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1.0 Water System Design Criteria

1.1 General

Water system improvements proposed for inclusion into the City shall be designed in accordance with the criteria set forth herein, unless otherwise approved in writing by the City.

The design shall take into consideration physical conditions known to exist at the time and place of each installation and the probable operating requirements. Where such conditions render sections of these Specifications inapplicable, alternate methods of design may be submitted to the City, and upon approval thereof, may be incorporated in the plan.

1.2 General Layout

The system shall be designed as a circulating grid with at least three (3) main line valves at each four way intersection. Tee's shall be designed with at least two (2) main line valves.

Each line shall be valved so that any segment not exceeding one block (1000 + feet) or two fire hydrants of the system may be isolated from service.

Permanent dead ends over 300 feet in length, at the option of the City, shall have circulating ties on twenty feet easements through side lot lines.

Dead end mains shall be provided with means of flushing with a blow-off or fire hydrant.

Pipelines 8-inches and smaller shall be installed with a minimum of 42-inches of cover between the top of the pipe and the finished grade. Pipelines 12-inches or greater shall be installed with a minimum of 48-inches from the top of the pipe to the finished grade.

1.3 System Demand Criteria

System demand criteria shall be in accordance with the City of Ontario Public Works Agency Report "POTABLE AND RECYCLED WATER GUIDELINES FOR THE PREPARATION AND REVIEW OF HYDRAULIC ANALYSIS FOR NEW DEVELOPMENTS IN THE CITY OF ONTARIO UPDATED DECEMBER 1, 2005".

1.4 Pipe Sizing Criteria

The standard water mainlines sizes allowed in the City shall be 8-inch, 12-inch, 16-inch, 18-inch, 24-inch, 30-inch, 36-inch and 42-inch in diameter.

Pipeline velocities shall not exceed 10 feet per second during peak hourly domestic flow. Use a "C" value of 120 in the Hazen-Williams formula for flow computations utilizing CML/CMC or DI pipe. A "C" value of 150 shall be used for PVC pipe.

The City reserves the right to require 12-inch diameter minimum size pipelines in residential areas, with no incremental pipeline diameter upsizing cost to the City, when necessary, as determined by the City.

Whenever possible, pipelines shall be looped to provide dual direction supply and system flexibility.

In commercial and industrial areas, the standard minimum pipe size shall be 12-inch diameter.

The City may require pipe sizing in excess of the minimum size as determined by the design criteria herein when the facilities being constructed will serve, or may be extended to serve, additional lands.

Services and meters shall be sized in accordance with the provisions of Section 1009 of the Uniform Plumbing code, using minimum pressure expected in the system. Minimum service pipe diameter and meter size shall be: 1" line and 5/8" x 3/4" meter.

1.5 Pipeline Materials

Per the Water Pipeline Material Specification and Approved Material List.

1.6 Potable Pipeline Location

Potable water lines shall be located on south side or east side of the street and out of the main traveled lanes of the road where possible. Locate 8 feet from curb face or berm. Location is not to interfere with other existing utilities.

Installation of potable water lines adjacent to existing or proposed sewer lines, recycle water lines, and storm drain lines shall be in accordance with Department of Health Services regulations, or City requirements; whichever is greater. Generally, always cross above sewer lines and recycle water lines, preferably with a minimum clearance of 1 foot, and parallel at least 10 feet (O.D. to O.D.) away from sewer lines.

When minimum cover cannot be provided, concrete encasement or protective slab construction over the pipeline may be substituted. Consult with City staff as it would require special approval.

City will require pipeline looping whenever possible. Dead end mains are undesirable.

1.7 Valves

Small mains (12-inch and less). Full line size gate valves 12-inches and less in diameter shall be resilient seat gate valves. All gate valves shall be ductile-iron, epoxy coated and lined in accordance with AWWA C509.

Large mains (16-inch and greater). Full line size butterfly valves 16-inches in diameter and larger shall be epoxy lined and coated ductile-iron flanged butterfly valves. All butterfly valves shall be Class 150B in accordance with AWWA C504.

Valves shall be located on discharge side of pipe connections; minimum 3 at crosses, 2 at tees and always at beginning of dead end mains. City may require additional valving on critical sections or where proposed valving requires closing more than 3 valves to isolate a section of pipeline. Maximum spacing for mainline valves shall not exceed 1000 feet or as directed by the City.

Isolation valves shall be flanged to the tee or cross within the street intersection. All isolation valves shall be direct buried (no vaults are required).

1.8 Backflow Prevention

Backflow prevention device shall be required on domestic water service connections and irrigation water service connections on all industrial or commercial buildings.

Backflow prevention device shall be required on domestic water service connections where recycle water is used on the property.

Backflow prevention device shall be required on domestic service connections where water from other sources may become cross-connected to other water supplies or sources as determined by the City, an approved backflow prevention device is required by Title 17, Drinking Water Supplies, of the California Administrative code, and shall be installed in accordance with City requirements.

All materials, installation, and testing shall be in accordance with City of Ontario Municipal Code, Title 6 Sanitation and Health, Chapter 8B Water Services, Section 6-8.57 Water Quality Control. The water meter shall not be installed until an approved backflow prevention device is installed.

1.9 Pressure Reducing Station

Where required by the City, pressure reducing station shall be individually designed specifically for each installation, subject to City review and approval of design and materials.

1.10 Fire Service Installations

Where fire service installations are necessary, the minimum construction requirement shall be in accordance with City Standards.

1.11 Corrosive Soil Design

Where pipelines are to be constructed in known or likely corrosive soil conditions, cathodic test stations shall be provided in accordance with City requirements and standards at the locations determined by the City. The City, at its option, may also require cathodic test stations for its transmission mains and major pipelines, regardless of existing soil conditions.

In order to determine whether or not unfavorable soil conditions exist, the City may request that soil boring samples and laboratory analysis be provided as part of the project. The analysis shall include an evaluation of PH, Redox, Sulfide, Resistivity and Sulfate.

Under certain circumstances, the City may require special pipe installation procedures or types of pipe, including special protective coatings for pipe and fittings.

All test stations shall be installed behind existing or proposed curbs to allow safe access for personnel during testing. Test boxes shall be from City approved manufacturers list. Test stations shall be installed at 1000 foot intervals or as directed by the City.

1.12 Water Sampling Stations

Where water sampling stations are required, as determined by the City, the stations shall be constructed in accordance with City Standards.

1.13 Service Installations

All services shall be constructed in accordance with the applicable City Standard Drawings. Services shall not be connected to 18-inch or larger mains unless specifically permitted by the City. In addition to a domestic water service meter, all commercial/industrial projects shall be required to provide a separate landscape irrigation meter, in conformance with City Standards.

1.14 Fire Hydrants

All fire hydrants shall be installed at 300-foot intervals with the exception of fire hydrants located on arterial roads, which will be spaced at 500-foot intervals on alternate sides of the roadway (1000 feet separation same side). Fire hydrants shall be installed with a minimum separation of 5-feet from any driveway, street light, power pole, sign, fence, walls, etc.

Fire hydrants shall be installed 12-inches behind sidewalk when sidewalk is adjacent to curb and 20-inches behind curb face when sidewalk is not adjacent to curb. All fire hydrants piping shall be same as main and installed with a break-off check valve.

1.15 Blow-Offs

Appropriately sized blow-offs shall be located at all low points along the pipeline alignment and at all "dead end" locations. Additionally, for all pipelines 16-inches in diameter and greater, a blow-off shall be located on the upstream side of all mainline valves. All blow-offs shall be constructed to City Standards.

Blow-offs should be located as near to storm drain catch basins whenever possible. On arterial streets blow-offs are to be placed prior to the curb radius with service line perpendicular with mainline.

The size of the blow-off shall be based on the mainline pipe diameter as follows:

Main Size	Blow-Off Size
12-inch to 16-inch	4-inch
18-inch to 24-inch	6-inch
Greater than 24 inch	8-inch

1.16 Combination Air/Vacuum Release Valves

Appropriately sized air vacuum release valves shall be located at all high points along the pipeline alignment and at all "dead ends" that occur at a high point. Additionally, for all pipelines 16-inches in diameter and greater, an air vac valve shall be located on the downstream side of all mainline valves. On arterial streets air vac valves are to be placed prior to the curb radius with service line perpendicular with mainline. All air vac's shall be constructed per City Standards.

The size of the air vac's shall be based using the APCO APSLIDE Model or engineering calculations.

1.17 Temporary End of Line Appurtenances

A 4-inch blow off shall be installed at the end of each segment of pipeline that is installed for future use. If the section of pipe is installed creating a high point an air vac will be required.

1.18 Tracer Wire

Tracer wire shall be installed on all PVC waterlines for the purpose of providing a continuous signal path used to determine pipe alignment after installation. Locator wire shall be brought to

the surface at all appurtenances (i.e. fire hydrants, water services, air valves, blow-offs, etc.), thus providing continuous "looping" between the appurtenances and the water main.

1.19 Ductile Iron Fittings for PVC

All fittings for use with PVC C900 pipe shall be cast-iron outside diameter (C.I.O.D.) push-on or mechanical joint fittings with the exception of fittings with valves which shall be push-on or mechanical joint by flange. Ductile iron fittings shall be classified as "compact ductile iron fittings" and shall be produced in strict accordance with ANSI/AWWA A21.53/C153. Unless otherwise specified, the interior of the ductile iron fitting shall be lined with a uniform thickness of cement mortar "double thickness" then sealed with a bituminous coating in accordance with AWWA C 104. The outside surfaces of the DIP fittings shall be coated with a bituminous coating in accordance with ANSI A21.6 or ANSI A21.51.

All ductile iron fittings shall be polyethylene encased at the time of installation. Polyethylene encasement and installation shall be accordance with AWWA C105.

1.20 Restrained System

Restrained joints shall be utilized for thrust restraint on all pipelines per City Standards. The acceptable method of restraint for PVC would be Uni-flange or Mega-lug type restraints, field-lock gaskets or TR-Flex joints for DIP and welded joints for CML&CMC steel pipe.

All restraint devices for shall have a water working pressure rating equivalent to the full rated pressure of the pipe on which they are installed, with a minimum 2:1 safety factor in any nominal pipe size. Restraining devices shall provide full (360 degree) support around the circumference of the pipe.

Length of pipe to be restrained on each side of bends, tees, reducers and other fittings shall be determined by the Private Engineer or manufacturer of the restraint device in accordance with City Standards.

2.0 Recycle Water System Design Criteria

2.1 Off-Site Recycled Water System

2.1.1 General

The City of Ontario (City) recycled water program is supervised by the California Department of Health Services. As set forth in the City of Ontario Municipal Code, Title 6 Sanitation and Health, Chapter 8C Recycle Water Use. The City shall determine whether a given service will be furnished with recycled water or potable water. The determination shall be in accordance with the standards of treatment and water quality requirements set forth in Title 22, Chapter 4 of the California Administrative Code, with the intent of the City to work in conjunction with the health agencies to protect the public health, and with the availability and/or feasibility of making available recycled water facilities. All on-site facilities using recycled water will have a cross connection test every four years unless otherwise approved by the state based on a case by case basis. However, in unusual circumstances, the cross connection test could be required on an annual basis. All inspections and any cross connection found are reportable to California Department of Health Services.

All potential uses of recycled water, including, but not limited to, uses for landscape irrigation systems, agricultural irrigation systems, systems used for industrial process or construction purposes, or recreational impoundment systems shall be reviewed by the City. If recycled water is to be used, the facilities shall be constructed in accordance with the procedures and requirements set forth below.

2.1.2 General Layout

- A. The tertiary treated recycled water lines shall be constructed in accordance with the color-coding, and labeling requirements per Section 116815, California Health and Safety Code of Regulations. All pipeline material used in the recycle water system shall be purple in color or installed with a purple polyethylene sleeve at the time of installation.
- B. The system shall be designed as a circulating grid with at least three (3) main line valves at each four way intersection. Tee's shall be designed with at least two (2) main line valves.
- C. Recycled water facilities shall typically be located 8-feet from the curb face on the opposite side of the street from the potable water
- D. Each line shall be valved so that any segment does not exceed 2000 feet.
- E. Dead end mains shall be provided with means of flushing with a blow-off.
- F. Pipelines 8-inches and smaller shall be installed with a minimum of 54-inches of cover between the top of the pipe and the finished grade.
- G. Pipelines 12-inches or greater shall be installed with a minimum of 60-inches from the top of the pipe to the finished grade. Recycle water pipes shall be installed at a depth greater than the potable waterlines.

2.1.3 SYSTEM DEMAND CRITERIA

System demand criteria shall be in accordance with the City of Ontario Public Works Agency Report "POTABLE AND RECYCLED WATER GUIDELINES FOR THE PREPARATION AND REVIEW OF HYDRAULIC ANALYSIS FOR NEW DEVELOPMENTS IN THE CITY OF ONTARIO UPDATED DECEMBER 1, 2005".

2.1.4 Pipe Sizing

The standard recycle water mainlines sizes allowed in the City shall be 8-inch, 12-inch, 16-inch, 24-inch, 30-inch and 36-inch in diameter. For recycled water, the minimum pipeline size in arterial streets of new development is 8-inch diameter. Smaller diameter pipeline will be considered in collector streets on a case-by-case basis by the City. These mains shall be sized so that sufficient water is regularly drawn to prevent stagnation.

Whenever possible, pipelines shall be looped to provide dual direction supply and system flexibility. The City may require pipe sizing in excess of the minimum size as determined by the design criteria herein when the facilities being constructed will serve, or may be extended to serve, additional lands.

2.1.5 Pipeline Materials

Per the Water Pipeline Material Specification and Approved Material List.

2.1.6 Recycle Pipeline Location

Recycle water lines shall be located on the opposite side of the street from the potable waterlines and out of the main traveled lanes of the road where possible. Locate 8 feet from curb face or berm. Location is not to interfere with other existing utilities.

Separation Between Water, Sewer, and Recycled Water Lines

Installation of recycle water lines adjacent to existing or proposed sewer lines, recycle water lines, and storm drain lines shall be in accordance with Department of Health Services regulations, or City requirements; whichever is greater.

The basic separation criteria for water mains and pipelines conveying tertiary treated recycled water or storm drainage lines are a 4-foot horizontal separation where lines are running parallel and a 1-foot vertical separation (water line above recycled or storm drainage) where the lines cross each other. Generally, always cross above sewer lines with the recycle water lines, preferably with a minimum clearance of 1 foot, and parallel at least 10 feet (O.D. to O.D.) away from sewer lines.

2.1.7 Valves

Small mains (12-inch and less). Full line size gate valves 12 inches and less in diameter shall be resilient seat gate valves. All gate valves shall be ductile-iron, epoxy coated and lined in accordance with AWWA C509.

Large mains (16-inch and greater). Full line size butterfly valves 16 inches in diameter and larger shall be epoxy lined and coated ductile-iron flanged butterfly valves. All butterfly valves shall be Class 150B in accordance with AWWA C504.

Valves shall be located on discharge side of pipe connections; minimum 3 at crosses, 2 at tees and always at beginning of dead end mains. City may require additional valving on critical sections or where proposed valving requires closing more than 3 valves to isolate a section of pipeline. Maximum spacing for mainline valves shall not exceed 2000 feet or as directed by the City.

Isolation valves shall be flanged to the tee or cross within the street intersection. All isolation valves shall be direct buried (no vaults are required).

2.1.8 Backflow Prevention

Backflow prevention devices will not be required on the on-site recycled water facilities using recycled water. However, in accordance with the section on water backflow prevention in the City's Rules and Regulations, "backflow protection devices may be required of the developer's, owner's, or customer's potable water service."

2.1.9 Pressure Reducing Station

Where required by the City, pressure reducing station shall be individually designed specifically for each installation, subject to City review and approval of design and materials.

2.1.10 Corrosive Soil Design

Where pipelines are to be constructed in known or likely corrosive soil conditions, cathodic test stations shall be provided in accordance with City requirements and standards at the locations determined by the City. The City, at its option, may also require cathodic test stations for its transmission mains and major pipelines, regardless of existing soil conditions.

In order to determine whether or not unfavorable soil conditions exist, the City may request that soil boring samples and laboratory analysis be provided as part of the project. The analysis shall include an evaluation of PH, Redox, Sulfide, Resistivity and Sulfate.

Under certain circumstances, the City may require special pipe installation procedures or types of pipe, including special protective coatings for pipe and fittings.

All test stations shall be installed behind existing or proposed curbs to allow safe access for personnel during testing. Test boxes shall be from City approved manufacturers list. Test stations shall be installed at 1000 foot intervals or as directed by the City.

2.1.11 Service Installations

All services shall be constructed in accordance with the applicable City Standard Drawings. Services shall not be connected to 18-inch or larger mains unless specifically permitted by the City.

2.1.12 Blow-Offs

Appropriately sized blow-offs shall be located at all low points along the pipeline alignment and at all "dead end" locations. Additionally, for all pipelines 16-inches in diameter and greater, a blow-off shall be located on the upstream side of all mainline valves. All blow-offs shall be constructed to City Standards.

Blow-offs should be located as near to storm drain catch basins whenever possible. On arterial streets blow-offs are to be placed prior to the curb radius with service line perpendicular with mainline.

The size of the blow-off shall be based on the mainline pipe diameter as follows:

Main Size	Blow-Off Size
12-inch to 16-inch	4-inch
18-inch to 24-inch	6-inch
Greater than 24 inch	8-inch

2.1.13 Combination Air/Vacuum Release Valves

Appropriately sized air vacuum release valves shall be located at all high points along the pipeline alignment and at all "dead ends" that occur at a high point. Additionally, for all pipelines 16" in diameter and greater, an air vac valve shall be located on the downstream side of all mainline valves. On arterial streets air vac valves are to be placed prior to the curb radius with service line perpendicular with mainline. All air vac's shall be constructed per City Standards.

The size of the air vac's shall be based using the APCO APSLIDE Model or engineering calculations.

2.1.14 Temporary End of Line Appurtenances

A 4-inch blow off shall be installed at the end of each segment of pipeline that is installed for future use. If the section of pipe is installed creating a high point an air vac will also be required.

2.1.15 Tracer Wire

Tracer wire shall be installed on all PVC waterlines for the purpose of providing a continuous signal path used to determine pipe alignment after installation. Locator wire shall be brought to the surface at all appurtenances (i.e. fire hydrants, water services, air valves, blow-offs, etc.), thus providing continuous "looping" between the appurtenances and the water main.

2.1.16 Ductile Iron Fittings for PVC

All fittings for use with PVC C900 pipe shall be cast-iron outside diameter (C.I.O.D.) push-on or mechanical joint fittings with the exception of fittings with valves which shall be push-on or mechanical joint by flange. Ductile iron fittings shall be classified as "compact ductile iron fittings" and shall be produced in strict accordance with ANSI/AWWA A21.53/C153. Unless otherwise specified, the interior of the ductile iron fitting shall be lined with a uniform thickness of cement mortar "double thickness" then sealed with a bituminous coating in accordance with AWWA C104. The outside surfaces of the DIP fittings shall be coated with a bituminous coating in accordance with ANSI A21.6 or ANSI A21.51.

All ductile iron fittings shall be polyethylene encased at the time of installation. Polyethylene encasement and installation shall be accordance with ANSI/AWWA C105.

2.1.17 Restrained System

Restrained joints shall be utilized for thrust restraint on all pipelines per City Standards. The acceptable method of restraint for PVC would be Uni-flange or Mega-lug type restraints, field-lock gaskets or TR-Flex joints for DIP and welded joints for CML&CMC steel pipe.

All restraint devices shall have a water working pressure rating equivalent to the full rated pressure of the pipe on which they are installed, with a minimum 2:1 safety factor in any nominal pipe size. Restraining devices shall provide full (360 degree) support around the circumference of the pipe.

Length of pipe to be restrained on each side of bends, tees, reducers and other fittings shall be determined by the Private Engineer or manufacturer of the restraint device in accordance with City Standards.

2.2 On-site Recycled Water Facilities

2.2.1 General

Design of all on-site facilities including, but not limited to, landscape irrigation systems, agricultural irrigation systems, systems used for industrial process, construction purposes, or recreational impoundment systems shall conform to the provisions set forth herein and to any conditions, standards, and requirements set forth by the City in addition to these standard specifications.

2.2.2 Design of Recycled Water Facilities with Temporary Potable Water Service

Before design, the developer should obtain the following from the City:

- A. Approval to use recycled water for the proposed system, as stated in the previous section.
- B. Verification of locations and size of proposed points of connection (meter facilities).
- C. Design pressures for the proposed facilities.

Where recycled water is not immediately available for use when the design area is ready for construction, and if the City has determined that recycled water will be supplied in the future, the on-site facilities shall be designated to use recycled water. The on-site system shall be designed and constructed to the City's construction specifications as set forth herein. Provisions shall be made as directed by the City and these specifications followed to allow for connection to the recycled water facilities when they become available. In the interim, potable water will be supplied to the recycled water facilities through a temporary potable water connection. Until recycled water is available, potable water rates will be charged as set forth in the City of Ontario Municipal Code Title 6 Sanitation and Health, Chapter 8B Water Service.

A backflow prevention device acceptable to the Health Department and the City will be required as long as the on-site facilities area uses potable water. The backflow prevention device shall be downstream of the meter and a part of the on-site facilities. When recycled water becomes available, the backflow prevention device will be removed by the owner and the on-site facility reconnected to the meter.

2.2.3 Backflow Prevention Devices and Signage

Backflow prevention devices will not be required on the on-site recycled water facilities using recycled water. However, in accordance with the section on water backflow prevention in the City's Municipal Code Title 6 Sanitation and Health, Chapter 8B Water Service, backflow protection devices shall be required of the developer's, owner's, or customer's potable water service." All new common areas where recycled water is used and that are accessible to the

general public shall be posted with conspicuous signs that include the following wording in a size no less than 4 inches high by 8 inches wide: "RECYCLED WATER DO NOT DRINK "or "RECLAIMED WATER DO NOT DRINK ". Each sign shall also display an international symbol conveying the same warning.

2.2.4 Prohibitions and Limitations

Design of on-site recycled water facilities shall conform to the following:

- A. The recycled water system shall be separate and independent of any potable water system. Cross connections between potable water facilities and on-site recycled water facilities are prohibited.
- B. Hose bibs on recycled water facilities are prohibited.
- C. Drinking fountains shall be protected from the spray of recycled water in a manner approved by the City Engineer, prior to installation.
- D. Overspray and runoff shall be limited or prevented.
- E. Potable and recycled lines are not to be installed in the same trench.
- F. Recycled water shall not be used for any purpose other than the approved uses as set forth herein.
- G. The system shall be designed to irrigate the design area within the allowable time periods as set forth herein.
- H. On-site looped meters are prohibited.

2.2.5 Control of Runoff and Application Areas

The City encourages new and innovative methods of irrigation. The use of drip or subsurface irrigation may prove effective in the reduction of total water consumption and control of unnecessary runoff by containment of the water to the design area.

In accordance with the requirements of the City's Rules and Regulations for control of runoff and for control of the areas to which recycled water is applied, the design of irrigation systems shall conform to the following:

- A. The on-site recycled water facilities shall be designed to meet the peak moisture demand of all plant materials used within the design area. The use of moisture sensors is encouraged, but not mandatory.
- B. On-site recycled water facilities shall be designed to prevent discharge onto areas not under control of the customer. Part circle sprinklers shall be used adjacent to roadways and property lines to confine the discharge from sprinklers to the design area.
- C. The design of the on-site recycled water irrigation facilities shall provide for watering during the periods of minimal use of the service area. This is typically between the hours of 9 p.m. and 6 a.m., or as directed by the City Engineer. Consideration shall be given to allow a maximum dry out time before the design area will be used by the public.
- D. The total time required to irrigate the design area shall not exceed 9 hours in any 24-hour period. Irrigation systems shall be designed to operate within this time requirement.

- E. Recycled water shall be applied at a rate that does not exceed the infiltration rate of the soil. Where varying soil types are present, the design of the recycled water facilities shall be compatible with the lowest infiltration rate present. Copies of the developer's soils test reports shall be made available to the City upon request.

2.2.6 Minimum Depth to Top of On-Site Recycled Water Piping

For on-site recycled water piping, the minimum depth from finished grade to top of pipe (minimum cover) shall be as follows:

- A. Constant pressure lines 3 inches and larger: 24"
- B. Constant pressure lines 2-1/2 inches and smaller: 18"
- C. Intermittent pressure lines: 12"

Where piping is under paved areas, these dimensions shall be considered below subgrade.

2.2.7 Data Required on Plans

- A. Meter Data - The following information shall be supplied for each recycled water meter desired; information is to be provided and shown at each meter location.
 - 1. The meter location and size (inches); meter address.
 - 2. The peak flow through the meter (gpm).
 - 3. The (static) design pressure at the meter (psi).
 - 4. The total area served through the irrigation meter in square feet or acres.
 - 5. An estimate of the yearly water requirement through the meter (acre-feet).
- B. Drinking Fountains – Exterior drinking fountains must be shown and called out on the recycled water system plans. If no exterior drinking fountains are present in the design area, it must be specifically stated on the plans that none exist. The potable water line supplying the drinking fountain must have a warning tape installed as provided in Section 5.10.8 herein and shall be so stated on the plans. Drinking fountains must be protected from the direct spray of recycled water either by proper placement of the drinking fountain within the design area or the use of a covered fountain approved for this purpose.
- C. Irrigation Equipment Legend – For irrigation systems, a legend showing the pertinent data for the materials used in the system shall be recorded on the plans. The legend shall include a pipe schedule listing pipe sizes and materials of construction, a listing of valve types including quick-coupling valves, and the following information for each type of sprinkler head:
 - 1. Manufacturer and model number.
 - 2. Sprinkler radius (feet).
 - 3. Operating pressure (psi).
 - 4. Flow (gpm).
 - 5. Sprinkler pattern

3.0 Sewer System Design Criteria

3.1 General

Sewer system improvements proposed for inclusion into the City's shall be designed in accordance with the criteria set forth herein, unless otherwise approved in writing by the City.

The design shall take into consideration physical conditions known to exist at the time and place of each installation and the probable operating requirements. Where such conditions render sections of these Specifications inapplicable, alternate methods of design may be submitted to the City, and upon approval thereof, may be incorporated in the Plan.

3.2 Unit Flow Factors

System design criteria and flow factors shall be in accordance with the City of Ontario Public Works Agency Report "SEWER SYSTEM DESIGN GUIDELINES FOR THE PREPARATION AND REVIEW OF SEWER ANALYSIS FOR NEW DEVELOPMENTS IN THE CITY OF ONTARIO UPDATED DECEMBER 27, 2005"

3.3 Locations of Mains

In local residential and industrial streets, sewer mains are to be located six (6) feet from the centerline of the street in the center of the driving lane. In major, primary, and secondary highways, the sewer mains will be located in the center of the driving lane nearest to the center of the street, but will not be located in the median strip or parking lanes. On curved streets, sewer mains shall be parallel with the centerline of the street by use of horizontal curves for the alignment, unless approved by the City Engineer.

Horizontal curves are allowed on all pipe sizes 8" and larger, but are not encouraged except where necessary to maintain the required clearance from water pipelines. The minimum curve radius for sewers shall conform to the manufacturer's minimum recommendations. No reverse curves shall be allowed between manholes. No vertical curves shall be allowed.

Sewer main lines shall have a minimum cover over pipe which should be sufficient to service adjacent property by gravity, and cover shall not be less than 7.5' to finish grade of street, unless otherwise approved by City. In addition, sewer mains must be sufficiently deep in subdivisions to allow water lines to be set with 4' min. cover without interference from sewer laterals.

Sewer installation shall provide a minimum clearance of 50 feet from all potable, non-potable, and water quality monitoring wells.

3.4 Pipe Sizing

The standard sewer mainlines sizes allowed in the City shall be 8-inch, 10-inch, 12-inch, 15-inch, 18-inch, 21-inch, 24-inch, and 27-inch in diameter.

3.5 Pipe Material

Per the Sewer Pipeline Material Specification and Approved Material List.

3.6 Manholes

Manholes are required at the end of each line, change in grade or size, change in alignment or intersection of two or more sewer mains. Manholes shall be spaced at a maximum distance of 350-feet, unless otherwise approved by City. Manholes shall be located at or near all BC's, EC's, PRC's and PCC's on curved sewers. Distance noted between manholes shall be measured to manhole centerlines.

Minimum 48-inch ID manhole shall be required for sewers with a diameter of 18-inch or less and/or at a depth of 12-feet or less. A 30-inch frame and cover shall be used on a 48-inch manhole. Minimum 60-inch ID manholes shall be required for sewers with a diameter of 20-inch or larger and/or deeper than 12-feet. A 36-inch frame and cover shall be used on a 60-inch manhole. Minimum 72-inch ID manhole shall be required for sewers with a diameter of 30-inches. A 36-inch frame and cover shall be used on a 72-inch manhole.

Manholes shall have 0.2-feet of elevation differential through the manhole on straight runs and at angles. Pipe flow line elevations at inlet and outlet of manhole as well as centerline manhole stationing shall be shown on plans. Unless otherwise approved by the City, junction manholes shall have the crowns (soffits) of the intersecting pipes at the same elevation where their projections intersect the manhole centerline.

Drop manholes may be utilized only upon prior approval by the City. Drops shall not be less than 3 feet ("Steep" slopes from the first manhole upstream are preferred to drop manholes). Manholes shall not be buried except where approved by City. Manholes shall be raised above ground level where necessary to maintain them in farmed areas and in waterways.

Manholes may be required on laterals 8-inch or larger at the point of connection to the mainline and at the property line. A monitoring manhole can be used for the manhole at the property line.

Manholes located outside of the pave area shall be installed with the frame and cover .1-foot above finish grade with a 3-foot concrete collar. Manholes located in landscape area and in fields shall be installed 18-inches above finish grade.

3.7 Cleanouts

The use of cleanouts is not permitted except on laterals at the property line.

3.8 Laterals

Minimum 4-inch lateral shall be required for single family residences. Minimum 6-inch lateral shall be required for multi-family dwellings, commercial and industrial use. Lateral shall be constructed of same material as main line.

House Connection Laterals at 2% slope, utilizing 45° connection at main.

3.9 Bedding

Minimum requirements per City Standard Drawings No. 2104 and No. 2105

3.10 Backflow Valves

Backflow valves shall be required in accordance with the Uniform Plumbing Code, Latest Edition.

Backflow valves shall be installed at shallowest location allowing access for future inspection and maintenance. Where backflow valves are required, they shall be installed on private property by the property owner or tract developer and are to be maintained by property owner.

3.11 Industrial Waste Provisions

The developers of all commercial/industrial projects shall provide the City with detailed information concerning the project's expected wastewater quality and quantity. The City will review this information and determine which of the following facilities are required.

1. Building sewer sampler.
2. Wastewater flow monitoring station.
3. Gravity separator.
4. Industrial waste clarifier.
5. Pretreatment facilities.

4.0 Material Specifications–Water Pipeline

4.1 General

All pipe and fittings delivered to the job site shall be clearly marked to identify the manufacturer's name, material, class, and thickness. All material shall be new and free of blemishes. Acceptance of pipe and accessories by the City will be based on load bearing tests, and inspection of the complete products as specified hereinafter. Acceptance of installed piping will be based on inspection and leakage tests as specified hereinafter.

4.1.1 Piping Schedule

Unless noted otherwise on the plans or in the specifications, pipe shall be furnished in accord with the following materials schedule.

Piping Schedule			
Diameter	Domestic Water		Recycle Water
	OMC	NMC	
2-inch and smaller	Copper	PE Tubing	PE Tubing w/purple tape wrap or sleeve
8-inch & 12-inch	CML/CMC DIP	PVC C900	Purple PVC C900
16-inch	CML/CMC DIP	CML/CMC PVC C905	Purple PVC C905
18-inch to 42-inch	CML/CMC DIP	CML/CMC	CML/CMC w/purple warning tape
DIP – Ductile iron pipe CML/CMC – Cement Mortar lined and coated steel pipe PVC C900 – Polyvinyl Chloride pressure pipe			

4.1.2 Welded Steel Pipe, CML & CMC

Shop fabricated pipe with machine-applied lining and coating, dye-check shop welding performed after hydrostatic testing of cylinders, pipe per A.W.W.A. C200, steel plate per A.S.T.M. A-570, 10 ga. minimum, minimum yield 33,000 psi, cement mortar coating and lining per AWWA C-205. Design stress shall not exceed 16,500 psi. Each pipe section shall be provided, prior to delivery, with temporary plastic end covers, with exposed steel shopcoated, 40' maximum joint lengths, lap weld bell x plain end spigot, or rubber gasket bell x rubber gasket spigot, including rubber gaskets and gasket lubricant.

Cement used in mortar lining and coating shall be Portland Cement per ASTM C 150, Type V for coating and Type II or Type V for lining. Cement-mortar coating shall be reinforced in accordance with AWWA C205.

4.1.3 Welded Steel Fittings

All bends, reducers, increasers, tees, crosses, wyes, and other special fittings, except as specifically noted on the Drawings, shall be constructed of cement mortar lined steel pipe with coating as specified for balance of pipeline, and shall be shop fabricated in accordance with the latest revision of A.W.W.A. C208. (as modified below).

ELBOWS				
Angle	0-22 1/2°	22 1/2°-45°	45°-67 1/2°	67 1/2°-90°
No. Pieces	2	3	4	5

NOTE: At the break point angles (i.e. 22 1/2°, 45°, and 67 1/2°) use the elbow with the largest number of pieces.

All fittings shall have a steel cylinder thickness equal to or greater than the specified wall thickness of the pipeline, but not less than 10-gauge. The minimum radius for all bends shall not be less than 2.5 times the nominal diameter of the pipelines. Where simulated weld bells are used for lap-welded fittings, the bell plate thickness shall be 1/4". Fittings shall be designed and fabricated for a pressure which is 150 percent of the pressure class as designated for the pipeline, except where otherwise indicated.

Special fittings shall be fabricated from machine cement mortar lined and machine outside coated. The individual parts of the fittings shall be cut from the pipe, welded together, and the coating and lining of shop joints shall be hand applied to provide a finished cement mortar lined and finished outside coated joint comparable to the mechanically applied lining and coating detailed herein.

Special fittings and sections shall be reinforced with stiffener rings, collars, crotch plates, etc. as necessary to keep the maximum working stress to that level permitted for the pipe in accordance with AWWA M11 Steel Pipe Manual, Section 13.3.

Non-flanged joints shall be designed for lap-weld joints, and shall have bell ends for receiving the O.D. of the mating steel pipe cylinder.

Specials and fittings fabricated from cylinders that have been hydrostatically tested in accordance with these specifications shall be tested by the dye-check method, or approved equal, prior to the lining and coating of said material. Contractor shall submit fabrication drawings for all AWWA shop fabricated fittings to the City for approval prior to construction.

Butt Straps

Use two-piece rolled steel straps with a minimum thickness of ¼-inch and a minimum width of 10-inch. Straps shall be fabricated to snugly fit over the plain pipe ends, and shall be centered over the ends of the pipe sections to be joined. Weld one or more standard 5-inch, 3000 lb. threaded half-couplings to the butt strap. Provide a threaded billet steel plug for each half-coupling. Two hand-holes shall be required on pipelines 14-inch and larger.

4.1.4 Ductile Iron Water Pipe

Ductile iron pipe and fittings shall be manufactured per AWWA C110, C111, C115, C150, C151 and C153. The minimum wall thickness for ductile iron pipe shall be as specified in AWWA C150 for the design pressure class, and thickness Class 53 for flanged spools. Gray iron and cast iron fittings or flanges shall not be used.

Joints for ductile iron pipe and fittings shall be mechanical, flanged, or push-on in accordance with AWWA C110, C111 and C153. The joint dimension and gasket shall be as specified in AWWA C111. All pipe joints shall be bonded to provide electrical continuity for corrosion monitoring and future cathodic protection.

The standard restrained joints shall be of the type utilizing cast lugs, shop welded retainer lugs, retainer rings bearing against pipe shoulders, or retainer rings in pipe grooves. Where the restrained joint is of the grooved type, the wall thickness beneath the groove shall be equal to or greater than the minimum specified wall thickness. Retainer glands or uni-flange adapters utilizing setscrews bearing against the pipe wall are not acceptable.

The exterior surfaces of all pipe and fittings shall be factory coated with a minimum one 1-mil thick petroleum asphaltic material per AWWA C110 and C151. All pipe and fittings shall be cement-mortar lined in accordance with AWWA C104. Cement-mortar shall be in accordance with ASTM C150, Type II or Type V.

Ductile pipe and fittings shall be polyethylene encased in accordance with AWWA C105.

4.2 Polyvinyl Chloride (PVC) PIPE

PVC pressure pipe shall be manufactured per AWWA C900 and C905. C900 PVC pipe shall be used for mains and related appurtenances 12-inches or less in diameter. C905 PVC pipe shall be used for mains and related appurtenances 16-inches and greater. PVC pipe shall be provided in standard 20-foot lengths, unless otherwise detailed or required on the Approved Plans. The minimum length of PVC pipe sections used for tie-ins and stub-outs shall be 3 times the pipe diameter or 48-inches, whichever is longer, unless otherwise approved by the City.

PVC pipe shall have common profiles for inter-changeability between rough-barrel dimensions, couplings, ends, and elastomeric gaskets to facilitate future repairs. When assembled, the pipe shall have only one gasket per bell and spigot end, and/or two gaskets per coupling. These rubber rings (elastomeric gaskets) shall be manufactured to conform to the requirements of ASTM F-477 and furnished by the pipe manufacturer.

In areas where it is required to lay the pipe along a curve, the use of deflection couplings will be used to form the arc. The pipe shall not be bent to form the arc, nor shall the pipe be deflected within integral bells or ductile-iron fittings. Deflection couplings shall be limited to use only on 8-inch and 12-inch AWWA C900 PVC pipe. Unless otherwise approved by the City, PVC pipe shall be installed using 5° deflection couplings (2½° at each bell) to form arcs with radii no less than the minimums noted below:

Pipe Length Used Minimum Radius	
20-foot length	229-foot radius
10-foot length	115-foot radius

All pipe to be supplied under these specifications must have the following markings on the pipe barrel: Nominal size and O.D. base (for example, 8" C.I.O.D.); dimension ratio number; AWWA pressure class; and manufacturer's name or trademark and production record code. PVC pipe shall carry a current certification of the National Sanitation Foundation (NSF) as acceptable to use in the transport of potable water.

PVC pipe shall be installed within one year of its manufactured date. Pipe older than one year shall not be delivered to the construction site. The City shall require the manufacturer to submit a certificate stating that all pipe has been manufactured and tested in accordance with this specification.

4.2.1 Pipe Outlets 2 Inches and Smaller

Outlet connections to PVC water mains two (2) inches and smaller shall be bronze service saddles with double stainless steel straps designed specifically for C.I.O.D. PVC pipe. No single strap saddles or full circle saddles are allowed.

4.2.2 Pipe Outlets Larger Than 2 Inches

Outlets in PVC pipe larger than two (2) inches shall be accomplished through the use of ductile fittings.

For outlets to be installed after initial pipeline construction, a tapping tee may be used subject to advanced written approval by the City.

4.2.3 Ductile Iron Fittings for PVC

This specification covers ductile iron fittings for use with AWWA C900 polyvinyl chloride (PVC) pipe including tees, crosses, elbows, reducers, and related special fittings. Cast iron fittings are not permitted. All fittings for use with PVC C900 and C905 pipe shall be cast-iron outside diameter (C.I.O.D.) push-on or mechanical joint fittings with the exception of fittings with valves which shall be push-on or mechanical joint by flange. Ductile iron fittings shall be classified as "compact ductile iron fittings" and shall be produced in strict accordance with ANSI/AWWA A21.53/C153. Unless otherwise specified, the interior of the ductile iron fitting shall be lined with a uniform thickness of cement mortar "double thickness" then sealed with a bituminous coating in accordance with AWWA C104 (latest). The outside surfaces of the DIP fittings shall be coated with a bituminous coating in accordance with ANSI A21.6 or ANSI A21.51.

All ductile iron fittings shall be polyethylene encased at the time of installation. Polyethylene encasement and installation shall be accordance with ANSI/AWWA C105.

4.2.4 Restrained System

Restrained joints shall be provided by a clamping ring and an additional ring designed to seat on the bell end of the pipe. The rings shall be connected with T-Head bolts or rods. Restraining devices shall provide full (360 degree) support around the circumference of the pipe. No point loading shall be permitted.

Restraint of mechanical joint fittings shall be provided by a clamping ring installed on the PVC pipe and connected to the mechanical joint fitting with T-Head bolts or rods. All restraint devices for PVC pipe shall have a water working pressure rating equivalent to the full rated pressure of the PVC pipe on which they are installed, with a minimum 2:1 safety factor in any nominal pipe size. In addition, restraining devices shall meet or exceed requirements of UNI-Bell B-13

"Recommended Performance Specification for Joint Restraint Devices for Use with PVC Pipe." Restraining devices shall be approved by the City.

All buried steel parts shall be sand blasted in accordance with the coating manufacturer's technical data sheet for "submerged" service and coated with two-coat epoxy. Epoxy shall be Tnemec Series 66 or approved equal. All bolts and connecting hardware shall be of high strength low alloy material in accordance with ANSI/AWWA C111/A21.11. Buried steel parts shall be covered with grease and wrapped with polyethylene encasement.

4.2.5 Locator Wire

Locator wire shall be installed over all PVC waterlines, non-ferrous services and pipelines. Locator wire shall be 14-1 solid insulated copper wire (UF), in a continuous strand, placed on top of pipe and secured with tape. Locator wire shall be brought to the surface at all appurtenances (i.e. fire hydrants, water services, air valves, blowoffs, etc.), thus providing continuous "looping" between the appurtenances and the water main.

After all trench backfill operations are complete, the Contractor shall conduct the conductivity test to confirm that the wire is continuous. The Contractor shall be responsible for all costs to confirm, locate, and repair any breaks in the locator wire identified in the conductivity test. The Contractor is advised to use care in the installation and backfilling operations to prevent damage to the wire.

Splices shall be made at locations approved by the City. The wire connecting device shall be an underground electrical wire connector to splice and effectively moisture-seal the conductors. Wire connectors shall be approved by the City and shall be UL listed and CSA certified for direct burial splices.

4.2.6 Polyethylene Water Service Pipe (PVC Mains Only)

1-inch diameter polyethylene water service pipe shall conform to all applicable requirements of the latest revision of AWWA C901. Polyethylene water service pipe shall be iron pipe size and supplied by a City approved manufacturer.

The PE pipe or tubing shall be marked in accordance with ASTM D2239 for IPS pipe sizes. It shall also carry the seal of the National Sanitation Foundation (NSF). The PE pipe and tubing shall be rated for use with water at 73.4°F at a maximum working pressure of 200 psi, based on ASTM D2837.

For iron pipe sizes (IPS), the standard inside dimension ratio (SIDR) shall be SIDR 7 with the average inside diameter, minimum wall thickness and respective tolerances for any cross section as specified in ASTM D2239. The minimum burst pressure at 73.4°F determined in accordance with ASTM D1599 latest revision shall be 630 psi. The time of testing of each specimen shall be between 60 and 70 seconds. The PE pipe and tubing shall not fail, balloon, burst or weep as defined in ASTM D1598, latest revision, when tested in accordance with Section 7.6 of ASTM D2239.

4.3 A.W.W.A. GATE VALVES

All resilient seat gate valves shall meet the requirements of A.W.W.A. C509 (latest) for rubber seated gate valves and shall be tested bubble-tight. In addition, RS gate valves shall be furnished with low zinc bronze stems, stainless steel body hardware and valve body and bonnet

fusion bonded epoxy coated inside and out (10 mils nominal thickness) and meet all requirements of AWWA C550.

4.4 Rubber Seated Butterfly Valves

Butterfly valves shall conform to the latest revision of A.W.W.A. C504. Butterfly valves and operators shall be Class 150B, constructed for direct burial and have flanged ends to mate A.S.A. 150 lb. steel flanges.

Butterfly valves shall be furnished with operators of the traveling nut or worm gear type, self-locking in any position, and sealed, gasketed, and lubricated to withstand a submersion in water to 10 psi. The valve shall open by counter-clockwise rotation of a 2 inch square A.W.W.A. operating nut. The operator shall be capable of meeting the torque requirements for opening and closing the valve against 150 psi upstream and 0 psi downstream pressure and a maximum inlet-outlet flow rate of 12 FPS, normal flow rate of 6 FPS, and shall be provided with A.W.W.A. stops capable of absorbing up to 300 foot-pounds of input torque without damage to the valve or operator.

Butterfly valves shall have Buna N seat bonded or mechanically retained, without use of metal retainers or other devices located in the flow stream, to the body and have a disc seating edge of ni-crome or stainless steel. All internal mountings or working parts shall be stainless steel.

Butterfly valves shall have the shaft V-type self-adjusting packing. The shaft shall not be exposed between the valve body and the operator.

Butterfly valves shall have their internal and external surfaces (except flange faces, stainless steel and rubber surfaces) epoxy coated, to meet all requirements of A.W.W.A. C550. All butterfly valves shall be lined (holiday free) with a minimum of 10-mils (2,5-mil coats) of Keysite 750, (white); or DeVoe Bar-Rust No. 235 (white). The epoxy lining shall be applied at the valve manufacturer's plant in accordance with the coating manufacturer's application specifications.

4.5 COPPER TUBING (CML & DI Pipe)

Copper tubing shall conform to the requirements of the "Specifications for Seamless Copper Water Tube" (ASTM Designation B88) and shall be Type K. As required by the City, copper tubing shall be installed with a 6-mil (minimum) polyethylene sleeve "Polywrap C" by Northtown Company or City approved equal.

4.6 Red Brass Pipe

Brass pipe and fittings shall conform to the requirements of the "Specifications for Seamless Red Brass Pipe, Standard Sizes" (ASTM Designation B43). As required by the City, brass pipe shall be installed with a 6-mil (minimum) polyethylene sleeve "Polywrap C" by Northtown Company or City approved equal.

4.7 Protecto Wrap

For specified outside wrapped steel pipelines and/or where specifically directed by the City, outside pipe wrapping shall be Protecto Wrap No. 200, or 310 bituminous resin tape with No. 1170 primer.

4.8 Precast Concrete Vaults

All precast concrete manhole sections shall be manufactured in a plant especially designed for that purpose. All units will conform to the design shown on the drawings, and all work shall be conducted under strict plant controlled supervision.

Design loads shall consist of dead load, live load, impact, and in addition, loads due to water table, and any other loads which may be imposed upon the structure.

Live loads shall be for H-20 and/or H-20-S16 per AASHTO Standard Specifications for Highway Bridges with revisions. Design wheel load shall be 16 kips. The live load shall be that loading which produces the maximum shears and bending moments in the structure. All reinforcing steel shall be intermediate or hard grade billet steel conforming to ASTM A615/A706. Bars other than ¼-inch round, or smaller, shall be deformed in accordance with ASTM A305.

All vaults shall have a 2 piece torsion hinged cover specified for traffic loads where required. The effort necessary to lift the cover shall not exceed OSHA requirements. Also, cover shall be provided with a safety chain capable of limiting the travel of the cover. Precast sections shall be joined with a plastic joint sealing compound.

Vaults shall be located outside of sidewalk areas. The dimension from the top of the vault to the centerline of the piping within the vault shall not exceed 5-feet.

4.9 Fusion Bonded Epoxy Coating

Wherever fusion-bonded epoxy coating is specified on steel piping or equipment for potable water, the coating system shall consist of two or more coats of Scotchkote 306; Tnemec Series 104 or City approved equal. Minimum dry film thickness shall be 10-mils. Surface preparation shall be SSPC-10. Coating shall be in accordance with NSF-61. Method of application shall be either electrostatic method or heat fusion method.

Submit manufacturer's data sheets for review and approval, including: method of application; minimum and maximum DFT for prime, intermediate and finish coats; percent solids by volume; recommended surface preparation; application instructions and curing requirements; etc.

4.10 Test Cable and Bonding Cable

All test cable and bonding cable shall be stranded copper wire with insulation rated at 600 volts. Cable with cut or damaged insulation is not acceptable. All cable shall be of sufficient length to extend from the point of connection to the appropriate corrosion monitoring test box without splices. The cable shall have a 7/64-inch thick, high molecular weight polyethylene (HMW/PE) insulation specifically designed for cathodic protection service and suitable for direct burial in corrosive soil or water, conforming to ASTM D 1248, Type I, Class C, Category 5 (HMW/PE Type CP) Grade E-5 or J-1. Test cable shall have at least 18-inches of slack in the test box. Cable size shall be in accordance with the Standard Drawings.

4.11 Pipe Flange Insulating Kits

All pipe flange-insulating materials shall be of the type designated by the manufacturer as suitable for service at the operating temperatures and pressures of the pipeline. Insulating gaskets shall be full-face dielectric neoprene-faced phenolic. Insulating sleeves shall be full-length phenolic. Insulating washers shall be phenolic.

BRASS IDENTIFICATION TAGS

All wires terminating in CP Test Boxes shall be identified with brass tags securely attached to the wires with nylon fasteners. The tags shall be 1½-inch in diameter, 1/16-inch thick, and shall be die-stamped with identifying letters and numbers ¼-inch high.

4.12 Steel Flanges, Bolts, Nuts and Gaskets

Flanges for steel pipe shall conform to requirements for ASA 150-lb. flanges and flanged fittings or ASA 300-lb. flanges and flanged fittings, as noted on Drawings. All flanges shall be forged steel welding-neck or slip-on flanges. Dimensions and drilling of flanges for steel pipe shall conform to ASA 150 or 300, respectively, steel pipe flanges and flanged fittings, and all flanges shall be attached with bolt holes straddling vertical axis of pipe, unless otherwise shown on Drawings. Flanges and their attachment to pipe shall conform to applicable requirements of latest edition of API-ASME Code for Unfired Pressure Vessels. Welding-neck flanges shall be bored to same inside diameter as adjoining pipe.

Bolts shall be standard hexhead machine per ASTM A-307, Grade B. Nuts shall be hexagonal, cold pressed, semi-finished steel, per ASTM A-194, Class 2H. Studs with nuts on both ends shall be furnished wherever close clearances make removal and replacement of fixed head bolts difficult. Bolts and studs shall be of such lengths that not less than two or more than four threads shall project through nut when nut is drawn tight. All bolts, studs, or cap screws used in tapped holes shall be of sufficient length to provide an engagement of length of threaded portion of not less than nominal diameter of bolt for steel nor less than one and one-half times the diameter for cast iron fittings.

Unless stainless steel nuts and bolts are used, each steel/iron type fitting shall be equipped with at least one (1) sacrificial zinc anode cap. Said cap shall be "protecto-cap" or City approved equal.

Slip-on flanges shall be welded along the inner seam surrounding the pipe diameter as well as along the outside pipe and flange interface.

Gaskets for flanged joints shall be 1/16-inch thick compressed non-asbestos sheet, produced by a "City Approved Manufacturer". Flat-faced flanges shall be provided with full face gaskets with bolt holes pre-punched. Raised-face flanges shall be provided with ring gaskets.

5.0 Materials Specifications—Sewer Pipeline

5.1 General

Where alternate pipeline materials are allowed by the City, the Contractor shall select such materials and construction methods as will result in a satisfactory completed project. All pipe materials shall be new and unused unless otherwise specified. Materials and strength of pipe shall be as shown on the plans or as specified herein.

5.2 Gravity Mains

5.2.1 Vitrified Clay Pipe (VCP)

Vitrified clay pipe and fittings shall be extra strength Vittrified Clay Pipe (VCP) and shall conform to the requirements of ASTM C-700 "Specifications for Extra Strength Vittrified Clay Pipe), the "Green Book" 207-8, 208-2, and the requirement specified herein. Vittrified clay pipe shall be of the best quality, vittrified, homogeneous in structure, thoroughly burned throughout the entire thickness, free from cracks or other imperfections and must give a clear metallic ring when struck with a hammer.

All Vittrified Clay Pipe shall be subject to the Bearing Strength Tests and hydrostatic pressure tests described in ASTM C-301. The City may select at random and test one length of pipe for each 200 lengths of pipe (or fraction thereof) delivered to the project site.

5.2.2 Joints

Joints in vittrified clay pipe shall be made using a factory-made mechanical compression joint, consisting of a plastic material (Polyurethane), and shall be produced by a City Approved Manufacturer and shall conform with the requirements of Section 208.2.3 Type "G" Joints of the "Standard Specifications for Public Works Construction", Latest Edition.

5.2.3 Fittings

Vitrified Clay Pipe fittings shall include branches of every type and stoppers. These fittings shall conform to these specifications, ASTM C-301, and shall equal or exceed the pipe in quality. Branches shall be of the type called for on the plan and standard drawings and shall be securely and completely fastened to the barrel of the pipe in the process of manufacture. Stoppers shall be strong enough to sustain all applied earth and hydrostatic tests or air testing. Stoppers shall be capable, unbraced, of remaining in place when subjected an air pressure up to 5 psi.

5.2.4 Ductile Iron Pipe (DIP)

Ductile iron pipe shall comply with the provisions of Section 207-9 of the "Standard Specifications for Public Works Construction", Latest Edition. All pipe/fittings shall be coated inside and outside per ANSI Standard A21.6 - (latest edition) unless otherwise noted. Ductile iron pipe shall be compression (slip) joint, conforming with ANSI A21.11 and A21.51, latest, and have a standard thickness class (minimum CL 50) based on internal pressures and external loadings as supported by engineering calculations signed by a professional engineer registered in the State of California. All ductile iron pipe shall be provided with an 8 mil polyethylene

encasement for the entire length of the pipeline. The minimum bedding class shall be Class "C" per the City's specifications and standards.

Where restrained joints are required, ductile iron pipe/fittings shall be U.S. Pipe TR flex restrained joint or equal, conforming with ANSI A21.11 and A21.51, latest.

Unless otherwise specified, all ductile iron pipe shall be cement-mortar lined with a to the specifications of ASTM designation C150. The weight, class or nominal thickness, and casting period shall be shown on each pipe/fittings. The manufacturer's mark, the year in which the pipe/fitting was produced and the letters "DI" or "DUCTILE" shall be cast or stamped on the pipe.

5.3 Force Mains

Polyvinyl Chloride Plastic Pipe (PVC), (4" to 12" Dia.) The pipe to be used shall be rubber gasket joint polyvinyl chloride pressure pipe, Class 150, conforming to A.W.W.A. C900 (latest), outside dimensions of cast-iron pipe, plain end x gasket bell ends.

Fittings shall be cast iron A.N.S.I./A.W.W.A. C101(latest), 250 psi rated working pressure, cement mortar lining with Type 5 cement conforming to the specifications of ASTM designation C150, mechanical joint ends (MT) to fit Class 150 and 200 PVC C-900 pipe, flange ends (F) shall conform in dimensions and drilling to A.N.S.I. B16.1 for cast-iron flanges and flanged fittings for 125 lb.

The PVC force main pipe shall be accompanied with a reinforced detectable underground marking tape "Terra Tape Sentry Line 1350" or approved equal for use in the protection and location of the force main. Tape shall be green in color imprinted with the message "Caution Sewage Force Main Buried Below" and shall be installed approximately 12 inches above the pipeline.

5.4 Manholes

Precast concrete manhole components shall be in accordance with ASTM C 478 and the Standard Drawings. Manhole components shall be designed for H-20 highway wheel loading and specific site conditions. Manhole shafts shall be fabricated only from precast shaft sections, eccentric cone sections and grade rings.

Manhole bases may be either precast or cast-in-place, as appropriate for the application, with a formed recess shaped to match the first precast shaft section. The manhole base shall extend 9-inches below the bottom of the lowest pipe and 6-inches above the top of the largest pipe.

5.5 Manhole Frames and Covers

Manhole frames shall be 30-inch and 36-inch in diameter made of cast-iron in accordance with ASTM A 48, Class 30, the Standard Drawings and the Approved Materials List. Frames and covers shall be designed for H-20 highway wheel loading.

Castings shall be smooth, clean, and free from blisters, blowholes, and shrinkage. Mating surfaces of the frame and cover shall be machined to prevent movement of the lid. Frames and covers shall be match marked in sets before shipping to the site. Locking frames and covers may be required as determined by the City.

Covers shall have the words "City Of Ontario" and "SEWER" cast into the cover as appropriate to the application. No other lettering will be permitted on the top portion of the cover.

All castings shall be dipped twice in a preparation of asphalt or coal tar and oil applied at a temperature of not less than 143.3 degrees C (290 degrees F) nor more than 154.4 degrees C (310 degrees F) and in such a manner as to form a firm and tenacious coating.