ENGINEERING DESIGN STANDARDS

City of Fenton

Adopted by the City Council
March 24, 2008

Prepared by:

HUBBELL, ROTH & CLARK, INC.
Consulting Engineers
3399 East Grand River Avenue, Suite 102
Howell, MI 48843
517.552.9199 T - 517.552.6099 F
www.hrc-engr.com

City of Fenton
Engineering Design Standards

These Engineering Design Standards are intended to provide a reasonable basis for design of public and private improvements in the City of Fenton. They are not intended as a substitute for sound engineering judgment. The Standards may not apply to all conditions, and alternate solutions shall be permitted as approved by the City's Administration and/or Engineer.

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City of Fenton
Engineering Design Standards

1. GENERAL

1.1 Complete improvement plans bearing the seal of a licensed Professional Engineer, Surveyor or Architect licensed to practice in the State of Michigan shall be submitted prior to review and approval of any portion thereof.

1.2 A certified boundary survey of the site, prepared and sealed by a licensed Professional Engineer, Surveyor licensed to practice in the State of Michigan, or a copy of the completed plat shall be submitted with the engineering drawings.

1.3 Plans submitted shall be on 24" x 36" white prints having blue or black lines, and shall be neatly and accurately prepared.

1.4 For projects or subdivisions having more than one sheet of plans, a general plan having a scale of 1" = 100' shall be provided showing the overall project and indicating the size and general location of all improvements shown in the detailed plans.

1.5 Street names, street and easement widths, lot lines, lot dimensions, lot numbers and ownership shall be shown on all plans.

1.6 Elevations shall be on U.S.G.S. Datum. Two (2) permanent bench marks for the work shall be indicated on the plans.

1.7 Any areas that are considered to be "wetlands" as defined by the Michigan Department of Environmental Quality (MDEQ) shall be indicated on the plans. No improvements will be allowed in wetlands unless the MDEQ or City issues a permit, or a letter of "No Authority", for such improvements.

1.8 Finished grade shall be indicated for all structures.

1.9 The developer or their engineer shall be responsible for forwarding plans for approval to any private utility company (gas, electric, phone, cable, etc.) and any Federal, State or County (Drain Commission, Road Commission, etc.) agency whose facilities or rights-of-way may be affected by the proposed construction.

1.10 It shall be the owner's engineer and contractor's responsibility to verify the existence and location of all underground utilities.

1.11 All engineering construction plans shall contain the latest version of the applicable City of Fenton Standard Detail Sheets and the developer's/owner's company and contact name(s), address, phone number and fax number.

1.12 An Engineer's Opinion of Construction Cost must be supplied with the Site Plan submittal. This estimate will be used by the City to establish review and inspection fees for the improvements in accordance with the City Ordinance.

1.13 All sewer trenches under the 45 degree zone of influence line of existing or proposed pavements, bike paths, sidewalks or drive approaches shall be backfilled with sand compacted to at least 95% of maximum unit weight.

1.14 Utility crossings of paved roadways will be required to be bored. Open cutting of paved roadways will not be permitted.

1.15 An itemized quantity list will be required for all proposed utility improvements (water main, sanitary sewer, storm sewer).

1.16 The developer shall submit to the City two (2) sets of complete construction plans for review. Once the construction plans are approved the developer shall submit five (5) complete sets for distribution as follows; one (1) set to the City, one (1) set to the developer/owner and three (3) sets to the City Administration and/or Engineer.

1.17 Plan Review and Construction Process

The following is a general description of the engineering plan review and construction process for the City of Fenton.

Site Plan Reviews

The engineering consultant will review of the preliminary site plan including water supply, wastewater disposal, storm water management, wetlands, site grading, pavement improvements and right-of-way improvements. Review comments will be issued to the City Planning Commission for discussion at Planning Commission meetings. Once the Site Plan has been accepted by the Planning Commission, the Applicant will be required to submit engineering drawings and an updated itemized cost estimate of the proposed improvements so that an escrow account may be established for plan reviews and construction observation.

Engineering Plan Reviews

The engineering consultant will review of the engineering plans for conformance to City Engineering Design Standards. Once the plans are in an acceptable form, the plans will be issued as approved construction plans. The Applicant will be responsible to apply for all required County and State permits including soil erosion, water supply, wastewater disposal, right-of-way, wetlands, etc. Public water main and sanitary sewer improvements will require the submittal of plans and permit applications for review, approval, and forwarding to the governing agency by the City engineering consultant.

Pre-Construction Meeting

Once the approved engineering plans have been issued, a pre-construction meeting with the Applicant and/or their representative is required prior to the start of any site work. This meeting will verify that all relevant permits have been applied for, that the proper insurance is provided and to schedule construction observation. The owner's representative and underground contractor are

required to attend this meeting.

Site Construction and Observation

Once construction begins, the following construction observation is required:

- Roadways and parking lots including subgrade, aggregate base, curb and gutter, pavement installation, sidewalks and bike paths.
- Storm sewer installation and underground detention/retention systems.
- Water main installation and testing.
- Sanitary sewer installation and testing.
- Retaining wall installation.
- Additional miscellaneous construction observations may be required by the City.

Bond Inspections and Final Inspections

Once the proposed improvements have been completed, the Applicant shall request that the City perform a site inspection to establish bond amounts to complete the remaining site improvements for final acceptance by the City.

Record Drawing Plan Review

Record drawings describing the location and elevations of the proposed site improvements are required to be submitted for review and approval. See Section 9 of the City Engineering Design Standards for Record Drawing Requirements.

As part of the record drawing submittal, the applicant shall provide copies of any necessary easements (sanitary, storm, water, cross access, drainage, etc.) to the City for review. The City's Administration and/or Engineer will review these documents to verify the as installed utilities fall within the described easements. Upon acceptance of the easement sketch and description, the applicant will be required to submit these final documents along with properly executed easement cover sheets to the City so they can be recorded at Genesee County.

2. WATER MAIN

2.1 *General*

2.1.1 If the proposed improvements include the construction of public water main, the developer shall submit nine (9) sets of water main only plans with a completed MDEQ permit application. This information will be forwarded by the City's Administration and/or Engineer to the MDEQ for permitting.

2.1.2 All water system improvements shall be design in accordance with the current edition of "Recommended Standards for Water Works" (a/k/a Ten State Standards).

2.1.3 All testing of new water mains (Bac-T, pressure, etc.) shall comply with the lastest requirements of the American Water Works Association (AWWA).

2.1.4 Water mains in new developments shall be installed from boundary to boundary in abutting roads, on roads the project fronts, on interior streets and at other locations as may be deemed necessary by the City for future extensions.

2.2 *Design Requirements*

2.2.1 Eight inch (8") minimum diameter mains will be installed in single family residential areas.

2.2.2 Twelve (12) inch mains are considered to be the minimum size in commercial, office, industrial, and multiple family residential areas except in a looped system of 1,500 feet or less where eight (8) inch mains may be permitted.

2.2.3 Water mains are to be looped whenever possible. Interconnection to existing public water supply systems is encouraged.

2.2.4 Hydrant leads longer than 75 feet must be eight (8) inches.

2.2.5 No service leads are allowed to connect to a hydrant lead.

2.2.6 Profile view is required for 16" and larger water mains, and for other smaller sizes when determined necessary by the City.

2.2.7 Water mains shall be kept on one side of the street for the entire length of the street. Water mains shall not be located under pavement or under cul-de-sacs unless approved by the City's administration and/or Engineer.

2.2.8 Gate valves shall be spaced at a maximum of 800 feet intervals on distribution lines. They shall be spaced such that not more than four valves need to be turned off to isolate any section of the water main.

2.2.9 Sufficient valves shall be placed such that not more than 24 single family homes, 30 multiple family units or two (2) hydrants shall be out of service within a section of isolated water main.

2.2.10 Dead-end mains must end with a hydrant and a gate valve and box.

2.2.11 Gate valves should not be located under roadway pavement, bike paths, sidewalks or driveway approaches when possible, unless approved by the City's administration and/or Engineer.

2.2.12 All gate valves are required to be installed in a valve box.

2.2.13 In single family residential areas, hydrants shall be spaced along the water main a maximum of 600 feet. In no case shall a house be more than 350' from a hydrant. Commercial, industrial and multiple family spacing shall be a maximum of 350 feet.

2.2.14 Hydrants shall be located a minimum of 3 feet or a maximum of 8 feet behind the back of curb, unless approved by the City Administration and/or Engineer.

2.2.15 In commercial and industrial areas, the exterior of buildings shall be no further than 250 feet from a hydrant, measured along shortest feasible exterior route for laying hose. Hydrants shall be no closer than 2 times the height of the tallest part of the structure. There shall be a fire hydrant located within 150 feet of any building fire department connection.

2.2.16 Hydrants located in parking areas shall be protected with a six (6) inches (minimum) concrete curb or standard guard posts.

2.2.17 When connecting to an existing water main, a tapping sleeve, gate valve and box will be required unless connection to the existing main can be made without interrupting service on the main.

2.2.18 The plans shall indicate the finish grades of all hydrants and valve box.

2.2.19 Water mains shall be located so as to provide a minimum of ten (10) feet horizontal clearance between the nearest edge of the water main and the nearest edge of any sanitary or storm sewer.

2.2.20 A minimum vertical clearance of 18 inches shall be maintained between the top or bottom of any water main and the top or bottom of any sewer or utility. Vertical clearance of less than 18 inches will require concrete encasement of the sewer or utility.

2.2.21 Thrust blocks and restrained joints shall be used at all bends, tees, hydrant shoes, plugs and caps where necessary to prevent lateral movement of the water main.

2.2.22 A 6 gauge single strand copper tracer wire shall be installed along the

length of the water main. The tracing wire shall be accessible at all valve boxes and hydrants.

2.2.23 All public water main shall be centered within a minimum 12' wide easement, dedicated to the City of Fenton.

2.3 *Materials*

2.3.1 All water main 20" diameter and smaller shall be Ductile Iron pipe, Class 54. Two (2) brass wedges shall be used per joint.

2.3.2 City of Fenton standard valve is East Jordan Iron Works, series A, Left Hand Open. All valves shall be resilient seated and conform to AWWA C509 Standards.

2.3.3 Hydrants shall be East Jordan Iron Works 5-BR traffic model or Mueller Centurion A-423.

2.3.4 Restrained joints shall be Mega-Lug or Field-Lok gaskets.

2.4 *Installation*

2.4.1 All water main shall be installed with a minimum cover of five (5) feet below finish grade. When water mains must dip to pass under another utility, the sections which are deeper than normal shall be kept to a minimum length by the use of vertical bends, properly restrained.

2.4.2 The contractor will fill, disinfect and pressure test all new water main construction under the supervision of the City of Fenton and/or its agent.

2.4.3 Before any water main will be accepted by the City, it must pass bacteriological and pressure testing complying with the current specifications and procedures of the City.

2.4.4 Before any water main system will be accepted by the City, the fire hydrants must be painted in accordance with the hydrant paint schedule shown on the City's Standard Detail Sheet.

3. SANITARY SEWER

3.1 *General*

3.1.1 If the proposed improvements include the construction of public sanitary sewer, the developer shall submit nine (9) sets of sanitary sewer only plans with a completed Part 41 MDEQ permit application. This information will be forwarded by the City's Administration and/or Engineer to the MDEQ for permitting.

3.1.2 All sanitary sewer improvements shall be design in accordance with the current edition of "Recommended Standards for Wastewater Facilities" (a/k/a Ten State Standards).

3.1.3 A grease interceptor will be required for all food service operations. No connections for domestic waste will be allowed to the interceptor.

3.1.4 Downspouts, weep tile, footing drains, sump pump discharges, or any conduit, that carries storm or ground water shall not be allowed to discharge into a sanitary sewer.

3.1.5 Sanitary sewer mains in new developments shall be installed from boundary to boundary in abutting roads, on roads the project fronts, on interior streets and at other locations as may be deemed necessary by the City for future extensions.

3.2 *Design Requirements*

3.2.1 At all connections to the City 's Sanitary System or extension thereto, in the first manhole upstream from the connection, provide a water-tight bulkhead with a 1" diameter pipe through the bulkhead for measuring infiltration immediately upstream. Also a one foot sump at the base of the manhole shall be provided.

3.2.2 The minimum allowable size of a public sanitary sewer is 8" diameter.

3.2.3 The following table of minimum slopes for sanitary sewers shall be adhered to:

Size	Minimum Grade
8"	0.36%
10"	0.28%
12"	0.22%
15"	0.15%
18"	0.12%
21"	0.10%

3.2.4 The last upstream run of sewer must be at a grade of 1.00% or greater.

3.2.5 The minimum slope for 6" building leads is 1.00%.

3.2.6 Each building structure shall have a separate individual sanitary service lead connected to a public sanitary sewer.

3.2.7 Sanitary sewer manholes shall not exceed the spacing listed below:

Diameter of Sewer	Maximum Manhole Spacing
8” – 10”	300 feet
12" – 21”	350 feet
24" and larger	400 feet

3.2.8 Sanitary sewers must be placed in standard minimum 20 foot easements. The easement width may be increased depending on the proposed sewer depth, soil conditions or adjacent facilities.

3.2.9 Generally, sanitary sewers will not be approved in a rear lot easement.

3.2.10 The following information shall be indicated on the sanitary sewer profile:

a. Length of run between manholes.
b. Type, class, size and slope of pipe and leads.
c. Class of bedding.
d. Rim elevation of all manholes.
e. Existing and proposed ground elevation line above the route of the sewer.
f. A logical numbering system for manholes shall be included.
g. Invert elevations of all sewer at manholes.
h. Location and limits of sand backfill where required.
i. Location and elevations of crossings with other utilities.

3.2.11 Provide a minimum depth from top of curb (or road centerline if uncurbed) to the top of any sanitary sewer of 9 feet at locations where the sewer grade is parallel to the road grade. Under any design the sewer shall be deep enough to reasonably serve, by gravity, a standard depth basement.

3.2.12 Sanitary sewer shall be placed on the opposite side of the street from the water main, and shall have a horizontal separation of at least 10 feet.

3.2.13 External drop connections are required at manholes where the invert of the outlet pipe is 18 inches or more below the invert of the inlet pipe. Internal drop connections will not be allowed.

3.2.14 Where the applicant must extend the sanitary sewer from off-site, the proprietor shall extend sanitary sewer leads to the property line of all adjacent property on both sides of the right-of-way the entire length of the off-site sanitary sewer installation.

3.2.15 In new subdivisions, all service leads shall be sand backfilled and extended a minimum of ten (10) feet past the property line or to the easement line.

3.2.16 The plan and profile view of the proposed sanitary sewer shall generally

be shown on the same sheet.

3.2.17 Maximum flow velocity for pipe flowing full shall be maintained by matching the 0.80 of the diameter depth above invert for pipe size increases.

3.2.18 Provide a drop of 0.10 feet in the downstream sewer invert for a direction change of 30 degrees or greater to compensate for velocity head loss of the incoming flow.

3.2.19 Cleanouts shall be provided on sanitary leads every 90 feet and at all bends in the pipe. No more than 2 - 45 degree bends (or equivalent) shall be placed on a lead between cleanouts.

3.3 *Materials*

3.3.1 Service leads installed with the lateral sewer shall be a minimum of 6" in diameter and shall be Schedule 40 PVC or DR 26.

3.3.2 New sanitary sewer manholes must be water-tight and shall be pre-cast sections with modified grooved tongue joints with rubber gaskets, conforming to A.S.T.M. Designation, C-478. Also, a butel rubber coating around the casing and cone shall be provided for all new manholes as noted on the City's standard detail sheet.

3.3.3 Main line sewer shall be PVC Truss pipe, PVC Solidwall DR26, or RCP, C-76, Class IV or V, or approved equal.

3.4 *Installation*

3.4.1 Each end of a service lead shall be marked by setting a 2" square wooden stake vertically above the end of the lead.

3.4.2 The end of each service lead shall have water-tight and airtight stopper of compatible joint material and shall be adequately braced to withstand exfiltration and/or air test pressure.

3.4.3 When existing manholes are to be tapped, a hole of the appropriate diameter shall be core drilled through the wall of the manhole. A watertight fitting shall be used to connect the pipe into the manhole.

3.4.4 All sewers shall be subjected to infiltration, air or exfiltration tests, or a combination thereof, in accordance with the following requirements, prior to acceptance of the system by the City of Fenton and prior to removal of the bulkhead.

a. All sewers, where ground water level above the top of sewer is over seven (7) feet, shall be subjected to an infiltration test. The infiltration testing rate shall not exceed 100 gallons per inch diameter per mile of pipe per 24 hour period.

b. All sewers of 24" diameter or less, where the ground water level above the top of the sewer is seven (7) or less, shall be subjected to air tests or exfiltration tests. The exfiltration test shall be a four (4) minute test at 4 psi. The allowable loss in pressure shall not exceed 1 psi in the four (4) minutes.

3.4.5 A minimum of 30 days after installation and prior to the acceptance of new mainline sanitary sewer systems, a televised inspection of each section of the mainline shall be conducted from manhole to manhole. The video DVD and log of this inspection shall be submitted to the City's Administration and/or Engineer to document the current condition of the sanitary system at the time of the utility acceptance. The video DVD and log shall be consistent with the Standards of the City of Fenton.

4. STORM SEWER

4.1 *Design Requirements*

4.1.1 In no event will maximum design rate or volume of discharge exceed the maximum capacity of the downstream land, channel, pipe or watercourse to accommodate the flow. It is the applicant's obligation to meet this standard. Should a storm water system, as built, fail to comply, it is the applicant's responsibility to redesign, reconstruct, or make modifications at his/her expense to storm water management facilities. Such modifications or additional facilities will be subject to the City's review and approval.

4.1.2 Storm drainage systems shall be designed for a ten year rainfall intensity. The Rational Method for arriving at storm sewer runoff shall be used. An "n" value of 0.013 shall be used for concrete pipe and 0.009 for High Density Polyethylene (HDPE) pipe.

4.1.3 The formula for a ten (10) year rainfall intensity shall be equivalent to I = 175/(T+25) in which T is the time of concentration in minutes, and I is the rainfall intensity in inches per hour.

4.1.4 The initial T is generally 20 minutes for residential areas and 15 minutes for high runoff areas.

4.1.5 The consulting engineer shall use the following minimum values for "C", the runoff coefficient, in the "Rational Formula" of computing storm water flows (Q = CIA).

Impervious Hard Surfaces	C = 0.70
Gravel Surface	C = 0.50
Vegetated/Turf Surface	C = 0.20

Other values of the runoff coefficient may be used or required at the discretion of the City's Administration and/or Engineer for such areas as parks and open-spaces or unusual sites.

4.1.6 Sufficient capacity shall be provided in the storm sewer system to take fully developed upstream drainage into the system. When a storm sewer is designed to provide capacity for upstream areas, the hydraulic gradient shall remain in the pipe.

4.1.7 Storm sewer design calculations, including a drainage area map shall be submitted with the construction plans. The storm district map shall show all on-site and off-site drainage districts. The district limits must be over laid on a proposed grading plan for the site.

4.1.8 All storm sewers must be located in a public right-of-way or an easement. The minimum storm sewer easement shall be 12 feet wide. The easement size will vary as required for maintenance and access. Any storm sewer that accepts runoff from abutting property or public

right-of-way must be placed in a minimum 12 foot storm sewer easement.

4.1.9 If a storm sewer is designed to take on-site drainage only, the hydraulic gradient must be no higher than one (1) foot below ground. When the hydraulic gradient is above the top of the sewer pipe, the design elevation of the hydraulic gradient shall be indicated on the profile at each manhole.

4.1.10 Storm water detention is necessary for all developments in the City. See Section 5, Detention / Retention Facilities, for details.

4.1.11 Manholes shall be located as follows:

a. All changes in alignment
b. Points where the size of the sewer changes
c. Points where the grade of the sewer changes
d. The junction of sewer lines
e. Street intersections or other points where catch basins or inlets are to be connected.

4.1.12 Manhole spacing for storm sewers shall be as follows:

Diameter of Sewer	Maximum Manhole Spacing
12" - 15"	330 ft.
18" - 30"	350 ft.
36" & 42"	400 ft.
48"	450 ft.
54" & 60"	500 ft.
66" & larger	600 ft.

4.1.13 The minimum size of a public storm sewer is 12" diameter. 10" diameter pipe will be allowed for sewer lines that pick up footing drain or roof conductor drainage. No open covers will be permitted for a 10" diameter storm sewer.

4.1.14 Connection must be made at manholes, blind taps are not allowed.

4.1.15 The following information shall be indicated on the storm sewer profile:

a. Length of run between manholes.
b. Type, class, size and slope of pipe and leads.
c. Class of bedding.
d. Rim elevations of all manholes.
e. Existing and proposed ground elevations above the route of the sewer.
f. A logical numbering system for manholes shall be included.
g. Invert elevations of all sewers at manholes.
h. Locations and limits of sand backfill, where required.
i. Locations and elevations of crossing with other utilities.

4.1.16 The following table of minimum slopes for storm sewers shall be adhered to:

Size and Minimum Slope

10” @ 0.45%	36" @ 0.07%
12" @ 0.32%	42" @ 0.06%
15" @ 0.24%	48" @ 0.05%
18" @ 0.18%	54” @ 0.04%
21" @ 0.14%	60” @ 0.036%
24" @ 0.12%	66” @ 0.032%
27" @ 0.10%	72” @ 0.028%
30" @ 0.09%	

4.1.17 The minimum velocity may not be less than 2.5 feet per second in a pipe flowing full. The maximum velocity in storm sewers shall be ten (10) feet per second. The contents of a larger pipe will never be discharged into a smaller line even though the slope may be steeper for the smaller line. This principle does not apply, however, to a restricted opening or discharge.

4.1.18 Where possible provide a minimum of three (3) feet of cover from the top of curb (or road centerline) to the top of any storm sewer.

4.1.19 For subdivisions, storm sewers shall be located in the public road right-of-way or in easements adjacent to the public road right-of-way and shall be public sewer. Storm sewers shall not be located in rear yards except to pick up rear yard drainage or for sump pump discharge lines and they will be privately owned and maintained.

4.1.20 At all pavement catch basins and inlets, forty (40) lineal feet (twenty in each direction) of 6" edge drain shall be constructed at the back of curb line in each direction, backfilled with pea gravel.

4.1.21 No more than 1.0 acre of area shall be tributary to one standard catch basin. Catch basins may be placed side by side in order to provide for additional capacity.

4.1.22 A maximum of 900 feet of drainage is allowed from two (2) directions.

4.1.23 All new homes which required sump pumps must be constructed with a discharge lead to an underground pipe connected to an underground storm sewer or an approved alternate storm drain. The sump pump discharge lead shall be a minimum of four (4) inch diameter. The lead shall be constructed at a minimum 1.0% grade.

4.1.24 The minimum grade for swales shall be 1%.

4.1.25 The City encourages the use of Best Management Practices (BMPs). The use of such will be reviewed and approved on a site by site basis by the City's Administration and/or Engineer.

4.2 *Materials*

4.2.1 Allowable pipe material for storm sewers shall be:

a. C-76 reinforced concrete pipe conforming to Classes III, IV or V.

b. Perforated HDPE with smooth interior and annular exterior corrugation meeting requirements of ASTM F2306. Bedding and backfill shall be as shown on the Standard Detail Sheets.

4.2.2 Joints for storm sewer shall be tongue and groove premium joints with rubber gaskets.

4.2.3 All lead material shall be schedule 40 PVC or DR 26.

4.3 *Installation*

4.3.1 All RCP storm sewers shall be installed on Class II sand compacted to 95% of its maximum unit weight or better.

4.3.2 A pre-fabricated bar screen shall be installed on all storm sewers eighteen (18) inch in diameter and larger.

5. DETENTION / RETENTION FACILITIES

STORM WATER MANAGEMENT

5.1 *Applicability*

Residential, commercial, and industrial developments should provide two (2) stage storm water management facilities consisting of a sediment forebay and storage for the one hundred (100) year storm event. Commercial and industrial facilities must indicate what type of site precautions will be implemented to minimize the potential of contaminants entering the storm water management facilities.

5.2 *Sizing of Storm Water Management Facilities*

5.2.1 **General Criteria**

a. Storm water management facilities should be located in the low area of a site and set at least twenty-five (25) feet from any lakes, streams, wetlands, or watercourses. In addition, these facilities should not be located in any existing one hundred (100) year floodplains.

b. Composite runoff coefficients should be based on the values shown in the table below *Storm Water Management Facilities Composite Runoff Coefficients.*

Storm Water Management Facilities Composite Runoff Coefficients			
Type of Surface	**Runoff Coefficient**		
Water surfaces	1.00		
Roofs	0.95		
Asphalt or Concrete Pavements	0.95		
Gravel, Brick, or Macadam Surfaces	0.85		
Semi-Pervious; Lawns, Parks, Playgrounds	Slope <4%	Slope 4%-8%	Slope >8%
Hydrologic Soil Group A	0.15	0.20	0.25
Hydrologic Soil Group B	0.25	0.30	0.35
Hydrologic Soil Group C	0.30	0.35	0.40
Hydrologic Soil Group D	0.45	0.50	0.55

c. Clear maintenance access that supports heavy equipment should be provided to all sides of the basin.

d. Side slopes should be no steeper than one to five (1:5) unless a fence has been approved by the City of Fenton.

e. A minimum one (1) foot of freeboard must be provided above the detention basin design storm event. All building openings must be a minimum of 12” above the freeboard elevation.

5.2.2 **Sediment Forebay**. A sediment forebay should be provided at the inlet of all detention basins for energy dissipation and sediment deposition. The volume of the forebay should be at least five percent (5%) of the design storm event based on the inlet's tributary area.

5.2.3 **Detention Basin**. The detention basin should be sized to handle the first flush, bankfull and the design storm events.

a. The first flush is defined as the half (½) inch rain runoff across the entire site. The volume of first flush storage is determined as follows:

V = 1815*A*C where,
V = volume (cf)
A = acreage
C = composite runoff coefficient

b. The bankfull flood is defined as the one and a half (1.5) year, twenty-four (24) hour storm runoff across the entire site. The volume of the bankfull flood storage is determined as follows:

V = 8170*A*C where,
V = volume (cf)
A = acreage
C = composite runoff coefficient

c. The storage volume for each of these events is based on an allowable outflow of 0.15 cfs/acre and is determined in the table below *Detention Basin Storage Volume Designation*.

Detention Basin Storage Volume Designation

Frequency of Storm	Rainfall Intensity I (In/Hr)	Storage Time Equation T (Min)	Storage Volume Equation V_s (Ft^3 /Acre Impervious)
100 Year	$I_{100}=275/(T+25)$	$T_{100}=-25+(10{,}312.5/Q_0)^{1/2}$	$V_{s100}=(16{,}500T/T+25)-40Q_0T$

Note: Equations from Detention Basin Design Formulas for Oakland County, Michigan, Orifice Outlet Formulas dated January 1, 1990.

d. Extended detention basins and wet detention basins are preferable over dry basins. Retention ponds are discouraged throughout the community.

e. Extended detention basins should incorporate the following design components:

1) Lower stage that functions as a shallow marsh or wetland, has an average water depth of six to twelve (6 – 12) inches, and is designed to treat and store the first flush volume.

2) Upper stage that is sized to handle the design storm event and is graded to remain dry except during large storms.

f. Wet detention basins should incorporate the following design components:

1) Minimum three (3) feet permanent pool of water.
2) Minimum length to width ratio of three to one (3:1).
3) Native vegetation fringe around at least fifty percent (50%) of the perimeter.

5.2.4 **Underground Storm Water Treatment Systems.** Any underground storm water treatment systems should meet a minimum eighty percent (80%) Total Suspended Solids (TSS) removal and eighty percent (80%) Oil/Grease removal criteria. Field data verifying removal efficiencies should be provided to the City of Fenton for review and approval.

a. Data and calculations supplied to the manufacturer should also be provided to the City.
b. Data and sizing results from manufacturer should also be provided to the City.
c. These systems must be inspected every six (6) months at a minimum to verify proper operation and identify any necessary maintenance.

5.2.5 **Outlet Structure**

a. The storm water inlets and the outlet should be located at opposite ends of the basin.
b. The outlet structure should be designed to release the first flush over a minimum of twenty-four (24) hours, the bankfull flood between thirty-six (36) and forty-eight (48) hours, and release the design storm event at no greater than 0.15 cfs/acre.
c. The rim of the overflow structure should be set at the elevation of the design storm event.
d. A non-erodible overland overflow should be provided 0.5 feet above the elevation of the design storm event.

5.3 ***Vegetation in Storm Water Management Facilities*****.** Native vegetation is encouraged for all storm water management facilities, including native grasses for the detention basin side slopes along with native wetland vegetation in the bottom of the basin. Detention basins should be stabilized as soon as practical to minimize soil erosion potential.

5.4 *Exceptions*

5.4.1 **Special Assessment Districts.** The design storm event requirement may be less for those developments that outlet storm water to a storm sewer that has been sized to handle the developed runoff from the site. At a minimum, those sites must still address storm water quality for the smaller storm events. These situations are site specific and the design storm requirement will be determined on a case-by-case basis.

5.5 *Plan Review*

5.5.1 **Site Plan**

a. Project location map.
b. Scale not less than 1" = 50'.
c. Proposed lot divisions and building footprints.
d. Proposed storm sewer system with rim and invert elevations.
e. Total drainage area and associated individual tributary drainage areas.
f. Runoff coefficients associated with each tributary area.
g. Storm water calculations.
h. Storage provided by one (1) foot elevation increments.
i. Proposed storm water management facilities (both plan and profile view).
j. Overflow detail.
k. Rip-rap detail.

5.5.2 **Grading Plan**

a. Existing site topography at minimum two (2) foot elevation contour.
b. Proposed elevations of storm sewer structures and storm water management facilities.
c. Existing watercourses, lakes, wetlands and any offsite drainage areas contributing flow to the development.
d. Permanent water elevation of any of the above.
e. Natural feature buffer areas as applicable.
f. Average GWT elevation in basin area.
g. Soil hydraulic conductivity from bottom of basin to five (5) feet below bottom of basin.

5.5.3 **As-Built Certification.** A detention basin as-built certification should be provided to the City of Fenton prior to final approval of the development. This certification should include the following items:

a. A plan view of the detention basin detailing the proposed and final as-built elevation contours. A few spot elevations should be provided on each side of the basin, the bottom of the basin, and along the emergency overflow area.
b. Detention basin design calculations along with corresponding volumes associated with the as-built elevations should be detailed on this plan. The proposed volume and the final as-built

volume should be indicated.

c. Final as-built invert elevations for all inlet pipes and all associated outlet structure elevations, riser pipe hole sizes, and number of holes should be included. Invert elevations of the final outlet pipe to the receiving stream should also be provided. The elevation of the final overflow structure should also be shown.

d. The side slopes should also be indicated on the detention basin plan on all sides of the basin and must meet minimum safety requirements.

e. This certification should be signed and sealed by a licensed professional engineer.

f. An agreement for the long-term operation and maintenance of the detention facility must be completed by the developer and submitted to the City prior to final acceptance of the record drawings. Standard maintenance forms can be secured from the City.

5.6 ***Maintenance Plans***. A maintenance plan that outlines tasks associated with maintenance of the storm water management facilities both during the construction process and once the property owner has assumed responsibility should be provided with the plans.

6. GRADING

6.1 *General*

6.1.1 A grading plan is required for all developments. Rear yard storm drainage systems are required for all residential projects.

6.1.2 The grading of the proposed development shall not create drainage problems, or make existing drainage problems worse, on adjacent property. If necessary, storm drains shall be extended to the adjacent property to alleviate drainage problems.

6.1.3 A building permit shall not be issued until a grading plan has been submitted to the City and approved by its Engineer.

6.2 *Design Requirements*

6.2.1 First floor and basement (where applicable) elevations for each proposed structure or building shall be shown on the plans.

6.2.2 The grades of existing adjacent houses, buildings, drainage structures and streets shall be shown. The actual surveyed grades of existing adjacent ground and yards shall be shown on a grid pattern up to a minimum of 100 feet from the property line. The drainage pattern of all adjacent existing land shall be indicated.

6.2.3 The grading plan shall be designed to insure that if a failure or overflow occurs within the storm system, water will drain away in overland swales without flooding houses.

6.2.4 Finish grade shall be compatible with the grades of surrounding existing houses, yards and with the existing ground at the proposed house.

6.2.5 All existing and proposed ground grades are to be in tenths of a foot.

6.2.6 Rear yard swales shall be no longer than 400 feet before being intercepted by a catch basin and shall have a minimum grade of 1.0%.

6.2.7 The proposed side yard swale elevation shall be shown between all houses. This elevation must be a minimum of 0.5 feet below the lower adjacent house grade. The side yard swale must have a minimum slope of 1.0% to the front or rear.

6.2.8 General direction of flow of the rear yard drainage and swales must be indicated with arrows.

6.2.9 The maximum allowable grade shall be 1 vertical to 4 horizontal.

6.2.10 The maximum driveway slope for non-single family sites is 8.0%. All driveway approaches shall not exceed 1.50% for a minimum distance of twenty-five (25) feet from the edge of the roadway. The slope of the driveway shall be labeled on the plans.

6.2.11 All proposed retaining wall designs will require review by the City Administration and/or Engineer on an individual basis.

7. PAVING

7.1 *General*

7.1.1 For roadways proposed in the City, the Genesee County Road Commission (GCRC) design standards for subdivisions will be utilized as the basis for the design unless modified in this section.

7.1.2 Private roads will only be allowed when the requirements of the City's Ordinance Section 2.23 are met.

7.1.3 Alternative paving designs may be submitted to the City for consideration. They will be reviewed by the City's Administration and/or Engineer and recommendation will be made to the City. Such alternative paving designs shall only be acceptable in those instances where the City finds that the proposed design will provide an acceptable level of serviceability, ease of maintenance and are consistent with other paving in similar areas elsewhere in the City.

7.1.4 For roads under the jurisdiction of Michigan Department of Transportation or GCRC, all improvements shall be designed to meet their requirements.

7.1.5 The requirement of acceleration, deceleration and passing lanes will be at the discretion of the City's Traffic Engineer.

7.2 *Design Requirements*

7.2.1 The minimum outside pavement radius of a residential cul-de-sac (back of curb) shall be fifty (50) feet. No islands are permitted in the center of the cul-de-sac. All right-of-way radii shall be sixty (60) feet minimum.

7.2.2 The minimum road widths within the City shall be as follows:

Residential Road with open ditch – 20' of bituminous pavement with 4' aggregate shoulders on both sides.
Residential Road with curb and gutter – 26' back of curb to back of curb.
Major/Industrial Road – 32' from back of curb to back of curb.

Open ditches will not be allowed on major/industrial roads.

7.2.3 A boulevard section may be allowed in an enlarged right-of-way. Pavement widths shall be at least twenty-four (24) feet for all boulevard streets (back of curb to back of curb). The distance from the property line to curb shall be sixteen (16) feet on boulevards. The minimum island width shall be ten (10) feet and maximum sixteen (16) feet. The nose of the boulevard island shall be set back at least twelve (12) feet from the edge of pavement of the intersecting street.

7.2.4 Vertical curves are necessary when a change in grade of 1.0% or more occurs. The minimum length of vertical curve shall be 100 feet.

7.2.5 The minimum pavement vertical grade for roadways shall be 0.40% when concrete curb and gutter is provided and 1.0% with open ditch. The maximum allowable grade on any roadway is 8.0%.

7.2.6 The maximum cross slope on a cul-de-sac is 3.0%.

7.2.7 All proposed roadways shall be profiled. The pavement profile view shall include:

a. Elevations at each station for the top of curb, or at centerline if not curbed.

b. Existing ground elevations at the center of the right-of-way, and 30 feet either side of the centerline.

c. Station and elevations of all high points, low points, grade-breaks and necessary information at vertical curves. Grades for vertical curves must be indicated at twenty-five (25) foot intervals.

d. The station and top of curb grade of all pavement catch basins and inlets.

7.2.8 The pavement radius at all intersections of all roads shall be a minimum twenty-five (25) feet. Industrial developments will require a minimum radius of thirty-five (35) feet.

7.2.9 Finish grade of all structures shall be indicated in the plan and profile views.

7.2.10 Parking lots shall have a minimum slope to catch basins of 1.0% for bituminous pavement and 0.40% for concrete pavement.

7.2.11 All sidewalk and sidewalk ramps shall meet MDOT ADA Standards.

7.2.12 The minimum pavement cross-section for roads in the City is; a residential road is four (4) inches of bituminous on twelve (12) inches of aggregate; a major road is six (6) inches of bituminous on twelve (12) inches of aggregate on twelve (12) inches Class II sand with edge drain.

7.2.13 The minimum parking lot pavement cross-section is four (4) inches of bituminous on eight (8) inches of aggregate, or six (6) inches of concrete on 6” of aggregate.

7.2.14 The minimum sidewalk cross-section is four (4) inches of concrete on four (4) inches of Class II sand. For areas of vehicular crossings it shall be thickened to 6” of concrete.

7.2.15 Industrial street cross-sections will be reviewed on a case-by-case basis.

7.3 *Materials*

7.3.1 Surface material for shoulders shall be 23A limestone.

7.3.2 The subgrade material for paved roads and parking lots shall be 21AA limestone.

7.3.3 The bituminous mix for parking lots and residential roads shall be MDOT 1500.

7.3.4 The bituminous mix for major roads shall be MDOT 4C for wearing course and 3C for leveling/base.

7.4 *Installation*

7.4.1 The installation of roads within the City shall require inspection by the City Administration and/or Engineer at the following stages:

a. After the sub grade has been rought cut to the plan elevation.

b. After the placement of the aggregate base.

c. Full-time during the placement of the bituminous pavement.

d. After all the required vegetation has been established.

e. Full-time during all work within the City right-of-way, including sidewalks, bike paths, and lane improvements.

8. SANITARY PUMP STATIONS

8.1 *General*

8.1.1 The Standards herein apply to all pumping stations that discharge sanitary flow to force mains, sewers, or interceptors that are owned, operated and/or maintained by City of Fenton.

8.1.2 In addition to the minimum required standards specified herein, the design and construction of all sanitary pumping stations within City of Fenton shall comply with the following additional requirements, codes and standards:

a. Michigan Department of Environmental Quality (MDEQ).

b. "Recommended Standards for Sewage Works" as prepared by the Great Lakes-Upper Mississippi River Board of State and Provincial Health and Environmental Managers, also commonly referred to as the "Ten States Standards."

c. Applicable State and Federal safety regulations including the Occupational Safety and Health Act (OSHA/MIOSHA).

d. Applicable Local, State and Federal electrical codes including the National Electrical Code (NEC).

e. Applicable Local, State and Federal building and plumbing codes.

8.1.3 All required permits (MDEQ, Building, Plumbing, Electrical, etc.) must be obtained from the City prior to the start of construction of any sanitary pump station.

8.2 *Design Requirements*

8.2.1 Location of Sanitary Pumping Stations

a. Sanitary pumping stations shall generally be located within a suitable easement or property dedicated or deeded to the City. The easement description or deed shall contain restrictions against the use or occupation of easements by the property owners and/or by other utilities in any manner which would restrict access, operation, maintenance, and/or repair of the pumping station.

b. Easements or property for pumping stations shall be of sufficient dimensions to accommodate the facility and its appurtenances, and to provide access for service vehicles.

c. Sanitary pumping stations should be located and sited logically to accommodate gravity sewer service while minimizing the depth of the wet well and minimizing the number of pumping stations required. Lower lying locations are often desired for this purpose; however, pump stations must be located so as not to be affected by the 100-year flood plain.

d. All pumping stations and outdoor control panels shall be accessible from a paved access driveway with sufficient parking area provided for two vehicles. The access driveway alignment shall be such that it is convenient for installing, removing and turning around of the City's equipment.

8.2.2 Pumping Station Sizing

a. Sanitary pumping stations shall be designed to serve all areas within the defined tributary area, anticipating full development of such areas, with due consideration given to topography, existing natural features, established zoning and the Master Land Use Plan.

b. For design purposes, population shall be based on a minimum of 3.5 persons per detached single-family dwelling unit, and 2.8 persons for each multiple-family dwelling unit. Submissions for review shall include a tabulation of occupancy (usage) types and the conversion of these into terms of equivalent single-family (or residential equivalency) units. The area of the site, in acres, may be used to calculate population and equivalent single family units based on density allowed in the Master Land Use Plan. Please note that these calculations may be shown on the sanitary sewer plans, in which case, only the overall population or residential equivalency units need be shown on the pumping station plans if submitted separately.

c. The average daily sanitary flow shall be based on 100 gallons per capita (person) per day (gpcd).

d. The pumping station shall have the capacity for pumping peak flows with the largest pump out of service. Peak flow is defined as the average daily flow multiplied by a peaking factor. The average and peak flows may be calculated as follows:

1) Q_{avg} (gpm) = Average Daily Flow = (Population) x (100 gpcd) / 1440

a) P_f = Peaking Factor = $\frac{18 + \sqrt{P}}{4 + \sqrt{P}}$ where,

b) P = Design population expressed in thousands

c) Q_{peak} (gpm) = Peak Flow = (Q_{avg}) x (P_f)

e. The pumping station must be capable of supplying the required system total dynamic head at the station design capacity. The total dynamic head (TDH) is defined as the total head due to the summation of the static elevation difference, frictional pipe losses, and minor (fitting and valve) losses.

1) Frictional pipe losses should be calculated using either the Hazen-Williams or the Darcy-Weisbach equations. When using the Hazen-Williams equation, the MDEQ will typically require that a pipe roughness coefficient ("C" value) of 100 be used for unlined pipe and 120 for lined pipe. The use of alternate higher C values, such as that for plastic pipe, must be approved by the MDEQ.

2) Minor fitting and valve losses may be calculated using the fitting and valve loss coefficient ("k" value) or equivalent pipe length method. Fitting and valve losses as well as equivalent lengths may be obtained from reference sources including the Hydraulic Institute Engineering Data Book, Cranes Technical Paper No. 410, Cameron Hydraulic Data, and other engineering references. Please note that entrance and exit losses must be included along with valve and fitting losses.

f. Wet wells shall be sized such that the operational volume allows a maximum filling time during average flow of not greater than 30 minutes. The minimum operational volume of the wet well shall be based on the maximum number of pump cycles (starts/stops) allowed by the pump or motor manufacturer per hour. The maximum number of pump cycles will occur when the influent sanitary flow is exactly half of the pumping capacity; therefore, the minimum wet well volume may be calculated by the following equation:

1) $V_{min} = (Q_p \times T) / 4$ Where,

a) V_{min} = Minimum Wet Well Volume (gallons)
b) Q_p = Pump Capacity (gpm)
c) T = Cycle Time (min) = 60 minutes / maximum # of pump starts

g. Wet wells shall be of sufficient size to permit not less than two (2) hours of storage at average station design flow above the high water alarm elevation prior to any basement or structures being flooded or wastewater overflowing from any structure.

8.2.3 Pumping Station Types

a. It is not the intention of these Standards to mandate any particular pumping station type(s) except as may be required based on special design circumstances, site conditions, or operating requirements. The City acknowledges the following pumping station types to be acceptable:

1) Conventional Wet Well/Dry Well Solids Handling
   a) Flooded Suction Vertical Centrifugal
   b) Self-Priming Suction Lift (excludes vacuum prime)
2) Wet Well Submersible Solids Handling
3) Dry Well Submersible Solids Handling
4) Simplex Grinder Pumps (Multiple connections, less than 80 gpm) for residential use only.
5) Simplex Grinder Pumps (Individual residential, less than 15 gpm) for residential use only.

The above pumping station types may be either of the built-in-place or prepackaged/ prefabricated type suitable for municipal sanitary applications.

b. Pumping station types other than those listed in Item 3.3 A. above should be discussed with the City and their Engineering Consultant prior to submittal of the construction plans.

c. Table 1 below provides a design matrix showing each of the pumping station types listed in Item 3.3 A. and the varying conditions under which each may be suitable. The design matrix is not all encompassing; therefore, other conditions not listed may further affect the suitability of the use of each station type.

Table 1 – Pumping Station Type Design Matrix

	Flows < 15 gpm	Flows 15-80 gpm	Flows 81-1,500 gpm	Flows > 1,500 gpm	Heads ≤ 90'	Heads > 90'	Wet Well Depths ≤ 40'	Wet Well Depths > 40'	Suction Lift[1]	Horsepower Req'd ≤ 150 hp[2]	Horsepower Req'd > 150 hp[3]	Troublesome Debris[4]
Wet Well/Dry Well												
Flooded Suction			X	X	X	X	X	X		X	X	
Suction Lift			X		X		X	X	X	X		
Submersible Dry Pit			X	X	X	X	X	X		X	X	
Wet Well Submersible			X	X	X		X			X		
Grinder - Centrifugal		X										X
Grinder - Residential	X											X

Notes:

1. Suction lift shall be limited to 18' maximum and shall based on the net positive suction head available (NPSHa).
2. Motors 150 hp and smaller shall be limited to 1,200 or 1,800 nominal rpm or less depending on motor size and motor manufacturer requirements. Motors 2 hp and smaller may be rated at 3,600 rpm nominal depending on application (i.e. Grinder Pumps).
3. Motors greater than 150 hp shall be limited to 1,200 nominal rpm or less.
4. Troublesome debris refers to that typically unsuitable for normal solids handling pump use.

8.2.4 Pumping Station Requirements – General

a. **Clearance –** Clearance around all equipment shall be adequate for easy maintenance and removal. Lifting hooks, eyes, or beams shall be furnished over major items of equipment to facilitate removal and installation. Clearances in front of electrical panels, equipment and devices shall conform to the requirements of the current National Electric Code.

b. **Corrosion Resistance** – All fasteners, pipe and cable supports, guide rails/cables, lifting chains, etc. located within the wet well shall be manufactured of Type 316 Stainless Steel. Safety landings or platforms located in wet wells shall be of stainless steel or fiberglass reinforced plastic (FRP) construction. Alternate corrosion resistant materials may be considered on a case by case basis depending on application.

c. **Dry Well/Valve Chamber Ventilation** – Dry wells, especially packaged below grade pumping stations, shall be provided with permanent forced ventilation. Valve chambers, such as those utilized with submersible stations, shall utilize either portable or

permanent forced ventilation depending on the size of the chamber. Forced ventilation shall be sized to provide 30 complete air changes per hour intermittent or at least 6 air changes per hour for continuous ventilation. Alternatively, permanent forced ventilation may be provided with a timer that allows high speed intermittent operation for 10 minutes and then low speed continuous operation for the duration of personnel occupancy.

d. **Emergency Pump Connection** – An emergency valved pump connection with minimum 4" diameter quick connect fittings shall be provided on the force main in or near the pumping station to facilitate the connection of emergency portable pumping equipment. The emergency connection shall be located downstream of any pump check and isolation valves preferably within the valve chamber or dry well, or terminating above grade with a lockable quick connect cap.

e. **Equipment Access** – Pumping stations shall be provided with suitable access openings sized to allow for the removal of pumps, piping, valves, and other equipment for maintenance.

f. **Firm Capacity** – Pumping stations shall be equipped with not less than two pumps with capacities such that the station can handle peak flows with the largest pump out of service.

g. **Hazardous Location Ventilation** – Those hazardous areas classified as Class I Division I (such as the wet well) requiring periodic personnel access for the inspection or maintenance of mechanical equipment shall be provided with permanent forced ventilation. (Ventilation is not required for submersible pump stations.) Forced ventilation shall be sized to provide a minimum of 30 complete air changes per hour for intermittent operation, or 12 complete air changes per hour for continuous operation.

h. **Odor Control** – Odor control systems may be required at those locations affected by high concentrations of hydrogen sulfide (H_2S) or other odor causing compounds in the sanitary stream. This requirement will be reviewed on a site-by-site basis and will take into consideration the proximity of the pumping station to adjacent residential or commercial establishments.

i. **Pumps Minimum Size** – On non-grinder pumping stations, each pump shall have minimum 4" diameter suction and discharge openings and shall be capable of passing a minimum 3" solid without clogging.

j. **Secondary Power** – All pumping stations shall be provided with a secondary or backup power source. This may be accomplished by any one of the following methods:

1) Onsite emergency natural gas, liquid petroleum gas, or diesel powered generator with automatic transfer switch. Diesel or liquid petroleum gas driven units shall only be provided when natural gas is not available at the site. Refer to Section 8.6 for generator requirements. In addition, a portable generator receptacle and manual transfer switch shall be provided per Section 8.3.11.b.

2) Onsite secondary engine driven pump driver with automatic starting and switch over controls.

8.3 *Materials*

8.3.1 General

a. The items, components, manufacturers, model numbers, etc., described in this section convey a minimum level of build, quality and performance. All pumping stations are required to meet the minimum requirements as described.

b. Where the words "or City approved alternate" are used, the item provided must meet or exceed the build, quality, performance, etc., of the manufacturers listed for that item. Where the words "or City approved alternate" are not used, requests for substituted manufacturers must be submitted to City of Fenton prior to submittal of the construction plans.

8.3.2 Warranties

a. General Components, Maintenance and Guaranty: two (2) years after final acceptance.

b. Major Components: two (2) years after final acceptance.

c. Pumps: two (2) years non-prorated; or five (5) years prorated.

d. Prepackaged Systems: two (2) years after final acceptance.

e. Engine Generator Set: Five (5) years, with biannual (twice-yearly) inspection and annual load bank test.

8.3.3 Operation and Maintenance Manuals

a. Shall include copies of all final approved shop drawings and the basis of design for the specific pump station constructed. Operation and Maintenance manuals will also need to be supplied. Two (2) copies of this information will need to be submitted to the City.

8.3.4 Pumps

a. **General**

1) Pump casings and volutes shall be of cast or ductile iron construction.

2) All pumps shall be provided with double mechanical seals of the flushless design where available depending on the pump type. Those pump types requiring seal water shall utilize municipal water provided through a reduced pressure backflow preventer installed above ground level and regulating system. Where no municipal water is available, a manually replenished hydropneumatic system may be provided. Acceptable brands of mechanical seals shall be J.F. Crane, Durametalic, or City approved alternate.

3) Unless otherwise specified herein, all pump shafts shall be of the heavy-duty type designed to minimize shaft deflection and constructed of Type 316 Stainless Steel or high-grade, high-strength alloy steel furnished with a replaceable corrosion and wear resistant stainless steel sleeve through the mechanical seal.

4) Where the pump design allows, pumps shall be provided with replaceable brass or stainless steel wear rings or wear plates on the impeller and/or volute to allow periodic adjustment of the impeller to maintain pumping efficiency.

5) Non-submersible, non-clog and chopper pump motors shall be of shielded drip proof or totally enclosed fan cooled construction, premium efficiency, 1.15 service factor, and with a nominal speed of not more than 1,800 rpm. Motors larger than 2 hp shall be suitable for operation on 240/480 volt, 3 phase, 60 Hz electrical service. Motors that are to be used with variable frequency drives shall be inverter-duty rated.

6) Submersible pump motors shall be rated explosion-proof and shall be provided with leak detection, winding overtemperature protection devices and associated motor protection relays.

7) Pump and motor bearings shall be of the ball type, oil or grease lubricated with an AFBMA minimum B-10 life of not less than 100,000 hours.

8) Prior to shipping, the pump manufacturer shall submit for review and approval, certified pump performance tests certifying actual pump performance. Upon installation in

the field but prior to acceptance by the City, installed pump performance shall be verified by the design engineer and witnessed by the City's Engineering Consultant.

b. **Flooded Suction Pumps** – Flooded suction pumps shall be of the vertical non-clog centrifugal, close-coupled type, complete with pump support frame and suction elbow with cleanout port. Flooded suction pumps used in locations that may be subject to accidental submergence or flooding shall utilize submersible type motors. Flooded suction pumps shall be as manufactured by Fairbanks-Morse, ITT A-C, Paco, or City approved alternate.

c. **Grinder Pumps**

1) Residential grinder pumps (<15 gpm) shall be of the semi-positive displacement, progressing-cavity type as manufactured by Environment-One, Crane, or City approved alternate.

2) Grinder pumps for larger, non-residential applications (15-80 gpm), shall be of the submersible centrifugal type as manufactured by ABS, Hydromatic, Crane, or City approved alternate.

d. **Submersible Pumps** – Submersible pumps shall be of the non-clog centrifugal, explosion-proof rated type and complete with sliding bracket, discharge base elbow, and pump removal system. Submersible pumps shall be as manufactured by ABS, KSB, Flygt, Fairbanks Morse, or City approved alternate.

e. **Suction Lift Pumps** – Suction lift pumps shall be of the self-priming centrifugal type with solids-handling impeller, removable cover plate and rotating assembly, shimless impeller adjustment, and V-belt drive. Suction lift pumps shall be as manufactured by Gorman-Rupp, ITT A-C, or City approved alternate.

8.3.5 Valves

a. **General**

1) Valves 3" and smaller shall be screwed or solder fitting type for brass valves, or Tru-Union type for PVC valves. Valves 4" and larger shall be flanged in conformance to ANSI B16.1 Class 125. Grooved end valve connections may be considered depending on application.

2) Isolation valves in contact with the sanitary flow shall be of the eccentric plug or resilient-wedge gate type.

b. **Air and Air/Vacuum Release Valves** – Sewage style air or air/vacuum release valves shall be provide at all high points in the system. Valves shall be cast or ductile iron body with stainless steel floats and trim and complete with flushing hose and attachments. Valves shall be as manufactured by Apco, Crispin Valve, Valmatic, or City approved alternate.

c. **Ball Valves** - Ball valves, for use on compressed air, seal water systems, or pressure gauge isolation, shall be of the two piece type with bronze body, brass trim, PTFE seat ring, threaded ends, lever operator, and adjustable packing gland. Valves shall be Watts Regulator Series B-6000, Crane Figure 9302, or City approved alternate.

d. **Check Valves**

1) Check valves 3" diameter and smaller shall be screwed, regrindable swing type, 200 lb. bronze, Hammond IB944, Jenkins Model 762C, Stockham Model B-345, or City approved alternate.

2) Check valves 4" and larger shall be of the swing type meeting or exceeding AWWA C-508, cast or ductile iron body, ductile iron disk, stainless steel shaft and trim, Buna-N disk seat, removable inspection/cleanout cover, and complete with lever arm and weight and adjustable air-cushioned cylinder. Check valves shall be Crispin Valve Series SWC, Golden Anderson Model 250-D, or City approved alternate.

e. **Gate Valves**

1) Gate valves 3" and smaller shall be of the bronze body type with screwed ends and solid wedge. Crane Model 428, Jenkins Model 47C, Stockham Model B 105, or City approved alternate.

2) Gate valves 4" and larger shall be of the resilient wedge type, ductile iron body, in conformance with AWWA C-509. Valves shall be U.S. Pipe Metroseal, American Flow Control, Mueller A-2360, M&H, or City approved alternate.

f. **Plug Valves** – Plug valves shall be of the non-lubricated quarter-turn eccentric type with cast iron body, cast iron plug completely encapsulated in Buna-N, permanently lubricated stainless steel upper and lower bearings, and multiple V-ring packing of Buna-N. Valves 4" and smaller shall be lever operated. Valves 6" and larger shall be handwheel gear operated. Plug Valves shall be as manufactured by DeZurik, Valmatic, Clow, or City approved alternate.

8.3.6 Piping & Fittings

a. All pump station piping (except sump pump, compressed air, or seal water piping) shall be Ductile Iron Class 53 (exposed) or Class 54 (buried) in conformance with ANSI A21.51, (AWWA C151). Ductile Iron Fittings shall be in conformance with ANSI A21.10 (AWWA C110). Ductile iron pipe and fittings shall have bituminous seal coated double thickness cement mortar internal lining with tapered ends in conformance with ANSI A21.4 (AWWA C104). Exterior coating for buried or submerged piping and fittings shall be two coats of coal-tar varnish, applied by the hot-dip method. Exterior surfaces of pipe and fittings installed above grade shall be epoxy coated.

b. Exposed ductile iron pipe shall be flanged or made with grooved pipe couplings. Flanges shall conform to ANSI B16.1 Class 125. Buried piping shall have Tyton style push on joints. Buried fittings shall have push-on or mechanical joints. Joints shall be restrained at bends, tees, dead ends, or other changes in direction using restrained fittings or thrust blocks. The method of pipe and fitting restraint shall be reviewed with the City's Engineering Consultant.

c. Force main piping shall be constructed of Ductile Iron Class 53 or 54 as specified or high density polyethylene (HDPE) pipe (subject to prior approval by the City). Where approved HDPE pipe shall be minimum SDR 11. HDPE pipe material shall meet with the latest ASTM D3350 with a cell classification of PE345464C, shall meet the manufacturing requirements of ASTM F714. Pipe sizes 4"-24" shall equivalent ductile iron pipe outside diameters. Fittings shall be butt (ASTM D326) or electrofusion (ASTM F1055) type, PE3408 HDPE, pressure ratings equal to or exceeding that of the pipe. Flanged and mechanical joint adapters shall be PE3408 HDPE and in conformance with ASTM D3216 with pressure rating equal to or exceeding that of the pipe. Mechanical restraint shall be in accordance with the pipe manufacturer's requirements.

d. Sump pump discharge piping shall be Schedule 10 type 304 stainless steel (prepackaged pump stations) inside the pump station and Schedule 40 PVC below grade. Unions shall be provided at all pump and valve locations to facilitate maintenance.

e. Compressed air and seal water piping shall be copper tubing in conformity with the current ASTM Designation B 88, "Seamless Copper Tube," Type K soft temper (buried), or Type K hard temper (exposed). Annealed tubes shall be used with flared joint fittings. Drawn temper tube shall be used with solder joint type

fittings. Flared joint fittings shall be brass SAE type.

8.3.7 Miscellaneous Mechanical

a. **Access Hatches** – Wet well and valve chamber access hatches shall be of the aluminum single or double door type as required per application and shall be gas tight. Access hatches shall have slam locks and a recessed padlock and hasp cover. Hatch hardware shall be stainless steel. Hatches shall be H-20 rated where required due to potential vehicle loading. At dry well or valve chamber locations, the hatches shall be of the drainable channel type with the drain outlet piped to the dry well or valve chamber sump. Consideration shall be given to the provision of secondary fall protection devices on hatches installed over a wet well. Access hatches shall be as manufactured by Bilco, Halliday, or City approved alternate.

b. **Backflow Preventers –** Backflow prevention shall be provided for any pumping station utilizing a municipal water based seal water system. The backflow preventer shall be of the reduced pressure principle type complete with isolation valves and shall be listed as an approved model by the local water supplier.

c. **Air Compressors** – Where required for bubbler level control or hydropneumatic based seal water systems, dual compressors of the oilless type shall be provided and mounted on a suitably sized ASME rated pressure tank. The compressors shall automatically alternate upon the completion of each cycle.

d. **Pressure Gauges** – Pressure gauges shall be provided upstream and downstream of each pump (downstream of each submersible pump) and downstream of a check valve (one required) to measure force main pressure. Gauges shall be 4", stainless steel case, ring, socket and movement, liquid filled, and range as appropriate. Gauges located on the discharge of submersible pumps shall be of the combination type (pressure and vacuum) to prevent gauge damage due to the suction created on pump shutdown. All gauges shall be mounted to a stainless steel gauge isolator with Buna-N diaphragm. The gauge shall be factory glycerin filled as a unit. The gauge shall be as furnished by Red Valve Series 742 with Ashcroft, Trerice, or Wika gauge. A shut-off valve shall be provided for the gauge so it can be isolated from the system when it is not in use.

e. **Sump Pumps** – Sump pumps shall be of the submersible centrifugal type, cast iron or bronze motor housing and casing, bronze or thermoplastic impeller, stainless steel shaft with upper and lower oil lubricated ball bearings, single or dual Type 21 mechanical seal, 1½" NPT discharge, thermal overload protection, ½ hp, 115/230 volt, single phase, 60 herts, 3,450 rpm. A single pump with automatic piggyback plug float switch shall

be provided in a minimum 18" diameter sump in small dry wells or valve chambers. Two pumps with automatic alternation controls shall be furnished in a minimum 18" x 30" rectangular sump for larger locations. Each sump discharge shall contain a minimum of two check valves upstream of the isolation valve. The sump discharge shall be piped to the wet well. Pumps shall be as manufactured by Hydromatic, Barnes, Myers, Goulds, or City approved alternate.

f. **Ventilation Fan** – Ventilation fans where utilized shall be of precision resin injection molded glass reinforced and corrosion-resistant construction. The fan shall be of the centrifugal, direct or belt drive type meeting minimum Class II construction. Fans used to ventilate the wet well or other hazardous location shall be non-sparking. Fan motors shall be totally enclosed fan cooled sized to be non-overloading. Fans shall be as manufactured by Duall, Hartzell, or City approved alternate.

8.3.8 Prefabricated/Prepackaged Pumping Stations

a. Prefabricated/prepackaged sanitary pumping stations shall be acceptable as provided by experienced manufacturers having not less than ten (10) years experience in the manufacture, assembly, and packaging of municipal sanitary pumping station experience. Prefabricated/prepackaged stations may be of the below grade or above grade type designed to meet all pumping capacity, electrical, instrumentation, control, and applicable structural loading requirements. Pumps, valves, piping, ancillary equipment, electrical systems and controls furnished as part of the pumping station shall meet all required City Engineering Design Standards.

b. Structural design for the prefabricated/prepackaged stations shall be sealed by a professional engineer registered in the State of Michigan. Above-grade building enclosures will be subject to review and approval by the City Building Department.

c. Packaged pumping stations shall meet all applicable NEC requirements and shall be UL listed.

d. Packaged pumping facilities located below grade shall be of steel or reinforced fiberglass construction, minimum 10' diameter with a steel access riser of not les than 3'-6" diameter. Safety landings shall be installed in accordance with OSHA requirements. Where elevator access is provided, a secondary access shall also be provided.

e. Below-grade or buried portions of steel structures shall be coal tar epoxy coated with a minimum dry-film thickness of 18 mils. Interior coatings shall be a two-coat epoxy paint system total minimum dry film thickness of 8 mils. Coatings shall be Tnemec,

Carboline, or City approved alternate. Below-grade steel structures shall be further protected against corrosion by an impressed current type cathodic protection system.

f. Acceptable prefabricated/prepackaged pump station manufacturers include, but may not be limited to, the following:

1) Dakota Pump
2) Gorman Rupp
3) Smith & Loveless – Stainless Steel
4) USEMCO

Manufacturers other than those listed above shall be required to receive prior approval from the City before submittal of the construction drawings.

g. Shop drawings for packaged pumping stations shall include all major equipment, components and devices, and shall include electrical and controls diagrams, plan and sections of the facility and other data as may be requested by the City's Engineering Consultant.

8.3.9 Packaged Residential Grinder Pumping Stations

a. Packaged residential grinder pump stations shall be furnished as a complete unit, including grinder pump, check valve, tank and all necessary controls packaged into a single unit, ready to connect.

b. The grinder pump basin shall be a tough, corrosion resistant tank of HDPE, sized on the basis of anticipated residential sanitary daily flow. The basin shall have an inlet grommet suitable for connection to a 4" or 6" PVC DWV sanitary lead. The pump discharge termination at the basin shall be 1¼" NPT female thread with appropriate adaptors for connection to 1¼" PVC or HDPE force main. The basin shall be provided with a concrete ballast, sized and installed per the station manufacturer's requirements, to resist buoyant forces and prevent flotation of the station during or following installation.

c. The internal check valve assembly within the grinder pump basin shall be constructed of glass filled PVC and of non-clogging design. A stainless steel cast or PVC Tru-Union ball isolation valve shall be provided within the basin just ahead of the pump discharge termination at the basin wall. A pump discharge quick-disconnect fitting shall also be furnished to facilitate pump removal from the basin.

d. Level controls shall be integral to the pump (core) or separately mounted floats or pressure switches. Activation levels shall include Pump Stop, Pump Start, and High Level Alarm.

e. The grinder station control panel shall be a separate wall mount unit with a NEMA 4X rated fiberglass enclosure with hinged access panel, padlockable latch, motor starter, circuit breakers, terminal and ground lugs. The control panel shall be furnished with visual and audible alarms, elapsed time meter, manual run and alarm silence pushbuttons, and dry contacts. The panel shall be available for connection to either 120 volt or 240 volt, single phase residential electrical service. The internal control voltage for all control devices shall be 24VDC. Any device connections or terminals with voltages greater than 50VAC/VDC shall either be wired to "finger-safe" terminals or have a lexan shield mounted on stand-offs, protecting the maintenance staff from accidental contact with live voltage. All terminal blocks within the enclosure shall be "finger-safe" and rated for 55 amps at 600 VAC/VDC and shall be manufactured by Allen-Bradley (1492-HM3) or approved equivalent.

f. Grinder pumps shall be of the semi-positive displacement, progressing cavity type as previously specified, with a 1 HP, 1725 rpm, high torque, capacitor start, thermally protected motor, 240 or 120 volt, 60 hertz, single phase. Pump discharge characteristics shall be 15 gpm at 0 psig, 11 gpm at 40 psig, and 9 gpm at 60 psig.

g. Each grinder pump station force main lead shall terminate at the right-of-way or utility easement with a bronze swing type check valve and stop box.

h. The entire packaged grinder pumping station shall be as manufactured by Environment-One, Crane Pumps and Systems, Zoeller Engineered Products, or City approved alternate.

8.3.10 Spares

a. Submersible pumping stations shall be provided with one (1) spare pump of each size complete with discharge hardware turned over to the City for storage.

b. One (1) mechanical seal for each pump size.

c. One (1) volute gasket for each pump size.

d. One (1) each air and oil filters for backup engine-driven power supplies or pump drivers.

8.3.11 Electrical & Controls

a. **Electrical Service** – Electrical service to the sanitary pumping station, except for residential grinder stations, shall be 480 volt, 3 phase, 60 hertz, three wire plus ground wherever possible.

Electrical service for lighting, receptacles, etc., shall be 120 volt, single phase, 60 hertz provided from a separate dry-type transformer.

b. **Emergency Generator Set**

1) All pumping stations shall be provided with a stand-by generator housed in a weather and vandal resistant enclosure or masonry building, designed to start and operate sufficient pumps to deliver the station design capacity in the event of utility power failure. Power shall transfer to the generator by means of an Automatic Transfer Switch. Each pumping station shall also be provided with a manual transfer switch and a generator receptacle to enable a portable generator to be substituted for the permanently installed generator in the event of problems occurring to the permanent generator.

2) See Section 8.6 for additional generator set requirements.

c. **Intrinsically Safe Wiring** – Intrinsically safe wiring shall not be run in the same raceway with non-intrinsically safe wiring. Physical separation and/or a suitable barrier shall be provided between intrinsically safe and non-intrinsically safe wiring. Intrinsically safe relays shall be used for connection to wet well mounted float switches.

d. **Junction Boxes & Seal-Off Fittings**

1) Junction boxes shall be provided where required to provide access to wiring and splices. Provide one box per pump and one or more boxes for float switches as required to limit conduit sizes to 1 ½".

2) Junction boxes and seal-off fittings (or suitable, protected vented raceway) shall be installed on conduit emanating from a hazardous location such as a wet well prior to entry into an enclosure or control panel. Junction boxes shall be rated as follows:

a) NEMA 7 for non-intrinsically safe wiring.

b) NEMA 4 cast or 4X stainless steel for intrinsically safe wiring.

e. **Level Control and Alarm Monitoring** – Level control and alarm monitoring shall be accomplished by one of the following methods:

1) Ultrasonic

2) Submersible Hydrostatic Level Transducer

f. The method of level control chosen shall utilize intrinsically safe systems suitable for use in hazardous locations. Furthermore, the level control method shall be designed so as not to be affected by grease build-up, foaming, or turbulence in the wet well. Float switches shall be used for back-up control and alarm, and shall be as specified under Section 8.

g. **Lighting**

1) Interior – Interior lighting shall be enclosed fluorescent or incandescent.

h. Exterior – Exterior lighting shall be HPS with photocell control.

i. **Panels and Enclosures**

1) Panels and/or enclosures located outdoor or in an unconditioned/unprotected space shall be rated NEMA 12 with a drip lip or gasketed NEMA 3R and constructed of stainless steel. A three-point door latching system with a padlockable handle shall be provided. Outdoor enclosures shall be provided with closable vents, stainless steel door hinges, an inner door in which to mount the operator interface devices and operator interface terminal, two 100 watt enclosure heaters with integral thermostat, door mounted programming port with GFI type convenience receptacle and switched interior lighting fixture.

2) Panels and enclosures located indoors or in conditioned/protected spaces shall be rated NEMA 12, constructed of steel with a powder-coated painting system.

j. **Wiring and Conduit**

1) Wiring shall be single conductor type THHN-THWN. Conduit shall be rigid heavy wall galvanized steel.

k. **Electrical Components**

1) Motor starters shall be of the combination motor circuit protector type (with ground fault protection for submersible pumps) and shall be NEMA size 1 minimum.

2) Pilot lights shall be NEMA 4/13, 30.5mm, push-to-test, full voltage, oil tight, heavy duty type with an LED lamp. All pilot lights shall have “finger-safe” guards on the terminals.

3) Push buttons and selector switches shall be NEMA 4/13, 30.5mm, oil tight, heavy duty type have 10 amp rated contacts. All push buttons and selector switches shall have “finger-safe” guards on the terminals.

4) Control relays shall have 10 amp contacts and 120 volt coils. Alternators and timers shall be as specified under Section 8.

5) All electrical equipment shall be manufactured by Allen-Bradley, Square D, Cutler Hammer or City approved alternate.

l. **Remote Alarm System**

1) An alarm dialer shall be provided at each pumping station, Raco Verbatim or other City approved alternate. Pumping station alarms shall be sent back to the City of Fenton Police Department and then to the DPW, with appropriate phone numbers and alarm messages programmed into the alarm dialer.

8.4 *Plan Requirements*

8.4.1 All construction plans for sanitary pumping stations shall be submitted to City of Fenton for review and approval. It is recommended that these plans be submitted concurrently with the sanitary collection system plans if applicable.

8.4.2 In addition to the plan requirements for the sanitary collection system, the sanitary pumping station construction plans shall contain, but not be limited to, the following information:

a. Cover Sheet or Site Plan to scale showing the location of the proposed pumping station and force main routing with respect to the tributary sanitary collection system.

b. Site Plan to scale showing the layout of the pumping station, adjacent onsite utilities, structures, parking, and site access.

c. Plan and profile of the force main showing size, length, type and class of pipe, including the locations of air relief or air/vacuum relief valves, cleanouts, and crossings.

d. Plan and sections to scale showing the dimensions, elevations, layout and arrangement of the wet well, dry well, access openings, risers, vents, and any ancillary structures, including equipment, piping, valve, fitting, and hatch locations. The wet well section shall include the pump operational levels including high and low alarm levels.

e. Direction, size, and invert elevation of all influent sanitary sewers and drain line connections to the wet well.

f. Dimensions from structures to property lines, right-of-way lines, or buildings.

g. Limits of special excavation and backfill requirements.

h. Location of existing or proposed utilities, building, or structures that may affect or impact construction of the pumping station, influent sewers, or force main in plan and profile views.

i. Design calculations for the system head requirements, pump capacity, total dynamic head, wet well sizing, emergency storage, and structure buoyancy. Calculations for the system head shall include static lift, friction losses and minor losses.

j. Electrical plan, including an electrical riser detail, electrical site plan, and appropriate electrical, instrumentation and control details. The electrical plan shall include main service breaker, service voltage, phase, and meter size, total connected horsepower, and total connected amperes.

k. Specifications for the pumps, piping, valves, miscellaneous mechanical equipment, structures, electrical controls, devices, wiring, telemetry equipment, emergency power equipment. Please note that accompanying specification books may also be provided for this purpose.

8.4.3 Detail Sheets

a. Detail sheets shall include specific and complete details for all pumping station appurtenances and structures to be included with the station construction and any special or unusual construction requirements.

b. Scales utilized for special details shall be selected to clearly portray intended construction and component or equipment arrangement. Scales used shall be clearly identified.

8.5 *Construction Standards*

8.5.1 Manhole Materials and Appurtenances – Manholes, materials & appurtenances shall meet the requirements established in Section 3.

8.5.2 Precast and Cast-In-Place Structures

a. Circular precast wet wells and valves chambers shall be in conformance with ASTM C478 or C-76 Class II with circular reinforcement.

b. Structure bases shall extend beyond the outside diameter of the riser section as required to offset the affects of buoyancy on the structure. The base shall be integral to the vertical riser section or installed separately and anchored to the vertical riser section using stainless steel brackets and fasteners.

c. Structures shall be founded on a minimum 3" thick mud mat or 6" angular stone on top of undisturbed soil with a minimum compressive strength of 3,000 psf. Unsuitable material shall be excavated and replaced with mud mat.

d. Top slabs shall be either precast or cast-in-place with reinforcing designed to withstand expected soil loads, overburden, and live traffic loads. Exposed surfaces of cast-in-place top slabs shall have a broomed appearance. Exposed surfaces of precast top slabs shall meet the finish appearance requirements of Precast Concrete Institute (PCI) C3.5.3 Grade B.

e. Cast-in-place structures shall utilize concrete with a minimum 28-day compressive strength of 3,500 psi. Steel reinforcement shall be new billet conforming to ASTM A615 Grade 60. Reinforcement steel for ties and stirrups may be new billet steel conforming to A615 Grade 40.

f. The exposed edges of all concrete structure shall receive a ¾" to 1" chamfer all around.

g. Contoured concrete fill used to form the contoured bottom of wet wells or sloped floors in dry well/valve chambers shall be concrete of 3,500 psi 28-day compressive strength reinforced with 1.5 lbs per cubic yard of polypropylene fibers 1½" long (Fibermesh or City approved alternate).

h. All structures shall be founded on undisturbed soil to reduce differential settlement between structures. Where structure are located within close proximity of each other to preclude founding one or more structures on undisturbed soil, the station designer shall utilize braced excavation, excavation with engineered stone or flowable fill, or combinations thereof so that differential settlement is minimized.

i. Backfill surrounding structures shall be MDOT Class II material compacted to 95% of maximum density at optimum moisture content.

8.5.3 Test for Alignment

a. All equipment shall be tested and adjusted for proper alignment.

8.6 *Generator Requirements*

8.6.1 Natural gas driven units are preferred. Diesel or liquid propane units may be supplied only where natural gas is not available.

8.6.2 The maximum voltage dip allowed when equipment is activated will be 20%. All data shall be supplied by company supplying unit. This data must confirm the engineering data supplied by project design firm.

8.6.3 Entire unit must come with a full 100% warranty for not less than five full years from date of acceptance. Parts and labor inclusive.

8.6.4 Only liquid cooled units are allowed. Each unit shall have a thermostatically operated block heater to maintain unit at starting temperatures. The critical ambient outside temperature shall be -20 degrees F.

8.6.5 The natural gas fuel system shall include all required components and accessories including but not limited to the following:

a. Primary and Secondary Regulators
b. Low Gas Pressure Switch
c. Solenoid Valve
d. Fuel Filter
e. Supply Line Flexible Connector

8.6.6 Propane and diesel driven units shall have a minimum (72) seventy-two hours of fuel storage capacity calculated at 50% load. Diesel units shall have a double-wall, steel storage tank. The tank shall meet MDEQ standards as well as any local codes and shall include a leak alarm sensor. Minimum tank size is 450 gallons with fuel level indicator. A screened, 2" outside fuel tank vent and an outside emergency vent shall be provided. The fuel tank shall have an outside 2" fill port with pad lockable spill containment.

8.6.7 To maintain environmental quality, the engine shall be equipped with suitable emission control equipment to meet, as a minimum, current Environmental Protection Agency specifications for stationary, industrial engines. Verification of the ability to meet these emission specifications shall be provided by the engine manufacturer.

8.6.8 Units shall be equipped with critical silencing mufflers. Battery charger shall be permanently mounted and hard wired into unit.

8.6.9 All louvers and shutters on generator air intake shall be mechanically operated, mounted on interior of building or enclosure. The exterior of building or enclosure shall be provided with fixed storm proof louvers with screens to prevent insects and bug infestation of room proper. These are to cover intake and exhaust louvers entirely.

8.6.10 A complete instrument package shall be provided on engine monitoring board. All engine monitoring gauges shall be affixed to main generator

unit or an adjacent wall within reach of unit. When available, gauges shall be supplied in lieu of lights. Minimum instrument package shall include: engine temp., water temp, engine RPM, gen hz., oil pressure, voltage of battery, exciter voltage and current, auto/man operator switch, panel lights, latching type unit, trouble lights with acknowledge switch. Field circuit breaker and all normal systems operations shall be monitored in such a fashion that they will protect unit from failure. Include overcrank, overspeed, and overrun circuitry for shut down.

8.6.11 Maximum RPM on engine shall not exceed 1800 RPM. Gear boxes to reduce engine/to/generator RPM are not acceptable under any circumstances.

8.6.12 Import units are acceptable only if a local distributor is available and that distributor has original equipment parts for entire unit in stock as well as factory authorized service and factory trained personnel on full time staff. Local distributor is defined as one in Greater Detroit Metropolitan area. Distributor must also provide 24 hour emergency service.

8.6.13 Four sets of parts and service manuals shall be supplied and turned over to City of Fenton before unit is to be accepted, in addition to warranty documents and as built drawings.

8.6.14 Load test will be conducted at developer's expense. This will consist of 3 hours at full load. Developer will supply manpower and all necessary fuels. This test shall be witnessed by a City of Fenton representative with not less than 72 hours notification to City authorized representative.

8.6.15 Diesel or propane tanks shall be turned over to City of Fenton full of fuel before final acceptance of facility will be given.

8.6.16 All generator units shall be mounted on skid rails with large vibration isolators.

8.6.17 Generator units shall be mounted no less than 16" above finished floor. Remainder of electrical equipment shall be mounted no less than 24" above finished floor to bottom of panel or any other electrical device. Adequate room shall be provided to service unit including the draining of oil pans. Oil pans on engines shall be provided with a drain plumbed to outside perimeter of unit where oil can be captured in a container.

8.6.18 Concrete floor beneath generator unit shall be 6 sack 3,500 psi concrete.

8.6.19 Unit-Mounted Radiator Cooling:

a. Duct work should be as short, straight, and as unobstructed as possible. Static pressure of more than ½ inch (1.27 cm) water column on the fan from inlet or exhaust restrictions will reduce air flow to the point of limiting maximum power and/or ambient temperature at which overheating will occur, and will not be allowed.

b. The connection from the radiator duct flange to the duct work shall be heavy canvas or similar flexible material to prevent noise and vibration transmission. In general, the outlet duct shall have an unrestricted area 150% greater than that enclosed by the radiator duct flange. The inlet opening shall be at least as large and preferably 50% larger than the outlet. If screens, louvers, or filters are used in the inlet or outlet openings, the openings shall be increased in size to compensate for restriction. In general, when louvers are used, increased by 50%; when insect screening is used, the opening area shall be increased by 80%; when furnace filters are used, the opening area shall be increased by 120%.

c. Air inlet and outlet locations shall be chosen to prevent air recirculation inside or outside the enclosure. Consideration should also be given to prevailing winds, facing inlets into the expected winds, and outlets on the down wind side where possible. Inlets and outlets shall be located where they will not be blocked by accumulated snow or any other obstruction. The bottom of any air intake or exhaust louvers shall be located not less than 16" above floor level to prevent snow intrusion.

d. Any temperature controlling louvers shall be designed so that inlet air is not restricted to the point that pressure inside the building is reduced. If the generator is installed within a building, the building design shall include removable wall/louver sections to allow for generator installation/removal.

8.6.20 It is the intent of this specification to secure an emergency generator system that has been prototype tested, factory built, production tested, site tested, of the latest commercial design, together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein. The equipment supplied and installed shall meet the requirements of the National Electric Code and all applicable local codes and regulations. All equipment shall be new, of current production by a national firm which manufactures the generator, controls, and transfer switch; and assembles the generator set as a matched unit. The intent of this requirement is to provide the owner with one-source responsibility for warranty, parts and service through a local representative with factory-trained service personnel. Generator sets shall be as manufactured by Kohler, Cummins, Caterpillar, or City approved alternate.

8.6.21 SUBMITTAL: Submittal shall include specification sheets showing all standard and optional accessories to be supplied, schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and other remote devices if included elsewhere in these specifications.

8.6.22 TESTING: To assure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer shall be responsible for design prototype tests as described herein: Components of the emergency system, such as the engine/generator set, transfer switch, and accessories shall not be subjected to prototype tests since the tests are potentially damaging. Rather, similar design prototypes which will not be sold, shall be used for these tests. Prototype test programs shall include the requirements of NFPA-110 and the following:

a. Maximum power (kw).

b. Maximum starting (kva) at 35% instantaneous voltage dip.

c. Alternator temperature rise by embedded thermocouple and by resistance method per NEMA MG1-22.40 and 16.40.

d. Governor speed regulation under steady-state and transient conditions.

e. Voltage regulation and generator transient response.

f. Fuel consumption at 1/4, ½, 3/4 and full load.

g. Harmonic analysis, voltage waveform deviation, and telephone influence factor.

h. Three-phase line-to-line short circuit test.

i. Cooling air flow.

j. Torsional analysis testing to verify that the generator set is free of harmful torsional stresses.

k. Endurance testing.

8.6.23 WARRANTY: The emergency generator system shall be warranted by the manufacturer for five years or 1,000 hours, whichever occurs first, from the date of the site start-up. Parts and labor included.

8.6.24 The standby generator set shall be rated continuous standby (defined as continuous for the duration of any power outage)___volts,___phase, wire, .8 power factor,___kw, ___kva,___amperes at 1,000 feet altitude, 104 degrees Fahrenheit. (Data required above shall be provided by the Developer.)

8.6.25 Final Production Tests: Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:

a. Single-step load pickup.

b. Transient and steady-state governing.

c. Safety shutdown device testing.

d. Voltage regulation.

e. Rated power.

f. Maximum power.

8.6.26 Upon request, arrangements to witness this test shall be made or a certified test record will be sent prior to shipment.

8.6.27 ENGINE: The_____cubic inch displacement engine shall deliver a minimum of ___hp at a governed speed of 1800 rpm. The engine shall be equipped with the following:

a. Fuel supply equipment as specified hereinbefore.

b. Isochronous governor capable of 0.25% steady-state frequency regulation.

c. 24 volt positive engagement solenoid shift-starting motor.

d. 35-ampere minimum automatic battery charging alternator with solid-state voltage regulation.

e. Positive displacement, full pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain.

f. Dry-type replaceable air cleaner elements.

Note: Engines requiring glow plugs will not be acceptable.

g. A unit-mounted radiator, blower fan, water pump, thermostat, and radiator duct flange (unhoused only) shall properly cool the engine with up to 0.5 inches water external static pressure on the cooling system.

8.6.28 GENERATOR

a. The alternator shall be salient-pole, reconnectable 10 lead, self-ventilated of drip-proof construction with amortisseur rotor windings, made from copper and skewed for smooth voltage waveform. The insulation material shall meet the NEMA standard (MGI-22.40 and 16.40) for Class H and be vacuum impregnated with epoxy varnish to be fungus resistant per MIL I-24092. Temperature rise of the rotor and starter shall be limited to NEMA Class F. The excitation system shall be of brushless construction controlled by a solid-state voltage regulator with adjustable Volts-per-Hertz operation capable of maintaining

voltage within + or -0.5% at any constant load from 0 to 100% or rating. The regulator shall be sealed from the environment and isolated from the load to prevent tracking when connected to SCR loads.

b. On application of any load up to the rated load, the instantaneous voltage dip shall not exceed 10% and shall recover to + or - 0.5% of rated voltage within one second.

c. The generator shall be capable of sustaining at least 250% of rated current for at least 10 seconds under a 3 phase symmetrical short by inherent design or by the addition of an optional current boost system.

d. The generator shall be capable of delivering __KVA, __kw with a maximum instantaneous voltage dip of 20% when loads are started as specified elsewhere or on the drawings.

e. A resettable line current sensing circuit breaker with inverse time versus current response shall be furnished and shall not automatically reset preventing restoration of voltage if maintenance is being performed. This breaker shall protect the generator from damage due to its own high current capability and shall not trip within the 10 second specified above to allow selective tripping of down-stream fuses or circuit breakers under a fault condition.

f. The generator, having a single maintenance-free bearing, shall be directly connected to the flywheel housing with a semiflexible coupling between the rotor and the flywheel.

8.6.29 CONTROLLER**:** Set-Mounted controller capable of facing right, left, or rear shall be vibration isolated on the generator enclosure. The microprocessor control board shall be moisture proof and capable of operation from -40°C to 85°C. Relays will only be acceptable in high current circuits. Circuitry shall be of plug-in design for quick replacement. Controller shall be equipped to accept a plug-in device capable of allowing maintenance personnel to test controller performance without operating the engine. The controller shall include:

a. Fused DC circuits.

b. Complete two-wire start/stop control which shall operate on closure of a remote contact.

c. A speed sensing system and a second independent starter motor disengagement system shall protect against the starter engaging with a moving flywheel. Battery charging alternator voltage will not be acceptable for this purpose.

d. The starting system shall be designed for restarting in the event of a false engine start, by permitting the engine to completely stop and then reengage the starter.

e. Cranking cycler with four 15-second ON and OFF cranking periods.

f. Overcrank protection designed to open the cranking circuit after 105 seconds, if the engine fails to start.

g. Circuitry to shut down the engine when signal for high coolant temperature, low oil pressure, or overspeed are received.

h. Engine cool down timer factory set at five minutes to permit unloaded running of the standby set after transfer of the load to normal.

i. Three-position (Automatic - OFF - TEST) selector switch. In the test position, the engine shall start and run regardless of the position of the remote starting contacts. In the automatic position, the engine shall start when contacts in the remote control circuit close and stop five minutes after those contacts open. In the off position, the engine shall not start even though the remote start contacts close. This position shall also provide for immediate shutdown in case of an emergency. Reset of any fault lamp shall also be accomplished by putting the switch to the off position.

j. Indicating lights to signal:

1) Not-in-auto (flashing red)
2) Overcrank (red)
3) High engine temperature/low coolant level (red)
4) Overspeed (red)
5) Air damper (red)
6) Battery charger malfunction (red)
7) Low battery voltage (red)
8) *Low fuel (red)
9) System ready (green)
10) Pre-alarm high engine temp. (yellow)
11) Pre-alarm low oil pressure (yellow)
12) Low coolant temp. (red)
13) *Fuel tank leaking (red)

*for diesel units only

k. Test button for indicating lights.

l. Alarm horn with silencer switch per NFPA-110.

m. Terminals shall be provided for each signal in j. above for connection to remote monitoring devices.

8.6.30 INSTRUMENT PANEL**:** A set mounted instrument panel shall include:

a. Dual range voltmeter, 3-1/2 inch, + or -2% accuracy.

b. Dual range ammeter, 3-1/2 inch, + or - 2% accuracy.

c. Volt meter-ammeter phase selector switch.

d. Lights to indicate high or low meter scale.

e. Direct reading pointer-type frequency meter, 3-1/2 inch, + or - 5% accuracy, 45 to 65 Hz scale.

f. Panel illuminating lights.

g. Battery charging meter.

h. Coolant temperature gauge.

i. Oil pressure gauge.

j. Running time meter.

k. Voltage adjust rheostat (+ or - 5% range).

l. A solid state instrument panel with selectable digital displays is also acceptable.

8.6.31 ACCESSORIES**:** The following accessories shall be provided:

a. Overvoltage protection which shall shut down the unit after one second of 15% or more overvoltage.

b. Battery rack, battery cables, 12-volt battery(ies) capable of delivering the minimum cold-cranking amps required at zero degrees Fahrenheit per SAE Standard J-537.

c. Gas proof, seamless, stainless steel, flexible exhaust connector(s) ending in pipe thread.

d. Flexible fuel line(s) rated 300 degrees F and 100 psi ending in pipe thread.

e. Engine exhaust silencer, coated to be temperature and rust resistant, rated for critical applications. Exhaust noise shall be limited to 85 dba as measured at 10 feet in a free-field environment.

f. Block heater of proper wattage and voltage, thermostatically controlled to maintain engine coolant at 90 degrees Fahrenheit (32 degrees Celsius) to meet the start-up requirement of NFPA-99 or NFPA-110 Regulations.

g. 10-Ampere automatic float and equalize battery charger with +-1% constant voltage regulation from no load to full load over +-10% AC input line variation, current limited during engine cranking and short circuit conditions, temperature compensated for ambients from -40 degrees C to +60 degrees C, 5% accurate voltmeter and ammeter, fused, reverse polarity and transient protected. Optional alarm circuit board to meet the requirements of NFPA-110 for low battery voltage, high battery voltage, and battery charger malfunction shall be provided.

h. 16 - light remote annunciator shall monitor all controller functions described in the controller section plus line power and generator power monitoring. An integral lamp test and horn silence switch shall be included that meets NFPA-110.

8.6.32 EXECUTION**:**

a. The equipment shall be installed as shown on the plans, in accordance with the manufacturer's recommendations and all applicable codes.

8.6.33 SITE TESTS**:** An installation check, start-up, and building load test shall be performed by the manufacturer's local representative. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:

a. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations under the environmental conditions present and expected.

b. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. This shall include: engine heaters, battery charger, generator strip heaters, remote annunciator, etc.

c. Start-up under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and phase rotation.

d. Automatic start-up by means of simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper systems coordination. Engine temperature, oil pressure and battery charge level along with generator

voltage, amperes, and frequency shall be monitored throughout the test.

e. Labor, fuel, and load bank for 3 hour test shall be supplied at developer's/builder's expense.

8.7 Control Panel Requirements and Hardware:

8.7.1 Programmable Logic Controller

a. Each pump station shall incorporate a “Micro”, modular Programmable Logic Controller (PLC) with the following integral communication ports:

1) One RS-232 / RS-485 Combo Port

2) One 10/100 Mbps RJ-45 Ethernet/IP port.

b. The PLC power requirements shall be 24VDC.

c. The PLC I/O (integral to the base controller) shall be:

1) Discrete Inputs: (6) 24VDC and (4) fast 24VDC.

2) Analog Inputs: (2) 0-10VDC.

3) Discrete Outputs: (2) relay, (2) 24VDC FET and (2) high-speed 24VDC FET.

4) Additional I/O may be added via I/O modules. The PLC shall be capable of supporting up to 4 addition modules.

d. Manufacturer shall be Allen-Bradley.

1) Model #: MicroLogix 1100 or approved equivalent.

8.7.2 Pump Station Control Panel Operator Interface:

a. Each pump shall have independent 30.5mm, NEMA 4/13, 3-position, maintained contact, “Run-Off-Auto” selector switches. This shall allow the operator / maintenance staff to manually override the operation of the pump in the event of a level probe or controller failure.

b. Each pump shall have independent 30.5mm, NEMA 4/13, Push-to-Test, full-voltage, 24VDC, LED pilot lights which illuminate when their corresponding pump is “Running”.

c. Each pump station control panel shall come with a 12.1” 65K color TFT LCD touch screen operator interface (OIT) terminal [mounted in the inner door (only applicable in outdoor

enclosure)].

d. The OIT shall display the following information:

1) Wetwell level.

2) Float switch position.

3) Pump status.

4) Valve position (if applicable).

e. The OIT shall allow for the following control:

1) Pump On and Off (if pump selector switch is placed in the "Auto" position.

2) Pump Sequencing:

3) "P-1 – Lead / P-2 – Standby" (forces pump P-1 to always be the "Lead" pump and pump P-2 to always be the "Standby" pump).

4) "P-2 – Lead / P-1 – Standby" (forces pump P-2 to always be the "Lead" pump and pump P-1 to always be the "Standby" pump).

5) "Automatic Alternation" (alternate pumps automatically upon completion of each pumping cycle).

f. Other OIT features shall include:

1) System warning and alarm logging with time and date stamp.

2) Pump running elapsed time meter (with password protected reset capabilities).

3) Pump service notification (when the pump run time equals or exceeds the manufacturer's run time for servicing).

4) Automatic "Standby" pump substitution (for when the "Lead" pump is considered failed by the PLC).

5) Wetwell level setpoint adjustment (via password protected screen).

g. OIT displayed alarms:

1) Wet Well "High-High" Level.

2) Wet Well “Low-Low” Level.

3) Pump Failure.

4) Pump High Temperature (where applicable).

5) Pump Station Intrusion.

6) Pump Station Control Panel Enclosure Intrusion.

h. OIT displayed warnings:

1) Wet Well “High” Level.

2) Wet Well “Low” Level.

3) Seal Leak Detected (where applicable).

8.8 *Supervisory Control and Data Acquisition (SCADA)*

8.8.1 SCADA Equipment

a. Prior to the selection of which type of radio to use, a radio survey must be taken at all the sites (from each site to the DPW) which are to be incorporated in the wireless network. The radio survey shall be done during the spring or summer months when the tree foliage is at its maximum. This shall allow for the best selection of frequency to be utilized on the I/P radio, based on signal strength, signal obstruction and any repeater towers (if necessary).

b. The wireless modem shall be equipped with both an Ethernet port and a serial data connector. The wireless modems shall be capable of receiving data from either the Ethernet port or the serial data connector, or both connections simultaneously.

c. The Ethernet port shall be able to be configured in one of the following modes of operation: IP bridge, IP gateway or an IP remote.

8.8.2 General Requirements:

a. Input Power: 10 to 30 VDC.

b. Input Power:15 Watts max

c. Power Over Ethernet (POE). The wireless modem shall have capability of being supplied power through the Ethernet connector (RJ-45) and is compliant with the IEEE 802.3af POE standard.

d. The RF Data Rate of the wireless modem will be 512/256 kbps (user selectable).

e. Data encryption: AES 128-bit encryption.

f. IP Configurations: The wireless modem will allow the user to set the IP operation in either one of three modes: bridge, gateway, or remote depending on the need of the specific network location.

g. Serial Ports: The wireless modem will be equipped with 2 RS-232, DE-9F serial ports that support communications at 300 – 115,200 bps. One port is designated for device setup and the other can support communications with a serial device when operated in the terminal server mode.

h. Ethernet Port: RJ-45 10/100 BaseT, auto-MDIX

i. Indicators: Separate bi-colored LED indicators for Lan LNK, Lan Activity, Tx/Rx, Sync, and Power are to be provided on the front panel.

8.8.3 Supported Protocols: The wireless modem will support the following protocols:

a. Ethernet IEEE 802.3

b. ICMP

c. IGMP

d. TCP

e. UDP

f. Dynamic Routing (RIP version 2)

g. IPSec and other transport protocols encapsulated within IP

h. IP Fragmentation

i. ARP (Address Resolution Protocol)

j. IP directed broadcast

k. IP limited broadcast

l. IP multicast relay

m. DHCP Client and Server

n. NAT (Network Address Translation)

8.8.4 Remote Configuration

a. A user will be capable of programming the parameters of a wireless modem from anywhere on the wireless network, or an internal LAN network that has access to the wireless network.

b. Access to the internal web server of a wireless modem unit will be controlled by a user name and password to restrict unwanted access to information contained on the wireless modem's internal web server.

c. Diagnostics: The wireless modem shall be capable of passing both on-line, non-intrusive system diagnostic information, as well as off-line diagnostic information with loop-back testing. Diagnostics reported shall include the following parameters:

1) Receive signal strength in dBm.

2) Internal Temperature.

3) Power supply voltage.

4) Forward and reflected RF power.

5) Packet Error Rate (PER)

d. Diagnostics shall include the capability to acquire spectrum usage analysis from both the local unit and a specified or series of specified remote units. Ideally, the access to the spectrum analysis information should be provided by the product's internal web server. The tool shall reflect the Received Signal Strength Indication (RSSI) in dBm, the channel associated with the RSSI indication, and a dynamically placed noise floor. Information will be available as a dynamic graphic presentation.

8.8.5 Physical Requirements:

a. Package: The wireless modem must be flexible enough to be mounted on a flat surface, on a DIN rail, or in an industry standard 19" rack mount.

b. Maintainability: Radio modules and associated hardware must be modularly designed to facilitate replacement of defective units with minimal down time. Temperature range: -30 to +60 Celsius.

c. Humidity range: 0 to 95% relative humidity at 40 ºC, non-condensing.

d. Antenna Connection: Dual TNC female.

e. Design: The radio design shall make use of surface mount PC board components.

8.8.6 Transmission Cable & Miscellaneous For Master Wireless Modem

a. Use transmission cable of the low-loss foam-dielectric type to connect the master station radio antenna port to the antenna.

b. Provide a three-foot section of 'super-flex' transmission cable at the master wireless modem antenna port. Provide standard TNC connectors for connection to a continuous piece of cable extending to the antenna.

c. Provide weatherproof transmission cable suitable for direct environmental exposure. Use 'O' ring seals on connectors.

d. Utilize appropriate bulkhead RF transmission cable surge suppression devices at cable entrances, Polyphaser or equivalent.

e. Include specifications on cable hangers and ground kits, as required in the particular installation.

8.8.7 Transmission Cable & Miscellaneous For Remote Station Radio

a. Provide cable connecting the radio antenna port to the antenna, which is low-loss foam-dielectric type. Cable type will be affected by specific situation at the site.

b. Provide a six-foot section of 'super-flex' transmission cable at the radio antenna port. Make this section pass through the enclosing panel and the control building exterior wall. Provide standard Type N connectors for connection to a continuous piece of cable extending to the antenna.

c. Provide weatherproof transmission cable, suitable for direct environmental exposure. Use 'O' ring seals on connections.

d. Coaxial lines to antennas shall be enclosed in conduit to protect against vandalism.

e. Utilize appropriate bulkhead RF transmission cable surge suppression devices at cable entrances, Polyphaser or equivalent.

f. Provide information on hangers, ground kits, etc. as appropriate for particular installation.

g. All installations are to be performed by a professional installer.

8.8.8 Directional Antenna for Remote Station Wireless Modem

a. Must meet the following requirements:

1) Frequency Range: Appropriate to frequency of operation.

2) Gain: Per user system requirements and system design

3) Surge and impulse Protection: Direct ground protection.

4) Front-to-Back Ratio: 20 dB, minimum.

5) Connector: 18 inch flexible extension TNC with neoprene housing to appropriate connector type of antenna cable.

6) Mounting Hardware: Weatherproof clamp suitable for direct mount to 2 inch, Schedule 40 steel pipe.

7) Antenna Hardware Kits: All the aforementioned items should be supplied from the equipment provider in a complete, easy to use kit that provides all the necessary items to properly connect the wireless modem to the antenna and field install the antenna assembly.

b. Manufacturer: Dataradio

1) ViPR (if licensed frequency is used).

2) HiPR-900 (if non-licensed frequency is used).

c. The contractor (professional installer) shall provide all masts, lightning suppressors, and any other apparatus required to assemble a complete, operable, and reliable fixed wireless data system.

8.8.9 Omnidirectional Antenna(s) For Host Or Master Station Wireless Modem

a. Frequency Range: Appropriate to frequency of operation.

b. Gain: Per user system requirements and system design

c. SWR: Less than 1.5:1.

d. Surge and impulse protection: Direct ground protection.

e. Connector: 18-inch flexible extension TNC with neoprene housing.

f. Mounting Hardware: Clamps, standoff hardware as recommended by the antenna manufacturer to adapt to the tower.

g. Antenna Hardware Kits: All the aforementioned items should be supplied from the equipment provider in a complete, easy to use kit that provides all the necessary items to properly connect the wireless modem to the antenna and field install the antenna assembly.

h. Manufacturer: Dataradio

1) ViPR (if licensed frequency is used).

2) HiPR-900 (if non-licensed frequency is used).

8.8.10 Spare Parts

a. Vendor must include a complete itemized list of radio system spare parts including pricing.

8.8.11 Test Equipment

a. Vendor must include a complete list of all test equipment, extender boards, and interface equipment for maintenance and diagnostic testing.

9. RECORD DRAWINGS

9.1 *General*

9.1.1 All projects within the City which go through site plan and/or construction plan review shall be required to submit record drawings. The drawings will need to be reviewed and approved by the City Administration and/or Engineer prior to final acceptance of the project by City of Fenton.

9.1.2 The initial submittals shall be of two (2) sets of black line prints providing the applicable information shown on the attached checklist. The minimum scale shall be 1"=50' and shall bear the seal of a registered professional engineer or surveyor licensed to practice within the State of Michigan. All record lengths and elevations must be labeled as record.

9.1.3 After the record drawings have been approved by the City Administration and/or Engineer, the applicant shall submit two (2) mylar copies of the approved drawings. A CD shall also be provided which contains a .pdf version of each sheet of the record drawing plan set.

CITY OF FENTON AS-BUILT REQUIREMENTS CHECKLIST

SANITARY SEWER – IN PLAN & PROFILE SHOW:	N/A	OUTSTANDING	COMPLETED
All invert & rim elevations to USGS Datum			
Actual laying length between structures			
Type of pipe used			
Actual slope of pipe			
Size of pipe			
Tie down all structures via coordinates			
Lead information (distance from downstream manhole, riser length, depth, tie down end, etc.)			

STORM SEWER – IN PLAN & PROFILE SHOW:	N/A	OUTSTANDING	COMPLETED
All invert & rim elevations to USGS Datum			
Actual laying length between structures			
Type of pipe used			
Actual slope of pipe			
Size of pipe			
Tie down all structures via coordinates			
Lead information (distance from downstream manhole, depth, tie down end, etc.)			

WATER MAIN – IN PLAN VIEW SHOW:	N/A	OUTSTANDING	COMPLETED
Valve rim elevations			
Size & type of pipe			
Length of pipe			
Tie down all structures and hydrants via coordinates			
Call out actual offset from pavement			

DETENTION POND	N/A	OUTSTANDING	COMPLETED
Letter required by the design engineer stating that the pond is properly sized according to approved plans and the outlets are properly located and sized			

PAVEMENT	N/A	OUTSTANDING	COMPLETED
Sidewalk/bike path spot elevations every 50 feet			
Curbing and sidewalk ramp spot elevations			

SUBMITTALS	SUBMIT DOCUMENTS TO CITY	SUBMIT WITH REVISIONS NOTED ABOVE	APPROVED - SUBMIT TO CITY
Public easements, including sketch, description, and cover sheet			
Maintenance & Guarantee Bond for one (1) year at 100% of the value of the public utilities			
Two (2) Paper Copies of Record Drawings			
Two (2) Mylar Copies of Record Drawings			
Electronic Version (.pdf) of Record Drawings			

Additional specific information per site may be required at the discretion of the Engineer.

10. ENGINEERING FEES

10.1 At the time of submittal of plans for site plan review, a detailed estimate of cost must be provided for any proposed development, subdivision, site condominium project, or road development. From this estimate, the applicant shall deposit with the City a sum equal to the following:

Construction Costs	Review Fee Escrow (deposit required)
Up to $50,000	3-1/2% ($1,000 minimum)
$50,001 to $100,000	3% ($1,750 minimum)
$100,001 to $1,000,000	1-1/2% ($3,000 minimum)
Over $1,000,001	1% ($15,000 minimum)

The actual fee for the project review shall be borne by the applicant and will be on the basis of the actual costs incurred by the City for outside consultants, for plan review services.

10.2 Prior to the commencement of construction or project improvement, the applicant shall deposit with the City, a percentage of the total contract price for on-site construction observation, according to the following schedule:

Contract Amount	Deposit Requirement
Up to $10,000	$1,000
$10,000 to $50,000	8%
$50,000 to $100,000	7% but not less than $5,500
$100,000 to $200,000	6% but not less than $9,000
$200,000 to $300,000	5% but not less than $16,000
$300,000 to $500,000	4% but not less than $24,000
$500,000 to $1,000,000	3% but not less than $30,000

The following items shall be included within the construction costs which must be observed by the City; roadways (curbs, roads, etc.), storm sewer (manhole, pipe, etc.), sanitary sewer (manhole, pipe, etc.), water supply systems (hydrants, mains, etc.), sidewalks and stormwater retention/detention facilities.

10.3 A minimum of four (4) hours will be charged to the subject project if the observer keeps a scheduled observation appointment and the Contractor does not work. All costs incurred for consulting services will be billed against this account.

10.4 The actual fee for observation shall be borne by the applicant, and shall be on the basis of the actual costs incurred by the City Administration and/or Engineers. Any unused amount of the deposit following observation and approval shall be returned to the applicant. At anytime the City is of the opinion that the deposit is not sufficient to cover the services that are being provided, the developer shall be notified in writing as to the estimated deficiency, and the deposit shall be immediately increased accordingly.

10.5 The fees and charges specified in this section, shall be in addition to those charged for debt service charges, connection charges, and other charges or fees for sanitary sewer and water supply.

10.6 Prior to construction of a subdivision or other site improvement covered by the City's Ordinances, the proprietor or contractor shall procure and maintain during the life of any contract or agreement for such construction, insurance protecting the City, its officers, employees and consultants from any claim or damages, real, personal or otherwise, in such amounts as established by the City Council.

10.7 Prior to acceptance of improvements by the City, a one year maintenance bond in an amount set by and acceptable to the City shall be posted by the applicant/proprietor.

10.8 If an applicant requests a building permit prior to completion of the required proposed site improvements, the City Council may also require surety deposits or bonds, to assure completion of the improvements and payment of any additional fees, not paid in advance. When a deposit or bond is required, the applicant shall file with the City Clerk a cash deposit, certified check, irrevocable bank letter of credit or surety bond acceptable to the City. The City may also accept, at its discretion, a bond or other guarantee furnished by a subcontractor or a lending institution when the City is listed as an interested body of such a guarantee. The amount of such bond shall cover the cost of all remaining improvements. Monies may be released to the applicant in proportion to work completed on the different elements after inspection of work and approval of the City. Any partial release of funds shall be less ten (10%) percent which shall be retained by the City until all work has been completed and subsequently inspected and approved by the City.