.5 c/u)
Single Family	(100 g/c/d) x (3.3 c/u)

Where: g/c/d=gal/capita/day
and
c/u=capita/unit

Commercial (1)

Hotel-Motel	50 x (No. employees + No. Beds)
Hospitals	200 x (No. employees + No. Beds)
Restaurants	15 x (No. employees + 4 x (meals/day)
Offices	15 x (No. employees)
Service Station x No Bays)	15 x (No. employees + 2 x No. pumps + 10
Schools	20 x (No. employees + No. students)
Self Service Laundry	50 x (No. of machines)
Theatre	5 x (No. of seats)
Warehouses	15 x (No. of employees)

Industrial (1)

Factories Waste)	15 x (No. employees) + (Industrial and Cafeteria
Other	Evaluate Separately

Peak Hour Factor = PHF*

$$PHF = 1 + 14/(4 + P^{0.5}) \text{ or } PHF = 1 + 14/(4 + 10Q^{0.5})$$

Where: P = saturation population in 1000's or fraction thereof.

Where: Q = average day flow in cfs.

Infiltration/Inflow

Pipe Diameter (inches) <u>Dia./Mile</u>	Type	<u>I/I</u> Gal/Day/Inch
8-27	PVC (Polyvinyl Chloride)	50
24-54	PVC (Polyvinyl Chloride)	200

Design Flow Rate = Q = cfs = Summation of all Average Daily Contributions converted to cfs x PHF where applicable + I/I

- (1) Average daily flow rates set forth in Appendix I, Table 1-3 of the Uniform Plumbing Code shall govern in case of discrepancies.
- B. All main extensions to the Town's sanitary sewer system shall be public.
- C. Materials and Installation. All construction shall be in accordance with the approved Town of Morrison construction standards for sanitary sewers.
- D. Location of Sanitary Sewers. As a general rule, sanitary sewers should be installed in public streets or alley rights-of way.
 1. Placement in Public Street or Alley Right-of-Way.
 - a. Sewer lines must be placed five feet (5') south of the center line in east/west streets and five feet (5') east of the center line in north/south streets.
 - b. No sanitary sewer center line may be placed closer than eight feet (8') to the face of an existing or future curb.
 - c. If impossible to place utilities in the public street or alley right-of-way, sewer easements will be required.
 2. Placement outside Public Right-of-Way. Sanitary sewers must be extended to the far edge of the property to be serviced, regardless of where the tap is made, or to edge of the platted subdivision, whichever is greater. Exceptions may be granted only if development of adjacent property is not contemplated within five years as determined by the Town. All sewer manholes must be accessible by sewer maintenance vehicles. Access must be via asphalt or concrete pavement or turf blocking.
 3. Easements.
 - a. When practical, new exclusive easements should be granted to the Town for its utilities, including water, sanitary sewer, and storm sewer. If exclusive easements to the Town are impractical, provisions for the protection of the sewer utility must be included in a separate easement document, which easement must be approved by the Town's attorney.

- b. All sanitary sewer easements must be a minimum of 25 feet wide. For sewer that is greater than ten feet (10') in depth, the easement shall increase symmetrically a minimum of one foot (1') in each direction for every additional foot in depth over ten feet (10').
 - c. The entire easement shall be placed on only one side of a property line.
 - d. No vegetative landscaping other than grass may be placed in the easement.
 - e. No permanent structure may be place in the easement.
 - f. The easement agreement must state that when maintenance or replacement activities require the removal of any temporary structures (including paving and fencing) placed in the easement, the owner will be responsible for the cost of removal and replacement of such structures and shall hold the Town harmless for any responsibility associated with the structures.
 - g. Sewer main installation in easements between single family residential lots will only be allowed for the purpose of continuing a sewer main which otherwise would dead-end at the end of a cul-de-sac.
 - h. Sewer mains placed in easements shall be located ten feet (10') from the southern edge of east/west easements and ten feet (10') from the eastern edge of north/south easements.
- E. Master Plan. If a sanitary sewer twelve inches (12") or larger in size as schematically located on the Wastewater Utility Master Plan is located within one thousand feet (1,000') of the proposed project, the engineer for the project must consider the feasibility of placing that sewer in the development. If the size of pipe is larger than actually required for the development, the developer may be reimbursed as per an executed oversizing agreement with the Town.
- F. Size. No public sanitary sewer shall be less than eight inches (8") in diameter. Dead end lines for which there is not possibility of extension in the future may be six inches (6") in diameter for not more than the final two hundred feet (200') and must have a terminus manhole. All changes in pipe size must occur at a manhole.
- G. Depth. Sewers shall be designed deep enough to collect and drain sewage from basements. The minimum allowable depth of cover for sewer mains shall be three feet (3'). If there is less than five feet (5') of cover, ductile iron pipe must be used.
- H. Slope.
- 1. The following table gives the minimum and maximum allowable slopes:

<u>Sewer Size (inches)</u>	<u>Min. Slope (ft./ft.)</u>	<u>Max. Slope (ft./ft.)</u>
6	0.01000	0.280
8	0.00400	0.190
10	0.00280	0.140
12	0.00220	0.110
15	0.00150	0.082
18	0.00120	0.064
21	0.00100	0.052
24	0.00080	0.044
27	0.00067	0.037
30	0.00058	0.032

2. The sewer must be designed at a slope great enough to produce a flow velocity of two feet per second (2 fps) at the peak design flow using the Manning equation and $n=0.013$. This slope will usually be much greater than the minimum slope when only a few units are to be served. If the minimum velocity requirements cannot be met using a standard design, the slope of the main shall be 0.02 ft./ft.
 3. In the event that a slope greater than the maximum needs to be considered, the design engineer must submit a letter with the plans explaining why the slope cannot be avoided and what special construction methods will be used to prevent damage to the sewer.
 4. All changes in slope must occur at manholes.
 5. The maximum allowable velocity for a sewer main is ten feet per second (10 fps).
 6. The maximum allowable depth to diameter (d/D) ratio for peak flow depth shall be zero point seven five (0.75).
- I. Pipe Strength. Design calculations must be presented with the design plans which demonstrate that the pipe that is to be used is of adequate strength to support the trench and AASHTO HS-20 highway loadings.
- J. Alignment. Sewer shall be laid with a straight alignment between manholes.
- K. Crossings.
1. Sanitary sewer crossings of water lines shall be done in accordance with the Town construction standards. When the sewer main crosses over or under an existing or proposed water line, the sewer shall be constructed to have a full length of pipe, either a poly-wrapped Special Thickness Class 50 ductile iron pipe manufactured in accordance with AWWA C151 or Type PSM SDR 35 PVC sewer pipe manufactured in accordance with ASTM D 3034, centered over the point of crossing.

2. Sanitary sewer crossings of storm sewers shall have no less than six inches (6") of clearance. Special structural support will be required if there is less than eighteen inches (18") clearance. The minimum horizontal clearance shall be two feet (2'), with clearance referring to the distance from the outside of the sewer pipe to the outside of the storm sewer pipe.
 3. Sanitary sewer crossings of irrigation ditches, drainage ditches, flood channels and natural creeks shall meet the following criteria:
 - a. There shall be a minimum depth of cover of three feet (3.0) from the bottom of the waterway to the top of the pipe, regardless of whether the waterway is in a culvert or not.
 - b. When the ditch or drainage way is not in a culvert, the sanitary sewer shall be encased in reinforced concrete in which encasement shall extend ten feet (10') beyond the top of bank on both sides of the channel.
- L. Ground Water Barriers. When imported granular bedding and encasement material is used and there exists a possibility that ground water may follow the path of the new sewer, ground water barriers shall be constructed in adequate number to prevent ground water migration down sewer trenches.
- M. Manholes.
1. Location.
 - a. Manholes shall be installed at the upper end of each line, at changes in grade, size, or alignment, and at distances not greater than: four hundred feet (400') for sewers fifteen inches (15") in diameter or less; four hundred fifty feet (450') for sewers eighteen inches (18") and twenty-one inches (21") in diameter; and five hundred feet (500') for sewers twenty-four inches (24") in diameter or larger.
 - b. When feasible, manholes should be installed at street intersections.
 - c. Manholes should be located in areas which are not subject to flooding from surface runoff.
 - d. Manholes must be located in areas which allow direct access via all-weather drives by maintenance vehicles.
 - e. Any new building constructed or proposed to be constructed in an industrially zoned area with a floor space of great than five thousand square feet (5,000 sf) or with a water meter size of greater than three-quarters inch ($\frac{3}{4}$ "), or if otherwise required by the Town, shall install a sewer monitoring facility prior to final

building inspection approval. The monitoring facility shall normally be situated outside of the building on the user's premises. If the industrial user's service line ties into an existing Town manhole and such manhole allows for safe sampling and isolation of the industrial user's discharge, the Town may allow said manhole to serve as the industrial users monitoring facility.

2. Covers.

- a. If the possibility of surface runoff cannot be avoided, a solid locking-type cover having an integral O-ring type gasket shall be used. Bolt down covers are not allowed.
- b. All manholes located outside dedicated street rights-of-way shall be designed and constructed with a locking-type cover and the manhole ring shall be bolted to the manhole cone.

3. Flow Channels.

- a. When there is an increase in sewer main size or smaller sewer laterals connect with a larger main, the invert of the smaller sewer must be raised to maintain the same energy gradient. An approximate method of doing this is to place the eight-tenths (0.8) depth point of both sewers at the same elevation.
- b. The standard difference in invert elevation across a manhole shall be two-tenths of a foot (0.2') for same diameter or the difference required for a change in pipe size. This can be exceeded if the projected grade of the pipe through the manhole is greater than five percent (5%).
- c. Drop manholes shall be avoided whenever possible. When the design requires additional slope to avoid extra excavation or to follow steep existing or proposed grades, drop manholes may be used if approved by the Town. Drop manholes can also be used to reduce the total numbers of structures through a steep section.
- d. For all manholes, floor channels shall be furnished for all entering mains and laterals. Channels must provide a smooth transition and shall be constructed to the top of pipe.

N. Service Lines.

1. General: Sanitary sewer service lines shall be four inches (4") or larger in diameter and connected, by means of a wye, watertight saddle, or fused adaptor to a lateral or a main. The wye or adaptor shall be mounted such that the service line effluent enters at an angle equal to or in excess of forty-five degrees (45°) to the springline of the lateral or main. Vertical

risers shall be installed when the top elevation of the wye, installed through the service saddle or adaptor, is more than twelve feet (12') below finished grade. Riser connections shall reach a grade of nine feet (9') below finished grade within a horizontal distance of two feet (2') from the vertical centerline of the lateral or main. Lateral lines will not be allowed to connect directly to a Town interceptor or collector. Connection to these lines shall be made by means of a manhole. All services greater than six inches (6") must be connected by a manhole.

2. On all new main, install forty-five degree (45°) wye branches in the direction of flow for future service connections at locations designated by the Town. Verify that service connection locations have been marked prior to commencing construction of any segment of sewer line.
3. Where an existing sewer is being replaced at the same alignment, locate and connect all existing services to the new sewer.
4. Install service connection on existing sewers using saddles securely fastened on the main. Cut a neat hole in the main by means of a tapping machine designed for such use. The finished connection shall be watertight and there shall be no projections inside the sewer main.
5. Incline the centerline of the branch upward at an angle of forty-five degrees (45°).
6. Lay services for future service connections to five feet (5') outside of roadway surface (edge of asphalt, back of curb, or back of sidewalk) at a minimum grade of two percent (2%) unless otherwise instructed by Engineer.
7. Install removable watertight plugs in each unused service branch and each unconnected lateral stub-out.
8. Mark the end locations of each unconnected branch with a steel fence post marker extended from the branch vertically to within one foot of the ground surface. Anchor markers and maintain in a vertical position during backfilling. The letter "S" shall be etched into the curb face directly above the service for future reference. Record location of each marker on the Drawings.

PART III. PUBLIC IMPROVEMENTS CONSTRUCTION STANDARDS

Section 1. Streets, Curb and Gutter, Sidewalks

- A. Scope. Furnishing and installing all pavement, concrete curb, gutter, and sidewalk, rough grading, excavation, backfill, compaction, and all related work necessary to complete the roadway section shall comply with the requirements given in this Section.
- B. General. Construction standards for roadway improvements shall be in accordance with the "Jefferson County Roadway Design and Construction Manual", current version.

Section 2. Drainage

- A. Scope. Furnishing and installing all pipe, manholes, inlets, detention ponds, retention ponds, water quality features, energy dissipaters, and all related work necessary to complete the storm drainage system shall comply with the requirements given in this Section.
- B. General. Construction standards for drainage facilities shall be in accordance with the "Jefferson County Storm Drainage Design and Technical Criteria", current version.

Section 3. Water

- A. Scope. Furnishing and installing all water pipe, valves, valve boxes, hydrants and fittings, related work and appurtenances, and water services including excavation, backfill, compaction, and all related work necessary to complete the water mains. Excavation and backfill shall comply with the requirements given in this Section.
- B. General.
 - 1. All piping and fittings shall be of the type and materials specified herein or shown on the drawings and all materials shall be new and unused. All pipe sizes and all references to pipe diameter on the drawings or in the construction specifications are intended to be nominal diameter and shall be interpreted as such.
 - 2. Work covered by this section will not be accepted until hydrostatic tests and backfilling connected with the work have been completed satisfactorily. Any section of water line that is found defective in hydrostatic tests, material, alignment, grade, or joints before acceptance, shall be corrected to the satisfaction of the Town without additional cost to the Town.

3. A copy of the manufacturer's installation recommendations for each kind of pipe used must be provided to the Town inspector prior to construction and must be followed during construction unless otherwise instructed.
4. Work will be performed in accordance with the latest revision of AWWA Specifications referenced herein.
5. At least eighty-five percent (85%) of the total footage of pipe of any material, class and size shall be furnished and installed in standard lengths. The remaining fifteen percent (15%) in random lengths shall not be less than one-half ($\frac{1}{2}$) the standard length.

C. Materials.

1. Ductile Iron Pipe.

- a. All ductile iron pipe shall be manufactured and designed in accordance with AWWA Specification C-151. Pipe shall conform to the requirements of AWWA Specification C-151, laying condition Type 3, except the minimum design thickness shall be Class 50.
- b. All pipe joints shall be an approved slip type or mechanical joint with rubber gasket as approved by the Town. Gaskets shall be molded rubber rings made expressly for the joint used.
- c. Pipe shall be cement lined on the inside. Cement mortar lining for ductile iron pipe and fittings shall be in conformance with AWWA Specification C-104. The pipe exterior shall be a tar or bituminous seal coating. Spotty or thin coating, or poor adhesion, shall be cause of rejection of the pipe.
- d. Each length of pipe shall be plainly stamped or indelibly marked or color coded to an acceptable standard specification as to the length, weight, class and type thereof, and the manufacturer's trademark or name. Prior to ordering pipe materials, approval of the manufacturer will be obtained from the Town.
- e. Ductile iron pipe shall be installed in accordance with AWWA C-600.

2. Ductile Iron Fittings.

- a. Fittings shall be ductile iron conforming to AWWA Specification C-110 or AWWA C-152 for compact fittings. Fittings shall be designed and manufactured for a pressure rating of 250 psi.

- b. Fittings shall be tar-coated outside and shall have a cement-lined interior in accordance with ANSI Specification A-21.4 (AWWA C-104).
- c. Fitting joints shall be mechanical joints conforming to ANSI Specification A-21.11 (AWWA C-111), or as approved by the Town.

3. Polyvinyl Chloride (PVC) Pipe.

- a. All PVC pipes six inches (6") through twelve inches (12") shall meet the requirements of AWWA Specification C-900 and shall be Pressure Class 200 (DR 14).
- b. All PVC pipes fourteen inches (14") through forty-eight inches (48") shall meet the requirements of AWWA Specification C-905 and shall be Pressure Class 200 (DR 21).
- c. All pipes shall be suitable for use as a pressure conduit. Provisions must be made for expansion and contraction at each joint with a rubber ring. The bell shall consist of an integral wall section with a solid cross-section rubber ring which meets the requirements of AWWA Specification C-900.
- d. Fittings shall conform to the requirements of Paragraph C.2 Ductile Iron Fittings, above, but shall be designed for use with PVC pipe.
- e. The pipe shall be installed in conformance with Uni-Bell Plastic Pipe Association guide for installation of PVC pressure pipe, and in accordance with the manufacturer's instructions.
- f. Each length of pipe shall bear the data manufactured, type, grade, length, manufacturer's name and National Sanitation Foundation (NSF) seal of approval.

4. Valves and Boxes.

- a. All valves twelve inches (12") and smaller shall be resilient seat gate valves and all valves over twelve inches (12") shall be butterfly valves unless otherwise specified. All valves shall open left (counterclockwise). All valves shall have a two-inch (2") square operating nut. Extension stems with a two-inch (2") operating nut and a support for the upper end of the extension shall be provided for all valves installed more than five feet (5') deep from the finished grade. The extension stem must be mechanically connected to the operating nut and the extension nut shall be set at the standard bury depth. All valves shall have a mechanical joint

end and shall be delivered complete with bolts, glands, and rubber gaskets.

- b. All resilient seat gate valves shall be manufactured to meet all applicable requirements of AWWA Specification C-509. The valve shall be designed for a two hundred pounds per square inch (200 psi) working and test pressure.
 - c. Butterfly valves shall conform to AWWA C-504, Class 150-B, and shall have fully enclosed manual operators with stop-limiting devices and "O" ring seals. Butterfly valves shall be designed for one hundred fifty pounds per square inch (150 psi) working and test pressure.
 - d. Valve boxes shall be of cast-iron, three-piece screw type. Extensions shall be the screw type and bases shall be No. 6 round or oval. Shafts shall be five and one-half inches (5½") diameter. They shall be Tyler 6860 series with stay put cover, or approved equal, bearing the word "Water" on top. Valve boxes shall be considered integral units and shall have at least six inches (6") adjustment above and below specified depth of cover over pipe.
5. Polyethylene Encasement Material. Polyethylene encasement for the ductile iron pipe and fittings shall be furnished and installed at the locations shown in the Plans and Specifications, or as directed by the Town. Polyethylene encasement shall be a minimum of eight (8) mils thick and shall be manufactured and installed in accordance with AWWA Standard Specifications C-105, latest revision.

D. Separation of Water and Sewer Mains.

1. Parallel Installation. Water mains shall be laid at least ten feet (10') horizontally from any existing or proposed sanitary sewer. The distance shall be measured centerline to centerline. In cases where it is not practical to maintain a ten-foot (10') separation, the Town may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the water main closer to sanitary sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least eighteen inches (18") above the top of the sewer.
2. Crossings. Water mains crossing sewers shall be laid to provide a minimum vertical distance to eighteen inches (18") between the outside of the water main and the outside of the sewer. This shall be the case where the water main is above the sewer. At all crossings, one full length of water pipe shall be located so both joints will be as far from the sewer as

possible. Special structural support for the water and sewer may be required.

3. Special Conditions. When impossible to obtain proper horizontal and vertical separation as stipulated above, and whenever the water main crosses under a sewer, the sewer should be constructed of ductile iron pipe, or PVC pressure pipe and the full-length sewer pipe shall be located so both joints will be as far from the water main as possible. The sewer shall remain pressure class pipe until the minimum distance between the joints of the sewer and the water mains are ten feet (10') apart. Both mains should be pressure tested to assure watertightness.
4. Construction Changes. If during construction, it is found that a water or sewer line cannot meet these requirements, the design engineer shall change the alignment to comply upon receipt of approval of the Town. This shall not be considered as basis for a claim for extra work compensation, but shall be considered as incidental work required in the performance of the contract.

E. Installation of Water Main and Appurtenances.

1. Laying of Pipe and Fittings.
 - a. Proper implements, tools and facilities satisfactory to the Town shall be provided and used by the Town for the safe and convenient prosecution of the work. All pipe fittings, valves and hydrants shall be carefully lowered into the trench piece by piece by means of a derrick, straps, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to water main materials and protective coatings and linings. Chains or cables shall not be used for handling pipe with protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench.
 - b. Every precaution shall be taken to prevent foreign material from entering the pipe before and while it is being placed in the line. If the pipe-laying crew cannot put the pipe into the trench and in place without getting earth into it, the Town may require that before lowering the pipe into the trench a heavy, tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing or other material shall be placed in the pipe.
 - c. An approved snug-fitting stopper or plug must be installed in each pipe immediately after it is laid and prior to any further excavating, backcasting or backfilling. All openings along the line of the main

shall be securely closed as directed and, in the suspension of work at any time, stoppers shall be placed to prevent earth or other substances from entering the main.

- d. All pipe and fittings shall be inspected for defects prior to installation and, in the case of metal pipe and fittings, shall be rung with a light hammer to detect cracks while suspended above grade.
- e. In the event of rock excavation, the bottom of the trench shall be lowered so that the bottom of the trench is six inches (6") below the outside surface of the pipe. The space between the rock and the pipe shall be filled with the specified foundation material. The foundation material shall be compacted to a density equal to or greater than ninety percent (90%) of the Standard Proctor density. During compaction, the foundation material shall be shaped to provide support along the full length of the pipe.
- f. The minimum depth of cover any water main or fire hydrant lead shall be four and one-half feet (4½').
- g. Deflection from a straight line or grade, as required by horizontal or vertical alignments or offsets shall not exceed maximum allowable set by the manufacturer's specifications.
- h. If the alignment requires deflections in excess of the allowable deflection per joint, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth, as approved by the Town.
- i. All pipes shall be laid and maintained to the required lines and grades as indicated on the drawings or as directed by the design engineer. Fittings, valves and fire hydrants shall be installed at the locations shown on the drawings.
- j. No pipe shall be laid in water or when the trench conditions are unsuitable for such work as deemed by the Town.
- k. All plugs, caps, tees, and bends shall be provided with reaction backing against undisturbed ground with concrete backing as shown on the drawings. The area of bearing on the pipe and on the ground in each instance shall be shown on the plans.
- l. Metal rods, harnesses, or retainer glands shall be treated to prevent rusting.
- m. Fine grading to the bottom of the barrel shall proceed ahead of the pipe laying and should any over-excavation exceeding two inches (2") be encountered, the material added shall be moistened and

compacted to the satisfaction of the Town, or foundation material shall be added. The pipe shall be supported for the bottom ninety degrees (90°) and throughout its length as shown on the drawings. Bell holes shall be dug adequate to make the joint, but no larger than necessary, so that maximum support on undisturbed ground or foundation materials will be provided for the pipe.

- n. Before laying a section of pipe, the contractor shall clean the surfaces of each bell and spigot, inspect and clean the gaskets, and remove any dirt from the inside of the pipe. After placing a length of pipe in the trench the spigot shall be centered in the bell and the pipe forced home and brought in correct line and grade. The pipe shall be secured in place with approved bedding and encasement materials tamped around it except at the bells.
- o. The contractor shall place and compact the selected backfill in uniform depths on each side of the pipe to prevent the pipe from moving during the backfilling operation.
- p. Bedding shall be placed under and on both sides of the pipe as each length of pipe is installed.
- q. The placing of bedding, backfill, and encasement shall be in accordance with these specifications.

2. Jointing Pipes to Fittings.

- a. Pipes shall be connected to valves and fittings by mechanical joints, unless specified differently in the drawings.
- b. For approved slip-on joints, the joint shall be assembled with a ratchet jack or other approved method in a manner that does not cause any damage to the pipe.
- c. Both the spigot and socket must be thoroughly clean, free from tar or other coatings and rust. For mechanical joint pipe, the last eight inches (8") outside the spigot end of the pipe and the inside of the bell, fittings, and gate valves shall be thoroughly cleaned to remove oil, grit, tar (other than standard coatings) and other foreign matter from the joint and then painted with a soap solution of one-half cup (1/2 cup) of granulated soap in one (1) gallon of water. The cast iron gland shall then be slipped on the spigot end of the pipe with lip extension of the gland toward the socket or bell. Paint the rubber gasket with soap solution and place on spigot end of pipe with thick edge toward gland. A standard solution furnished by pipe manufacturers may be used instead of the soap solution.

- d. After the spigot end of the pipe is placed into the bell and pulled home, gasket shall be pressed into place within the bell evenly around the entire joint. After the gland is positioned behind the gasket, the contractor shall install all bolts and nuts and tighten them with a suitable wrench (preferably a torque wrench). Nuts spaced one hundred eighty degrees (180°) apart shall be tightened alternately to produce equal pressure on all parts of glands.
- e. Jointing shall be done, unless specifically excepted above, in accordance with AWWA Specification C-111 for a mechanical joint for cast iron pressure pipe and fittings.
- f. When pipes are cut in the field, or where slip-on joints are jointed to mechanical joint spigots, or spigots with straight ends, the cut or straight end shall be beveled, and all sharp or rough edges shall be removed.

3. Setting Valves and Valve Boxes.

- a. Valves and valve boxes shall be installed where shown on the drawings and directed by the design engineer. Valve boxes shall be firmly supported and maintained centered and plumb over the wrench nut of the valve, with box cover flush with the surfaces of the finished pavement or at such other level as may be directed. Extensions must be provided for valves installed with more than five feet (5') of cover.
- b. Earth fill shall be carefully tamped around each valve box to a distance of four feet (4) on all sides of the box, or to the undisturbed trench face if less than four feet (4). Valves shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened, and the valve shall be inspected in opened and closed positions to insure that all parts are in working condition.

4. Setting Hydrants.

- a. Hydrants shall be set so that at least the minimum pipe cover is provided for the branch supply line and the flange for the hydrant is between two inches (2") and six inches (6") above finished grade. Each hydrant shall be blocked against the end of the trench with concrete, and the hydrant weep holes must be kept open.
- b. Hydrant drainage shall be provided by installing gravel or crushed rock around the hydrant, and below the top of the hydrant supply pipe. One-third cubic yard (1/3 cy) of one and one-half inch (1 1/2") gravel is to be placed around drain holes just above hydrant valve casing. All hydrants shall stand plump. Hydrants with pumper

nozzles shall have hose nozzles parallel with, and the pumper nozzle perpendicular to, the curb line. Hydrants shall be located inside the street right-of-way, and/or as directed by the design engineer.

- c. Hydrants shall normally be set without the use of extensions. Extensions must be specifically authorized by the Town before installation.
- d. Immediately before installation of a hydrant, the following operations shall be performed:
 - 1) The hydrant shall be thoroughly inspected.
 - 2) The hydrant shall be thoroughly cleaned.
 - 3) The hydrant shall be opened and closed as many times as may be necessary to determine if all the parts are in proper working order, with valves sealing properly and the drain valve operating freely.

5. Connection to Existing Mains.

- a. At locations where connections to existing water mains are to be installed, the contractor shall locate the existing mains both vertically and horizontally and shall verify their exact size in advance of the time scheduled for making the connections.
- b. The contractor shall notify and schedule the connection with the Town. Any customer who may be affected by the shutting off of water shall be given twenty-four (24) hour notice by the contractor as to when and for how long service shall be interrupted. All existing valves shall be operated only by the Town. In case of emergency interruptions, the contractor shall inform all affected water users of the cause and estimated time for repairs as soon as possible.
- c. Prior to connecting to existing water mains, the contractor shall have all staff, materials, and equipment ready to connect the fitting to the existing main, so as to keep the shutoff time to a minimum. As soon as possible after making the connections, the contractor shall flush the connection so as to prevent any contamination of the existing facilities. The contractor shall take every precaution necessary to prevent dirt or debris from entering the main.
- d. Water main connections shall be made under pressure, where shown on the drawings.

- e. The contractor shall expose the water mains sufficiently to facilitate the connection and shall furnish the necessary materials including tees, sleeves, tapping sleeves and valves. Only a licensed contractor approved by the Town shall be allowed to tap an existing main.

6. Polyethylene Encasement.

- a. Polyethylene wrap will be required on all ductile iron pipe and cast-iron fittings installed, unless otherwise stated in the plans.
- b. The polyethylene wrap tubing shall be cut to provide for a minimum of one foot of lap over both the adjoining pipes. The ends of the tubing shall be wrapped using three (3) circumvential turns of plastic adhesive tape.
- c. The loose wrap on the barrel is to be pulled snugly around the barrel of the pipe and the excess folded over at the top. This fold will be held in place by means of six-inch (6") strips of the plastic tape placed at intervals of three feet (3') along the pipe barrel.
- d. Bends, reducers, and offsets shall be wrapped in the same manner as pipe.
- e. Valves shall be wrapped by bringing the tube wrap on the adjacent pipe over the bells of the valve and sealing with adhesive tape. The valve bodies are then wrapped with flat sheets passed under the valve bottom and brought up around the body to the stem and fastened with the tape.

7. Placing of Thrust Blocks.

- a. The contractor shall place concrete thrust blocks at bends, tees, crosses, plugs, hydrants and other-directed locations.
- b. The contractor shall excavate as required to ensure that the thrust blocks are placed against undisturbed soil and shall form the sides of the thrust block to provide the size and shape required. After the concrete has been placed and has been set up, the contractor shall remove all forming materials prior to backfilling around the thrust block. The concrete must set 24 hours before the line is pressurized.
- c. Concrete for the thrust blocks shall comply with provisions set forth in the details.

8. Marking Pipeline Location. During the backfilling of all PVC water line trenches, a two-inch wide metallic coated tape labeled "Water Line Buried

Below" shall be placed in the trench backfill two feet (2') below the ground surface.

F. Testing and Disinfecting Mains.

1. General. The contractor shall test and disinfect all mains at no additional compensation regardless of existing conditions. The contractor will not be paid extra for corporation stops, taps, service pipe, bulkheads or any other fittings and appurtenances used to relieve air, fill, drain, pressure test or flush any water main installed under this contract.
2. Timing. Upon completion of the new and/or repaired water mains, or any usable portion thereof and prior to placing the system or part thereof in operation, all new mains, valves, hydrants, etc., shall be thoroughly flushed and disinfected, using a chlorine gas mixture or a hypochlorite and water mixture applied in amounts sufficient to produce the required dosage in accordance with AWWA Standard C-651, latest revision.
3. Pressure and Leakage Testing.
 - a. After the pipe has been laid, including fittings, valves, corporations, and hydrants, and the line has been backfilled in accordance with the construction standards, each valved section, unless otherwise directed by the Town, shall be subjected to hydrostatic pressure of not less than one hundred fifty pounds per square inch (150 psi) or one and one-half (1.5) times the maximum working pressure whichever is greater.
 - b. In no case will the maximum working pressure be less than actual line pressure in the water mains adjacent to the new lines at any given time. Butterfly valves or resilient seat gate valves may not be pressure tested against if the difference between the test pressure and the pressure on the back side of the valve is greater than one hundred fifty pounds per square inch (150 psi) or two hundred pounds per square inch (200 psi) respectively. In such cases the valve must be left in a fully open position during the test and a suitable plug and bulkhead shall be used to seal off the section of the pipe to be tested. The pressure test shall last two (2) hours.
 - c. Water added to maintain the pressure shall not exceed the allowable leakage from the following formula during the two-hour test period:

$$L = \frac{NDP^{0.5}}{7400}$$

7400

L = Allowable leakage in gallons

N = Total number of joints in the length of pipe tested

D = Nominal diameter of the pipe in inches

P = Average test pressure during the leakage test in psi.

- d. Each valved or bulkheaded section of pipe shall be slowly filled with water and the specified test pressure, measured at the lowest point of elevation, shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, gauges, and all necessary apparatus shall be furnished by the contractor. Gauges and measuring devices must comply with Town standards and the necessary pipe taps made as required. Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at points of highest elevations and afterward tightly plugged with brass plugs.
 - e. Any visible leak shall be eliminated by the contractor before the line is accepted. Any cracked or defective pipes, fittings, valves, or hydrants discovered in the pressure test shall be removed and replaced by the contractor with sound material in the manner provided. The test shall be repeated until the water main passes the pressure and leakage test and is accepted by the Town. A Town representative must witness the pressure test.
4. Pre-Disinfection Flushing. Flushing shall be done with a flushing velocity of at least two and one-half feet per second (2.5 fps). The contractor shall provide all fittings required to flush the line. Flushing shall be done prior to disinfection unless the table method of disinfection is used.
 5. Disinfection.
 - a. The chlorinating material shall be introduced into the water lines and distribution systems in a manner approved by the Town. After a contact period of not less than twenty-four (24) hours the treated water in the lines shall contain not less than twenty-five (25) mg/liter chlorine throughout the length of the line and the system shall be flushed with clean water until the residual chlorine content is between one (1.0) and three point five (3.5) parts per million. All valves in lines being disinfected shall be opened and closed several times during the contact period, unless they are being left closed for the pressure test, or to assure the highly chlorinated water doesn't affect existing lines.

- b. During the flushing and disinfection of the new mains, the contractor shall make sure that none of the disinfecting solution enters any existing main.
 - c. After disinfection and final flushing, the water in the new main shall be tested for bacteriological quality. The contractor shall contact the Jefferson County Health Department to sample the water for bacteriological quality. The contractor shall assist the Health Department in obtaining any samples from any readily available source, exposed corporation stop, fire hydrant, or other. The contractor is required to supply the Town with written certification from the Jefferson County Health Department for each section of pipe tested that the water meets County and State bacterial quality standards. If the samples are unsatisfactory, the mains must be re-disinfected and the whole procedure repeated until satisfactory.
6. Post-Disinfection Flushing. The entire line shall be flushed after the specified contact period and such flushing continued until the water is free from excess chlorine. The entire line, including hydrant leads, branch lines, and dead end mains shall be flushed. The discharge of flushed water shall be accomplished in such a manner that no erosion will occur and with no damage to streets, fish, animals, plants, or other property. Procedures for discharge will be subject to the review of the Town. Any damage caused by flushing shall be repaired by contractor to original condition.
7. Operational Inspection. At the completion of the project and in the presence of the Town, the contractor shall operate all valves, hydrants, and water services to ascertain that the entire facility is in good working order; that all valve boxes are centered and valves are opened; that all hydrants operate and drain properly; that all curb boxes are plumb and centered; and that water is available at all curb stops.

Section 4. Sanitary Sewer

- A. Scope. Furnishing and installing all sanitary sewer lines, manholes, sewer services, other appurtenances, and all related work necessary to complete the sewer mains. Excavation and backfill shall comply with the requirements of these construction standards.
- B. General.
 - 1. All piping and fittings shall be of the type and materials specified herein or shown on the drawings and all materials shall be new and unused. All pipe sizes and all references to pipe diameter on the drawings or in the

specifications are intended to be nominal diameter and shall be interpreted as such.

2. Work covered by this section will not be accepted until specified tests and backfilling connected with the work have been completed satisfactorily. Any section of sewer line that is found defective in tests, material, alignment, grade, or joints, before acceptance, shall be corrected to the satisfaction of the Town without additional cost to the Town.
3. A copy of the manufacturer's installation recommendations for each kind of pipe used must be provided to each Foreman and Inspector prior to construction and must be followed during construction unless otherwise instructed by the Town.

C. Materials

1. PVC Pipe 8" – 15". PVC (Polyvinyl Chloride) pipe fifteen inches (15") diameter and less shall conform to the requirements of ASTM D-3034 rigid PVC with the wall thicknesses being SDR (Standard Dimension Ratio) 35. The pipe shall have bell and spigot joints with gasketed joint. The spigot end shall be marked so that the Installer and the Town Inspector can determine when the pipe is properly installed.
2. PVC Pipe 18" – 27". PVC Pipe of 18" – 27" nominal diameters shall conform to the requirements of ASTM F-679. The pipe shall have bell and spigot joints with gasketed joint. The spigot end shall be so marked that the Installer, and the Town Inspector can determine when the pipe is properly installed.
3. Reinforced Concrete Pipe.
 - a. Reinforced Concrete Pipe (RCP) shall conform to the requirements of ASTM C-76. Each joint of pipe shall be a minimum of 7'-6" in length. The pipe shall be a minimum of Class III as designated in ASTM C-76 unless stated otherwise in the special conditions.
 - b. All RCP shall be constructed with Type II modified cement. The absorption of the concrete sewer pipe shall not exceed 5.5%.
 - c. Gaskets shall comply with ASTM C-361 and be made of neoprene with a minimum tensile strength of 1,500 psi. durometer hardness of 40, a maximum water absorption not more than 10%, and shall have a circular cross section.
 - d. Each pipe joint shall conform to ASTM C-361, Section 7, with the gaskets confined in a groove cast in the pipe spigot. Pipe with collars in lieu of integral cast bells will not be accepted. The pipe joints shall be designed to withstand, without cracking, the gasket

compression plus a differential load across the joint equal to 4,000 pounds per foot of inside diameter.

- e. Each piece of reinforced concrete sewer pipe shall be plainly and permanently marked showing the pipe class, date of manufacture, and the manufacturer's name or mark. These markings shall be made on the outside of the pipe before curing or shall be painted on the pipe using waterproof paint.

4. Ductile Iron Pipe – For Special Construction Situations.

- a. All ductile iron pipe shall be manufactured and designed for accordance with AWWA Specification C-151. Pipe shall conform to the requirements of AWWA Specification C-151, laying condition Type 3, except the minimum design thickness shall be Class 50.
- b. All pipe joints shall be an approved slip type rubber gasket as approved by the engineer. Gaskets shall be molded rubber rings made expressly for the joint and pipe used.
- c. Pipe shall be cement lined on the inside. Cement mortar lining for pipe and fittings shall be in conformance with AWWA Specification C-104. The pipe exterior shall be a tar or bituminous seal coating. Spotty or thin coating, or poor adhesion, shall be cause for rejection of the pipe.
- d. Each length of pipe shall be plainly stamped or indelibly marked or color coded to an acceptable standard specification as to the length, weight, class and type thereof, and the manufacturer's trademark or name. Prior to ordering pipe materials, approval of the manufacturer shall be obtained from the Town.
- e. Fittings shall be cast iron or ductile iron conforming to AWWA Specification C-110. Fittings shall be tar-coated, inside and out, and shall be cement-lined in accordance with ANSI Specification A-21.4 (AWWA C-104).
- f. Polyethylene Wrapping: Polyethylene wrap will be required on all ductile iron pipe and cast-iron fittings installed, unless otherwise stated in the plans.
- g. The polyethylene wrap tubing shall be cut to provide for a minimum of one foot of lap over both the adjoining pipes. The ends of the tubing shall be wrapped using three (3) circumferential turns of plastic adhesive tape.

External type Rubber Couplings with external clamps may only be used in special conditions with the approval of the Town and the external clamps must be stainless steel. All compression joints for vitrified clay pipe and fittings must meet ASTM C-425.

8. Manholes. All manholes shall be constructed with precast barrel sections unless otherwise approved.
 - a. Precast concrete manhole barrel sections shall be manufactured to standards at least equal to or greater than the requirements of the Standard Specifications for Precast Reinforced Concrete Manhole Sections, ASTM Designation C-478. The internal diameter for sanitary manholes shall be forty-eight (48) inches unless shown otherwise. Manholes shall conform to all requirements as shown on the detail drawings. Manholes shall have steps unless otherwise specified. Precast manhole joints shall be made watertight with Ram-Nek material or approved O-ring gasket at each joint. The Ram-Nek and primer must be used in accordance with the manufacturer's instructions.
 - b. Lift Holes will be allowed but must be sealed with non-shrink grout before backfill.
 - c. Cast-in-place flexible rubber junction connections may be used if approved in advance by the Town.
 - d. The concrete base shall be cast-in-place concrete of the size and depth shown on the drawings. Concrete used for bases shall have a twenty-eight (28) day compressive strength of at least three thousand pounds per square inch (3,000 psi). Approved precast concrete bases will be allowed if placed in an approved manner.
 - e. Manhole frames and covers shall be of the checkered or indented pattern, round base, twenty-four-inch (24") clear opening, non-locking type with frame and cover weighing over three hundred (300) pounds. Cover and frame seat shall be machine finished to prevent any rocking of cover in its associated frame. Cover shall have word "SEWER" clearly cast on its surface.
 - f. All manhole steps shall be plastic coated steel or aluminum alloy with minimum tread width of fourteen inches (14") and of a pattern approved by the Town. Aluminum steps shall be drop-front design.
- D. Separation of Sewers and Water Mains.
 1. Parallel Installation. Sewer mains shall be laid at least feet (10') horizontally from any existing or proposed water main. The distance shall

be measured centerline to centerline. In cases where it is not practical to maintain a ten-foot (10') separation, the Town may allow deviation on a case-by-case basis, upon submittal of adequate supporting data to be provided from the design engineer. Such deviation may allow installation of the sewer closer to a water main, provided that the sewer is laid in a separate trench at such an elevation that the top of the sewer is at least eighteen inches (18") below the bottom of the water main.

2. Crossings. Sewer crossing water mains shall be laid to provide a minimum vertical distance of eighteen inches (18") between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. At all crossings, one full length of sewer or water pipe shall be located so both joints will be as far from the crossing as possible. Special structural support for the water and sewer pipes may be required.
3. Site-specific Challenges. When impossible to obtain proper horizontal and vertical separation as stipulated above and the sewer main crosses above a water main, the sewer main should be constructed of slip-on or mechanical-joint ductile iron pipe or PVC pressure pipe and shall be located so both joints will be as far from the water main as possible. The sewer shall remain pressure class pipe until the minimum distance between the joints of the sewer and water mains are ten feet (10') apart. Both mains shall be pressure tested to assure watertightness.
4. Construction Changes. If during construction it is found that a water or sewer line cannot meet these requirements, the design engineer shall change the alignment to comply upon receipt of approval by the Town. This shall not be considered as basis for a claim for extra work compensation but shall be considered as incidental work required in the performance of the contract.

E. Installation of Pipe and Appurtenances.

1. Laying of Pipe.
 - a. Pipe shall be laid in trenches prepared in accordance as required by the Town.
 - b. Proper implements, tools and facilities satisfactory to the Town shall be provided and used by the contractor for the safe and convenient prosecution of the work.
 - c. Pipe and materials shall be unloaded and distributed on the job in a manner acceptable to the Town. No material shall be thrown or dumped from the truck.

- d. All materials shall be carefully lowered into the trench piece by piece by means of a derrick, straps, ropes or other suitable tools or equipment, in such a manner as to prevent damage. Under no circumstances shall materials be dropped or dumped into the trench. All pipe shall be inspected for defects prior to installation. Any defective, damaged, or unsound pipe shall be rejected.
- e. All foreign matter or dirt shall be removed from the inside of the pipe and fittings before it is lowered into its position in the trench.
- f. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. If the pipe-laying crew cannot put the pipe into the trench and in place without getting earth into it, the engineer may require that before lowering the pipe into the trench a heavy, tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipes.
- g. An approved snug-fitting stopper or plug shall be installed in each pipe immediately after it is laid and prior to any further excavating, backcasting, or backfilling. All openings along the line of the main shall be securely closed as directed and, in the suspension of work at any time, stoppers shall be placed to prevent earth or other substances from entering the main. During laying operations, no debris, tools, clothing or other material shall be placed in the pipe.
- h. In the event of rock excavation, the bottom of the trench shall be lowered so that the bottom of the trench is six inches (6") below the outside surface of the pipe. The space between the rock and the pipe shall be filled with the specified foundation material. The foundation material shall be compacted to a density equal to or greater than ninety-five percent (95%) of the maximum laboratory density. During compaction, the foundation material shall be shaped to provide support along the full length of the pipe.
- i. Pipes shall be laid to a true line and at uniform rates of grade between manholes as shown on the drawings. Fine grading to the bottom of the barrel shall proceed ahead of encountered, the material added shall be moistened and compacted to the satisfaction of the Town or foundation material shall be added.
- j. The grade shall be accurately established for each joint by laser beam. The laser beam shall be checked with a level each time it is moved and each day before construction proceeds and thereafter as required to assure that it is set at the correct alignment. If any errors of grade are observed, pipe laying shall stop until the grade is corrected.

- k. Holes shall be dug for the pipe bells and the material placed along the proceeding pipe laid. The pipe shall be supported for the bottom ninety degrees (90°) and throughout its length (except for the minimum distance necessary at the bell holes). Bell holes shall be adequate to make the joint, but no larger than necessary so that maximum support on embedment material will be provided for the pipe. In no event shall the weight of the pipe be resting on the bell. The remainder of the pipe shall be surrounded to at least the mid-point of the pipe by select materials, shovel placed and hand tamped, to fill completely all spaced under and adjacent to the pipe. Non-granular materials may be used if specifically accepted by the Town.
 - l. Pipe laying should proceed upgrade with the spigot ends pointed in the direction of flow. No pipe shall be laid in water or when the trench conditions are unsuitable for such work, except by written permission of the Town. The contractor shall make all connections of pipe to the manholes which have previously been constructed. When connecting to existing sewers, the contractor shall take every precaution necessary to prevent dirt or debris from entering the existing lines.
 - m. Bedding shall be placed under and on both sides of the pipe as each length of sewer pipe is installed.
 - n. The placing of bedding, backfill, and encasement shall be in accordance with these specifications.
2. Precast Concrete. Precast manhole barrel sections, adjusting rings, joint sealant materials, frames and lids are to be furnished by contractor.
- a. Concrete bases shall be poured on undisturbed ground. The ground surface below the concrete base shall be excavated three inches below the elevation of the bottom of the base and backfilled with gravel or other approved material. The gravel shall be carefully leveled and smoothed as to give uniform support to the base over its entire area. The base shall be set at the proper location to center the manhole.
 - b. The contractor shall provide a minimum of six inches (6") and a maximum of eighteen inches (18") in two-inch (2") layers of sewer brick or precast concrete adjusting rings between the cast iron frame and the manhole top section. Each ring or brick shall be set on a full bed of mortar and shall be made watertight. Wood or other foreign material will not be allowed. Adjusting rings shall conform to the size and shape of the casting frame. Frames and covers shall be set to the designated elevation in a full mortar bed.

- c. Manhole casting tops shall be one quarter inch (¼") below the street surfacing.
- d. The bottom of all manholes shall be smoothly shaped to conform to the pipe so as to allow a free, uninterrupted flow of sanitary sewage.
- e. The sanitary sewer pipe shall be laid continuously through the manholes where the plans show no horizontal deflection angle and no change in slope and cut out when the manhole invert is finished.
- f. All smooth surface pipes shall have a manhole waterstop gasket, to be furnished by the contractor, firmly attached to the pipe prior to grouting into the manhole. The opening in the manhole wall where a pipe enters or leaves shall be mortared shut and patched in a neat workmanlike manner, both inside and out with non-shrink mortar. The upper half of pipe projecting into the manhole shall be cut off even with the manhole wall and the break grouted smooth with walls and floors respectively.
- g. Precast manhole barrel sections shall be handled with mechanical equipment. They shall be centered on the base a section at a time with inlets and outlets properly aligned and placed in such a manner as to avoid damage to the base.
- h. Prior to placing the next higher section onto the preceding one, the gasket shall be placed in the joint to provide for a watertight joint. Steps shall be properly aligned as sections are added.
- i. All concrete work shall be protected from freezing if necessary.
- j. The exterior shall be supplemented by a waterproof bituminous coating where the Town determines unfavorable ground water conditions prevail.
- k. Any manhole in which the inlet invert is twenty-four inches (24") or more above the outlet invert shall be a drop manhole.
- l. The manhole frame and lid shall be centered over the manhole opening. The contractor shall insure that the frame and lid are not loose from the mortar bed or moved during the grading and paving operation.

3. Service Connections.

- a. It shall be the duty of the contractor to keep an accurate record of service connections as to the location, elevation of the service at the property line, type of connection provided, etc. Location shall

be made in respect to the survey line stationing and house corners or lot corners. All services must be inspected and approved by the Town prior the backfill.

- b. The contractor shall construct services for building connections and shall extend such service to the property line unless otherwise indicated on the drawings.
- c. A four-inch (4") or six-inch (6") wye shall be used in the main line.
- d. House connections shall be kept as deep as required to serve the property and shall extend on a straight-line grade to the property line unless otherwise directed by the Town.
- e. All house connections shall be capped with stoppers recommended by the pipe manufacturer, sealed firmly in place, or by other methods accepted by the Town, which shall effectively prevent water from entering the sewer until the connection is placed in service.
- f. The sewer services must be laid at not less than the minimum grade as determined by the Uniform Plumbing Code. Services shall be at angles to the main sewer unless otherwise directed.
- g. Rises are to be constructed at all points where the depth of cover over the invert of the sewer line is fifteen feet (15') or more and at other locations as determined by the engineer.
- h. It may be necessary to tap sewer services into existing mains as shown on the drawings. It is the contractor's job to coordinate this activity with the Town. Only a licensed contractor approved by the Town shall be allowed to tap an existing main.
- i. Any customer whose sewer service may be affected by connection or reconnection to a new main or existing sewer shall be given twenty-four (24) hour notice by the contractor as to when and for how long service may be interrupted.
- j. Holes shall be machine tapped into the pipe to fit an approved tee saddle. The saddle is to be securely fastened to the pipe by means of an epoxy resin adhesive.
- k. At the end of all sewer services which will not be connected immediately after installation of the service, the contractor shall finish and set at no additional compensation two (2) marker posts. One marker post shall be buried a minimum of three feet (3') and shall extend a minimum of two feet (2') above the ground surface and shall have a piece of green flagging at the top or be painted

green. The second marker shall extend from the end of the service to eighteen inches (18") below the existing surface. The marker posts shall be wood 2 x 4's, 4 x 4's or #4 rebar.

- l. If sidewalk or curb is poured before the service is extended, the contractor shall mark the location of the sewer service with an S in the concrete.
- m. Water service shall be located at least ten feet (10') measured horizontally away from all sewer services. All service lines shall be constructed perpendicular to the property line of the property they are going to serve.

4. Pressure Sewers.

- a. Pressure sewers shall be laid in trenches prepared as required by the Town and installed as specified for Laying Pipe and Fittings, Water Main Construction Standards.
- b. All pressure sewers shall have thrust blocks placed at bends, tees, crosses, and plugs. The thrust blocks shall be designed for a minimum soil bearing load of two thousand pounds per square foot (2,000 psf) at the design water pressure.

5. Workmanship and Cleanup.

- a. It is the intent and purpose of the specification and drawings to obtain good sanitary sewer and workmanship throughout, with the completed work complying with the specifications and drawings, and in full working order.
- b. All debris and rubbish caused by the operations of the contractor shall be removed and the areas occupied during his operations shall be left in a neat and presentable condition.
- c. All manhole rings and covers shall be set to the exact elevation specified relative to the finished street surface, sidewalk surface, or alley grade. In no case shall the top of the manhole ring and the cover be placed beneath street or alley paving or any finished surface. Construction of sewer lines and appurtenances will not be accepted as having been completed by the contractor until manhole rings and covers have been set to finished surface grades.

6. Maintaining Sewer Service.

- a. If existing sanitary sewer main service is to be affected in any way by this project the contractor must submit a plan to the Town in writing the preconstruction conference detailing how sanitary

sewer service is to be maintained. The plan shall indicate the number, size, and capacity of pumps to be used, the size and location of the temporary piping and type and number of sewer plugs to be used.

- b. If temporary pumping of sewage is required, a standby pump, equal in capacity to the pump being used must be at the construction site.
- c. If pumping is required between 5 p.m. and 8 a.m., special noise control will be required at the expense of the contractor.
- d. Under no conditions may an earth sump be dug to hold sewage or to aid in pumping.
- e. If the contractor plans to leave the pump unattended, he must have enough fuel to maintain continuous pumping.
- f. If the pumps and piping on hand cannot keep up with the demand for sewage pumping, the contractor will furnish additional pumping equipment.
- g. Any claims or damage caused due to failure of temporary sewer service measures will be totally the responsibility and at the expense of the contractor.

F. Testing and Inspection.

1. Sewer Tests.

- a. Upon completion of all utility construction and before any building services are connected, tests will be required of all sanitary sewer lines.
- b. Maximum infiltration/exfiltration limits for all new sanitary sewers shall not exceed two hundred gallons (200 gal) per inch of diameter per mile of pipe per twenty-four (24) hours. This standard is for every portion of the project and includes all manholes and sewer service connections. All sections of the sewer shall be tested and any sections not meeting this infiltration standard shall be repaired and retested.
- c. The contractor shall conduct a leakage test on the first section of each size and each type of sewer shall material installed. No additional sewer pipe shall be installed without permission of the Town, until the first reach of sewer of each site and each type of sewer material has satisfactorily passed the leakage test.

- d. Tests for watertightness shall be conducted on all installed sewers in the presence of and in the manner accepted by the Town. Contractor shall furnish and install all equipment necessary for the sewer tests except for air testing sewers fifteen inches (15") and smaller. Water for testing will be furnished by the contractor.
- e. Watertightness tests shall be conducted on short sections of the sewer as soon as the manholes have been constructed and the backfilling completed.
- f. The contractor shall receive no additional compensation for making the leakage tests or corrective work necessary to reduce leakage below the maximum allowed by the Specifications.
- g. The introduction of any substance into the water used for testing with the intent of sealing such leaks as may be indicated will not be permitted.
- h. All sewers fifteen inches (15") and smaller shall be air tested.
- i. Where the section is in excess of the allowable limits, the contractor shall correct the construction of the sewer so that the section test is within the allowable limit. All methods and materials used in the repair shall be approved by the Town, and performed in his presence.
- j. The program of testing shall fit the conditions as determined by the Town.

2. Infiltration Test.

- a. The infiltration test shall be used where the natural ground water table is a minimum of two feet (2') over the top of pipe in the section being tested.
- b. The ground water level at each manhole of the section being tested shall be determined by the contractor providing a three-eighths inch (3/8") inside diameter pipe through each manhole at an elevation near the invert. Aggregate shall be placed on the outside of the pipe to prevent clogging. The end of the pipe on the inside of the manhole shall contain fittings, together with a vertical transparent pipe to determine the ground water level. The pipe through the manhole shall be removed and the hole sealed with non-shrink grout after the tests have been completed.
- c. The test shall be conducted by plugging off the upper end of the pipe section being tested and placing a weir or other approved measuring device in the pipe at the lower of the section. Sufficient

time shall be allowed for the water level over the weir to stabilize before reading the flow. The ground water table shall be checked at the manholes on the section being tested to determine if a minimum of two feet (2') of head exists over the top of pipe at the time of the test.

- d. The total allowable infiltration into the completed sewer section, including connections, manholes, and structures, shall not exceed two hundred gallons (200 gal) per inch of internal diameter per mile of sewer per twenty-four (24) hour period.

3. Exfiltration Test.

- a. The exfiltration test for leakage shall be used where the natural ground water table is less than two feet (2') over the top of pipe in the section being tested.
- b. The test section shall be bulkheaded and the pipe subjected to a hydrostatic pressure produced by a head of water at a depth of two feet (2') above the invert of the sewer at the upper manhole under test. In areas where ground water exists, this head of water shall be two feet (2') above the existing water table.
- c. The head of water shall be maintained for a period of one (1) hour during which it is presumed that full absorption of the pipe body has taken place, and thereafter for a further period of one (1) hour for the actual test of leak age. During this one (1) hour test period, the measured maximum allowable rate of exfiltration for any section of sewer, including service snubs, shall not be greater than two hundred gallons (200 gal) per inch of pipe diameter per mile per day.
- d. If measurements indicate an exfiltration greater than the maximum allowable leakage, additional measurements shall be taken and continued until all leaks are located and the necessary repairs and corrective work have reduced the leakage in the section being tested below the maximum allowable by the Specifications. For purposes of the test, the line between adjoining manholes will be considered a section and will be tested as such.
- e. The contractor shall furnish the plugs, standpipe, and other material and labor for placing the plugs and standpipe in the sewer and for performing all measurements. The contractor shall receive no additional compensation for making the leakage tests or corrective work necessary to reduce leakage below the maximum allowed by the Specifications.

- f. The introduction of any substance into the water used for testing with the intent of sealing such leaks as may be indicated will not be permitted.
- g. If results of either of these tests are not satisfactory, repairs or pipe replacement will be required until the Town is satisfied that the leakage requirements are being met. All repair methods and materials used must be acceptable to the Town.

4. Air Tests.

- a. The contractor shall perform these tests with suitable equipment specifically designed for air testing sewers. Testing must be observed by the Town.
- b. The air test shall be made when the sewer is clean. The pipe, or sections of pipe to be tested, may be wetted before the air test. The line shall be plugged at each manhole with pneumatic balls. Low pressure air shall be introduced into the plugged line until the internal pressure reaches four pounds per square inch gauge (4.0 psig) greater than the average back pressure of any ground water pressure that may submerge the pipe. At least two (2) minutes shall be allowed for the air temperatures to stabilize before readings are taken and the time started.
- c. The portion being tested shall pass if it does not lose air at a rate to cause the pressure to drop from 3.6 to 3.0 psig (greater than the average back pressure of any ground water that may submerge the pipe) in less time than listed below.

<u>Pipe Diameter in Inches</u>	<u>Minimum Allowable Minutes</u> <u>3.6 to 3.0 psig Pressure Drop</u>
4	2.0
6	3.0
8	4.0
10	5.0
12	6.0
15	7.5
18	9.0
21	10.5
24	12.0

- d. For pipe larger than twenty-four inches (24") in diameter, the allowable time will be provided by the Town.
- e. If the installation fails this test, the testing equipment may be used to determine the location of the pipe leak.

- f. All service plugs shall be secured in place to prevent displacement during testing operations.

5. Manhole Leakage Test.

- a. Manholes will be tested for leakage separately from the pipe. The sewer pipe in the manhole shall be plugged. If the ground water table is below the invert, the manhole shall be filled with water to a depth five feet above the invert. If the ground water table is above the invert of the manhole, then the manhole shall be filled to a level at least three feet above the ground water table or to the top of the upper most precast manhole section whichever is less, but not less than five feet (5') above the invert. After soaking for one hour, the manhole shall be filled to the original level. It shall then be tested for two (2) hours. The allowable drop in water level shall be one-quarter inch (1/4").
- b. No manhole will be accepted that has any visible infiltration when empty.
- c. At least twenty percent (20%) of all manholes shall be tested. Based on these tests, and visual inspection of all manholes, additional tests may be required for other manholes. Any manhole whose test is unsatisfactory shall be repaired and retested until satisfactory results are obtained.

6. PVC Deflection Test. The maximum vertical deflection allowed for PVC pipe is five percent (5%). The Town shall require the contractor to perform deflection tests of the pipe before acceptance. Optional devices for testing includes calibrated television, photography, properly sized go-no-go mandrel, sewer ball or deflectometer. The method used shall be approved by the engineer. To ensure accurate testing, the line must be thoroughly cleaned prior to testing. The Town may lamp each section of sewer between manholes to determine whether any displacement of the pipe has occurred. The contractor shall provide suitable assistants to help Town. A full diameter ("full moon") of the pipe should be visible when viewed between manholes. Testing shall be done no sooner than thirty (30) days after the pipe has been backfilled.

7. Pressure Test for Pressure Sewers.

- a. After the pipe has been laid including fittings, thrust blocks, and backfill in accordance with the specifications it shall be subjected to a hydrostatic pressure of not less than the design pressure for one (1) hour. The allowable leakage shall not exceed the following formula:

$$L = \underline{NCP}^{0.5}$$

7400

L = allowable leakage in gallons

N = number of joints in the length of pipeline tested

D = nominal diameter of pipe in inches

P = average test pressure during the test, psi

- b. Each valved section of the entire line if there are no valves, shall be slowly filled with water and the specified test pressure, measured at the lowest point of elevation shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, gauges, and all necessary apparatus shall be furnished by the contractor. Gauges and measuring devices must meet with the acceptance of the Town and the necessary pipe taps made as required. Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at points of highest elevations and afterward tightly plugged with brass plugs.
- c. Any cracked or defective pipes, fittings, or valves discovered in the pressure test shall be removed and replaced by the contractor with sound material in the manner provided. The test shall be repeated until the pipeline passes the pressure test and is accepted by the Town.

8. Inspection and Flushing.

- a. Prior to acceptance of each section of sanitary sewer line, the contractor shall jet clean all sewers. Larger sewers may be cleaned by other appropriate methods as approved by the Town. All dirt and debris shall be prevented from entering the existing sewer system by means of watertight plugs or other suitable methods.
- b. The contractor will televise mains, and any defects found during televising will be repaired in a manner approved by the Town.
- c. If the sewer mains are developer-installed, the Town will provide general inspection services, and the contractor will be billed for said service before construction begins at a set per foot charge with a minimum dollar amount.
- d. Before acceptance of the work, the contractor shall survey the manhole invert and surface elevations. Any inverts or surface elevations not meeting the design plans shall be redone to the satisfaction of the Town standards set forth herein.

- e. Upon completion of the contract, the Town will carefully inspect all sewers and appurtenances. Any unsatisfactory work shall be removed and replaced in a proper manner. The invert of the sewer and manholes shall be left smooth, clean and free from any obstructions throughout the entire line. Manhole rings and covers must be raised to finished grade before acceptance of the sewer.

Section 5 – Standard Details

Refer to Appendix A, attached below, to find the current editions of the following details:

<u>Detail Number</u>	<u>Description</u>
SANITARY SEWER	
S-1	Standard Manhole
S-2	Stub-Out Manhole Base
S-3	Manhole Base Configurations
S-4	Outside Drop Manhole, 15-Inch and Smaller
S-5	Outside Drop Manhole, 18-Inch and Larger
S-6	Manhole Marker
S-7	Standard Bedding
S-8	Special Bedding
S-9	Sanitary Sewer Service
S-10	Sewer Service Line Cleanout
S-11	Pipe Casing and Sled
S-12	Concrete Encasement

POTABLE WATER

W-1	¾" and 1" Meter and Water Service
W-2	1 ½" to 4" Meter and Water Service
W-3A	Meter Notes
W-3B	Meter Notes (Continued)

W-4	Water Valve and Box
W-5	Fire Hydrant Assembly
W-6	Air Release and Manhole
W-7	Vent Pipe Assembly
W-8	Concrete Kickblock Bearing Surface
W-9	Vertical Concrete Thrust Block
W-10	Length of Restrained Pipe
W-11	Water Marker
W-12	Blow-off Assembly
W-13	Conduit Crossing
W-14	Standard Bedding

PART IV SUPPORTING DOCUMENTS SPECIFICATIONS

This section specifies certain studies or reports, referred to as Supporting Documents. Unless waived by the Town, these supporting documents are required. Any conflicts between these requirements and any other parts of this section or the Subdivision Regulations shall be resolved by the Town. The specifications for the supporting documents are as follows:

- A. Pavement Design Report. This report shall include:
1. Soil logs along the proposed roadway alignment at a maximum of 500-foot intervals;
 2. Each log shall have a soil profile of the four feet below proposed subgrade elevation;
 3. Representative samples for pavement design from each location shall be within two feet below proposed subgrade elevation.
 4. Each representative sample shall be classified according to the AASHTO Unified Soil Classification Table, along with an Atterberg Limit's Test and a Sieve Analysis;
 5. The pavement design procedure is based on the HVFEM Stabliometer Test or the Expansion Pressure Test which is used to compute a resistance value R of the subgrade. On private roads, local access roads and residential collectors a California Bearing Ratio (CBR) may be used to determine subgrade elevation;
 6. Recommended structural sections, based on the design considerations, proposed typical sections, and sections of roadway which may require additional stabilization or treatment.
- B. Traffic Studies. This report shall include:
1. A summary table listing each type of land use, the units involved, the general rates used (daily and AM/PM peaks), and the resultant trip generation;
 2. A site map that shows the location within the site of each land use;
 3. Traffic graphics showing:
 - a. AM peak hour site traffic (in and out);
 - b. PM peak hour site traffic (in and out);
 - c. AM peak hour total traffic (in and out);
 - d. PM peak hour total traffic (in and out);

- e. Total daily traffic (with site traffic shown in parentheses);
4. All traffic shall be assigned to existing and planned facilities in a manner consistent with accepted traffic patterns and approved by the Town;
5. A capacity analysis should be conducted for all major roadways that intersect collector or arterial streets, and all adjacent arterial-arterial, arterial-collector, and collector-collector intersections. Both peak hours should be tested to determine the critical movements. Pedestrian movements should also be considered in the evaluation;
6. Traffic signal warrant analysis;
7. Traffic progression is of paramount importance. Consequently, all potential signalized intersections will be placed at half-mile points. All other locations to be considered shall meet the following criteria:
 - a. Progression band width shall be fifty (50) second minimum in both directions;
 - b. Cycle length shall be one hundred (100) seconds;
 - c. Progression speed shall be from thirty-five (35) to forty-five 45 MPH; and
 - d. Remaining time for side street traffic must be sufficient for side street volumes.
8. Peak hour level of service D, as defined by the Transportation Research Board in Transportation Research Circular #212, shall be the design objective. The design year shall be twenty (20) years, following construction.
9. Trip generation rates shall be calculated from the latest edition of the Institute of Transportation Engineer's Trip Generation Guide. In the event that data are not available for the proposed land use, any estimated rates must be approved by the Town;
10. Internal trips shall not exceed ten percent (10%). Non-generated passerby traffic reductions in generation volumes may be considered if applicable. All estimates of trip distribution, assignment, and modal split are subject to review and approval by the Town.
11. Traffic accident data for affected street corridors shall be obtained for the study. Estimates of increased or decreased accident potential shall be evaluated for the development.

- C. Drainage Report and Erosion Control Plan. The report shall be prepared in accordance with the "*Jefferson County Storm Drainage Design and Technical Criteria*", current version.
- D. Utility Report and Plan. The report and plan shall include, if applicable, but not be limited to, the following:
1. A statement concerning the availability of and provision for electric gas, lighting, communication and cable television services.
 2. A Utility Plan that includes, if applicable, but not be limited to, the following:
 - a. Contracts or agreements that the developer/subdivider has or will enter with the serving utility companies.
 - b. The entity/entities that will implement the plan, construct required improvements, and will be responsible for the maintenance of the improvements and appropriate easements, if any.
Owner/subdivider shall grant no easements to a public utility company, telecommunications company, or cable company without first receiving Town review and approval of the easement document.
- E. Water Supply Report System Plan.
1. A Water Supply Report shall be prepared by the applicant's engineer who shall be qualified in the field and licensed in the State of Colorado, and signed by an authorized agent of the Town. The report shall state the time of year the field work was done and include the following information, statements and plans:
 - a. That the proposed subdivision is within the boundaries of the Town, has a contract with the Town, or will be included within the Town boundaries in accordance with the Colorado Revised Statutes;
 - b. That the Town will pursuant to their rules and regulations, supply water to the proposed subdivision;
 - c. The expected water requirements of the subdivision at full development including the various water uses to be permitted; and
 - d. Conceptual water distribution plans.
 2. Water System Plan Requirements. A water system plan shall be prepared and signed by a Professional Engineer, qualified in the field of civil engineering and registered in the State of Colorado, and submitted with

the final plat. The plan shall include the entity/entities that will implement the plan, construct required improvements, and will be responsible for the maintenance of the improvements and appropriate easements.

F. Sewage Disposal Report and Plan.

1. The Sewage Disposal Report shall be prepared by the applicant's engineer who shall be qualified in the field and licensed in the State of Colorado, and signed by an authorized agent of the Town. The report shall include what time of year the field work was done and list of references and other supportive data used. The report shall also include, if applicable, but not limited to, the following items:

- a. That the proposed subdivision is within the boundaries of the Town or will be included within the Town boundaries in accordance with Section 32-4-122, C.R.S. (1983 Supplement);
- b. That the Town will, pursuant to their rules and regulations, transport and/or treat the effluent;
- c. That the system has or will have adequate capacity to transport the effluent;
- d. That the treatment facility has or will have adequate capacity to treat the effluent or there are plans to expand the system to meet the needs of the subdivision in accordance with applicable state law; and
- e. Conceptual sewer system plans.

2. The Sanitary Sewer System and Sewage Disposal Plan shall be prepared and signed by a Professional Engineer qualified in the field of civil engineering and registered in the State of Colorado and submitted with the final plat. The plan shall include the entity/entities that will implement the plan, construct required improvements and will be responsible for the maintenance of the improvements and appropriate easements.

G. Preliminary Geologic and Soils Report. The applicant shall furnish a Preliminary Geological Report prepared by a Professional Geologist, as defined in Section 34-1-210(3) of the Colorado Revised Statutes, as amended. The report shall indicate:

1. The degree of compatibility of the existing geological, topographical, and drainage features of the area within the proposed development;
2. The effects of subsequent modification of these features by such development;

3. Plans to ensure adequate protection from potential geological, topographical and drainage hazards;
4. The report should include but not be limited to what is generally referred to as an "Engineering Geologic Report with Supplemental Report of Soils Investigation" with the following items:
 - a. Stratigraphic and engineering geological and topographical maps;
 - b. Geological cross sections;
 - c. Geological hazards and engineering problems including:
 - (1) Identification and description;
 - (2) Location and distribution;
 - (3) Mitigation procedures;
 - (4) Potential, present and past mineral extraction areas;
 - (5) Rock and soil descriptions oriented to engineering;
 - (6) Ground water elevation; (Indicate with a map where the high ground water table exists and if these areas would permit basements)
 - (7) Foundation design information including:
 - (a) Swell pressures of soils and bedrock shall be listed so that verification can be made of the individual foundation designs;
 - (b) If the area has clay soils which expand when wetted, the report should substantiate with proper design evaluation that the expansive clay problems have been mitigated;
 - (c) Depths to bedrock; and
 - (8) Additional engineering geological studies or soils studies to be performed before submission of the final plat.

H. Grading Plan.

The Grading Plan shall be prepared and signed by a Professional Engineer qualified in the field of civil engineering and registered in the State of Colorado, and shall include, but not be limited to, the following statements and plans:

1. The natural topography as shown by contour lines with minimum intervals of two feet (2') for slopes less than ten percent (10%) and five feet (5') for slopes in excess of ten percent (10%).
 2. The finished conditions as shown by contours, cross sections, spot elevations and other means.
 3. The one hundred (100) year floodplain boundaries, both existing and as modified by grading, and the location of all water courses and known or proposed surface water areas;
 4. The location and source of imported fill material and location where excess excavated material is to be disposed or stockpiled;
 5. The location of existing structures and other improvements interior or exterior to the subdivision that could be affected by grading; and
 6. The entity/entities that will implement the plan, construct required improvements and will be responsible for the maintenance of the improvements and appropriate easements, if any.
- I. The Plan shall include, but is not limited to, the following:
1. Streets and road horizontal alignment (plans) according to the following:
 - a. Stations and curve data shall be shown;
 - b. The centerline stationing of plans shall be by increasing stationing from left to right at five station intervals or less. All intermediate stations shall be delineated by tick marks.
 - c. Provide the super-elevation rate for each horizontal curve where super-elevation is required.
 2. Street and road vertical alignment (profiles) as follows:
 - a. The scale shall be a minimum of one inch to fifty feet (1"=50') horizontal and one inch to five feet (1"=5') vertical;
 - b. Stations and curve data shall be shown;
 - c. The vertical alignment stationing should correspond to the horizontal alignment stationing. All intermediate stations shall be delineated by tick marks.
 3. The plans and profiles shall include, but not be limited to, the following:
 - a. Cross sections when required by the Town;

- b. The curb return and cross pan elevations where the street is curbed;
 - c. Plans covering improvements which are to be installed in, on, over or under any street/road proposed for conveyance to the Town;
 - d. The location of all drainage structures or culverts and appurtenances with construction data, such as the size, type, length, slope, and invert elevations. The roadway cut and fill limits shall be plotted upon the contour map to determine culvert lengths and the necessity of drainage or maintenance easements beyond the dedicated right-of-way;
 - e. A minimum of one permanent bench mark, based on USGS's datum, fully described, established within each subdivision or filing thereof located on public property;
 - f. The entity that will implement the plan, construct required improvements, and will be responsible for the maintenance of the improvements and appropriate easements, if any; and
 - g. Noise abatement measures shall be shown on all arterial plans where adjacent to residential areas.
- 4. Intersection plans with arterial streets shall be prepared at a minimum scale of one inch to twenty feet (1"=20').
 - 5. The plans shall be prepared and signed by a Professional Engineer qualified in the field of civil engineering and registered in the State of Colorado;
 - 6. The plans shall be approved by the Town.

J. Sensory Impact Report.

The report shall include, but not be limited to, the following:

- 1. A sensory impact map showing:
 - a. The proposed subdivision including lots, tracts and street/road alignments;
 - b. The natural topography as shown by contour lines;
 - c. Acoustical, ocular and olfactory conditions as discussed in the report and the plan;
- 2. A report identifying:

- a. The existing and/or projected acoustical, ocular and olfactory emission sources, levels, occurrences and frequencies;
 - b. The distance between the emission sources and the receiver;
 - c. And intervening structures, vegetation and terrain that affect the relationship between the emission source and the receiver;
3. A sensory impact plan which includes:
- a. The emission sources which will or could affect the subdivision;
 - b. Solutions and alternatives to abate, minimize and/or improve the emission levels such as:
 - (1) Aesthetically designed barriers (earth berms, walls, fences, dense vegetation);
 - (2) Open space;
 - (3) Architectural design and/or construction techniques;
4. The entity/entities that will implement the plan, construct the required improvements, and will be responsible for the maintenance of the improvements and appropriate easements, if any; and
5. The map, plan and report shall be prepared and signed by a qualified Professional Planner, Landscape Architect or Engineer. Plans for engineered structures shall be prepared and signed by a Professional Engineer qualified in the field of civil engineering and registered in the State of Colorado.

K. Wildlife, Vegetation and Landscaping Plan.

The plan shall include, but not be limited to the following:

1. A map showing the proposed subdivision including lots, tracts and street/road alignments, the natural topography as shown by contour lines, and the wildlife and vegetation habitat discussed in the report and plan;
2. A report discussing the wildlife habitat and species and the vegetative habitat and species.
3. A plan identifying the wildlife and vegetative habitat conditions which should be preserved or improved within the subdivision; solutions and including development or preservation of open space and wildlife runs, buffering and screening of light and noise sources and orientation of such sources away from wildlife runs, removal and/or treatment of infected and

diseased vegetation, and revegetation and landscaping of lots, tracts and streets/roads right-of-way including type, caliper and number of trees and the type of ground cover including vegetative and non-vegetative cover;

4. The entity/entities that will implement the plan, construct required improvements, and will be responsible for the maintenance of the improvements and appropriate easements, if any; and
5. The map, plan and report shall be prepared and signed by a qualified Professional Planner or Landscape Architect.

L. Historical, Archeological and Paleontological Report.

The Report shall contain, but not be limited to, the following:

1. A map showing the proposed subdivision including lots, tracts and street/road alignments and the historical, archeological and paleontological location discussed in the report and plan;
2. A description of the historical, archeological and paleontological sites as recorded in the National Register of Historic Places, the State Register of Historic Places, the Jefferson County Inventory of Historic Sites, or in the office of the State Archeologist;
3. A plan including solutions and alternatives to protect the historical, archeological and paleontological sites;
4. The entity/entities that will implement the plan, construct required improvements, and will be responsible for the maintenance of the improvements and appropriate easements, if any;
5. The map, report and plans shall be prepared and signed by a qualified professional Historian, Archeologist or Paleontologist, depending on the nature of the site;
6. The map, report and plans shall be reviewed by the State Historical Society, or approved by the State Archeologist, as appropriate to plat approval.

PART V PUBLIC IMPROVEMENTS REQUIRED

The subdivider shall prepare a list of all required public improvements required for the proposed subdivision. This list shall be included as an exhibit to the subdivision improvement agreement. The Town may require public improvements in addition to what is initially submitted. The list shall also include the subdividers estimate of the unit costs and a subtotal of the estimated costs for each improvement category, and, a total estimated cost for the subdivision.

Contingency Cost. A ten percent (10%) contingency cost factor, and inflation factor where applicable, shall be added to the total itemized cost estimate.