

**CITY OF SOUTH LYON  
STANDARD ENGINEERING SPECIFICATIONS**

**Adopted: DECEMBER 11, 1989**

**Revised: JANUARY 1, 2001**

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## South Lyon Standard Engineering Specifications 2004/2005 Updates

<u>Old Page #</u>	<u>New Page #</u>	<u>Item Description</u>	<u>Matter Updated</u>
i	i	Table of Contents	Update to account for changes, format pages viii-x
1	1	Easements	Ordinance says 12' utility easements, standards say 20'; wider esmts may be needed
none	3	Street Paving Policy	Include City's Street Paving Policy, adopted Nov. 11, 2002
3	3	Utility Acceptance Policy	Add reference to City's final acceptance procedure
7	7	Dust Control	Add requirement to have water/dust pallative on site
9	9	Maintenance of Traffic	Add requirement to follow MMUTCD
10	10	General Constr. Stds	Add requirement for protections against damage until acceptance
none	10	Vibration Monitoring	Add vibration monitoring requirement
10-11	11	Sunday and Night Work	Change "Inspector" to "Field Observer"
10	11	Working Hours	Add City's working hour times
14, 54	15,55	Television Inspection	Add recommendation for television inspection to be provided digitally (CD or DVD)
None	21	Street Lighting	Add requirement for street lighting into Standards, describe procedure
20	21	Site Plan Requirements	Add requirement for quantities on all site plans
20	21	Water Main Design Standards	Add Water Main Design Standards heading
21	23	Water Main Looping	Add 12" transmission main requirement
22	23	Watermain Construction Req's	Allow for HDD or other trenchless methods in addition to jack and bore
30	31	Hydrant Specifications	Remove allowance for hydrant drain hole; drain hole must be plugged
36	37	Water Services Curb Boxes	Add requirement that > 1" service requires 1-1/2" upper section
36	37	Water Services Curb Boxes	Correct requirement for 1-1/4" upper section with 2 hole lid (not sold)
37	38	Water Main Depth	Change depth requirement from 5 foot to 5-1/2 foot
38	39	Water Main Testing	Add requirement, testing witnessed by City and City's engineer
39	40	Sterilization of Mains	Add requirement, testing witnessed by City and City's engineer
40	41	Sanitary Sewer Extension	Remove allowance for easements, sewer must extend to property line
43	44	Sanitary Sewer Services	Update requirement, material Schedule 40 or equivalent (SDR 23.5)
49	50	Sanitary Sewer Testing	Re-write intro for air test and infiltration test with groundwater for clarity
none	56,56-74	Grinder Pump Systems	Describe private ownership and minimum system designs standards

## South Lyon Standard Engineering Specifications 2004/2005 Updates

<u>Old Page #</u>	<u>New Page #</u>	<u>Item Description</u>	<u>Matter Updated</u>
none	56-74	Pump Station Requirements	Add requirements for pump station design
none	75	Stormwater Mgmt. Facilities	Add requirement for maintenance of stormwater management facilities
56	76	Storm Sewer Plans	Add requirement for catch basins every 300 LF +/- in roadways
62	82	Storm Sewer Materials	Add requirement, 36" and greater cement lined at pipe to pipe joints
none	107	Road Design	Add requirement for curve radii design, allow access for Fire Dept's largest truck
95	107	Street Paving	Move Street Paving intro to before pavement sections, page 87
87	108	Base Course	Update requirement for 21AA in lieu of 22A
88	109	Bituminous Pavements	Add provision for quality assurance for evaluating segregation in bit pavement
88	109	Bituminous Pavements	Add requirement for no RAP in topping course
88	109	Bituminous Pavements	Add specifications for use of 3C/4C RCOC mix
88	109	Bituminous Pavements	Update MDOT specification year reference
88	109	Bituminous Pavements	Specify MDOT 21AA for gravel base
88	109	Road Design	Clarify 6" sand subbase
88	109	Edge Drain	Edge drain required under all new pavement; remove exception clause
none	112	Concrete Pavements	Add requirement for GGBFS for alkalai reactivity for pavement, C&G and sidewalks
89	112	Concrete Pavements	Add requirement for concrete pavement, include 4" 21AA over 4" Class II sand
92	113	Concrete Sidewalks	Update requirement for 1/4" per foot max cross slope (new ADA requirement)
94	116	Concrete Ramps	Correct MDOT reference to "II-28G"
96	117	As-Built Requirements	Add requirement for A-Bs to include all info Steve needs for GASB
96	117	As-Built Requirements	Add requirement for electronic info
H-1	H-1	Gate Valve and Well	Correct note to refer to "City"
R-1	R-1	Typical Pavement Section	Correct for 1-1/2" lifts and 95% compaction
R-1	R-1	Typical Pavement Section	Update to 3C/4C and 2" lifts for heavy traffic
STR 1	R-10	Pavement Thickness Guidelines	Re-create for clarity, update to remove asphalt with black base and 5" concrete
R-2	R-2	Concrete Curb and Gutter	Add note to detail, MDOT F4
R-2B	R-2B	Mountable Curb and Gutter	Add note to detail, MDOT D2

**South Lyon Standard Engineering Specifications  
2004/2005 Updates**

<u>Old Page #</u>	<u>New Page #</u>	<u>Item Description</u>	<u>Matter Updated</u>
R-4	R-4	Residential Driveway Approach	Add 25' max curb cut, note for max to govern over angle
R-4	R-4	Residential Driveway Approach	Add requirement for 1100 L/T bit mix
R-7	R-7	Residential Cul-De-Sac	Correct detail, remove note, extend arrow, "scalable"
none	R-8,R-9	Rail Trail Bridge	Add detail for 10' wide Rail Trail bridge, AASHTO compliant
none	R-9B	Pedestrian Bridge	Add detail for 5' wide pedestrian bridge
ST-10	ST-10	Storm Sewer Trench	Update detail to ref. 1996 MDOT, update to all utility trench requirements
ST-10	ST-10	Storm Sewer Trench	Update to be for all utilities (storm, sanitary and water)
ST-15	ST-15	Catch Basin Inlet Grate	Add detail with "Dump No Waste"
ST-15	ST-15	Catch Basin Inlet Grate	Add EJIW 7045 criteria
SW-1	SW-1	Sidewalk Detail	Update detail to 1/4"/ft max cross slope (new ADA requirement)
none	SW-3	Sidewalk Detail	Add detail for new MDOT sidewalk ramp
none	SW-4B	Sidewalk Replacement	Create sidewalk replacement guide line

## South Lyon Standard Engineering Specifications 2006 Updates

<u>Old Page #</u>	<u>New Page #</u>	<u>Item Description</u>	<u>Matter Updated</u>
75	75	Storm Water Plan Requirements	Add reference to current Oakland County standards
77	77	Storm Sewer Sizing	Clarify description that 10-year hydraulic grade line must be in the pipe
none	78	Sediment Forebay	Add requirement for sediment forebay, per new OCDC standards
none	78	Downstream Limitations	Clarify limitation for basin discharge due to downstream capacity, per new OCDC standards
78	78	Storm Water Retention Sizing	Add requirement for soil borings and percolation calcs by geotech engineer, per OCDC stds.
none	78	Storm Water Storage	Add requirement that no storage is permissible within a wetland area, per OCDC standards
none	78	Storm Water Basin Design	Add statement that irregularly shaped basins are encouraged, per OCDC standards

**CITY OF SOUTH LYON  
STANDARD ENGINEERING SPECIFICATIONS**

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To be returned to the City with application

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If these forms are missing, contact the City of South Lyon for additional forms.

## **INTRODUCTION**

### **SHORT TITLE**

These Standards shall be known as the "City of South Lyon Standard Engineering Specifications" and shall hereinafter be referred to as "Standards".

### **PURPOSE**

The purpose of these Standards is to establish minimum engineering requirements for the design and construction of subdivisions, site plan improvements, and utility systems located within the City of South Lyon.

As referred to herein, "City" shall mean City of South Lyon and "Engineer" shall refer to the so designated employee of the City and/or its designated consulting Engineering firm.

### **PROCEDURES AND REQUIREMENTS**

1. All construction shall be in compliance with the procedural and substantive requirements of the City of South Lyon Ordinance Code; Title IV, Streets and Sidewalks, Title V, as amended, Zoning and Planning, Title VIII, as amended, Building Regulations, as amended, and all other statutes and Ordinances, in addition to the requirements contained herein.
2. Engineering drawings for proposed subdivision improvements, site plan improvements, and utility construction shall be approved by all jurisdictional agencies and the City's Engineer prior to the beginning of any construction.

Engineering drawings shall further conform to the requirements of the "Site Plan Review Check List", as adopted by the South Lyon Planning Commission, March 24, 1988, as amended, and with the requirements as specified under "Plan Submittals" contained within this document.

Permits will not be issued until all required approvals and permits are secured from State and County agencies (MDNR, MDEQ, MDOT, OCDC, and RCOC) and any others as required.

3. A developer must provide the City with the necessary easements to allow maintenance of any water mains, sanitary sewers, or storm drains that are to be located on developed property and maintained by the City. The easements shall be subject to the approval of the City Engineer and the City Attorney.

The easement and proof of title shall be provided by the grantor along with the easement in the form of title insurance, acceptable to the City Engineer and Attorney, to show that the grantor of the easement is the owner of the property. All parties having a legal interest in the property shall execute and grant the easement. Easements shall be a minimum twenty- (20) foot width unless a more narrow width is approved by the City Engineers. Easement widths greater than 20 feet may also be required by the City Engineer if necessary to access the sewer assuming future trench

excavations with one-on-one trench side slopes.

### **SEALING OF PLANS**

All subdivision construction plans, site plans and utility plans submitted to the City for review shall bear the signature of a Civil Engineer, Architect, or Land Surveyor currently registered in the State of Michigan, except as otherwise stated herein.

### **STANDARD DETAILS**

All utilities described and contained herein shall be constructed in accordance with the City's standard details which shall be adopted as part of these Standards, and are incorporated by reference, and included as an Appendix. Applicable fees shall be established by the Ordinance.

### **PHASED CONSTRUCTION**

On all projects in which construction is to proceed in phases, a separate plan sheet shall be included in the construction drawings which break down all improvement quantities by item, i.e. water main, sanitary sewer, storm sewer, landscaping, pavement base and wearing courses, and utilities for each phase. Said phasing limits shall match those approved or to be approved by the Planning Commission. Approval of phased construction shall not supersede the requirement to obtain site plan approval for each phase of the construction. Permits typically expire one year from date of issue.

### **CONSTRUCTION OBSERVATION**

Fulltime observation shall be required during the construction of subdivisions, site plan improvements and utility systems. Observation personnel shall be provided by the City or its agents. The developer shall pay all applicable observation fees as established by Ordinance. The Contractor shall notify the City and the City's engineer supervising field observation at least 48 hours prior to commencing construction.

### **SPECIFICATIONS BY REFERENCE**

Where reference is made in the Specifications to standards of any technical society, association, governmental agency, etc., such as those promulgated by AASHTO, ANSI, MDOT, etc., said specifications shall apply and be binding as if fully set forth herein. It is understood and agreed that such Specifications or standards are incorporated by reference.

Reference to standard specifications of any technical society, organization, association or to codes of local or state authorities shall mean the latest standard, code, specifications, or tentative specification adopted and published unless specifically stated otherwise.



## **CODES, ORDINANCES, LAWS AND REGULATIONS**

The Contractor and subcontractors shall observe and comply with all Federal, State and Local Codes, ordinances, Laws and Regulations in force at the construction site. The Contractor shall pay for and obtain all building permits, licenses for the work, pay for inspection and tests, and file plans and specifications to the inspection department having jurisdiction.

## **UTILITY MAP UPDATE**

City Utility Map Record Drawings must be modified to incorporate the utilities proposed to service the subject development. The city engineer is responsible for performing all necessary updates once the Final Site Plan approval has been issued. Utility maps shall also be revised based upon "As-built" information prior to final acceptance of the development by the City. Moreover, the developer is obligated to provide the city engineer with electronic files of the approved Final Site Plan in order to facilitate the utility updates. The costs of such updates shall be the sole responsibility of the developer.

## **FINAL ACCEPTANCE**

Final acceptance of the project, including all utilities and roads, shall only take place once a development is determined by the City of South Lyon to be complete or substantially complete. This determination shall be at the sole discretion of the City of South Lyon and shall generally follow substantial completion of all home construction. Roadways shall not be paved with a final wearing course until approval is given by the City, which shall also generally follow substantial completion of all home construction. All development and paving activity shall be in accordance with the City's Street Paving Policy, adopted November 11, 2002 (or current street paving policy). Testing required for water and sanitary systems prior to substantial completion and/or final acceptance is described in detail in the water and sanitary system sections, respectively.

## **START OF CONSTRUCTION**

No work shall begin on site, including clearing, grubbing, and dewatering, until final construction plan approval has been received by the City and a pre-construction meeting has been held, unless otherwise approved by the City Manager.

**GENERAL STIPULATIONS  
(INSURANCE REQUIREMENTS)**

It is agreed that the Contractor shall comply with the following general stipulations. All monetary amounts quoted herein may be revised at the discretion of the City.

WORKER'S COMPENSATION INSURANCE. The Contractor shall procure and shall maintain during the life of this Contract, Employee's Liability and Worker's Compensation Insurance for all of his employees to be engaged in work on the project under this Contract; and in case any such work is sublet, the Contractor shall require the subcontractor similarly to provide Employer's Liability and Worker's Compensation Insurance for all of the latter's employees to be engaged in such work.

In case any class of employees engaged in hazardous work under this Contract is not protected under the Worker's Compensation statute, the Contractor shall provide and shall cause such subcontractor to provide adequate insurance coverage for the protection of the employees not so covered.

CONTRACTOR'S COMPREHENSIVE GENERAL LIABILITY INSURANCE. The Contractor shall procure and shall maintain during the life of this Contract Contractor's Personal Injury Insurance in an amount not less than \$1,000,000 for injuries, including accidental death, to each person, in an amount not less than \$1,000,000 on account of each occurrence; and Contractor's Property Damage Insurance in an amount not less than \$1,000,000 each occurrence; and \$1,000,000 aggregate including Completed Operations and Contractual Liability Coverage's.

This Comprehensive General Liability Insurance shall include coverage for Explosion, Collapse and Underground Hazards and coverage assumed in the Indemnification Clause of this section of the work.

SUBCONTRACTOR'S COMPREHENSIVE GENERAL LIABILITY INSURANCE. The Contractor shall require each of his subcontractors to procure and to maintain during the life of his subcontract, Personal Injury Insurance in an amount not less than \$1,000,000 for injuries, including accidental death to each person and in an amount not less than \$1,000,000 on account of each occurrence; and Contractor's Property Damage Insurance in an amount not less than \$1,000,000 each occurrence and \$1,000,000 aggregate.

The Contractor shall require each of his subcontractors to procure and maintain during the life of this Contract Contractor's Protective Public Liability Insurance in an amount not less than \$1,000,000 for injuries, including accidental death to each person, and in an amount not less than \$1,000,000 on account of each occurrence; and property damage in an amount not less than \$1,000,000 each occurrence, and \$1,000,000 aggregate. Public Liability Insurance shall include coverage for Explosion, Collapse and Underground Hazards.

As an alternative to the above, the Contractor may insure the activities of his Subcontractors in his own policy.

CONTRACTOR'S AUTOMOBILE BODILY INJURY AND PROPERTY DAMAGE INSURANCE.

1. The Contractor shall procure and shall maintain during the life of this Contract Automobile Bodily Injury Insurance in an amount not less than \$1,000,000 for injuries, including accidental death, to each

**CITY OF SOUTH LYON**  
**ENGINEERING STANDARDS**  
**ADOPTED: DECEMBER 11, 1989**  
**REVISED: March 13, 2006**

person, and in an amount not less than \$1,000,000 for each occurrence; and property damage in an amount not less than \$1,000,000 for each occurrence.

2. The Contractor shall procure and shall maintain during the life of this Contract Hired and Non-Ownership Automobile Bodily Injury and Protection Damage Insurance in an amount not less than \$1,000,000 for injuries, including accidental death, to each person; and in an amount not less than \$1,000,000 for each occurrence; and property damage in an amount not less than \$1,000,000 for each occurrence.

**OWNER'S PROTECTIVE PUBLIC LIABILITY INSURANCE.** The Contractor shall procure and maintain during the life of this Contract Owner's Protective Public Liability Insurance in the name of the Owner and Engineer in an amount not less than \$1,000,000 for injuries, including accidental death, to each person, and in an amount not less than \$1,000,000 on account of each occurrence; and property damage in an amount not less than \$1,000,000 each occurrence and \$1,000,000 aggregate.

**BUILDER'S RISK/ALL RISK INSURANCE.** The Contractor shall insure for the life of the Contract, and until the work is accepted by the Owner, all risk type builder's risk insurance. The Policy shall cover no less than the losses due to fire, explosion, hail, lightning, vandalism, malicious mischief, wind, collapse, riot, aircraft and smoke. The insurance policy shall be held jointly in the names of the Owner. The amount of the policy may vary with the extent of the work completed, but shall at all times be at least equal to the amount paid on account of work and materials plus the value of the work or materials furnished or delivered by the Contractor but not paid by the Owner.

**INDEMNIFICATION CLAUSE.** The Contractor shall hold harmless from and indemnify the Owner and Engineer against all claims, suits, action, costs, counsel fees, expenses, damages, judgments or decrees, by reason of any person or persons or property being damaged or injured by the performance of the Contractor or any of his subcontractors, and suppliers, or any person employed under said Contractor, or under any of his subcontractors, during the progress of this Contract.

**PROOF OF CARRIAGE OF INSURANCE.** The Contractor shall provide the Owner, at the time contracts are returned by him for execution, certificates and policies listed below. A guarantee that thirty (30) day's notice to the Owner prior to cancellation of or change in any such insurance shall be endorsed on each policy and certificate of insurance.

1. Original and two copies of Certificate of Coverage for Contractor's Public Liability Insurance.
2. Original and two copies of Certificate of Coverage for Contractor's Public Liability Insurance.
3. Original and two copies of Certificate of Coverage for Contractor's Automobile Bodily Injury and Property Damage Insurance covering owned, hired, and non-owned vehicles.
4. Original and two copies of policy of Owner's Protective Public Liability Insurance.
5. Original and two copies of policy of Coverage for Builder's Risk.

## **GENERAL CONSTRUCTION STANDARDS**

### **SCOPE**

Standards and specifications contained herein shall apply to the design and construction of all water main, storm sewer, sanitary sewer and related appurtenances.

### **SITE GRADING**

In new developments, the entire site shall be positively graded to within six (6) inches of proposed finished grade prior to construction of any permanent improvements, other than permanent soil erosion and sedimentation control facilities.

### **CLEANUP**

General cleanup, including completion of rough grading of backfilled trench areas, shall continuously progress along with pipe installation and shall lag no further than fifty (50) feet behind the pipe installation operations.

### **PAVEMENT REPLACEMENT (TEMPORARY)**

All pavement removed or disrupted in crossing and/or paralleling paved streets, alleys, drives and parking areas shall be temporarily replaced by the Contractor immediately following completion of backfilling operations. Temporary pavements for streets and alleys shall conform in all respects to the Oakland County Road Commission Supplementary Permit Specifications for Underground Construction, except that placement must immediately follow backfilling. Temporary pavements for driveways (including approaches) and parking areas shall consist of a minimum of three (3) inches of compacted cold patch asphalt over a minimum of seven (7) inches of compacted MDOT 22A aggregate base. All temporary pavements, including those constructed for streets, alleys, drives and parking areas shall be maintained in good condition by the Contractor until the final pavement replacement is made.

### **TRENCH ENCLOSURES**

All trenches shall normally be backfilled at the end of the workday. Only under special conditions and with the approval of the Engineer shall trenches be left open overnight. Trenches which are allowed to be left open overnight shall be completely enclosed with suitable fencing and lighted barricades. When the trench contains water or when required by the Engineer, the exposed end of the pipe shall be securely closed with a watertight plug.

## **SITE DEWATERING**

Any construction dewatering activity requires a "Dewatering Plan" approved by the City and the City's engineer prior to commencing construction. If the need for dewatering arises during construction, a Dewatering Plan must be submitted to and approved by the City and City's engineer prior to dewatering.

The Dewatering Plan shall include the number and location, depth, and size of all proposed pumps. The maximum flow from each pump should be determined. In addition, the Dewatering Plan shall indicate the precise location for discharge of the water. All water must be retained on site, unless extenuating circumstances are demonstrated and the City and City's engineer approve of the concept to discharge off-site.

Furthermore, the contractor shall be responsible for obtaining permission from the appropriate regulatory agencies that may have jurisdiction over the proposed receiving waters.

## **PROHIBITION OF SALVAGED MATERIALS**

All sewer pipe, water main, precast structures, castings and appurtenances shall meet or exceed the specifications herein required. No secondhand or salvaged materials will be permitted, except upon specific written authorization from the City.

## **ABANDONED UTILITIES**

All castings, hydrants, valves, and similar items to be abandoned shall become the property of the City, and shall be returned to the Department of Public Works yard if requested.

## **STAKING REQUIREMENTS**

All underground utilities and appurtenances shall be properly staked for location and elevation under the supervision of a Land Surveyor or Registered Engineer in the State of Michigan prior to construction.

## **ON-SITE BURNING**

No burning of waste materials of any type will be allowed at anytime. The Contractor shall haul all waste materials resulting from his work from the site and dispose of the same in a manner acceptable to the Engineer. The cost of hauling and disposal of waste materials shall be incidental to the work.

## **DUST CONTROL**

The Contractor shall at all times take necessary steps to alleviate and to prevent dust nuisance caused by or resulting from his operations, and shall apply water or dust palliative, or both, as required. A water or dust palliative is required to be on-site at all times.

## **MUD AND DIRT CONTROL**

The Contractor shall at all time take necessary precautions to control mud and dirt on public roads and streets, and shall remove mud and dirt from said streets at the direction and to the satisfaction of the Engineer or a designated representative of the City.

## **RIGHTS-OF-WAY**

The necessary right-of-way for the construction of drains, sewers, mains and appurtenant structures across or under private property will be obtained by the City. In instances of privately funded construction, the Developer will be responsible for all procurement and demonstrate that appropriate easements exist. In carrying out the work on private rights-of-way, the Contractor shall take due and proper precautions against any injury to adjacent structures and shall hold himself strictly within the rights secured by the City. In the event the City is unable to obtain the rights-of-way for City funded construction before construction begins, the Contractor shall not be entitled to make or assert a claim for damage for said delay but time for completion of the work shall be extended to such time the City determines will compensate for time lost by such delay.

## **FENCES**

No fences shall be removed or destroyed by the Contractor without the written permission of the Engineer. The Contractor shall be held fully responsible for any damages caused by his work to any adjoining fences. Fences that have been removed shall be preserved and replaced in a manner acceptable to the Engineer. Damaged material shall be replaced by new material.

## **MONUMENTS**

Under this section, the term "monument" shall be considered as any object defining the location of a property corner, street location, section line, right-of-way marker or other delineation of land ownership or division. During the progress of work, the Contractor may encounter monuments within the working area. The Contractor, prior to actual construction, shall erect protective barricades around all known monuments that are in or are adjacent to the construction area. Any other monument uncovered or located during progress of the work shall be protected from damage or loss and the Engineer shall be notified in writing as to the exact location.

During the normal course of the work, monuments may require removal. The Contractor shall not remove any such monument until a Registered Land Surveyor shall have set four (4) iron pipe stakes each two (2) feet long as reference points for the resetting of such monument, at the Contractor's expense. Reference stakes shall be located so that they will not be disturbed by any construction operations. After this referencing has been done and permanent sketches prepared, the Engineer may give permission to the Contractor for the removal of the monument. Referenced monuments shall be reset under the supervision of a Registered Land Surveyor after all backfilling has fully settled.

Any monument damaged or destroyed by the Contractor that is not within the normal work area as determined by the Engineer shall be replaced, and the Contractor shall pay all costs of the replacement

survey. The replacement survey shall be performed by or under the direct supervision of a Registered Land Surveyor, licensed in the state of Michigan.

## **MAINTENANCE OF TRAFFIC**

During the progress of the work, the Contractor shall accommodate both vehicular and pedestrian traffic as provided in these Specifications. In the absence of specific requirements, the Contractor shall maintain such traffic. Access to fire hydrants, sewers, water and gas valves shall always be maintained. The Contractor's vehicles and equipment operations on public streets shall be governed by all local traffic ordinances and regulations of the Fire and Police Departments. Work within Oakland County Road right-of-way shall be under the jurisdiction of the Road Commission for Oakland County.

Small street openings necessary for manholes, alignment holes, sewer connections, etc. may be permitted. Such holes shall not be open longer than necessary and shall be protected in accordance with the requirements of the local agency having jurisdiction, and any traffic detouring necessary shall be done to the satisfaction of the agency. Whenever possible, small openings shall be covered with steel plates at pavement level and secured in place at the time that work is being performed. All such openings shall be replaced with concrete, regardless of surface style removed.

Shaft locations shall be selected at points which will cause as little interference with traffic as possible. Working site arrangements shall meet with the approval of the Engineer. Detouring of traffic shall be in accordance with the approval of the local Department of Public Works and/or the local Department of Public Safety and/or the Road Commission for Oakland County.

Where streets are partially obstructed, the Contractor shall place and maintain temporary driveways, ramps, bridges and crossings which, in the opinion of the Engineer, are necessary to accommodate the public. The Contractor shall be responsible for providing and maintaining flagmen, warning lights, signs and/or barricades including necessary detour signs outside the project limits as required to direct and protect vehicular and pedestrian traffic. Maintenance of traffic, including within the County and public right-of-way, shall be in accordance with the current edition of the State Manual of Uniform Traffic Control Devices.

In the event of the Contractor's failure to comply with the foregoing provisions, the City may, with or without notice, cause the same to be done and deduct the cost of such work from any monies due or to become due the Contractor, or complete the required repair work at the Contractor's expense. The performance of such work by the City or at its insistence shall serve in no way to release the Contractor from his liability for the safety of the traveling public. The City may also choose to cease all work until such protection is in place.

The Contractor shall inform the local Department of Public Safety, which includes the Department of Public Works, Fire, Ambulance and local Police Department, at least one (1) week prior to obstructing any street. In Oakland County rights-of-way, a permit is necessary.

## **PROTECTION OF WORK AND PROPERTY**

The Contractor shall continuously maintain adequate protection of all of his work from damage and shall protect all public property and private abutting property from injury or loss arising in connection with his work. The Contractor shall, without delay, make good any such damage, injury or loss and shall defend and

save the City and Engineer harmless from such damages or injuries occurring because of his work. The Contractor shall furnish and maintain protected pedestrian sidewalks, passageways, barricades, guard fences, lights and danger signals, provide watchmen and other facilities for protection required by public authority by local conditions, or by order of the Engineer, at no additional cost to the City. Protection of the work, including property and persons within the County and public right-of-way, shall be in accordance with the current edition of the State Manual of Uniform Traffic Control Devices.

### **RESPONSIBILITY FOR ADJOINING STRUCTURES**

The Contractor shall assume full responsibility for the protection of pavements, curb, poles, storm sewer and any other surface structures, water main, sewers, service feeds and structures along and near the work which may be affected by his operations, and shall indemnify, defend and save harmless the City against the damages or alleged damages to any such structure arising out of his work. The Contractor shall bear the cost of repair or replacement of any such structure damaged as a result of his operations.

Damaged structures shall be repaired or replaced to the condition at the time of damage, or better condition. Such repair or replacement shall be made by the Contractor or by the City, as directed by the Engineer.

### **PROTECTION OF TREES AND SHRUBBERY**

No trees or shrubbery of any kind shall be removed or destroyed by the Contractor without the written permission of the Engineer, unless removal is indicated on the Drawings. The Contractor will be held fully responsible for any damages caused by his work to adjoining trees and shrubs. Ample precautions shall be taken by the Contractor to protect such trees and shrubs that are to remain in place by surrounding them with fences or other protection before construction work begins. Shrubby that has to be removed shall be preserved and replaced in a manner acceptable to the Engineer.

### **PROTECTION AGAINST DAMAGE TO WORK**

The Contractor shall assume full responsibility for loss or damage to the work during the entire construction period resulting from caving earth, storms, floods, frosts, other adverse weather conditions, and from other causes whatsoever not directly due to the acts or neglect of the City and shall turn the finished work over to the City in good condition and repair at the time of completion. The Contractor shall be responsible to take the precautions necessary to protect the work from damage until acceptance by the City. Damage shall include damage caused by use, misuse, or vandalism.

### **VIBRATION MONITORING**

The Contractor shall provide an approved vibration monitoring system if requested by the City. The Contractor must provide and install an approved vibration monitoring plan that includes the monitoring locations and equipment, that is reviewed and approved by the City, and that is certified by the developer's engineer to not cause negative impacts to nearby structures. At a minimum, criteria from the U.S. Bureau of Mines should be used which states that vibration at 0.5 inch per second starts to damage plaster and vibration at 0.75 inches per second starts to damage drywall.



## **CLEANING UP**

The Contractor shall at all times keep the premises free from accumulations of waste material or rubbish caused by his employees or work. Upon completion of construction, the Contractor shall clean the premises. The Contractor shall remove surplus excavation, debris, rubbish and all unused material from the premises.

## **SUNDAY AND NIGHT WORK**

Working hours are 7:00 AM - 6:30 PM as determined by City ordinance. Ordinarily, no Sunday or night work shall be carried on which will require the presence of the Engineer or Field Observer, except with written permission by the City Manager. Sunday and night work is permissible in an emergency to the extent required to meet the emergency, but the Contractor shall notify the Engineer and/or Field Observer as far in advance as possible of his intention to carry on such emergency work and the time and place for the work.

## **SAFETY**

The Contractor and subcontractors shall comply with Federal, State and local laws and regulations governing the furnishing and use of safeguards, safety devices, and protective equipment and shall take any other actions as reasonably necessary to protect life and health of employees on the job, the safety of the public, and to protect property during the construction of the project.

The "Safety and Health Regulations for Construction" and subsequent amendments promulgated by the U.S. Department of Labor must be followed. These regulations are identified as Chapter XVII of Title 29, Code of Federal Regulations (CFR), Part 1926.

All Contractors' and subcontractors' operations and construction equipment shall comply with the requirements of the Michigan Occupational Safety and Health Act, Act 154, P.A. 1974, and Michigan Occupational Safety and Health Rules and Standards, insofar as they apply to the work being performed.

## **TESTING**

All design, material and performance testing costs, including soil density and compaction tests, shall be made at the expense of the Contractor. Testing costs shall include all manpower, equipment and handling costs, including preparation, collection, transportation, and storing.

The Contractor shall obtain the services of a certified testing laboratory approved by the Engineer. This laboratory will perform all design and material testing required.

For materials covered by ASTM, AWWA, State and/or Federal Specifications, the required tests are to be made by the manufacturer or supplier and his certificates submitted to the Engineer.

Soil density and compaction tests will be made by a representative of the City at the request of the City Engineer and will be paid for by the Contractor.

## **SAMPLES**

Where called for in the Specifications, samples of materials in the quantity required shall be submitted to the Engineer for approval. The work shall be in accordance with approved samples.

Where samples are requested or items are required to be approved by the Engineer, the Contractor shall make a written request at least three (3) weeks before approval is required and obtain approval in writing from the Engineer before ordering such materials.

Samples are to be forwarded to the Engineer with all shipping charges prepaid, boxed or wrapped separately and each labeled with the name of the material, the name of the producer, the Contractor furnishing the same, and the use for which the material is intended.

The approval of the samples is generally for quality, color and finish and does not modify the requirements of the Specifications or Drawings as to dimensions and design.

## **MOVING EQUIPMENT**

All heavy equipment moved over improved streets shall be transported on equipment trailers or moved over planking placed on the pavement, or as directed by the Engineer.

## **PLACING EQUIPMENT IN OPERATION**

It is the intent of these Specifications to provide operating units complete and ready to put into service. Mechanisms shall be properly lubricated and adjusted and all electrical connections and devices shall be tested for proper performance. Where the medium to be handled is available, a test run shall be made to demonstrate the workability of the equipment. Where no such medium is available, the equipment shall be run "dry", if feasible. All necessary oils, greases, and special lubricants shall be provided. The Contractor shall maintain the equipment until it is accepted by the City. Machinery shall be operated at least once each week to insure proper grease distribution to bearings and other mechanical parts. Spare parts, lubricants and operating instructions shall be segregated and labeled before being turned over to the City.

## **GUARANTEE**

Where called for in the Specifications or Drawings, the Contractor shall secure for and furnish to the City a written guarantee that all equipment and all parts thereof, material, and/or workmanship shall be first class and free from defects and that the guarantor will, upon notice and without undue delay or expense to the City, make good or repair, the whole or any part of the work which shall, within the indicated time after the date of acceptance of the completed work, fail or develop unfitness for the purpose for which it is intended, as a result of any defect in design, material or workmanship. Where no time limit is shown, it shall automatically imply one year. Upon completion of the work, the Contractor shall furnish the Engineer a tabbed binder containing all guarantees for each piece of equipment or item as herein required. When requested by the Engineer, the manufacturer's guarantee shall be attached to the Contractor's guarantee.

## **TIME AND SEQUENCE OF WORK**

In general, it is the intention and understanding that the Contractor shall have control over the sequence or order of execution of the several parts of the work to be done and over the method of accomplishing the required results, except as some particular sequence or method may be distinctly demanded by the Drawings and Specifications. The Engineer may, however, make such reasonable requirements as may in his judgment be necessary for the proper and effective protection of work partially or wholly completed; the Contractor shall conform to these requirements.

## **SUPERINTENDENCE**

The Contractor shall employ on the work site, during its progress, a competent superintendent and any necessary assistants, all satisfactory to the Engineer. The Superintendent shall not be replaced except with the consent of the Engineer, unless the Superintendent proves to be unsatisfactory to the Contractor and ceases to be in his employment. The Superintendent shall represent the Contractor in his absence and all directions given to him shall be as binding as if given to the Contractor. Important directions shall be confirmed in writing to the Contractor. Other directions shall be so confirmed on written request for each case. The Contractor shall give efficient supervision to the work, using his best skill and attention.

## **SUBCONTRACTS**

The Contractor agrees to be fully responsible to the City for the acts or omissions of his Subcontractors and for anyone employed directly or indirectly by him or them. The Contractor agrees to bind every Subcontractor and every Subcontractor agrees to be bound by the Drawings and Specifications, as far as applicable to his work, unless otherwise specifically approved in writing to the City.

## **EQUIVALENT MATERIALS AND EQUIPMENT**

Whenever any of the material or equipment is defined by describing a proprietary product or by using the name of a manufacturer or vender, the term "or equal," if not inserted, shall be implied. The specific article, material, or equipment mentioned shall be understood as indicating the type, function, and minimum standard of design efficiency and quality desired and shall not be construed in such a manner as to exclude manufacturers' products of comparable quality, design and efficiency. Other manufacturers' products will be accepted provided sufficient information is submitted to the Engineer to determine that the products proposed are equivalent to those named. Whenever material or equipment is submitted for approval as being equal to that specified, the decision of whether or not such material or equipment is equal to that specified shall be made by the Engineer. Upon rejection of any material or equipment submitted as the equivalent of that specifically named, the Contractor shall immediately proceed to furnish the designated material or equipment. The approval by the Engineer of alternate material or equipment as being equivalent to that specified shall not in any way relieve the Contractor of responsibility for failure of the material or workmanship to perform the functions required of them.

## **ROYALTIES AND PATENTS**

The Contractor shall pay all royalties and license fees. He shall defend all suits or claims of infringement of any patent rights and shall save the City harmless from loss on account thereof, except that the City shall be responsible for all such loss when a particular process or the product of a particular manufacturer or manufacturers is specified, but if the Contractor has information that the process or article specified is an infringement of a patent, he shall be responsible for such loss unless he promptly gives such information to the Engineer or the City.

## **AUDIOVISUAL TAPE COVERAGE**

### **GENERAL**

The Contractor shall furnish the City an audiovisual record for the construction site for the purpose of establishing, for the record, conditions prior to construction. The audio-video taping shall be of a professional quality that will clearly log an accurate visual description of existing conditions. The tape shall be in color.

The video tape shall be of VHS format tape or may alternatively be provided digitally on a DVD.

The audiovisual taping shall clearly show the date and time of the taping. The audiovisual taping shall be done within a two-week period prior to the preconstruction meeting and under the supervision of the Engineer.

Any portion of the tape not acceptable for the determination of clarity and conditions must be refilmed at no additional charge.

Said tape shall be furnished one week prior to the preconstruction meeting and/or prior to the placement of material or equipment in the construction area.

- A. Tape coverage must include all existing cross streets, driveways sidewalks, curbs, ditches, shrubbery or other structures located on the construction site. Where construction may necessitate a local detour of traffic, additional planning of the full highway right-of-way will be required. It will not be necessary to cover the side street detours, only areas within the full highway right-of-way of the street along which the construction is being done.
- B. Both sides of the entire construction site must be recorded with the rate of speed in the general direction of travel not to exceed 48 feet per minute. Panning rates and zoom-in zoom-out rates shall be controlled sufficiently so that playback will produce clarity of the object being viewed, and locations must be identified by audio and video means at intervals of not more than 100 lineal feet.
- C. Tape must be recorded during a time of good visibility. Taping should not be made during periods of precipitation, snow, leaves, or other natural debris.
- D. To insure proper perspective, the distance from the ground to the camera lens shall not be less than 12 feet. The City shall have the authority to designate what areas may be omitted or added for audio-video coverage.
- E. The recording must be on a continuous running tape on which sound and video information can be recorded.

To preclude the possibility of tampering or editing in any manner, all video recordings must be by electronic means and display continuously and simultaneously generated transparent digital information to include the date and time of recording, as well as the corresponding Engineering station numbers. The date information shall contain the month, day and year (i.e., 01/01/01), and be placed directly below the time information. The time information shall consist of hours, minutes and

seconds, separated by colons (i.e. 15:35:18). This transparent information will appear in the upper left hand third of the screen.

The Engineering stationing numbers must be accurate and correspond to the project stationing and must include the standard Engineering symbols (i.e. 2+84). This transparent information must appear in the lower half of the viewing screen. If there is no engineering stationing, each street shall be stationed individually starting at 0+00.

Below the engineering stationing, periodic transparent alpha/numeric information will appear. This information will consist of the name of the project, name of the area covered, direction of travel, viewing side, etc.

- F. For ease of playback, the speed and electronics of the videotape or DVD shall be equal to that which is standard to the electronic industry.

Services shall be performed by one of the following organizations or another as approved by the Engineer:

Construction Video Service  
Video Media Corp. of America  
Midwest Company

## **SOIL EROSION AND SEDIMENTATION CONTROL**

### **GENERAL**

The Contractor shall follow procedures consistent with:

1. Act 451 of the Public Acts of 1994 of Michigan, the Natural Resources and Environmental Protection Act, and corresponding general rules.
2. Local Soil Erosion Control Ordinance or requirements.

The Contractor shall prepare a soil erosion and sedimentation control program for submittal to and approval by Local Soil Erosion and Sedimentation Control Agent prior to the start of construction, as required by the Local Agency and further described in the following paragraphs. Copies of State Guidelines "Guidebook of Best Management Practices for Michigan Watersheds," 1998 edition, may be obtained from the Michigan Department of Environmental Quality.

Since it is impractical to identify specific potential soil erosion problems at a construction site, the Contractor, prior to the preconstruction conference, together with the local soil erosion Enforcing Agent, shall identify all potential soil erosion problem areas and prepare a detailed soil erosion and sedimentation control program satisfying the Contractor's specific method of operation. This program shall include as a minimum, but not limited to, the following:

1. Identify on a separate set of plans all soil erosion problem areas.
2. Identify specific control structure(s) to be placed to control erosion and to prevent soil from entering storm sewers and streams.
3. Indicate timing of placement and removal of structures both in the relationship to time of year and to sequence of construction.
4. Indicate timing of completion of clean up and surface restoration after control structures are removed.

The soil erosion control program, prepared by the Contractor, shall be reviewed and have received at least preliminary concurrence from the Local Enforcing Agent before it will be presented and discussed at the preconstruction meeting, at which time final revisions may be made. Copies of the final agreed program shall be made available for the Engineer and the Local Enforcing Agent. Should the local regulatory agency determine at any time during construction that the construction operation is in violation of the Act and cite the Owner or Developer, the Contractor or Subcontractor shall take immediate action to insure compliance with the Act.

### **DEWATERING TRENCHES AND DISPOSAL OF EXCESS EXCAVATED MATERIAL**

Pumping or draining from trench excavation shall be made on either side of the pipeline and not into the

waters of the state. It shall be the Contractor's responsibility to secure the necessary approval of private landowners before discharging water from the trench excavation onto the private lands. Water shall be discharged in such a manner as to cause no pollution or erosion problems. Under no circumstances may the Contractor discharge sanitary sewage onto the ground surface. The Contractor shall dewater to existing storm system sewers wherever possible. The method of disposal shall be approved by the Engineer. All discharge from dewatering wells discharged onto the ground before being piped to a natural watercourse or lake via an existing storm sewer system or by a temporary piping system shall have a silt retention structure built at the point of entry into such storm sewer.

This silt structure may consist of several straw bales adequately anchored and placed as directed by the Engineer. Any eventual silt or solids retained in the area of these structures shall be removed prior to the removal of the structure. At no time will silt or similar materials be permitted to filter into a lake or natural watercourse. There shall be no sidecasting of any excavated material into any waterway. Excess excavated material from stream crossings and excavation near streams shall be removed and disposed of elsewhere and not within the flood plain.

### **STREAM BANK PROTECTION**

The banks of streams shall not be left unprotected for more than one (1) day where possible, but never more than seven (7) days after the stream crossing is completed. Replacing of bank plug and grading of stream banks within fifty (50) feet of the stream shall be accomplished immediately following pipe laying. Construction shall not be allowed to continue at the expense of not providing stream bank protection.

All disturbed stream banks shall be finished with a slope not steeper than 2:1 (two horizontal to one vertical). The 2:1 slope shall be graded up and back to the high water line. If the top of the natural bank is more than three (3) feet above the high water line, a minimum of one (1) foot berm shall be constructed at this level and the remaining slope constructed upward parallel with or on a flatter slope than the original natural bank, provided sufficient adjoining property is available. If such property is not available, permanent riprap shall be placed to the top of the bank. Permanent riprap material shall be placed from the bed of the channel to three-(3) foot above the normal high water line or to the top of the bank. If riprap is placed to the top of the bank, a berm will not be required. Permanent riprap shall be a 5 to 1 mix of sand to cement in burlap or canvas bags, "Sacrete", broken concrete, man-size rock or other material approved by the Engineer. "Sacrete," where used, shall be transferred to burlap or canvas bags. All raw soil exposed above the riprap shall either be sodded or seeded, fertilized and mulched. On slopes greater than 10%, sod shall be pegged for stability.

### **SLOPE PROTECTION-ADJACENT TO STREAM CROSSINGS**

In clearing and grubbing of the right-of-way, a twenty (20) foot deep strip of natural vegetation the full width of the right-of-way shall be left on both sides of the streams or drains to be crossed. Deflection dikes consisting of gravel or other suitable material, reinforced by one (1) row of sandbags, shall be used to divert runoff from steep slopes adjacent to water crossings where contributing runoff could be great enough to cause slope erosion and resulting sedimentation at the stream crossing. Diversion berms, filter berms, diversion ditches or terracing may be appropriate. On slopes greater than 20%, such diversion structures shall be placed at the top of said slopes and at one hundred (100) foot intervals or less on the slope face. Similar



diversion structures shall be placed along the top of the stream bank where the entire slope is not protected with riprap. Water shall be diverted to undisturbed areas adjacent to the right-of-way.

All pipe trench excavation shall stop some distance from the stream to leave a protective plug of ten (10) to twenty (20) feet of unexcavated material at each bank. The plugs shall be left in place until the pipe laying operation across the stream has begun. Bypassing of the water in the trench to the side by diversion ditches or by pumping may be required. The water shall be diverted to undisturbed areas adjacent to the right-of-way.

Replacing of bank plug and grading of the stream banks within fifty (50) feet of the stream shall be accomplished immediately following pipe laying. Clearing and the removal of protective vegetation shall be kept at a minimum distance ahead of the trenching unit.

Any unforeseen situations that may be encountered during the course of construction that may cause accelerated erosion and deposition of sediment into the waterways and/or lakes shall be controlled by methods that may include sediment traps, sediment basins, or holding ponds. Any slope failures or development of gullies after construction has been completed shall be corrected immediately.

## **SURFACE RESTORATION**

In addition to the aforementioned specific requirements for the stream crossings, stream bank protection and slope stabilization adjacent to streams, the following restoration shall be done by the Contractor:

1. When final topography has been established, all bared soil shall be seeded, fertilized and mulched in an effort to restore to a protected condition, except in flat, active farm fields. Critical areas shall be sodded as specified hereinafter under "Excavation and Backfill".
2. Seed shall be at least, per acre, ten (10) pounds Kentucky 31 fescue, three (3) pounds Birdsfoot Trefoil, and three (3) pounds White Clover.
3. Fertilizer shall be, at least, two hundred (200) pounds per acre 12:12:12 or equivalent.
4. Mulch shall be 2 tons/acre of straw or hay. A chemical mulch or other approved material may be used. Mulch shall be anchored in place by an approved tackifier to prevent it from being blown or washed away.
5. On slopes greater than 20% but not immediately adjacent to stream crossings, a wood cellulose fiber mulch shall be applied. The mulch shall be degradable wood cellulose fiber or 100% recycled long fiber pulp, free from weeds or other foreign matter toxic to seed germination and suitable for hydromulching. Acceptable manufacturers of Wood cellulose fiber mulch are:
  - a. Conwed Hydro Mulch: Conwed Corp., St. Paul, Minnesota
  - b. Cellin Fiber Mulch: Cellin Manufacturing, Inc., Lorton, Virginia
  - c. Superior Turf-Guard: Cellin Manufacturing, Inc., Lorton, Virginia

A tackifier shall be applied to all erosion prone slopes, or at the direction of the owner or engineer, to

hold either wood cellulose fiber mulch or straw in place. The tackifier shall consist of a liquid concentrate diluted with water forming a transparent 3-dimensional film like crust permeable to water and air and containing no agents toxic to seed germination. Available manufacturers and types include:

- a. Polybind DLR: Celtite, Inc., Cleveland, Ohio
- b. Curasol AK: American Hoechst Corp., Elk Grove, Illinois

If mulch materials such as netting or mulch blankets are used, they may have to be pegged. Erosion control blankets shall be designed for the specific application and the design shall be submitted to the City engineer in writing for review and approval prior to installation.

The aforementioned permanent protection measures (1-5) shall be in effect not more than 30 days after the earth change is completed, except for tie-in areas at both sides of the stream where temporary measures will be installed within three (3) days following a pipeline crossing. Temporary measures may include a row of sandbags at the top of the bank, a row of pegged bales of straw, or an earth berm or diversion ditch. These temporary measures shall be maintained until permanent measures are installed.

Where construction calls for or the Drawings involve placing sewers in the roadways or under other impervious materials, special care shall be provided by the Contractor.

- 1. Provide control measures at all storm sewer catch basins by providing straw or other types of filters or construct sediment traps adjacent to inlets.
- 2. If a roadway has a grass ditch area, minimize disturbance and provide filter berms (straw or gravel) or sediment traps as appropriate.
- 3. Provide proper down drain structures to control increased runoff to streams and drains.
- 4. Stabilize the roadway as soon as possible after placement of the sewer. Temporary erosion control measures shall be instituted until final paving is complete. Such measures may include a subbase surfacing application or gravel surfacing. Compaction of soil may suffice if other control measures are affected.

## **UTILITY DESIGN AND CONSTRUCTION STANDARDS**

### **GENERAL**

Plans for water main, sanitary sewer and storm sewer shall consist of a title sheet and plan sheets showing a plan view of the complete job, split plan, profile sheets and standard detail sheets. Sheet size shall be 24"x36". A location map at a scale of 1"=2000' shall be provided.

A quantity table must be included on all site plans. Total lineal footage, size and material type shall be specified for water main, sanitary sewer, sanitary force main and storm sewer. Quantities for all appurtenances (including but not limited to hydrants, manholes, etc.) must be included on the Quantity Table.

Existing topography is required, extending 100' past the site boundaries and including all existing or planned surface or underground improvements in streets or easements in which construction is proposed or in contiguous areas if pertinent to design and construction.

All residential development projects require that street lighting be provided, unless otherwise approved by the City Manager. A Street Lighting Plan should be submitted to the City with the utility drawings on the Final Site Plan. Street lights shall be provided at all locations where driver action (turning, stopping, etc.) is required, or as directed by the City. The City shall submit the Developer's approved Street Lighting Plan to Detroit Edison for their determination of price. The Developer shall be responsible for all payment to Detroit Edison for street light installation; the City shall be billed for street light operation.

## **WATER MAIN DESIGN STANDARDS**

### **WATER MAIN PLANS**

1. Water main plans shall be presented on 24"x36" sheets. The scale should not be smaller than 1"=100', with plan and profile a scale of 1"=50' horizontal and 1"=5' vertical as required. The minimum water main size shall be 8 inch.
2. A north arrow, scale and legend shall be provided for each sheet.
3. Plans shall be dated, with each revision date noted with explanation of change.
4. Elevations shall be on U.S.G.S. datum. Benchmarks shall be shown at least every 1200 feet. Street names and widths, subdivision names, lot numbers and sizes, and a legend shall be shown.
5. The plans shall carry a note requiring that all construction shall conform to the City of South Lyon Engineering Standards.
6. Existing topography including all utilities existing and proposed shall be shown.
7. All water mains larger than 6 inches shall be shown in profile. The Engineer may also require profiles be shown where multiple utility crossings provide the potential for conflicts.
8. Provide elevation at top of mains at all points of potential conflict with other utilities (for all water mains regardless of size).
9. Plans should show size, type and class of pipe, with distances between fittings, valves, and other appurtenances. The plans should include a list of quantities.
10. Finished grades must be provided at hydrants and valve wells.
11. Dimensions to property lines, right-of-way lines and buildings.
12. Service line location and diameter shall be shown to all buildings including location of curb stop box.
13. Detail sheets shall be provided for all water main and appurtenances and structures to be included with underground construction, special or unusual mains or allied construction requirements.
14. Scales used for special details shall be selected to clearly portray intended construction and component or equipment arrangement. Scales used shall be clearly identified.
15. Hydrants shall be provided at 300' intervals along the main or so as to provide for coverage of the entire site with arches of 500' diameter, or as required by the City, City Engineer, or Fire Department. It is recommended that a hydrant be located at every intersection on the same corner with the street sign name.

16. Hydrants shall be placed at high spots along the main for air release and at low spots along the main for sediment blowoff.
17. All water main valves shall be installed in wells, except hydrant valves.
18. Plans shall carry "Miss Dig" note.
19. The water main shall be installed across the length of the property to provide for future system expansion for adjoining property. Appropriate easements shall be dedicated for such purpose.

## **WATER MAIN CONSTRUCTION**

### **General**

This work shall consist of the furnishing and installation of water mains, valves, hydrants and connections of the size and character and at the locations shown on the Drawing, and include excavation, bedding, backfill, testing and sterilization. The Contractor shall set crosses, tees, bends, sleeves, and other special fittings in the main where shown on the Drawings or where directed by the Engineer. All unconnected openings shall be closed by standard plugs. All special fittings shall be incidental to the water main construction.

### **Reference Standards**

Performance and material requirements shall meet or exceed specific Reference Standards as referred to hereinafter under individual items.

### **General Requirements**

The distribution system in all developments requiring greater than 600 feet of water main shall have a minimum of two connections to a source of supply and shall be a "Looped" system. Water mains less than 600 feet are to be looped whenever possible. The distribution system shall have the ability to serve at least 2000 gpm in single-family detached residential; 3000 gpm in apartment, cluster residential and similar complexes, institutional, and school areas; and at least 4000 gpm in office, industrial and shopping centers. Water mains are required to be extended along all road frontages abutting the proposed development. Transmission water main lines through a development shall be 12" minimum unless otherwise approved by the Engineer. Water mains shall in no case be less than eight (8) inches in size. Hydrant leads shall be a minimum of at least six (6) inches in size.

All water mains shall have a minimum of 5'-0" cover.

Generally, water mains shall be installed on the north or east side of all streets, seven and one half (7.5) feet from a public street right-of-way, or in an easement exclusively reserved for such use. A barrel-to-barrel horizontal separation of at least ten (10) feet shall be maintained between water main and sewers. Vertical separation shall be at least eighteen (18) inches.

Water mains shall, where feasible, be constructed outside of paved parking areas, streets and drives.

Water main stubs shall be provided to the property lines at locations designated by the Engineer for future extensions.

Easement descriptions shall include hydrant leads and shall extend a minimum of 10 feet beyond the hydrant on any lead. The easement documents shall contain a provision prohibiting the construction of, or locating of, any above ground structures, trees or bushes within the limits of such easements.

Water main stubs shall terminate with a hydrant, followed by a gate valve in a well.

All water mains crossing paved public streets shall be bored and jacked or constructed by other trenchless technology methods, unless otherwise approved by the Engineer.

For interior fire protection systems, a separate line shall be provided in addition to a domestic service for each building. Individual shutoff valves shall be provided within a public water main easement.

A tapping sleeve, valve and well shall be provided at every connection to an existing main unless otherwise approved by the Engineer. All such connections provided shall not disrupt the existing water service.

In general, valves shall be arranged such that no single line failure will require more than 800 feet of main, 24 homes, or 30 multiple units be out of service. Valves shall be arranged so that any section can be isolated by closing not more than 4 valves. Valves shall also be required as directed by the City or City's engineer.

A trace wire shall be installed and secured in place on all water main and appurtenances, as specified in "Trace wire".

### **Tests**

Testing shall be accomplished as specified hereinafter under individual items.

### **Certification and Inspection**

All pipe and fittings delivered to the job shall be accompanied by certification papers showing that the pipe and fittings have been tested in accordance with the applicable Specifications and that the pipe and fittings meet the Specifications for this project. All pipe and fittings will be inspected upon delivery to the jobsite. No cracked, broken or damaged pipe or fittings will be allowed in this work.

Each piece of ductile iron pipe and each fitting shall have its weight and class designation conspicuously painted thereon. Where required, other designation marks shall be painted on the pipe or fittings to indicate correct location in the pipeline in conformity to a detailed layout plan.

## **SUBMITTALS**

### **Shop Drawings and Guarantees**

Furnish shop Drawings and guarantees of the items to be furnished. Design details of joints and joint restraint shall be submitted to the Engineer for his consideration and approval before ordering any pipe.

## **PIPE, JOINTS AND FITTINGS**

### **General**

The allowable types of pipe, fittings and joints for water mains are specified below. All pipe shall have clear inside diameters not less than the dimensions shown on the Drawings.

### **Ductile Iron Pipe (DIP)**

Ductile iron pipe shall meet or exceed the requirements of ANSI Specification A21.11 (AWWA C111), A21.51 (AWWA C151) or latest revisions thereof and shall be designed for 150 psi working pressure with mechanical joints or slip-on rubber gasket "Tyton" type joints. All water main pipe shall be Class 54 at a minimum class. Eight-inch (8") shall be the minimum size main.

All pipe shall be provided with external electrical conductivity connections. A trace wire shall be installed as specified in "Trace wire".

Mechanical joint pipe, fittings and accessories shall conform with applicable requirements of American National Standards Institute ANSI A21.11 and Federal Specification WW-P-421b. Rubber gaskets shall conform to the manufacturer standards.

Fittings for ductile iron pipe shall be cast or ductile iron pipe and shall be mechanical joint, conforming to ANSI A21.10 (AWWA C110). Ductile iron fittings shall be Class 54 wall thickness and shall conform to ANSI A21.53.

Where bell and spigot pipe and fittings may be necessary for occasional connections to existing water mains, Class 150 pipe shall conform to the requirements of Federal Specification WW-P-421 and Class D fittings shall conform to the latest standards of the American Water Works Association.

All joint material shall be furnished with the pipe. All pipe fittings shall be coated on the outside with a bituminous coating of coal tar varnish or asphalt base paint, one mil thick, at the point of manufacture in accordance with the specifications of the AWWA and cement lined, half thickness, in accordance with ASA Specification A21.4. The spigot ends of all pipe lengths which have been cut in the field shall be ground and beveled to a smooth surface and painted with two coats of asphaltum metal protective paint.

### **Tracer Wire**

A 12 gauge single strand copper wire, encased with blue color code, shall be attached to the top of the main for the entire length of the main being installed, including all appurtenances. The same type of wire may be used to hold the wire onto the top of the main. The wire shall be run to the top step of each manhole and tied off. When splicing wire, a knot shall be placed in the wire to relieve stress at the connection. A grease filled, underground splice kit shall be used for all connections.

### **Pipe Taps**

Water mains shall be tapped for corporation cocks as required for testing and sterilization of completed water mains. A corporation cock shall be required on each side of a valve located within a gatewell or manhole.

Corporations for pipe taps only shall be threaded directly into the pipe.

**Joint Restraint**

All pipe deflections over 20 degrees, all tees and dead ends shall be restrained, tied or harnessed in a manner approved by the Engineer. The restraint shall be applied to joints in each direction from the deflection an adequate distance to resist the axial thrust of the test pressure. Fire hydrants shall be restrained from the main line to the hydrant. Details of all proposed joint restraint, showing type and locations, shall be submitted to the Engineer for approval. **CONCRETE THRUST BLOCKS WILL NOT BE PERMITTED.** Acceptable methods of joint restraint are by means of a mechanical joint with retainer glands such as “MEGALUG” (EBBA Iron) or Tr.Flex (U.S. Pipe) through 24-inch pipe and Superlock (CLOW), Lockfast (American/Griffin) or Tr.Flex (U.S. Pipe) pipe above 24-inch.

**Pipe Restraint Schedule for Water Main**

Minimum length of pipe (in feet) to be restrained each direction from point of intersection, by deflection angle.

PIPE DIAMETER (INCHES)	90 Degree	60 Degree	45 Degree	22.5 Degree
8	50 (3)	23 (2)	16 (1)	8 (1)
10	61 (4)	28 (2)	19 (1)	9 (1)
12	73 (4)	33 (2)	23 (2)	11 (1)
16	95 (5)	42 (3)	28 (2)	11 (1)
20	118 (6)	53 (3)	35 (2)	11 (1)
24	138 (7)	61 (4)	40 (2)	11 (1)
30	170 (9)	75 (4)	50 (3)	13 (1)
36	199 (10)	88 (5)	59 (3)	15 (1)

Notes:

1. All deflection angles falling between those listed above shall utilize the restraining length for the next greatest angle.
2. Values in parentheses indicate the minimum number of joints that must be restrained.



## **SPECIAL CROSSINGS**

### **Rail Road**

Water main shall be installed within an encasement pipe specified by the railroad. Details shall include encasement pipe thickness and diameter, water main bedding, and complete pressure grouting with a flowable fill approved by the engineer. A valve shall be installed on each side of the railroad.

### **Stream or Regulated Wetland Crossing**

Ball joint river pipe shall be used unless otherwise approved by the City. A valve shall be installed on each side of crossing.

### **Acceptance Inspection**

All water main systems shall be subject to a final inspection prior to acceptance of the system by the City.

## **VALVES**

### **GENERAL**

Valves shall be furnished and installed at locations indicated on the Drawings. Valves 12-inches in diameter and smaller shall be gate valves. Valves larger than 12-inches in diameter shall be butterfly valves.

### **GATE VALVES**

Gate valves shall be designed for 150 psi working pressure and meet the requirements of AWWA Specification C500. Gate valves shall be cast iron body, fully bronze mounted, bronze stem, O-ring stem seal, non-rising stem and resilient wedge E.J.I.W. Model D 509. Gate valves shall have a clear waterway equivalent in area, equal to that of the connecting pipe, when fully open. Valves shall be made to open when turned to the left, or counterclockwise. The gate valves shall have square wrench nut operators and furnished with flange connection. Flanges shall be faced and drilled to 125-pound standard. Two complete sets of joint accessories shall be furnished with each valve.

Gate valves shall be installed in wells in such a way that valve can be repaired and/or replaced.

One operating wrench of suitable length shall be provided under this section.

Gate valves shall be manufactured by East Jordan Iron Works, Clow Corporation or equal.

### **BUTTERFLY VALVES**

Butterfly valves shall be Class 150B and shall meet the requirements of AWWA Specification C504-94 or most current standard. Butterfly valves shall be short body laying length and be provided with square wrench nut operators and furnished with 125-pound standard flanges. Butterfly valves shall be installed in manholes in such a way that valves can be removed and replaced.

Butterfly valves shall be manufactured by Henry Pratt Co., Allis Chalmers Mfg. Co., or approved equal.

### **VALVE BOXES**

Valve boxes shall be used only for hydrant valves. Valve boxes shall be cast iron with a cast iron lid marked "WATER" in raised letters.

Cast iron boxes shall be three piece adjustable type. A number 6 base shall be furnished with valves 8-inches or less, and a number 8 base shall be furnished with valves over 8 inches.

## **GATE WELLS**

Gate wells (valve wells) shall be detailed on the Drawings and meet the minimum standards as indicated in the City of South Lyon Water Main Construction Details and as described under “MANHOLES AND CATCH BASINS”. Extension stems and stem guides shall be provided in each valve well where the valve opening nut is five (5) feet below the top of the valve well cover. Extension stems shall extend to within five (5) feet of the top-of-cover elevation.

## **FIRE HYDRANTS AND APPURTENANCES**

### **GENERAL**

- (1) In single-family residential areas, hydrants shall be provided at three hundred (300) foot intervals along the main line or so as to provide for coverage of the entire site with arches of five hundred (500) foot diameter.
- (2) Hydrants shall be spaced at three hundred (300) foot intervals (maximum) in commercial, industrial and multiple resident areas and meet the following requirements:
  - (a) In general, no part of building shall be more than three hundred (300) feet from a fire hydrant as measured by the unobstructed hose length.
  - (b) The City shall approve final locations of all hydrants, which are subject to review by the Fire Chief.
  - (c) Spacing of hydrants around commercial and/or manufacturing establishments shall be considered as individual cases and shall be determined by consultation with the Fire Chief.
  - (d) Fire hydrants located within parking areas shall be protected by a minimum six (6) inch curb, standard guardposts or other acceptable method. Guard post specification: four (4) inch steel pipe, eight (8) feet in length, installed four (4) feet below grade, pipe filled with concrete.
  - (e) The center of the nozzle outlets shall be 28-1/2 inches above finish grade. In all cases, the visibility of the hydrant shall be considered. No parking shall be allowed within fifteen (15) feet of a hydrant.
  - (f) Additional hydrants may be required depending on the specific hazard or use to protect the Structure.
  - (g) A hydrant shall be installed at the end of every dead-end main.
  - (h) A six (6) inch gate valve with a three piece cast iron valve box, five and one quarter inch (5 1/4) diameter screw shaft, shall be placed at each hydrant.
- (3) The four-(4) inch outlet shall face the roadway or other paved area subject to fire department approval.
- (4) All hydrants shall be accessible by roadway capable of supporting fire apparatus and equipment weighing up to twenty-five (25) tons.
- (5) Fire hydrants shall be located within three (3) feet of the curb line or fire lanes, streets, or private streets when installed along such access ways (NFPA 3-7.6).

- (6) Fire hydrant location is important when sprinklers and standpipe systems are installed and the distance between the hydrant and the Siamese shall be located within fifty (50) feet of a fire hydrant. Siamese connection must be visible, readily accessible and properly identified (NFPA 3-6.2.2).
- (7) Fire lanes shall be designated where necessary and as deemed by the Fire Chief.
- (8) If a new building is more than one hundred seventy five (175) feet from a public fire hydrant, a fire hydrant shall be provided ten (10) to fifteen (15) feet off the right side of the drive entrance or as recommended by the fire chief.
- (9) All grade, facing and vertical alignment adjustment of hydrants shall be completed prior to pressure testing.
- (10) All hydrants shall be cleaned and painted with a rust inhibitive, oil base paint such as Rustoleum or approved equal. Color shall be as specified under "Marking of Hydrants."

#### **MATERIALS AND SPECIFICATIONS**

- (1) Hydrants shall meet the requirements of AWWA C502 and shall be manufactured by East Jordan Iron Works 5-BR Breakable Flange with 250 psi working pressure, or approved equal.
- (2) All hydrants shall be ordered with the following specific details unless otherwise directed by the City:
  - (a) Nozzle Combination:  
Two - 2-1/2 inch Hose Connections (National Standard Threads)  
One - 4 inch Steamer Connection (Detroit Standard Threads)
  - (b) Operating Nut: 1-1/8 inch pentagon
  - (c) Inlet Size and Type Connection: 5-1/4 inch Mechanical Joint.
  - (d) Opening Direction: Left (Counterclockwise).
  - (e) Depth of Bury: 5' 6" from the bottom of the connection to the grade line on the hydrant.
  - (f) Minimum Height Above Ground: 28 ½ inches from the ground to center of steamer nozzle.
  - (g) Drain Hole: Must be plugged; no drainback self draining hydrants.
  - (h) Flanges: Breakable Flange.

- (3) The hydrant assembly shall be restrained from the main line to the hydrant. Note: Hydrant assembly to show gravel around base of hydrant.
- (4) Each hydrant assembly shall be tested by the Contractor. The test shall consist of flushing the hydrant for a minimum of 10-minutes. During the test period, the 6-inch gate valve shall be closed and opened. The Contractor shall furnish necessary hoses for the disposal of water. A testing schedule and a method of disposing of flushing water shall be submitted to the Engineer for approval. The Contractor shall coordinate the testing schedule with the Water Department.
- (5) Hydrant lead shall run parallel with the water main.
- (6) Lucas Tee's shall not be used.
- (7) Valve boxes shall be East Jordan Iron Works Figure E3002, or approved equivalent.

## **MARKING OF HYDRANTS**

- (1) Classification of Hydrants

<i>Class AA</i> -	16" Diameter Water Main
<i>Class A</i> -	12" Diameter Water Main
<i>Class B</i> -	8" Diameter Water Main
<i>Class C</i> -	6" Diameter Water Main
<i>Class D</i> -	4" Diameter Water Main

- (2) Marking of Hydrants

- (a) Public Hydrants

All barrels and heads are to be fire hydrant red. The tops and nozzle caps shall be painted with the following capacity indicating color scheme to provide simplicity and consistency with colors used in signal work for safety, danger, and intermediate condition:

<i>Class AA</i> -	Light Blue
<i>Class A</i> -	Green
<i>Class B</i> -	Orange
<i>Class C</i> -	Red
<i>Class D</i> -	Red/Black Striping

Hydrants rated at less than 20 psi should have the rated pressure stenciled in black on the hydrant top. In addition to the painted top and nozzle caps, it may be advantageous to stencil the rated capacity of high volume hydrants on the top. The classification and marking of hydrants are based on individual flow test (NFPA 3-1).

(b) Private Hydrants

When private hydrants are located on public streets or within private enclosures, they shall be painted yellow to distinguish them from Public hydrants. Markings on private hydrants within private enclosures are to be at the owner's discretion (NFPA 3-2).

### **Hydrant Repair Tools**

At the option of the City, a complete set of hydrant repair tools shall be supplied to the Department of Public Works for the hydrants supplied and installed, or required to supply repair kits/parts, as to be determined by the City.

### **SETTING HYDRANTS**

Under each hydrant, the ground shall be excavated to a depth of at least 1-foot below the hydrant base and over an area approximately 3-feet square. This excavation shall be backfilled up to the elevation of the hydrant base with well compacted, clean, coarse gravel or crushed stone.

Each hydrant shall be set truly plumb and held firmly braced in this position. The connection of the hydrant to the branch shall be made by means of mechanical joints as herein specified. All joints between the hydrant and the main shall be restrained by the same means as used for the water main as specified herein under "Joint Restraint".

After the hydrant has been set, an additional 1-foot depth of gravel shall be spread and tamped around the hydrant. When this has been done, the remaining backfill shall be placed and compacted, taking care at all times to avoid jarring the hydrant.

After the hydrants have been set and tested, the above ground portion shall be painted with 2 coats of first quality metal protective paint. The color shall be in accordance with "Marking of Hydrants" stated above.

Prior to acceptance, the lubricant reservoirs in all hydrants having such construction shall be filled with a lubricant acceptable to the State Department of Public Health and recommended by the manufacturer.

## **ELECTRICAL CONDUCTIVITY**

### **GENERAL**

All ductile iron pipe and fittings furnished and installed shall be provided with electrical conductivity connections.

### **EXTERNAL CONDUCTORS**

The electrical conductivity connections shall be of the external conductor type. The conducting strap or cable shall be adequately sized to carry 300 amperes for an extended period of time. The conductor shall be fastened to each side of joint in a permanent manner in accordance with the manufacturer's recommendations. External conductors shall be U.S. Pipe and Foundry Co. "Electro-Bond" strips, Erico Products, Inc. "Cadweld" connectors, Clow Corporation "Cable-Bond Conductor," or approved equal.

Bronze wedges are not acceptable for use as electrical conductivity connections.

### **TESTING**

After the installation of the mains, backfilling, and the hydrostatic pressure tests are completed, the system (pipeline and hydrants) shall be tested for electrical continuity by either the high current "Resistance Method" or the "Pipe to Soil Potential" method. The test method shall be performed and pass the respective requirements to be acceptable. The Contractor shall furnish all equipment required for the test to be performed.

#### **Resistance Method**

The high current resistance method shall be performed by passing a direct current of 200 amperes +/- 10% through the pipeline for a period of 5 minutes. The voltage impressed on the pipe and the current through the pipe shall be measured and recorded for each section. If the resistance compares favorably with the calculated resistance for the length of pipe under test (within +/- 30%), the pipe is electrically continuous.

Insufficient current, intermittent current, or arcing, as indicated by the fluctuations of the voltmeter or ammeter of more than the magnitude of local power line fluctuations at the time of testing shall be evidence of defective electrical contact in the pipeline. The cause shall be isolated and corrected. The defective section shall again be tested and shall meet the test requirements to the satisfaction of the Engineer.

#### **Pipe-to-soil Potential Method**

The pipe to soil potential method shall be performed by applying a small test current (cathodic protection range) to a point on the pipe and observing the potential voltage change at equal distances along the pipe on either side of the test current point. Test current point locations shall be selected to insure the entire length of pipe is electrically conductive.



The negative lead of the test current source shall be connected to the pipe. The positive lead of the test current source shall have an earth ground connection a distance from the pipe perpendicular to the negative lead connection on the pipe. An ammeter shall be used to establish the test current being used. The negative lead of a voltmeter shall be attached alternately to 2 places on the pipe with the positive lead of the voltmeter in a fixed earth ground connection located between the current source and earth ground and the pipe. The test current is then turned ON and OFF while the voltmeter negative lead is at the 2 locations along the pipe. If the same potential change  $\pm 10\%$  is measured from the 2 points of pipe contact, the pipe has electrical continuity. If the potential change is unequal by more than  $\pm 10\%$ , the pipe has an electrical discontinuity and shall be isolated and corrected. The defective section shall again be tested and shall meet the test requirements to the satisfaction of the Engineer.

## **WATER MAIN CONNECTIONS**

### **CONNECTIONS TO EXISTING MAINS**

Connection of new mains to existing mains will be done only after bacteriological analysis results confirm that the new mains are sterile.

#### **Tapping Sleeve**

All taps made into an existing water main shall be made live, with the use of a tapping sleeve, tapping valve, and gateway. Sleeves shall be made of ductile iron. All sleeves shall be mechanical joint and have an outlet flange with dimensions and drilling that comply with ANSI B16.1, Class 125 and with MSS SP-60.

Approved: Mueller Mechanical H-615, East Jordan Iron Works, or approved equal.

#### **Tapping Valve**

The valve shall be resilient wedge, mechanical joint, nonrising stem, open left, O-ring stuff box and shall meet all applicable parts of ANSI/AWWA C500 and C509, or most recent standard.

Approved:

Waterous series 500 Resilient Wedge tapping valve

Clow F-6114 Mechanical Joint for tapping

Mueller T-2360 Resilient wedge tapping valve

#### **Tapping Sleeve and Valve Testing**

Prior to making tap, the sleeve and valve shall be air pressure tested to 150 psi for a time period of 5 minutes after air pressure stabilizes.

### **SERVICE CONNECTIONS**

#### **Location of Water Service**

Location for water service shall be mid lot, in a straight line from water main to property line. The maximum water service lead length shall be 100 lineal feet. All water service leads shall be constructed with new materials and shall be continuous. Joints or splicing of new water service leads is strictly prohibited. A "Certificate of Occupancy" shall not be issued until location is acceptable to the Engineer.

#### **Tapping Saddle**

A tapping saddle must be utilized when tapping all service leads into an existing water main. Tapping saddles shall conform to AWWA C800 and shall be a double bronze strapped. Tapping saddles shall be Mueller H16137, Ford 202B, or approved equal.

All service connections shall be seamless 1-inch Type K, soft temper copper and conform to ASTM B88,

water tube with flared joints for underground service and shall extend from the main to 1-foot inside the property line or shall connect to an existing service.

### **Corporation Stops**

Corporation stops are allowed in a well only and are not acceptable for individual service connections to a water main. Corporation stops shall conform to AWWA C-800 and shall be Mueller H-15000, Clow F-4405, Ford Meter Box Co. F-600, or approved equal with 1-inch American National Taper Pipe Threads ASA B2.1 1960 inlet 1-inch copper outlet.

### **Curb Stops**

Curb stops shall conform to AWWA C800 and shall be Mueller H-15150, Ford Z22-444, Clow F-4544, or approved equal, with 1-inch inlet and outlet and flared joints. Curb stops shall NOT be located in a sidewalk or driveway. Curb stop box shall be visible, vertical and acceptable to the Engineer. The developer of record shall be responsible for exposing, operational demonstration, and raising to grade all water curb stop boxes prior to final acceptance of the development (regardless of individual lots having been sold or not).

### **Curb Boxes**

Curb boxes shall have a saddle style base with stationary rod which shall be attached to curb stop. Lid shall be two hole.

Curb stop shall be fully extended, marked with wooden stake, painted blue and be kept visible at all times.

Approved curb boxes:

M&B - Type A, with BSC-2H lid

Mueller - H-10314

McDonald - 5601 with 5601L lid

Clow - F-450, with F-4586 lid

Cast iron material shall meet requirements of ASTM A-126-B.

Curb box upper sections shall be 1" diameter for a 1" stop. For water services greater than 1", a 1-1/2" diameter upper section shall be provided or other necessary size as directed by the Water Department or DPW. If a pentagon plug lid (in lieu of a two hole lid) is necessary to provide a larger diameter upper section, it should be noted as such on the plans for review and approval by the City. The required size of the upper section shall govern over the required type of lid when both requirements cannot be simultaneously met.

### **Meter Valve**

A ball valve shall be installed prior to the water meter equal in size of the service line to the meter. Approved valves shall have bottom loaded pressure retaining stems, virgin TFE seats and standard port. Valves shall be pressure rated at 400 psi WOG (non-shock), 1/4 turn open or close operation.

Approved: Watts Regulator Company Series WBV (NPT)

## **WATER MAIN CONSTRUCTION**

### **HANDLING PIPE AND SPECIAL CASTINGS**

All pipes and special castings shall be unloaded and distributed along the line of work in such a manner and with such care as will be effectual to avoid the cracking of any pipe or fitting. Dropping pipe or fittings directly from the truck will not be permitted. Care must also be exercised to prevent the abrasion of the pipe coating. Wherever the coating may be found to have been rubbed off, the part shall be recoated as may be required by the nature of the pipe coating.

### **DEFECTIVE PIPE AND FITTINGS**

No pipe or fitting known to be defective shall be laid in the work. Any piece that is found to be defective after it has been laid shall be removed by the Contractor and replaced by a sound and perfect piece. If the major part of the defective pipe is sound, the good end may be cut off and used. Every such cut shall be square and ground smooth. Cut surfaces shall be painted with 2 coats of an approved asphaltum metal protective paint.

### **LAYING PIPE**

Pipe shall be carefully laid to line and grade and shall have bearing over its entire length except at joints where the joint hole shall be of such size as to give adequate room for working. Pipe shall be laid with a minimum 5 ½ -foot cover. Immediately before laying, each section of pipe or fitting shall be thoroughly cleaned of all debris, dirt or other foreign material. It shall be inspected for damage to coating or pipe material and repairs made where required. Care shall be taken to keep the interior of the pipe clean and free of dirt and other foreign materials. Bulkheads or other means shall be used at the open end for this reason.

### **TESTING THE WATER MAIN**

The water main, or section thereof, shall be tested by the Contractor in the presence of the City and the Engineer and all leaks shall be made tight to meet the requirements below. The City shall be notified and be present on site for the start and end of each test. The Contractor shall provide all piping, bulkheads, pumps, gauges, check valves and other equipment required to carry out the test using water furnished by the City of South Lyon and purchased by the Developer.

The section of main to be tested shall be filled with water at least 24-hours prior to starting the test. At the start of testing, the main shall be pumped up to a pressure of 150 psi and the test period shall start immediately thereafter. The line shall then be maintained under this test pressure for a continuous period of 2 hours by pumping water into the line at frequent intervals. The volume of water so added shall be measured and considered to represent the leakage from the line under test during the interval. The leakage per hour under the conditions of test shall not exceed the values shown in the following table:

<u>Size of Pipe</u>	<u>Maximum Leakage Gallons Per Hour Per 100 Joints</u>
4 inches	0.7
6 inches	1.0
8 inches	1.3
10 inches	1.7
12 inches	2.0
14 inches	2.3
16 inches	2.6
18 inches	3.0
20 inches	3.3
24 inches	4.0
30 inches	5.0

In the event that the leakage exceeds the specified amount, the joints in the line shall be carefully inspected for leaks and repaired where necessary. Any pipes or special castings found to be cracked shall be removed and replaced with new pieces by the Contractor. After this work is done, the test shall be repeated. Final acceptance of the lines will not be made until satisfactory tests have been passed.

### **STERILIZATION OF MAINS**

The newly installed water mains shall be disinfected in accordance with ANSI/AWWA C601. The proposed method of disinfection shall be submitted to the Engineer or City for approval.

After pressure testing and before disinfection, all new pipelines shall be flushed until the water runs clear. After flushing, liquid chlorine shall be added to the water in the amount of 80 ppm (parts per million). This will require the addition of the following quantities of powdered chlorine.

<u>Size of Pipe</u>	<u>Pounds of Powdered Chlorine (65%) Per 100-Foot Length of Pipe</u>
4 inches	0.066
6 inches	0.151
8 inches	0.268
10 inches	0.418
12 inches	0.603
14 inches	0.819
16 inches	1.069
18 inches	1.354
20 inches	1.686
24 inches	2.405
30 inches	3.762

After the main, or section thereof, has been filled with the chlorinated water, a contact period of 12 hours shall be allowed with an average chlorine level of 50 ppm, after which the main shall be flushed with water from the distribution system until the chlorine residual of the water in the main is 0.5 ppm. The main shall then be allowed to stand for a 24-hour period. At the end of this period, samples shall be drawn from the main at two or more locations for bacterial analyses. All samples shall be taken in the presence of the City and Engineer. If these analyses show the presence of harmful bacteria, the Contractor shall repeat the sterilization process until such time as the main or section thereof is shown to be sterile by the results of the bacteriological analyses. The Contractor shall furnish the chlorine and all necessary equipment for testing. The City will supply the water. The Contractor shall make suitable arrangements with the City for the bacteriological analyses. The Contractor shall dispose of the high residual chlorine water by a method approved by the Engineer.

The City and Engineer shall be notified and be present on site for the start and end of the test.

## **SANITARY SEWER PLANS**

### **GENERAL**

Plans must include the following general information as a minimum.

1. Sanitary sewer plans shall be presented on 24"x36" sheets. U.S.G.S. datum shall be used with a scale of 1"=50' horizontal and 1"=5' vertical.
2. An overall layout of the sewer system should be shown with manhole numbers, direction-of-flow arrows, and district limits of sewer.
3. North arrow, scale and legend shall be provided for each sheet.
4. Plans shall be dated with each revision date noted with explanation of change.
5. Elevations shall be on U.S.G.S. datum. Benchmarks shall be shown at least every 1200 feet and convenient to the proposed construction. They shall be noted on the Plan and Profile sheets with identification, location, description and established elevation listed. At least two benchmarks shall be noted on each sheet.
6. The plans shall carry a note requiring that all construction shall conform to the City's construction standard.
7. Existing topography including all utilities existing and proposed shall be shown.
8. All sanitary sewer mains shall be shown in profile.
9. Street names, streets and easement widths, subdivision name, lot numbers, lot dimensions, survey information including deflections and curve data, first floor elevations with indication of with or without basements, and list of quantities.
10. Location, length, size, class of pipe and direction of flow of each section between manholes.
11. Locations of all manholes and other sewer appurtenances and special structures.
12. Building sewers, wye branches, or tee inlets to be constructed concurrently with sewer construction, with locations at easements and/or property lines. Length, size, end of lead invert elevations, and amount of riser shall be shown on the plan for each building lead and type of connection between service lead and house lead.
13. Dimensions to manholes and sewers to property lines, right-of-way, or building.
14. Sewer line location and diameter shall be shown to all buildings including location of monitoring manhole for industrial connections.
15. The sewer main shall be installed across the length of the property to provide for future system expansion..

## **PROFILE**

Profile portion shall appear below companion plan portion, generally projected vertically, and shall show the following:

1. Size, slope, length, type and class of pipe, and controlling invert elevations for each section of proposed sewer between manholes. The minimum size of sanitary sewer shall be 8 inches.
2. Limits of special backfill requirements.
3. Profile over centerline of proposed sewer, of existing and finished grade, and pavement surfaces. Existing profile shall be obtained from actual field survey or aerial photographs. Profiles from aerial photographs shall be adequately field checked.
4. Location of existing or proposed installations crossing the sewer line or otherwise affecting sewer construction.
5. Location, by station, of every proposed manhole, with manhole number, invert elevation of all inlet or outlet pipes, top of casting elevation, and manhole type.
6. Location, by station, of all building sewers, wye branches or tee inlets to be constructed or installed concurrently with proposed sewer construction.
7. The elevation of the lowest floor and corresponding lot number to be served by the sanitary sewer. 3' minimum freeboard shall be maintained between the crown of the sanitary sewer and lowest finished floor elevation of each structure to be serviced by gravity sanitary sewer service.
8. Cover elevations of all manhole covers shall be shown.
9. All required risers, with control elevations.
10. Invert elevation at property line for building sewers to be included with sewer construction.
11. Manholes shall be identified by numbers assigned consecutively and increasing in direction opposite to direction of flow in each sewer.
12. Provide elevation of other utilities at all points of potential conflict.



## **SANITARY SEWER DETAILS**

Detail sheets shall be provided for all sanitary sewer mains and appurtenances and structures to be included with underground construction and special or unusual mains or allied construction requirements.

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

For sanitary sewer construction requiring permits from the Michigan Department of Environmental Quality, the petitioner shall submit a completed Part 41, Act 451 permit application, prepared for the signature of the City clerk or representative.

## **SANITARY SEWER CONSTRUCTION**

### **SEWER PIPE**

All sewer pipes shall meet the requirements of the National Clay Pipe Institute (NCPI), American Society for Testing and Materials (ASTM), or American Standards Association (ASA).

### **ACCEPTABLE PIPE FOR SANITARY SEWER**

POLYVINYL CHLORIDE PIPE (PVC)-Sewer pipe shall meet or exceed requirements of ASTM D 3034 or approved equal and have a minimum pipe stiffness of 115 psi, according to ASTM test D 2412. Pipe shall be stamped with the class of SDR 26, or approved equal.

Service Leads shall be Schedule 40 or SDR equivalent, unless otherwise approved by the engineer.

### **REINFORCED CONCRETE SEWER PIPE**

This pipe shall conform to the requirements of ASTM C76, Class IV (minimum).

### **DUCTILE IRON PIPE (CEMENT LINED, STANDARD THICKNESS)**

Ductile iron pipe shall be used for force mains and shall conform to the current requirements of ASA A21.51. Minimum class shall be 54.

Mechanical joints, when specified, shall conform to the current ASA A21.11. Bolts shall be high strength, low alloy steel type.

### **JOINTS IN POLYVINYL CHLORIDE PIPE**

Joints in polyvinyl chloride pipe shall be bell and spigot meeting ASTM Standards. Each joint shall consist of a spigot and formed bell, complete with a factory installed flexible elastomeric gasket meeting ASTM Standards. Joints in all polyvinyl chloride tee branches, wyes, fittings, riser pipes and service laterals shall conform to joints furnished for polyvinyl chloride pipe. All joints shall be made using lubricant as supplied and as directed by the pipe manufacturer. When necessary to field cut a standard length of pipe, the new spigot end shall be prepared as recommended by the manufacturer.

### **JOINTS IN REINFORCED CONCRETE SEWER PIPE**

#### **Sanitary Sewers**

Joints in concrete sewer pipe shall be bell and spigot or tongue and groove, meeting ASTM-443 standards, with rubber gasket or approved equal.

Modified groove tongue concrete pipe shall have a compression type rubber gasket snapped into a groove cast into the tongue. The modified groove or bell end of the pipe shall be made smooth and shall not have over a three (3) degree slope tapered to fit the rubber gasket to tolerances as detailed by the gasket manufacturer. Rubber gaskets shall meet the physical requirements of ASTM.

Lubricants shall be supplied by the manufacturer to be used on the groove and on the tongue in making up joints, and the joints shall be coupled in accordance with the pipe manufacturer's requirements.

Joints in reinforced concrete sewer pipe and reinforced concrete pressure pipe for sanitary sewers of diameters 49 inches and larger shall meet AWWA Standards.

When concrete pipe 49 inches in diameter and larger have been jointed, a band at least 5-1/2 inches wide shall be placed around the outside of the pipe at the joint as required by and available from the pipe manufacturer. This band shall serve as a form for placing a 1:2 cement mortar grout in the external recess formed by the face of the bell and the shoulder of the spigot. If the air temperature is below 40 degrees F., the spigot, bell and mortar shall be heated. If a reinforced paper joint band is used, it shall be drawn up tight around the pipe and the backfill tamped against it up to the springline before pouring the grout. If a cloth band is used, it shall be wired around the outside of the pipe and the grout poured before backfilling.

The annular inside angular space between pipe joints shall be completely filled with preformed, cold-applied, ready-to-use plastic joint-sealing compound and primer. Installation of the joint material shall be as recommended by the manufacturer. Excess joint material shall be trimmed smooth on the inside of the pipe.

All exposed steel joint material shall have a 4-mil factory applied galvanized or equal protective coating.

Material used for round gasket shall be compatible with plastic joint sealing compound.

### **JOINTS IN DUCTILE IRON PIPE**

Joints for ductile iron pipe shall be Tyton, Bell Tite, Fast Tite, or approved equal, and shall be made in accordance with the manufacturer's directions, using rubber gaskets and shall conform to ASA Standards. Joints between ductile iron pipe and concrete or clay pipe shall be made using a rubber adapter.

### **STORING PVC PIPE**

After delivery, PVC pipe shall be stored on a flat surface so that the barrel is evenly supported. Pipe shall not be stored in piles higher than four (4) feet. If pipe is to be stored for an extended period of time, it shall be covered with an opaque material so that it is protected from the sun's rays and the bells shall be inverted in alternate rows so they are not supporting the direct load. Deflection of any particular amount of PVC pipe shall not exceed five (5) percent.

## **LAYING PIPE**

All pipes shall be laid to the line and grade called for on the drawings. Each pipe, as laid, shall be checked by the Contractor with line and grade pole to insure that this result is obtained. The finished work shall be straight and shall be sighted through between manholes.

Each pipe shall be inspected for defects prior to being lowered into the trench. The inside of the pipe and outside of tongue shall be cleaned of any dirt or foreign matter. Joint materials shall be placed as recommended by the manufacturer.

The pipe shall be centered in the grooves and pushed tight together to form a smooth and continuous invert. After the pipe is laid, the bedding shall be carefully compacted under the haunches of the pipe and the trench shall be backfilled to 12 inches above the pipe as specified under "Excavation and Backfill." Sufficient backfill shall be placed after each joint is made along the sides of the pipe to offset conditions that might tend to move pipe off line and off grade. Any pipe found off grade or out of line shall be relayed properly by the Contractor.

## **CONCRETE CUTS**

When the trench must be cut through concrete pavement, driveway or sidewalk, particular care shall be taken not to unnecessarily damage the adjoining areas of the pavement, driveway or sidewalks. All cuts through existing surfaces shall be made with a concrete saw, sawing full\_depth to allow a straight cut parallel with longitudinal and transverse construction or contraction joints.

## **LASER ALIGNMENT**

As an alternate to using line and grade pole, the Contractor may use laser-aligning equipment for the laying of sewers to the specified lines and grades. The Contractor shall furnish all necessary equipment and personnel required to operate the laser equipment.

The laser beam projection shall be rigidly mounted to assure that all ground equipment vibrations will be kept to a minimum and will permit the laser beam to be projected coaxially through the center of the pipe. All units shall be furnished with equipment to control atmospheric conditions in the pipe which could affect the acceptable standard of construction. The equipment shall be operated by competent, trained operators.

## **ALLOWABLE TOLERANCES IN SEWER GRADE**

Sewers shall be constructed and laid to the alignment and grade indicated on the profile or as designated by the Engineer. The grade as shown on the profile or as furnished by the Engineer is that to which the work must conform. A variation of one-quarter (1/4) inch from this will be deemed sufficient reason to cause the work to be rejected and relayed.

## **WYE BRANCH CONNECTIONS**

Wye branch connections shall be provided at such points as are shown on the Drawings or as directed by the Engineer. This shall be of the size and character indicated on the Drawings. Branch connections shall be formed by the use of standard wye branches. All branches which will not have pipe connected to them immediately shall be closed by the use of a stopper set and joined to the bell or groove of the branch outlet by the same type jointing material as used for sewer pipe, or by a method approved by the City.

In order to properly mark the location of every branch connection, the Contractor shall take accurate measurements of all branches before the sewer trench is backfilled. The measurements shall indicate the distance from each branch to the center of the nearest downstream manhole. The Contractor shall furnish the City with a written copy of these measurements immediately upon the completion of any block of sewer.

In addition to the measurements, the Contractor shall furnish and place a 1/2 half inch diameter iron rod or pipe, or a 2-inch by 2-inch cypress, ash, or cedar marking stick at each branch connection of such length that it will reach from the branch up to within 6 inches of the ground surface, or to a length specified by the City. Each marker shall be set in a vertical position and held vertical while backfilling the trench.

## **MONITORING MANHOLES**

Monitoring manholes shall be placed on all industrial and commercial building leads located in an easement or the public road right-of-way, or as directed by the Owner or the Engineer.

## **RISER PIPE**

Where directed by the Engineer, or shown on the Drawings, the Contractor shall furnish and place risers of the size and type shown on the Drawings and/or as listed on the Proposal extending from the branch opening of the sewer up to the established elevation of the house sewer service lateral, as herein specified or to such elevation as will provide existing or future service.

These risers shall be laid up and held in place in a substantial manner and surrounded by Class C concrete as shown on the Drawings. Openings in the top of the riser pipe shall be closed by means of stoppers set as specified below. Each riser shall be provided with a marking stick as specified above for branches.

## **SERVICE LATERAL CONNECTIONS**

The end of service lateral connections shall be staked in the field by surveyed layout. Whenever indicated or noted on the Drawings, house connection sewer shall be installed and located so that the property owner may readily connect to house plumbing. The connections shall be shown on the Drawings and be specified herein under "Sewer Pipe" with a minimum fall of 1/4-inch per foot. A stopper of the same material and joint as the pipe shall be placed at the end of each connection, and marked with a marker stick as specified herein before.

Where new house services are extended to service existing houses not presently connected to a public sewer, the Contractor shall locate the termination of the service to intersect and/or connect to the homeowners

existing sewer system.

Where house services are provided for empty lots, the Contractor shall locate the terminus as directed by the Engineer.

The Contractor shall install house sewer service laterals at the elevation required to service all basement sanitary facilities.

Service to houses without basements or empty lots shall be installed no higher than 8 feet below the finished grade at the property line or lower than 10 feet below finish grade at the house unless directed otherwise by the Engineer.

A riser shall be constructed to adjust sewer lead elevation at the sewer main. All riser sections shall be fully encased in concrete.

Whenever a service connection crosses under a roadway pavement which may not be disturbed, an opening shall be bored to proper grade in the soil beneath the pavement. In case the earth is not sufficiently stable, a suitable casing pipe shall be installed by the boring and jacking method to enable the laying of the service connection through the casing pipe.

The casing pipe and the house sewer connection shall be installed according to applicable requirements given under "Excavation and Backfill" and details shown on the Drawings.

All sanitary sewer service connections shall be inspected prior to backfilling by a designated City representative.

Any cracked or damaged sanitary sewer main shall be removed and replaced by the Contractor.

An outside sewer cleanout shall be installed on all service leads in a location between the building and the property line. The developer of record shall be responsible for exposing, operational demonstration, and raising to grade all sanitary cleanouts prior to final acceptance of the development (regardless of individual lots having been sold or not).

#### **CONNECTION TO EXISTING SEWER MAIN**

Whenever a sewer connection requires that the road be open cut, installations shall be made according to applicable requirements given under "Excavation and Backfill." Streets must be saw cut prior to the start of excavation.

#### **SADDLE**

All new sanitary sewers requiring a tap into an existing sanitary sewer main shall require the use of a sanitary sewer tapping saddle.

Saddles will be Romac "CB" Sewer Saddles, or equal.

**CITY OF SOUTH LYON  
ENGINEERING STANDARDS  
ADOPTED: DECEMBER 11, 1989  
REVISED: March 13, 2006**

Gaskets shall meet or exceed ASTM D-2000 3 BA715. Gaskets shall be virgin SBR compounded for sewer service.

Saddle Casting shall meet or exceed ASTM 536-71 and shall be protected with a corrosion resistant paint.

Band shall be a minimum of 3-1/2" wide of Type 304 (18-8) stainless steel.

## **TESTING**

### **GENERAL**

All sanitary sewers and laterals shall have acceptance tests conducted for tightness. In areas where live leads have to be connected as the work progresses, then only television inspection will be required. All lines must be cleaned prior to being televised, with inspection tape and reports turned over to the City for permanent records.

All sewers 24-inch in diameter and smaller shall be tested using low-pressure air and, where the ground water is above the sewer invert, shall also be tested for infiltration. In areas where the ground water is more than five feet above the sewer invert, the Contractor shall air test with the dewatering system in operation and use an infiltration test after the dewatering system is turned off and the ground water has returned to its normal level.

### **INFILTRATION TEST**

The Contractor may, at his option, test any or all of the sewer lines prior to backfilling. However, such tests shall be in addition to the required test following the backfilling of the trench.

Following completion of the first section of sewer, if the Engineer determines that there is some question of the installation of the sewer, the Engineer may direct the Contractor to conduct a presumptive test to check his installation for defective pipe or faulty joints before it is completely covered with backfill material.

The Contractor shall make provisions for determining the ground water level prior to testing and the level will be confirmed by the Engineer.

All tests shall be made under the supervision of the Engineer. Testing schedule and procedures will be submitted by the Contractor and approved by the Engineer prior to the start of the work.

The Contractor shall provide the necessary materials, equipment and personnel to conduct the test.

Acceptance test sections may be the entire length of the sewer under contract, including laterals, but shall not be less than the length of sewer between two manholes.

The Contractor shall clean and flush the pipe prior to conducting acceptance tests.

TV segmenting testing or visual inspection shall be made to examine the length of sewer being tested to locate possible cracks, breaks, bad joints or misaligned pipe sections. Any cracks, breaks, bad joints or misaligned pipe sections located by the inspection shall be removed and replaced by the Contractor, or the Engineer may order the reconstruction of the defective portion of the sewer. After all repair work is completed, the test shall be repeated. Final acceptance of the sewer being tested will not be made until satisfactory tests have been passed.

All visible leakage in the sewers or manholes shall be repaired even though acceptance tests have been satisfactory.



Maximum allowable infiltration shall not exceed 200 gallons per inch of diameter per mile of pipe over 24 hours for the overall project. All sewers being tested by the infiltration method shall be allowed to stabilize for a period of 24 hours with the test bulkhead in place.

### **PRESUMPTIVE TESTS**

After the pipe section to be checked is plugged, air shall be supplied to the pipe section at a rate sufficient to maintain an internal pressure of 4.0 psig. The exposed surface of the pipe, fittings, and plugs shall then be sprayed with a foamable soap solution to detect by foam any abnormal leakage due to cracks, holes or improperly sealed joints. All sources of abnormal leakage shall be corrected. After all corrections are made, air shall again be added until an internal pressure of 4.0 psig is obtained. The pressure shall then be allowed to decrease to 3.5 psig, at which time a stopwatch shall be started to determine the total time required for the internal pressure to decrease to 2.5 psig.

If the time, in sections, for air pressure to decrease from 3.5 psig to 2.5 psig is greater than the holding time listed in the air test tables contained in the Low Pressure Air Test for Sanitary Sewers Manual published by the National Clay Pipe Institute, or by the Oakland County Department of Public Works Air Test Tables, the pipe shall be presumed to be free of defects.

## **AIR TESTING**

### **GENERAL**

Manholes on sewers to be subjected to air tests shall be provided with a 1/2-inch diameter, galvanized, capped test pipe installed through the manhole wall and extending 3 inches into the manhole at an elevation equal to the top of the sewer pipe. Prior to the air test, the ground water elevation shall be determined as follows:

1. The test pipe in the downstream manhole shall be cleared by blowing air through it.
2. A length of clear plastic tubing shall then be attached to the end of the test pipe and extended vertically upward to or near the top of the manhole.
3. Ground water will enter and rise in the tubing to the elevation of the ground water level at the manhole and will be readily visible.

The air test pressure shall be adjusted to compensate for the maximum ground water level above the top of the sewer pipe to be tested (1 ft. H<sub>2</sub>O = 0.433 psi). After all tests are performed and the sewer is ready for final acceptance, the test pipe shall be plugged in an acceptable manner.

Test equipment shall include source of compressed air, air hose, plugs, hose connections, shutoff valve, throttling valve, cage cock, monitoring pressure gauge, delicate 0.1 psi graduations pressure gauge, and stopwatch.

In all test pressures noted, a pressure adjustment of 0.433-psi pressure for each foot of ground water level above the invert of the pipe shall be added.

Safety precautions shall be carefully observed by the Contractor during air testing, recognizing the danger from plugs blowing out. No person shall be allowed in manholes during testing.

### **ISOLATE PIPE TO BE TESTED**

The section of pipe to be tested is plugged at each end. The ends of all branches, laterals, and wyes which are to be included in the test are to be plugged. All plugs are carefully braced to prevent slippage and blowout due to the internal pressure.

### **ADD AIR**

Supply air to the pipe section. Monitor the air pressure so that the pressure inside the pipe does not exceed 5.0 psig, plus adjustment for ground water.

## **STABILIZE**

When pressure reaches 4.0 psig, throttle the air supply so that the internal pressure is maintained between 4.0 and 3.5 psig, plus adjustment for ground water, for at least 2 minutes. If plugs are found to leak, bleed off the air, tighten the plugs and supply air again.

## **DETERMINE RATE OF AIR LOSS**

The control equipment consists of pressure gauges, valves, and a pocket stopwatch. After the air pressure has been allowed to stabilize for two minutes, the air supply is disconnected and the pressure is allowed to decrease to 3.5 psig plus any necessary pressure adjustments. At 3.5 psig or such other pressure as is necessary to compensate for ground water level, the stopwatch is started to determine the time required for the pressure to drop to 1.0 psig.

NOTE: Make proper pressure adjustment for ground water, where applicable, in determining the beginning and ending of the period for the 1.0 psig pressure drop. The pipeline shall be considered acceptable if the time interval for the 1.0 psi pressure drop is greater than the holding time listed in the air test tables contained in the Low Pressure Air Test for Sanitary Sewers Manual, published by the National Clay Pipe Institute, or Oakland County Department of Public Works Air Test Tables.

## **RING DEFLECTION TESTING**

PVC pipe shall be tested at least eight (8) months after installation and final backfill but no later than thirty (30) days prior to final acceptance of the project. All sewers constructed of flexible material shall be measured for vertical ring deflection by an accredited, independent company. Maximum ring deflection of the sewer under load shall be limited to 5% of the vertical internal pipe diameter. All pipes exceeding this deflection shall be considered to have reached the limit of its serviceability and shall be relayed or replaced by the Contractor.

The Engineer shall determine the footage to be tested, but in no case shall the test section be less than 200 feet.

Equipment used in the tests shall be direct reading, producing an immediate, continuous record of pipe deflection and shall consist of the following units: a nonrotating sensing element, a remote readout instrument, and a strip chart recorder providing a permanent record of the measurements. A copy of the Ring Deflection Testing shall be turned over to the City for permanent records.

Costs for these tests shall be incidental to the job.

**FORCE MAIN TESTING**

No sanitary sewer pumping system shall be put into service until all pressure piping (force main) has undergone a satisfactory hydrostatic pressure test witnessed by a representative of the City.

Before applying the specified test pressure, all air shall be expelled from the pipe. The Contractor shall furnish proper appliances and facilities for testing and draining the main without injury to the work and surrounding territory.

The Contractor shall be responsible for furnishing all equipment required for pressure testing. The main shall be tested with clean water under a minimum hydrostatic pressure of 100 psi. In no case shall the leakage in any stretch of pipe being tested exceed the following amounts in a two-hour period:

2" pipe	0.06 gal per 100 linear feet
3" pipe	0.12 gal per 100 linear feet
4" pipe	0.16 gal per 100 linear feet
6" pipe	0.24 gal per 100 linear feet
8" pipe	0.32 gal per 100 linear feet
12" pipe	0.48 gal per 100 linear feet

The Contractor shall pressure test sections of the force main as directed by the Engineer. Pressure testing shall be made in increments of 2,000 feet or less, unless otherwise authorized by the Engineer, and then only the allowable leakage for 2,000 feet will be allowed.

### **TELEVISION INSPECTION**

All sanitary sewers shall be televised. Under the work, the Contractor shall furnish all materials, labor, equipment and all else necessary for performing a television inspection of new sanitary sewers. Included will be any necessary cleaning and pumping of sewage.

The inspection shall be carried out under the direct supervision of the Engineer's representative with all television inspection being observed by the City Engineer.

All television inspection shall be recorded on a videotape, CD or DVD (or other format deemed acceptable by the City) which shall be turned over to the City. The recording must be made on a continuous running format on which sound and video information can be recorded. The speed and electronics of the recording shall be equal to that which can be played back on a standardized recorder of the electronics industry. The recording shall be made on VHS format tape or digitally on a CD or DVD.

The inspection shall involve the visual observation by closed circuit television. The inspection shall be performed at a rate of speed which will allow examination of all points of infiltration, cracked or crushed pipe, defective joints, misalignment in line or grade, location of wye openings and any defects which may appear. Any items which, in the opinion of the Engineer, require repair shall be precisely located and described by a detailed statement of the condition.

As part of the television inspection, the precise location of each wye shall be noted in relation to the downstream manhole. These locations shall be entered on the wye location sheet supplied by the Contractor.

If the camera encounters a dip in the sewer such that water is standing above the springline of the sewer pipe and if the camera lens becomes submerged because of the condition, the camera rig shall be withdrawn from the sewer and inserted from the other end as far as possible. At all times, backflooding into the reach from the adjacent section shall be prevented.

Two copies of all notes, wye locations and other pertinent information shall be made as a part of the television inspection. One set of this information shall be turned over to the City upon the completion of the inspection of each line. The second copy of the information shall be held by the Contractor until completion of the project, at which time it shall be neatly assembled and turned over to the City.

## **SANITARY PUMPING STATIONS**

### **SECTION 1 GENERAL**

- 1.1** The Standards herein apply to all pumping stations that discharge sanitary flow to force mains, sewers, or interceptors that are owned and/or operated and maintained by the City of South Lyon.
- 1.2** These Standards shall compliment any existing sanitary pumping station standards that may be currently utilized within the city. These Standards, although intended to serve as a guide, may supersede existing standards in cases where the existing standards are less stringent.
- 1.3** In addition to the minimum required standards specified herein, the design and construction of all sanitary pumping stations within the City of South Lyon 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.
- 1.4** All required permits (MDEQ, Building, Plumbing, Electrical, etc.) must be obtained prior to the start of construction of any sanitary pump station.
- 1.5** Residential grinder pumps (<15 gpm) shall be privately owned and maintained and shall not be maintained by the City of South Lyon. This shall be clearly noted on all plans. Documents, Master Deeds, etc. shall be provided that describes the responsible party for future maintenance and repair. However, future private ownership shall not exclude a developer from complying with all of the requirements and guidelines described herein.

### **SECTION 2 DESIGN CONSIDERATIONS**

#### **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. If the station is of the size to be served by a portable generator, then a paved parking area for the generator shall be provided in addition to required vehicle parking. The access driveway alignment shall be such that it is convenient for installing and removing the portable generator in its parking location.

## **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, the adopted Master Land Use Plan, and any other documents published by the city in this regard.
- 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:

$$Q_{avg} \text{ (gpm)} = \text{Average Daily Flow} = (\text{Population}) \times (100 \text{ gpcd}) / 1440$$

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

$P$  = Design population expressed in thousands

$$Q_{\text{peak}} \text{ (gpm)} = \text{Peak Flow} = (Q_{\text{avg}}) \times (P_f)$$

- 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:

$$V_{\text{min}} = (Q_p \times T) / 4 \quad \text{where,}$$

$V_{\text{min}}$  = Minimum Wet Well Volume (gallons)

$Q_p$  = Pump Capacity (gpm)

$T$  = 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.

### **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 of South Lyon 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 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 <sup>1</sup>	Horsepower Req'd ≤ 150 hp <sup>2</sup>	Horsepower Req'd > 150 hp <sup>3</sup>	Troublesome Debris <sup>4</sup>
<b>Wet Well/Dry Well</b>												
<b>Flooded Suction</b>			X	X	X	X	X	X		X	X	
<b>Suction Lift</b>			X		X		X	X	X	X		
<b>Submersible Dry Pit</b>			X	X	X	X	X	X		X	X	
<b>Wet Well Submersible</b>			X	X	X		X			X		
<b>Grinder - Centrifugal</b>		X										X
<b>Grinder - Residential</b>	X											X

- Notes:**
1. Suction lift shall be limited to 18' maximum and shall be 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.

#### 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. 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<sub>2</sub>S) 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. [Note: The acceptance of the method will depend on the pumping station location, availability of portable generator units, response time, and other variables and shall be determined by the city.]
  - 1) Onsite emergency natural gas, liquid petroleum, or diesel powered generator with automatic transfer switch.
  - 2) Onsite secondary engine driven pump driver with automatic starting and switch over controls.
  - 3) Emergency generator receptacle with manual transfer switch.

## **SECTION 3 EQUIPMENT, PIPING, ELECTRICAL, INSTRUMENTATION & CONTROLS**

### **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 that will be owned, operated and/or maintained by the City of South Lyon are required to meet the minimum requirements as described. Those pumping stations that will not be owned, operated and/or maintained by the City of South Lyon may utilize the requirements herein as a guide.

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 the city prior to submittal of the final site plans.

#### **C. Warranties**

- 1) General Components, Maintenance and Guaranty: two (2) years after final acceptance.
- 2) Major Components: two (2) years after final acceptance.
- 3) Pumps: two (2) years non-prorated; or five (5) years prorated.
- 4) Prepackaged Systems: two (2) years after final acceptance.
- 5) Engine Generator Set: Five (5) years, with biannual (twice-yearly) inspection and annual load bank test.

#### **D. Operation and Maintenance Manuals**

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.

### **3.2 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, Durametallic, 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.

**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 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, 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.

### 3.3 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 plug or resilient-wedge gate type.
- 3) Valves within a manhole shall be accessible from the top of the manhole.

B. **Air and Air/Vacuum Release Valves** – Sewage style air or air/vacuum release valves shall be provided 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, 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.

**3.4 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 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.
- 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, and shall meet the manufacturing requirements of ASTM F714. Pipe sizes 4”-24” shall have 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.

### 3.5 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 city.
- C. **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. Designs that incorporate manual alternation may be considered depending on application.
- 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 or Trefice 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 hertz, 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, Goulds, or approved equal.
  
- 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.

### **3.6 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 minimum city 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 may be subject to review and approval by the State of Michigan Building Department depending on the enclosure size and construction. Each manufacturer shall be responsible for contacting the State of Michigan Building Department to determine whether review of the enclosure is necessary.
  
- 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 construction, minimum 10’ diameter with a steel access riser of not less 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 above-grade steel facilities shall have applied to its exterior a coal tar epoxy coating 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.

### **3.7 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. It shall be mounted a minimum of 4 feet above grade.
- 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 or City approved alternate.

### **3.8 Spares**

- A. Submersible pumping stations shall be provided with one (1) spare pump 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.
- E. Relays, light bulbs, etc. for control panels.

### **3.9 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 diesel stand-by generator housed in a weather and vandal resistant enclosure or masonry building, designed to start and operate sufficient pumps to pump 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) All generators shall be provided with critical service mufflers. Generator exhausts from units in buildings shall be piped to the building exterior and shall be insulated with not less than 4" of calcium silicate insulation covered by an aluminum jacket.
- 3) The generator shall be as manufactured by Kohler, Cummins, Caterpillar or city approved alternate, and shall include all safety features, alarm lights, accessories, etc. as established by the City of South Lyon.
- 4) The generator control panel shall contain alarm relays and pilot lights for each alarm. All alarms shall require manual resetting via the reset push-button.

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.

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 rate 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) Bubbler
- 2) Ultrasonic
- 3) Level Transducer

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.

F. **Lighting**

- 1) Interior – Interior lighting shall be enclosed fluorescent or incandescent.
- 2) Exterior – Exterior lighting shall be HPS with photocell control.

**G. Panels and Enclosures**

- 1) Panels and/or enclosures located outdoor or in an unconditioned/unprotected space shall be rated NEMA 12 with a drip or gasketed NEMA 3R and constructed of either stainless steel or aluminum. 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, enclosure heaters with thermostat, GFI type convenience receptacle and switched 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.

**H. Wiring and Conduit**

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

**I. Electrical Components**

- 1) Motor starters shall be of the continuation motor circuit protector type (with ground fault protection for submersible pumps) and shall be NEMA size 1 minimum.
- 2) Pilot lights shall be press-to-test, transformer type, oil tight, heavy duty type. Push buttons shall have 10 amp rated contacts and shall be oil tight.
- 3) All electrical equipment shall be manufactured by Allen-Bradley, Square D, Cutler Hammer or city approved alternate where available.

**3.10 Supervisory Control and Data Acquisition (SCADA)**

- A. Type of system will be site specific, depending upon the existing systems and existing equipment.

**SECTION 4 PLAN REQUIREMENTS**

- 4.1** All construction plans for sanitary pumping stations that are intended to connect to the City of South Lyon sanitary collection system, or be owned, operated or funded through the City of South Lyon shall be submitted to the city for review and approval. It is recommended that these plans be submitted concurrently with the sanitary collection system plans if applicable.

- 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.

**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.

## **SECTION 5 CONSTRUCTION STANDARDS**

**5.1 Manhole Materials and Appurtenances** – Manholes, materials & appurtenances shall meet the requirements established in the City of South Lyon Standard Engineering Specifications.

### **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.

### **5.3 Test for Alignment**

- A. All equipment shall be tested and adjusted for proper alignment.



## **STORM SEWER PLANS**

### **PLAN REQUIREMENTS**

All construction plans submitted for storm sewer approval shall contain, but not limited to, the following information and the current Oakland County Drain Commissioner's Engineering Design Standards for Storm Water Facilities.

### **SEALED PLANS**

Plans and specifications shall be prepared under the supervision of a Civil Engineer registered in the State of Michigan. Each sheet shall contain the signature and seal of that Engineer.

### **PLAN CONTENTS**

1. Plans shall consist of a plan view of the complete job, split plan and profile sheets and standard detail sheets. Sheet size shall be 24"x36". Plans shall include the project title.
2. Location map with north indicator and graphic scale, generally not greater than 1"=100' nor smaller than 1"=2,000', showing location of proposed sewers and relationship of general project area to the surrounding area.
3. Overall layout of the sewer system with manhole numbers and direction-of-flow arrows.
4. Sheet index, symbol legend and plan completion date.
5. A statement that the work shall conform to the City's current standards and specifications.
6. A proposed drainage plan delineating the total area tributary to the sewer system, including areas tributary to individual drainage structures, calculations of runoff coefficients, and identification of any proposed unrestricted off-site drainage.
7. A statement describing the future maintenance of the storm water management facility, including who the entity responsible for that maintenance shall be.

### **PLAN AND PROFILE SHEETS**

The scale of the plan portion of a sheet shall be no less than 1"=50, with the scale of the profile portion of the sheet at 1"=50' horizontal and 1"=5' vertical at a minimum.

The plan portion of a sheet shall contain at least, but not limited to, the following information:

1. Existing topography extending 100 feet past the site boundaries and all existing or planned surface or underground improvements in streets or easements in which sewer construction is proposed, or in

continuous areas if pertinent to design and construction. Topography shall include elevation contours at a minimum of 2-foot intervals at a U.S.G.S. Datum.

2. Street names, street and easement widths, all other street and survey information including deflections and curve data, subdivision name, lot numbers and lot dimensions.
3. Location, length, size and direction of flow of each section of proposed sewer between manholes.
4. Locations of all manholes and other sewer appurtenances and special structures.
5. Sump pump leads, material, wye branches, or tee inlets to be installed concurrently with sewer construction, with locations at easement and/or property lines. Length, size, and end-of-lead invert elevations shall be shown on the plan for each lead.
6. Dimension to manholes and sewers, property lines, right-of-way lines or buildings.
7. A "Miss Dig" note shall be on each plan and profile sheet.
8. If detention or retention is required by the Oakland County Drain Commissioner or the City Engineer, the plan view should indicate proposed grading and details of the inlet and outlet designs.
9. For proposed subdivisions or site condominium projects, individual storm sewer leads of 2-inch minimum size shall be provided to the edge of the right-of-way line or to the equivalent lot line for site condominiums for each residence or industrial parcel being developed. Material for storm sewer leads shall be Schedule 40 PVC, ductile iron pipe or high-density polyethylene. Storm sewer leads shall slope away from the structure toward the main storm sewer.
10. Catch basins shall be located every 300 LF in roadways, or as approved by the City Engineer.

## **PROFILE PLAN**

Profile plan shall appear below the companion plan portion, generally projected vertically, and shall show at least the following:

1. Size, slope, length, type and class of pipe, and controlling invert elevations for each section of proposed sewer between manholes.
2. Limits of backfill requirements.
3. Profile over centerline of proposed sewer, of existing and finished ground and pavement surfaces. Existing profile shall be obtained from actual field survey or aerial photographs. Profiles obtained from aerial photographs shall be adequately field checked.
4. Location of existing or proposed installations crossing the line of sewer or otherwise affecting sewer construction.

5. Location, by station, of every proposed manhole with manhole number, invert elevation of all inlet or outlet pipes, top of cover elevation, and manhole type.
6. Hydraulic gradeline for 10 year and 100 year storms at each manhole.
7. Location, by station, of all building sewers, wye branches or tee inlets to be constructed or installed concurrently with proposed sewer construction.
8. Manholes shall be identified by numbers assigned consecutively and increasing in direction opposite to direction of flow in each sewer.
9. All elevations shall be U.S.G.S. Datum.
10. Reference benchmarks established at intervals not greater than 1,200 feet and convenient to the proposed construction shall be noted on the plan and profile sheets with identification, location, description and established elevation listed. Generally, at least two benchmarks shall be noted on each sheet.
11. Each Plan and Profile sheet shall include a tabulated list of quantities.

#### **DETAIL SHEETS**

1. Standard details shall include the standard sheet and notes.
2. Detail sheets shall include specific and complete details for all sewer appurtenances and structures to be included with the sewer construction and special or unusual sewer or allied construction requirements.
3. Scales utilized for special details shall be selected to clearly portray intended construction and component or equipment arrangement. Scales used shall be clearly identified.

#### **CALCULATIONS**

The petitioner must submit the following calculations to document the drainage design:

1. Storm sewer design calculations for a 10-year design storm, including areas tributary to drainage structures, calculations of runoff coefficients and flows calculated by the rational method. Calculations should show that the 10-year hydraulic grade line (HGL) is within the pipe, with the HGL starting at the elevation of  $0.8 \times$  pipe diameter of the outlet pipe or the permanent pool elevation, whichever is higher.
2. Detention calculations following the method of the Oakland County Drain Commission. Calculations shall also document the storage volume provided in the design basin. Calculations should be shown. The detention system design shall provide for a peak discharge from the site of no more than 0.2 cfs/acre for a 100-year event for the area. The detention system shall provide for at

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least one-foot freeboard and the design shall demonstrate positive overflow capacities. Fencing shall be required when the design sidewater detention depth exceeds 2 feet.

3. Storm water management facilities must also include a sediment forebay designed to capture the 1-year storm and detwater within 48-hours. The volume of the sediment forebay above any permanent pool can be considered as a part of the total detention volume provided.
4. Detention calculations shall demonstrate the mitigation of all stormwater from unrestricted off-site discharge, in addition to stormwater runoff from all area that is determined to be tributary to pre-development topographic depressions on site. Additional stormwater management measures may be required to ensure that the pre-development stormwater discharge conditions are not exceeded, at the discretion of the City and the City's Engineer.
5. If conditions downstream of a detention basin have a limitation in capacity then the discharge from the site will be restricted to conform to the governing downstream conditions, at the discretion of the City and the City's Engineer.
6. Where retention is proposed due to insufficient outlet or other factors, the volume of storage in the retention basin shall be calculated based upon total capture of back-to-back 100-year rainfall events with zero (0) outflow, utilizing the Storage volume equation from the Oakland County Engineering Design Standards for Storm Water Facilities. All storage must be provided above the existing ground water elevation. Soil borings must be provided to a depth of at least 20' below the basin bottom and must show that the soil has percolation ability. Soil percolation ability and rate calculation must be provided by a geotechnical engineer.
7. Storage of storm water within a wetland area will not be allowed.
8. Irregularly shaped basins are strongly encouraged.
9. Developments, renovations or additions less than 0.1 acres in area may not require storm water runoff detention at the time of improvement. Final determination will be made by the City or the Engineer. For such case, a recordable lien to the City must be executed by the property owner stating that when the next future improvement occurs in the property which will make the accumulated area of the recorded lien(s) and the future improvement greater than 0.1 acres, the property owner will make the storm water detention improvements as specified in this ordinance on the accumulated area. The lien shall be prepared by the property owner, at the property owner's expense, and be subject to review by the City attorney. The developer shall responsible for any and all costs incurred as related to the preparation and recording of the lien, including but not limited to: City, engineer, and attorney review, filing, recording, etc.

## **STORM WATER DETENTION LIEN**

### **INSTRUCTIONS TO COMPLETE STORM DETENTION LIENS**

1. The **OWNER** shall attach an 8-1/2" x 11" diagram showing the proposed improvements on the parcel in question. The diagram should show, at a minimum and to scale, the property boundary, all buildings, all paved surfaces (including walks and drives), and the proposed improved areas (buildings and new paved surfaces). Label the diagram **EXHIBIT "A."**
2. Fill in the blanks on the following form. Typing is preferred.
  - Line one should be filled in as the **OWNER** and what **BUSINESS/PROPERTY NAME** (i.e., Joe Johnson, Joe's Pizza, Johnson Condominiums, etc.).
  - The square footage of the proposed improvements and the type of improvement shall be entered in the second blank area on Page 1 (i.e., 5,000 square feet of new building and 1,000 square feet of new concrete/asphalt drive, sidewalk, parking lot, etc.).
  - The sidwell number(s) and proper description of the property, including the correct parcel identification numbers and lot and subdivision numbers, shall be entered in the third blank area on Page 1.
3. The **OWNER** shall formally submit **EXHIBIT "A"** and the completed Page 1 to the City Zoning and Building Department for **REVIEW** and **APPROVAL** by the City Engineer.
4. The **OWNER/OWNERS** shall sign on the second page and have the appropriate witnesses to sign in the appropriate locations.
5. The **OWNER** shall have the CITY APPROVED document **NOTARIZED** in the appropriate place on the second page.
6. The **OWNER** shall take the original document to the Oakland County Register of Deeds and have the document registered. The **OWNER** shall **return one (1) copy of the registered document to the City Engineering Department.** NOTE: The County will not create or distribute copies unless requested by the **OWNER**. All fees to prepare and secure copies of the necessary registered documents shall be borne by the **OWNER**.

**LIEN FOR FUTURE  
STORM WATER DETENTION**

The Grantor, \_\_\_\_\_, hereby grants and  
(Owner)

Conveys a lien to the CITY OF SOUTH LYON whereby he/she/it acknowledges receipt of relief from required storm water detention in exchange for this lien requiring that this deficit be completed corrected as and when future improvements are made to the parcel hereinafter described.

The improvement which was permitted is depicted in the attached diagram shown on the attached Exhibit "A" and described as:

The location of the parcel on which these improvements have been made is:

Prepared By:  
HUBBELL, ROTH & CLARK, INC.  
Consulting Engineers  
555 Hulet Drive  
Bloomfield Hills, Michigan 48303

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The Grantor hereby agrees that a lien shall be placed on this property under the following terms and conditions:

1. Storm water detention for the area(s) specified above will not be required by the City at this time, but will be provided by the property owner when any new development, renovation, or addition to this property is performed in the future, as determined by the City Engineer.
2. The storm water detention to be provided by the property owner shall adequately restrict storm water runoff from the site under a 10-year storm event to 0.2 cubic feet per second per acre, or as determined by the City. The detention shall be calculated using the "Oakland County Method of Detention Basin Design" as available from the Oakland County Drain Commissioner's Office, and incorporated into the City of South Lyon Standard Engineering Specifications by reference.
3. The covenants herein shall bind and the benefits and advantages inure to the respective heirs, assigns, and successors of the parties.

WITNESSETH:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Dated: \_\_\_\_\_

Subscribed and Sworn to before me this

\_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

\_\_\_\_\_  
Notary Public

\_\_\_\_\_ County, Michigan

My Commission Expires: \_\_\_\_\_

## **STORM SEWER MATERIALS**

### **STORM SEWER PIPE**

All sewer pipe shall meet the requirements of the National Clay Pipe Institute (NCPI), American Society for Testing and Materials (ASTM), or American Standards Association (ASA).

### **REINFORCED CONCRETE SEWER PIPE**

This pipe shall conform to the requirements of ASTM C76, Class IV. Pipe shall be premium joint, bell and spigot, with gasket on spigot. All pipe 36" diameter and greater must be cement lined at pipe to pipe joints.

### **SUMP PUMP LEADS**

Sump pump leads shall be Schedule 40 and a minimum of four (4) inch in size.

All sump leads shall be factory installed or a sewer tapping saddle shall be used.

### **CATCH BASINS AND FRAMES**

Catch basins and frames shall be as specified under "Manholes and Catch Basins".

### **RIP RAP**

Rip Rap shall consist of natural heavy stones having a minimum 8" and maximum 18" mean diameter. Rip Rap shall be installed over a woven geotextile fabric in accordance with the manufacturer's recommendation.

Woven geotextile fabric used shall have the following minimum properties:

Grab Tensile Strength:	300 lb
Mullen Burst Strength:	600 psi
Trapezoid Tear Strength:	120 lb
Ultra Violet Stability:	70%
Fabric:	Woven polypropylene monofilament yarns

The following products meet the above specifics for woven geotextile lines:

1. Mirafi Corp., Mirafi 600X
2. Amoco Fabrics, Amoco 2006
3. Exxon Chemicals, GTF 300
4. Or approved equal



## **SURFACE GRADING PLANS**

### **GENERAL REQUIREMENTS**

Grading plans shall be presented on 24"x36" sheets. U.S.G.S. elevation datum shall be used, and the scale of the drawing shall not be smaller than 1"=100'. Larger scales, such as 1"=50', shall be used for clarity of presentation. North arrow, scale, legal land description, property lines and dimensions shall also be shown. Plans shall be dated with each revision date noted with explanation of change.

### **PLAN CONTENT**

Grading plans shall show at least, but not limited to, the following information:

1. Existing topography and ground elevation contours, with a two-foot contour interval extending 100' past the boundary of the site.
2. All proposed and existing storm drainage facilities, such as storm sewers, manholes, catch basins and inlets including rim and end section finish grades. In addition, the grades of proposed and existing utility structures shall be shown. Any off site drainage draining onto or through the site should be noted.
3. Stationing of centerline of street pavements, pavement elevations at 50 foot intervals, and pavement elevations at all high points and all low points.
4. Top of curb or shoulder elevation opposite each front lot corner (and side lot corner for corner lots) to hundredths of a foot.
5. Proposed elevation at each corner lot (front and rear) and side lot elevations to tenths of a foot.
6. Finish house grades for each lot, to hundredths of a foot, shown inside rectangular boxes drawn comparable to a typical house to be built in the subdivision and placed within each lot according to the front yard setback.
7. Whenever swales for lot drainage are called for on the plan, swale elevations at the high point adjacent to the house shall be provided. General flow direction of swales shall be shown with arrows. Include a typical lot-grading scheme.
8. Existing elevations shall be provided at 50-foot intervals along all site boundary lines.
9. Drainage flow arrows shall be shown to indicate the direction of surface water flows on the lots and pavements.
10. Proposed elevations shall be provided for pavement, sidewalks, top of curbs, parking islands and additional locations as required.
11. First floor elevations and finish grades along the building shall be provided.

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12. A benchmark located within 100 feet of the site based on U.S.G.S. datum.
13. Proposed grades shall at no point exceed 25%.
14. The minimum grade for drainage of roadways shall be 0.4%. The minimum grade for parking lots or other large, paved surfaces shall be 1% , unless this slope is not physically possible. Surface grading shall be sufficient to promote positive drainage and final determination shall be at the discretion of the City and the City's Engineer.
15. Any proposed grade separation that necessitates the provision of a retaining wall or the like must be clearly indicated on the grading plan. Retaining walls must be designed by a geotechnical and or structural engineer. Retaining wall design and supporting calculations must be submitted to the City engineer at the time of Final Site Plan Submittal for design concept review. The retaining wall design and supporting calculations must bear the seal of a licensed professional engineer registered to practice in the State of Michigan.

## **CASING PIPE CONSTRUCTION**

### **CONSTRUCTION PROCEDURES**

#### **Excavation**

The Contractor shall excavate and dispose of material of any nature required to carry out the work. All tunnel and shaft excavation shall be performed in accordance with any paragraphs under the section on "EXCAVATION AND BACKFILL" which may apply thereto. All excavated material, except that needed for backfill, shall be promptly removed and disposed of.

Excavation shall be by boring or tunneling methods acceptable to the Engineer.

In all tunneling operations, excavations shall not proceed ahead of the casing pipe a greater distance than soil conditions permit in order to prevent caving of the earth.

During excavation by boring, the opening shall not exceed the maximum diameter of the casing pipe, including protective coating, as required for jacking the casing pipe through the hole.

The Contractor will be held responsible for any settlement of street surfaces, railroad tracks, or damage to pavement, sidewalk, curbing, or public utilities caused by the construction of tunnels and shall repair or have repaired any damage caused thereby.

Backfilling shall be accomplished under the appropriate carrier pipe section of the work.

#### **Drainage**

The Contractor shall furnish, install and maintain all facilities for collecting, conveying and disposing of water in tunnels and shafts until the completion of work. The Contractor shall have on hand at all times sufficient machinery for all emergencies that are likely to arise on work of this character and such machinery shall be kept in good working order. The pumping and power supply to the pumps shall be under the direct charge of competent mechanics, constantly attended on a 24-hour basis until their operation can be safely halted as deemed acceptable by the Engineer.

Effective and continuous control of water during the placing of concrete will be required and the Contractor shall maintain the ground water table to a level of 2 foot below the casing invert during construction.

These facilities may include, in addition to necessary pumping equipment, steel pans properly secured to the surface where seepage is encountered, pipes, dams, blind or tile drains, caulking of seams, sumps and/or other means.

#### **Shafts and Jacking Pits**

The Contractor shall furnish, construct, maintain and refill all shafts or jacking pits where required and shall remove other temporary construction and equipment which he requires to carry out the work specified. The Contractor shall provide steel ladderways at least 20-inches wide in each shaft, with rungs 12-inches on center and include a safety cage. All buildings, fences and other appurtenant temporary structures shall be of

neat suitable appearance and shall be so maintained until completion of the work.

### **Power and Lighting**

All power machinery and tools used in shafts and tunnels shall be operated by electricity or compressed air. No electric voltage in excess of 440 volts will be permitted. Transformers, if used, shall be mounted on platforms or in approved enclosure. The use of gasoline in power shafts or tunnels is prohibited.

All machinery and equipment used in tunnel headings or shafts under gaseous conditions shall bear the approval plate of the United States Bureau of Mines.

All tunnel work shall be lighted with electricity at the expense of the Contractor, with a sufficient number of lights being provided to illuminate properly all parts of the work. All lighting circuits shall be thoroughly insulated and kept separate from power circuits. In gaseous conditions, all lamps shall be mounted in protected gas and vapor proof fixtures.

### **Ventilation**

The Contractor shall keep the tunnel air in a condition suitable for the health of the workers and clear enough for the surveying operations of the Engineer. A sufficient supply of fresh air for the safety and efficiency of workers and Engineer shall be provided at all times throughout the length of tunnels, especially at working places and in all places underground, and provisions shall be made for quick removal of gases. Whenever a 24-hour tunneling operation exists, the Contractor shall have attainable, within one hours time, any spare piece of equipment or material vital to the tunnel operation.

### **Steel Liner Plates**

Care shall be exercised in trimming the excavated soil section in order that the steel liner plates fit snugly against undisturbed material. Excavation shall not be advanced ahead of the previously installed liner plates any more than necessary for the installation of the succeeding liner plate. The vertical face of the excavation shall be supported as necessary to prevent sloughing. At any interruption of the tunneling operation, the heading shall be completely bulkheaded. If soil conditions deem it necessary, tunneling shall be conducted continuously, on a 24-hour basis.

A shield shall be employed at the discretion of the Engineer when soil or other conditions indicate its need. It shall be of sufficient length to permit the installation of at least one complete ring of liner plates within the shield before it is advanced for the installation of the next ring of liner plates. Detail plans sufficient to determine the adequacy of the shield, accompanied with design calculations, shall be submitted to the Engineer for approval and no work shall proceed until such approval is obtained.

A uniform mixture of cement and sand grout as herein-specified under "Jacking Pipe," shall be placed under pressure behind the liner plates to fill any voids existing between the liner plates and the undisturbed material.

Grout holes tapped for no smaller than 1 1/2-inch pipe, spaced at approximately 3 feet around the circumference of the tunnel liners, shall be provided in every third ring. Grouting shall start at the lowest hole in each grout panel and proceed upwards simultaneously on both sides of the tunnel. A threaded plug

shall be installed in each grout hole as the grouting is completed at that hole. Grouting shall be kept as close to the headings as possible, using grout stops behind the liner plates as necessary. Grouting shall proceed as directed by the Engineer, but in no event shall more than 6 linear feet of tunnel be progressed beyond the grouting.

### **Jacking Pipe**

Each jacking shaft shall be completely sheeted to provide proper support for the banks and adequate support for the reaction blocks. The shaft shall be constructed long enough to provide room for jacking head frame, reaction blocks and two sections of pipe. The width shall be sufficient to allow ample working room. The backstops or reaction blocks shall be placed absolutely perpendicular in all directions to axis of the pipe and the guide timbers carefully installed to the proper line and grade.

Jacking pressure must be applied by a pushing frame at right angles to the line to avoid breaking the pipe or forcing it out of alignment. The first section of pipe shall be equipped with a steel cutting shield placed over the upper two-thirds of its circumference and securely bolted to the pipe. A positive stop boring arrangement to prevent excavation ahead of the pipe shall be provided. Excavation ahead of the pipe shall not be permitted.

When excavating, voids outside of the pipe and disturbances of the surrounding material shall be kept to a minimum. Excessive voids shall be filled immediately with sand or other suitable material and thoroughly compacted.

The jacking operation shall be continuous insofar as possible to prevent seizure of the pipe. However if the operation is discontinued for any time, the excavation shall be safely supported with wood bulkhead and adequate blocking.

The casing shall be installed for the full distance between jacking pits. All void spaces between the casing pipe and the ground shall be filled by pressure grouting.

Grouting pressure shall be sufficiently high to fill all voids. Necessary grouting holes shall be installed as required to insure complete filling of void spaces. A grout pipe at least 2 inches in diameter with a control valve attached thereto shall be inserted and securely caulked to the grout hole or a half coupling welded to the casing pipe. Couplings shall be fitted with a threaded cast iron plug. Grout shall consist of mixture of Portland cement thoroughly mixed with mortar sand, with sufficient water to permit steady flow through the grout pipes. The mix shall be 2 parts of sand to 1 part of cement, but the proportions may be varied at the Engineers order even to the extent of enriching the mix to neat cement. If necessary to speed up setting of grout, approved admixtures of quick-setting cement shall be used as directed by the Engineer.

Following satisfactory pipe grouting operations, the grout pipe shall be removed from the grout hole after the grout has taken its initial set. The space occupied by the grout pipe shall be completely filled with stiff mortar and trowled smooth at the inner face.

## **MANHOLES AND CATCH BASINS**

### **MATERIALS**

Manholes on new sanitary and storm sewers shall be precast reinforced concrete with flexible watertight connections between the manhole wall and the sewer pipe.

Manholes on new sanitary sewers larger than 48-inches in diameter shall be precast reinforced concrete set on integrally cast pipe tee sections. Pipe reinforcement shall meet ASTM Specification with class as indicated on the Drawings for the adjoining pipe. Vertical risers shall be set on the tangent of the horizontal pipe. As an alternate, manholes may be constructed of Class A concrete according to details shown on the Drawings.

Manholes on existing sanitary sewers shall be precast reinforced concrete with preformed arched openings and the sewer pipe grouted into the opening and made watertight.

Catch basins shall be constructed of precast reinforced concrete units. These precast units shall conform to the requirements of ASTM. Inside grouting with either cold-applied, ready-to-use plastic joint-sealing compound or rubber gasket shall be used to connect the units. The use of concrete manhole block conforming to ASTM as an alternate will be permitted. If block is used, a mortar coating shall be applied the same as with masonry construction of manholes.

Catch basins shall be constructed with 2' sumps.

Manhole slabs shall be constructed of Class A concrete and manhole channels and fillets shall be constructed of Class C concrete, as specified under "Concrete Work," according to the details given on the drawings. Unless otherwise directed, all surfaces of concrete channels and fillets shall be screeded and floated to a smooth, uniform surface and troweled to a hard finish.

### **MANHOLE STEPS**

Manhole steps shall be of cast iron and meet requirements of ASTM or be steel reinforced high density polypropylene plastic. They shall be a minimum of 10-inches wide and placed a maximum of 16-inches apart. Cast iron shall be manufactured by James B. Clow and Sons, East Jordan Iron Works, Neenah Foundry Co. or equal. Steel reinforced plastic steps shall be PSI-45 as manufactured by M.A. Industries, Inc., or equal.

### **FRAMES AND COVERS**

Cast iron frames and covers shall be furnished and placed on each manhole by the Contractor. Castings shall meet the requirements of ASTM, and shall be of the size and type specified on the City of South Lyon Standard details. Castings shall be set flush with sidewalk, pavement or ground surface and shall be securely cemented in place.

Lids for water main gate wells shall be custom cast as identified on the City of South Lyon Standard details.

Bolted, gasketed frames and covers shall be provided, when in the opinion of the City Engineer they are deemed necessary. The frames shall be anchored to the concrete manhole sections according to details shown on the drawings. When a manhole is located in a street, rubber gasket shall be eliminated and grout shall be installed between the manhole and frame to eliminate any possible movement from traffic. Grouting shall be such that the manhole shall be watertight.

### **DROP CONNECTIONS**

Where shown on Drawings, directed by the Engineer or where a sanitary branch sewer is brought into a manhole more than 18-inches above the invert elevation in the manhole, a drop connection shall be provided. The pipe shall be inserted into the manhole at the line invert for cleaning purposes. The top 1/3 shall be removed so that a sewer-cleaning nozzle can be inserted from the surface.

### **PRECAST REINFORCED CONCRETE MANHOLES**

#### **Joints**

Premium modified tongue and groove joints with rubber gaskets meeting the requirements of ASTM shall be provided for all sanitary sewer manholes. Joints in storm sewer, water main and pumping main manholes shall be either premium joint as specified for sanitary manholes or shall be tongue and groove with a cold-applied plastic joint-sealing compound and primer.

The joints around the inside circumference of the manhole shall be pointed with cement mortar. All holes provided for handling and lifting shall be filled with mortar and made watertight.

#### **Foundations**

Foundations for precast manholes shall be constructed as a cast-in-place concrete slab, precast reinforced concrete slab, or precast reinforced concrete base riser section with integral floor as specified under "Concrete Work". Steel reinforcing for precast base slabs shall meet the requirements of ASTM.

### **PIPE TO MANHOLE CONNECTIONS**

Pipe to manhole connections on new sewers shall be made with resilient connectors meeting the requirements of ASTM and shall be adequate for hydrostatic pressures of 10 psi, without leakage, when tested within accordance with ASTM Specifications. All manholes on sewers shall contain a 1/2-inch diameter, galvanized, capped test pipe installed through the manhole wall and extending three (3) inches into the manhole at an elevation equal to the top of the sewer pipe.

## **MASONRY MANHOLES**

### **Foundations**

Foundations shall be constructed as a cast-in-place concrete slab or precast reinforced concrete base slab as specified under "Concrete Work."

### **Masonry**

Masonry units for manholes shall be either concrete brick or concrete manhole blocks and shall meet the requirements of the standard specifications of the American Society of Testing Materials.

### **Laying Concrete Manhole Blocks**

All blocks shall be clean and shall be laid in full bed of mortar in courses with full and close mortar joints. The courses shall be level throughout, except where otherwise specified. Adjoining courses shall break joints by one-half the length of the block as nearly practicable. The outside surface of each manhole shall be plastered with mortar to a depth of not less than 1/2-inch.

### **Cement Mortar**

Mortar for laying masonry work in manholes and other appurtenances shall be mixed in the proportion of one (1) part Portland cement to three (3) parts sand. Hydrated lime may be added in proportion not to exceed 10% of the volume of the cement.

Mortars mixed by hand shall be prepared in a suitable, clean watertight box. The ingredients, except the water, shall first be thoroughly mixed dry until of uniform color; then water shall be added and the mixing continued until mortar is of proper consistency and uniform texture is produced.

No retempered mortar or mortar that has been mixed for more than thirty (30) minutes shall be used in the work. No cement mortar shall be mixed when the temperature is below thirty (30) degrees F. without properly heating the sand and the water.

### **Backfilling**

No backfilling shall be placed about the masonry manhole walls within 24 hours after the plaster coat has been applied to the outside of the walls.



## **CONCRETE**

### **DESCRIPTION OF WORK**

This work shall include the furnishing of all materials, equipment and construction equipment necessary to construct all concrete and cement work. For procedures not covered by these Specifications, the requirements of ACI 301, Specifications for structural Concrete for Buildings, shall apply.

### **QUALITY ASSURANCE**

#### **Reference Standards**

<u>Reference No.</u>	<u>Subject</u>
ASTM C-94	Ready-mixed Concrete
ASTM C-150	Portland Cement
ASTM C-260	Air-entraining Admixture
ASTM C-309	Curing Compound
ASTM C-494	Chemical Admixture
ASTM C-595	Blended Cement
MDOT SPEC.	Fine and Course Aggregate

### **TESTING**

During the progress of construction and at the direction of the Engineer, the Contractor shall have tests made to determine that the concrete being produced complies with the compressive strength and consistency requirements hereinafter specified.

The Engineer will witness the preparation of test cylinders. The Contractor shall provide concrete for test purposes and shall be responsible for making, handling and storage of the specimens to protect them from damage. Specimens shall be adequately packed and shipped in substantial packages which will prevent damage during transit. The Contractor shall bear all expenses of the shipment to and testing of the specimens by an approved, independent testing laboratory.

### **SUBMITTALS**

#### **Shop Drawings**

Concrete mix design and complete erection Drawings shall be furnished. Shop Drawings shall show setting plan, reinforcement and Details.

## **MATERIALS AND METHODS**

### **Classes**

Concrete shall be Class A except that mud mats and fill concrete shall be Class C unless otherwise approved by the Engineer.

### **Cement**

Cement shall be a well-known brand conforming to the requirements of ASTM Specifications C-150, Type IA, or Type I with air-entraining admixture; or ASTM C595, Type IP-A, or Type IP with air-entraining admixture.

### **Sand**

Sand shall be natural silica sand graded in size up to such grains as will, when dry, readily pass a screen having 4 meshes per lineal inch. It shall conform to MDOT Specifications Class 6AA.

### **Coarse Aggregate**

Coarse aggregate shall consist of crushed stone, gravel, or other approved materials having hard, strong, durable pieces free from adhering coatings. The aggregate shall range in size from 1-1/2 inch to No. 4. All gravel shall be washed and screened.

Coarse aggregate shall consist of premium grade and the total amount of objectionable materials, such as soft particles, chert and hard absorbent particles, shall not exceed four percent (4%). It shall conform to MDOT Specifications Class 6AA.

### **Admixture**

In general, concrete plasticity is secured by the selection of aggregates and in the proportioning of ingredients, including admixtures. Admixtures, when used, shall conform to ASTM Standards.

### **Water**

Water shall be clean and free from oil, acid, alkali or organic matter.

### **Storing Materials**

Cement at the site of work shall be housed in a building with floor raised above the ground and shall be adequately protected from dampness. Cement that has become lumpy or that has been otherwise injured shall

not be used in the work.

### **Reinforcing Steel**

Steel reinforcement shall be round deformed bars free from loose scale and dirt and shall be either billet steel (ASTM A615) or rail steel (ASTM A616) with a yield point strength of not less than 60,000 psi. Welded wire fabric shall conform to ASTM A185 or A497.

### **Bending and Placing Reinforcement**

Bars shall be bent accurately to the shape required by the Drawings before shipment to the job. They shall be placed in the exact position shown on the Drawings and shall be so fastened as to prevent any displacement while the concrete is being deposited.

Bars shall be spaced with a clear distance of not less than the diameter of the bar, nor 1-inch. They shall be placed so that the distance from the surface to the concrete to the nearest bars shall be 2-inches in slabs, walls, beams and columns and 3-inches in the bottom of footings where no mud mat is used.

### **Splicing of Reinforcement**

At splices, bars shall be lapped a distance of not less than the following to ensure full bond development of each bar:

<b>Bar Size</b>	<b>Lap Length</b>
No. 3	16-inches
No.4	18-inches
No. 5	22-inches
No. 6	26-inches
No. 7	32-inches
No. 8	42-inches
No. 9	54-inches
No. 10	66-inches
No. 11	84-inches

Wiremesh: 14-inches overlap between outermost cross wires of each fabric.

### **Forms**

Forms shall conform to the shape, lines and dimensions of the structures as called for on the Drawings. They shall be substantial and sufficiently tight to prevent leakage of mortar and shall be properly braced or tied together so as to maintain position and shape. Forms shall be clean inside when concrete is poured. All form lumber shall be surfaced four sides, unless otherwise specified.

Forms for walls, columns or piers shall have removable panels at the bottom for cleaning and inspections.

Braces inside the forms shall be removed as the concrete is poured. For all walls and columns, some approved type of form tie shall be used which permits the tie to be cut or broken off not less than 1 1/2-inches back of the surface of the concrete leaving a hole in the surface to be pointed up with mortar. To prevent leakage of mortar, structural wooded forms shall be free from distortion, deformity and cracks.

**Mixtures**

Concrete shall be proportioned by volume in accordance with the following table:

	Class	
	A	C
Cement	1	1
Sand	2-1/4	3-3/4
Aggregate	3	5
Maximum Gallons of Water per Sack of Cement	5	7
Minimum Sacks of Cement per Cubic Yard Concrete	6-1/2	4
Air Content (Percent by Volume)	4-6	---

Sand and gravel shall be stored separately and stored in such a manner that earth, grass and other foreign matter cannot be mixed with the materials.

The proportions of fine and course aggregate shall be such as to produce concrete that will work into the corners and angles of the forms and around the reinforcement under the particular conditions of placement without permitting the materials to segregate or free water to collect on the surface. To this end, slight variations from the specified proportions of sand and course aggregate will be permitted as approved by the Engineer.

No change will be permitted that increases the combined quantities (measured separately) of sand and course aggregate beyond those specified. The quantity of course aggregate shall not be less than one-half nor more than two-thirds the combined quantities of fine and course aggregate. The materials shall be measured separately for each batch.

**Mixing**

Concrete components shall be mixed in an approved manner and until the mass is uniform. No frozen or lump material shall be placed in the mix. No mortar or concrete shall be retempered for use. Mixing apparatus shall be kept clean.

**Ready-Mixed Concrete**

The use of ready-mixed concrete will be permitted at the Contractor's option. Such concrete shall conform to the ASTM "Standard Specifications for Ready-Mixed Concrete". Concrete shall have the compressive strength and consistency as follows:

	Class	
	A (psi)	C (psi)
7 Days Minimum Strength	2,500	1,200
8 Days Minimum Strength	4,000	2,000
28 Day Average Strength	4,600	2,600
For Selecting Proportions Consistency Range of Slump (inches)	2-4	3-6
Air Content (Percent by Volume)	5+/-1	

**Placing Concrete**

Forms shall be moist when concrete is placed. Concrete shall be so handled as to maintain its consistency and not to permit the ingredients to separate. It shall be placed immediately after mixing and in layers not over 18-inches deep and each layer shall be so vibrated, rodded, tamped or worked into places that no voids or segregation of the aggregate shall show when the forms are removed.

Concrete shall be discharged at the job within 1-1/2 hours after the cement has been added to the water or the aggregates, except that when the air temperature exceeds 85 degrees F, the time shall be reduced to 45 minutes.

When depositing concrete against the ground for slabs and footings, concrete shall be placed on undisturbed or compacted granular base free from water, mud, frost and ice.

**Removal of Forms**

The removal of forms shall be made without damage to the concrete and in such a manner as to insure complete safety to the structures. Shoring shall not be removed until the member has acquired sufficient strength to support safely its weight and loads placed thereon.

After forms have been removed, all exposed vertical and overhead surfaces shall have burrs and fins removed and all holes filled. The surfaces shall be true to line, with full corners and shall be reasonably smooth.

**CURING**

All concrete shall be maintained in a moist condition for at least the first 7 days after placing for normal concrete and three days after placing for high-early-strength concrete. This shall be done by keeping the surface continuously wet, covering it with a plastic membrane, or by the application of a curing compound

approved by the Engineer. Curing compound shall conform to ASTM Specifications except that moisture loss shall be limited to 0.040 gm/sq.cm. when applied at 200 sq.ft. per gal. coverage.

The surfaces of concrete from which forms are removed before seven days after placing shall be similarly protected until the concrete has been in place for seven days.

#### **CONCRETE WORK IN COLD WEATHER**

Concrete, when deposited, shall have a temperature of not less than 50 degrees F, nor not more than 85 degrees F. During cold weather, which shall be taken to mean weather in which the temperature of the air falls as low as 40 degrees F during any part of the 24-hours, the ingredients of which the concrete is composed, including the water, must be heated immediately before being mixed. Antifreeze additives shall not be used except as approved by the Engineer. During such weather all concrete work shall be housed in, or covered with, canvas or other suitable material, and shall be kept warm by salamanders or by other means which will ensure protection from freezing during the setting period.

#### **CONCRETE WORK IN HOT WEATHER**

During hot weather, concrete temperature shall be closely monitored and kept below 85 degrees F. with the use of cold water and/or ice for mixing water. It is important that the total water in the concrete mix not exceed the quantity approved in the concrete mix design.

## **EXCAVATION AND BACKFILL**

### **GENERAL**

### **WORK INCLUDED**

This section shall include the excavation, trenching, the complete and continual drainage of excavation, sheeting, bracing and shoring of sides of excavation, backfilling around structures and over pipe lines, and the disposal of excess excavated material.

### **QUALITY ASSURANCE**

### **REFERENCE STANDARDS**

Reference No.	Subject
MDOT 6A	Stone Refill
MDOT 8.02.05	Granular Fill
ASTM D1557	Modified Proctor Test
MDOT 6.53.08	Sodding
MDOT 8.21.12	Sodding
MDOT 6.53.05	Seeding
MDOT 8.21.09	Seeding

### **TESTS**

Compaction testing as specified in this section.

## **EXCAVATION**

### **METHOD OF EXCAVATION**

All excavation shall be by open cut from the surface except in special cases where tunneling under pavement or structures may be required, or where tunneling under the root system will be required for tree protection. All excavation shall be made in such a manner and to such a depth, length, and width as will give ample room for building the structures, for bracing, sheeting and supporting the sides of the excavation, for pumping and drainage of the ground water and sewage which may be encountered, and for the removal of all materials excavated. Special care shall be taken so that the soil below the bottom of structures to be built shall be left undisturbed to provide a firm bed for construction.

### **LIMITS OF EXCAVATION**

#### **General**

Trenches for pipes shall be excavated so that there will be a minimum clearance of six (6) inches on each side of the pipe barrel and a maximum width of not more than the O.D. of the pipe plus twelve (12) inches on each side. Trenches shall at all times be of sufficient width to permit the pipe to be laid by first class construction methods. Sufficient space shall be provided in the trench to permit the joints to be properly made. Joint holes may be provided in the excavation with overhanging sides provided the material excavated is of such a nature as to make this procedure safe for the workmen. Before excavation is started either in bituminous or concrete streets, within the jurisdiction of the City, a permit shall be obtained from the City. The paving shall be cut by means of concrete saws, to a neat and straight line along the edge of the intended trench opening.

The last six-(6) inches of depth of trench in granular material shall be carefully excavated and trimmed by hand to exact elevation and contour of the pipe. Where the trench excavation for pipe is in rock or clay soil, the trench shall be undercut a minimum of six (6) inches below the final location of the pipe and bedding material, hereinafter specified, shall be placed and compacted to the underside of the pipe. If the subgrade is disturbed, the space shall be refilled with sand or pea gravel solidly tamped to form a firm foundation for the pipe.

Excavation for structures shall be made to the outside lines and surfaces of such structures whenever it is practicable to build directly against the sides or bottoms of excavations. In such cases, care shall be taken not to disturb the original foundation or backing, with the final excavation or trimming being done by handwork just before the construction work. If excess excavation is made or the material becomes disturbed so as to require removal beyond the prescribed limits, the resulting space shall be refilled with bedding, as specified hereinafter, solidly machine tamped into place, 95% compaction, before construction work proceeds.

Excavation for structures shall be extended sufficiently beyond the limits of the structure to provide ample room for form construction and other construction methods to be followed, wherever necessary.



## **BEDDING**

At least the bottom quarter of the pipe shall be laid on a sand or pea gravel bedding, except that the bedding shall be exclusively pea gravel for pipe 48-inches and greater in diameter. Bedding shall be compacted by machine tamping in layers not to exceed 6-inches in depth with 95% compaction required.

Sand shall be sharp sand, free of lumps of clay, debris and frozen material, with 100% passing and a 1 1/4-inch sieve, and shall be approved by the Engineer. Pea gravel shall be unwashed and shall be 1/4-inch to 5/8-inch in size. The Contractor shall provide pea gravel and sand from offsite, except when the trench passes through a well-defined strata of sand or gravel.

## **STONE REFILL**

In locations where the soil at the bottom of the trench is unstable, when ordered by the Engineer, the Contractor shall excavate below the trench bottom and refill with crushed stone, slag, or crushed gravel equivalent in grading to Michigan Department of Transportation Specifications.

## **LENGTH OF TRENCH OPENING**

In excavating for pipelines, the excavation shall at all times be finished to the required grade for an adequate distance in advance of the completed pipeline. Unless otherwise permitted by the Engineer, not more than 50 foot of trench shall be open at one time in advance of the pipe. The length of street which may be occupied by construction work at any one time will be based on the requirements of the use of the street by the public. No more than 600 consecutive foot of length of the street shall be occupied at one time, and vehicle traffic through the street shall not be entirely stopped without the permission of the Engineer.

## **SHEETING, BRACING AND SHORING**

Sheeting, bracing and shoring shall be provided where required to properly support the surfaces of excavations to protect the construction work, adjacent property or workmen. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he may order additional supports at the expense of the Contractor, but neither the placing of such additional supports by the order of the Engineer nor the failure of the Engineer to order such additional supports placed shall release the Contractor from his responsibility for the sufficiency of such supports and the integrity of the work. In the removing of sheeting and bracing after the construction has been completed, special care shall be taken to prevent caving of the sides of excavation and injury to completed work or adjacent property.

## **SHEETING LEFT IN PLACE**

Sheeting, bracing and shoring shall not be left in place after completion of the work except as required by the Engineer. Where required to protect the work, adjacent structures or property, sheeting, bracing and shoring shall be left in place, but shall be cut off or left no less than two feet below the established surface grade. Sheetting, shoring or bracing so required to be left in place shall be considered as a change in the work.

## **DISPOSAL OF WATER AND SEWAGE**

The Contractor shall remove by wellpoints, pumping, bailing or other acceptable method any water which may accumulate or be found in the trenches or other excavations. He shall make all necessary provisions to keep the trenches and other excavations entirely free of water during construction of pipelines and structures. Newly laid concrete shall be adequately protected from injury resulting from ground water or sewage. No drainage ditches shall be placed within the area to be occupied by any structure except as permitted by the Engineer. Under no circumstances may sewage be discharged to the ground surface.

Discharge water from dewatering methods shall be sediment free or be discharged through an Engineer approved sediment entrapment basin. The Contractor shall at all times have on the site sufficient pumping equipment ready for immediate use to carry out the intent of this section.

## **DIVERTING EXISTING SEWERS**

Where existing sewers or drains are encountered in this work, adequate provision shall be made for diverting the flow in the existing sewers so that excavation will be kept dry during the progress of the construction work. Upon completion of the construction work the existing sewers shall be restored or otherwise provided with an adequate outlet as directed by the Engineer.

## **CONCRETE CUTS**

When the trench must be cut through concrete pavement, driveway or sidewalk, particular care shall be taken not to unnecessarily damage the adjoining areas of pavement, driveway or sidewalk. All cuts through existing surfaces shall be made with a concrete saw, sawing deep enough to allow a straight cut parallel to longitudinal or transverse construction or contraction joints.

The saw cuts shall not be nearer than five (5) foot to a transverse joint, to the center line of the pavement, or to the edge of the pavement or curb; i.e., no replacement shall be less than five feet in width. If the damaged pavement is nearer than five (5) foot to a joint, to the centerline of pavement, or to the edge of the pavement surface or curb, the removal and replacement shall be extended to such joint, centerline, edge of pavement surface or curb. These same requirements with reference to existing joints shall also apply to the cutting and replacement of concrete driveways.

If a square or block of sidewalk is cut, broken, cracked or moved the entire block or square shall be removed and replaced.

## **CROSSING EXISTING STRUCTURES**

During construction, it may be necessary to cross under certain sewers, drains, culverts, water lines, gas lines, electric conduits and other underground structures. Every effort shall be made to prevent damage to such underground structures. Whenever such structures are disturbed or broken, they shall be restored to good condition by the Contractor, unless otherwise noted.

## **BACKFILLING**

### **GENERAL**

Backfilling shall include all work as required as hereinafter specified. The placement of various pipes including bedding and construction structures, shall be completed prior to backfilling.

Any depression resulting from settlement of the trench backfill previous to the date of total acceptance of all work, shall be brought to proper grade and surface, and made to match the adjacent surface.

### **MATERIALS**

#### **Job Excavated Backfill**

Job excavated backfill shall be defined as job excavated material, free from frozen earth, boulders, rocks, stones larger than six (6) inches in size (subject to engineer's approval), debris and organic material.

#### **Granular Fill**

Granular fill shall be defined as sharp sand, gravel, or crushed stone free from clumps of clay, soft or flaky material and shall conform to the MDOT Specification "Granular Materials-Class II".

Material excavated from the trench shall be used as backfill, when in the opinion of the Engineer, it meets the granular fill grading requirements.

### **COMPACTION**

Specified compaction shall be acquired with the use of a bulldozer, sheepsfoot roller, mechanical tamper, or other similar and effective equipment. Whenever compaction is specified, it shall not mean less than 95% (not average 95%) of the maximum unit weight. If the material excavated is not suitable to obtain 95% compaction, the Contractor shall remove unstable materials or add granular materials, or both, to obtain 95% minimum compaction as previously specified.

The maximum unit weight of soil referred to in these Specifications shall be determined by the ASTM D-1557, Modified Proctor Test.

Compaction tests will be made by a representative of the Engineer or a testing company as selected by the developer, approved by the City, and paid for by the Contractor. The Contractor shall provide all equipment and labor required to dig the test holes or excavate for the compaction testing.

### **BACKFILLING TRENCHES**

After pipes have been laid and inspected, the trench shall be backfilled. Under the haunches, at the sides and top, from the bedding to a level at least one foot above the top of the pipe, sand or pea gravel, as specified

hereinbefore for bedding under "Limits of Excavation", shall be deposited and carefully compacted by hand or machine tamping in layers not to exceed six (6) inches in depth, 95% compaction required.

All trenches in paved streets, shoulders, traveled roadways, parking areas and driveways shall be backfilled with job excavated backfill with the city engineer approval first, or granular backfill, for the level one (1) foot above the top of pipe to the specified road surface subgrade. The job excavated backfill material or granular fill shall be placed in not more than six (6) inch layers and uniformly compacted by machine tamping, 95% compaction required. With the approval of the Engineer, water jetting on granular fill may be accepted in lieu of tamping in six (6) inch layers.

Trenches under concrete sidewalks shall be backfilled from a level one (1) foot above the top of the pipe to a level four (4) inches below the finished grade of the sidewalk with job excavated backfill or granular fill and compacted to 95% maximum unit weight.

Trenches not in paved streets, shoulders, traveled roadways, parking areas, driveways and under sidewalks, shall be backfilled from a level one (1) foot above the top of the pipe to the ground surface (except as noted under "Sodding and Seeding") with job excavated backfill and shall not require the tamping other than that required to prevent trench settlement.

Wherever gas mains, water mains, sewers, etc., are located in the trench area, granular fill shall be used for backfill from the bottom of trench up to the spring line of these pipes. Granular fill shall be placed full trench width with two (2) horizontal to one (1) vertical side slopes and compacted in six (6) inch layers to 95% of its maximum unit weight so as to thoroughly support the pipe within the trench area. Granular fill so required shall be incidental to the work.

## **BACKFILLING AROUND STRUCTURES**

As soon as practical after concrete structures have set, forms and debris shall be removed and the surface of the concrete pointed. After the structure had been inspected and approved, the excavated area around the structure shall be backfilled up to the specified subgrade with granular fill, or job excavated backfill, as called for in on the Drawings for the adjacent trench. The fill shall be in layers not to exceed six (6) inches in depth and thoroughly compacted by machine tamping. No large boulders or masonry shall be placed in backfilling. No backfilling will be placed against manhole walls within 24 hours after the plaster coat has been applied to the outside of the walls, nor shall backfilling be placed about the concrete structures until the concrete has attained at least 75% of its designed strength, and approval of the Engineer has been obtained.

## **DISPOSAL OF EXCAVATED MATERIAL**

Excavated material, where suitable, shall be used in backfilling around pipelines and structures. All material in excess of the quantity required for backfilling or unsuitable material shall be hauled away by the Contractor. The Contractor shall obtain such spoil sites as required, except that the Engineer may direct the Contractor to dump materials at any site designated by the Owner within a two-mile radius of the work area. The Contractor shall provide all labor and equipment for spreading such material at the place of dumping and shall leave the area in a neat condition satisfactory to the Engineer.

## **SODDING AND SEEDING**

Whenever the pipe trench passes through a lawn area in private right-of-way, the backfilling shall be carried up to the surface except the top four (4) inches, which shall be selected topsoil preserved or secured elsewhere for this purpose. This topsoil shall be rich black surface earth, free from sod, weed stalks or debris. The trench surface shall be carefully raked to an even surface, and all stones, sticks and other debris removed therefrom. Sod shall be Class A, Merion Blue.

Wherever the pipe trench passes through a sodded shoulder or slope area on public right-of-way, the backfill shall be carried up to the surface except the top 4 inches, which shall be selected soil as specified above. The area disturbed by the construction shall be graded as specified hereinbefore, fertilized with not less than 20 pounds of 10-6-4 commercial fertilizer per thousand sq. feet of area, and seeded with MDOT Roadside Mixture in an amount not less than 5 pounds per thousand sq. feet of area.

Wherever the pipe trench passes through a flat lawn area in the public right-of-way, the backfill shall be carried up to the surface except the top 4 inches, which shall be selected topsoil as specified above. The area disturbed by the construction shall be graded and fertilized as specified hereinbefore, and seeded with MDOT Mixture Class A in an amount not less than three pounds per thousand sq. feet of area.

Where the pipe trench passes through flat field areas, the area disturbed by the construction shall be graded and fertilized as specified hereinbefore, and seeded with MDOT Mixture Roadside in an amount not less than 5 pounds per 1,000 sq. feet of area, unless such grading and seeding is eliminated by specific notations on the drawings.

Seeded areas shall receive a proper mulch of chopped straw, jute matting or woven Kraft paper yarn. Seed shall not be sown between June 15 and August 15, nor between October 15 and April 15, nor at any time when the soil has insufficient moisture to insure proper germination, or the Contractor shall provide sufficient application of water by sprinkling until a growing catch of grass is established.

## **TREE ROOT PROTECTION**

Machines shall freely excavate no closer to the base of a tree than the radius of the tree in inches converted to feet for trees less than 24 inches in diameter; and no closer than 12 feet if the tree is more than 24 inches in diameter. Tunneling under the root system will be required between the points so determined. Approaches closer than the previously stated distance, or tree removal, may be authorized by the Engineer. Trees removed shall be done at the Contractor's expense.

## **ROADSIDE DITCHES AND CULVERTS**

All roadside ditches and driveway culverts shall be cleaned, repaired and replaced to the same or better condition as existed before trenching operations commenced.

## **FINAL CLEANUP AND GRADING**

Upon completion of construction, the contractor shall restore his working area to as clean a condition as existed before his operations were started. He shall go over the entire line and refill any place that may have settled. He shall then regrade and put in shape all backfilled trenches, all fills he may have made from excess excavated materials, and all other areas that may have been disturbed through his operations.

## **RESTORATION WORK**

### **GENERAL DESCRIPTION OF WORK**

This work shall include the replacement of all permanent type roadway surfaces, concrete sidewalks, curbs and gutters and driveways, damaged or removed due to the construction of the pipe and appurtenant structures. All such work shall be in accordance with the best modern practice, the Owner's standards and/or as specified herein.

All utilities such as catch basins, manhole castings, water valve boxes, etc., shall be adjusted prior to the installation of the new surface so that the finished surface will meet such utilities smoothly when surfacing is completed.

### **QUALITY ASSURANCE**

#### **Reference Standards.**

<u>Reference No.</u>	<u>Subject</u>
MDOT 4.00	Construction Mix Designs
MDOT 4.00.04	Trench Surface Conditioning
MDOT 4.06	Bituminous Seal Coats
MDOT 4.06.06	Bituminous Seal Coats
MDOT 4.06.09	Application of Cover Material
MDOT 4.06.10	Weather Limitations
MDOT 4.06.12	Maintenance of Surface
MDOT 6AA	Coarse Aggregate
MDOT 7.10	Plant Hot Mix Method

### **CERTIFICATION**

The Contractor shall submit certificates of compliance with applicable MDOT Standard Specifications.

### **SUBMITTALS**

#### **Shop Drawings**

Prior to performing permanent restoration under this section, the Contractor shall submit to the Engineer for approval his construction methods, design mixes, sieve analysis and/or certification of compliance with MDOT 1984 Standard Specifications for Construction.

## **ROADWAY SURFACES**

The placing of gravel base, the base course, gravel pavements and concrete pavements shall follow immediately after backfilling trench so that not more than 600 feet of length of trench shall be incomplete at one time. If areas of trench in excess of 600 feet are left incomplete, then the Contractor shall provide such necessary temporary roadway surface as directed by the Engineer. Any material placed in the trench other than that specified shall be considered as a temporary surface and shall be removed.

## **SAW CUT JOINTS**

Damaged areas shall be removed by sawing a straight cut parallel with longitudinal and transverse construction or contraction joints. No saw cuts shall be closer than 5 feet to a longitudinal or transverse construction or contraction joint or to the edge of the pavement. If the damaged area is less than 5 feet from an existing joint, the existing surface shall be saw cut 5 feet from the damaged area, removed and replaced. If the damaged area is less than 5 feet from the edge of the pavement, the removal and replacement shall be extended to said edge of pavement.

Saw cutting of concrete shall be done with a carborundum saw to minimum depth of half the slab thickness or that depth required to cut reinforcing steel. Bituminous surfaces shall be cut full depth.

After the trench is backfilled and before the pavement over the trench is replaced, all angular and ragged irregularities on the edge of the cut pavement shall be removed, giving a smooth and regular edge of pavement.

## **EXCAVATION**

Before repaving is started, all trenches and the area around structures shall be excavated or backfilled to the level of the subgrade as required by the type of pavement replacement and the cross section specified. All existing pavement that has been undercut by the excavation for the pipe or structures shall be removed. The finished subgrade shall be smoothed, trimmed and compacted to the required grade and cross section. Compaction of the finish subgrade shall be obtained by suitable means approved by the Engineer.



## **STREET PAVING**

The paving of all streets and intersections, including curbs on all streets and intersections, to the approved grade to a total width of thirty-three feet measured from back of curb to back of curb. All curbs shall be of concrete, and streets and intersection may be paved by either concrete or asphalt provided, however, that all curbs and paving shall meet or exceed Michigan Department of Transportation specifications for same.

Road shall be designed to accommodate the turning movements of the City's largest fire or emergency vehicle (WB-50 type truck or larger, if necessary). Curve radii shown on the plans shall demonstrate this.

## **BASE COURSE**

### **GRAVEL BASE**

All streets, roadways, alleys, shoulders and driveways shall be constructed with not less than 10-inches of road gravel placed in two 5-inch layers. Such surface shall be compacted to 95% of the maximum unit weight and shall extend 24-inches beyond the edge of the pavement in areas where there are no curbs and gutters. Road gravel shall meet MDOT Specifications No. 21AA.

<b>Sieve</b>	<b>Passing</b>
1-inch	100
3/4-inch	90-100
3/8-inch	65-85
No. 8	30-50
Loss by washing	4-8

Contractor shall furnish the Engineer for approval, a sieve analysis of the gravel base material.

### **GRAVEL PAVEMENTS**

Pavement surfaces shall be replaced with gravel as hereinbefore specified under Gravel Base or shown on the Drawings. After placing gravel base, this surface shall immediately be opened to traffic, and as holes and ruts appear, they shall be filled with above specified road gravel and the surface shall be maintained as a smooth, dust free street surface until the work is accepted by the Engineer and owner.

## **BITUMINOUS PAVEMENTS**

### **GENERAL**

Pavement surfaces shall be replaced with bituminous pavement or concrete equivalent in depth and base material to the existing. This work shall consist of saw cutting existing surfaces, as hereinbefore specified under "Saw Cut Joints", conditioning and treating the base course with prime or bond material and constructing thereon a bituminous or concrete pavement consisting of mineral aggregate, mineral filler, and bituminous material combined by a plant hot mix method per MDOT Specifications. Construction methods and equipment for placing bituminous materials shall be as specified in MDOT 1996 (or current) Standard Specifications.

Pavement surfaces shall be replaced to match existing widths.

Bituminous pavement shall be one of the following types:

#### Type A.

1-1/2-inch No. 1100L-20AA leveling course over a 10-inch MDOT 21AA gravel base with 1-1/2-inch No. 1100T-20AA wearing course in trench areas.

#### Type B.

1-1/2-inch No. 1100L-20AA leveling course over a 10-inch MDOT 21AA gravel base and a 6-inch sand cushion/free draining layer with 1-1/2-inch No. 1100T-20AA wearing course over entire width of pavement.

#### Type C

An RCOC 3C/4C bituminous mixture may also be utilized with the cross section for Type B pavement (above) for new, full width pavement construction. A 3C/4C mix may be required for City roadways by the City engineer for areas with high traffic levels, heavy truck traffic, or other road longevity concerns. Special care must always be taken to properly roll the 4C wearing course. Unless approved by the City engineer, 4C wearing course shall not be allowed for repairs, trenches, or other types of paving that are constructed with hand work.

Proposed bituminous pavements shall be designed in accordance with their anticipated usage. All designs shall be bituminous pavements with MDOT 21AA gravel base with the thickness' in accordance with the "MDOT Design Summary for AASHTO Design". All new pavements shall have, in addition to the 21AA gravel base, a 6-inch deep sand cushion compacted to 95%. Fabric wrapped PVC edge drains shall always be placed under new pavements.

Bituminous mixtures shall be Bituminous Mixture No. 1100 furnished and placed in accordance with MDOT Specification 7.10 with no restrictions for the "Aggregate Wear Index." Reclaimed Asphalt Pavement (RAP) is not allowed in the wearing course, unless otherwise approved by the City engineer.

Asphalt Cement shall have an asphalt penetration (viscosity) rate of 120-150. Aggregate required shall be 20AA. For the leveling course, reclaimed bituminous materials may be used, and shall meet MDOT 7.10

Specifications for Using Reclaimed Bituminous Pavement to Produce Bituminous Base Course and Leveling Course Mixtures. When tested at the optimum asphalt content in accordance with ASTM D1559, the bituminous mixture shall meet the requirements for stability, 1100 pounds, flow, 8-18 hundredths of an inch, and voids in mineral aggregate, 15.0%, as specified in Table 7.10-1 of the MDOT Specifications. The maximum allowable deviations permitted from the approved Job-Mix Formula shall be as shown in table 7.10-2 of the MDOT Specifications.

At the Contractors expense, a qualified laboratory shall furnish the Engineer a Job-Mix Formula in accordance with the above criteria. After the Job-Mix Formula is established, the aggregate gradation and the bitumen content of the bituminous mixture furnished for the work shall be maintained within the uniformity tolerance limits permitted in Table 7.10-3 and within the master gradation range as specified in Table 7.10-2 of the MDOT Specifications.

### **CONDITIONING OF THE BASE**

Upon prepared gravel base, a prime coat shall be applied at the rate of 0.25 gallon per square yard. Prime coat shall be MS-OP.

Bituminous base shall be treated with a bond coat applied at the rate of 0.10 gallon per square yard. Prime coat shall be SS-1H or MS-2A.

### **LEVELING COURSE**

Bituminous leveling course mixture shall be placed in one or more layers. When the total application rate exceeds 220 pounds per square yard, the leveling course shall be applied in two courses. A bond coat shall be applied at the rate of 0.10 gallon per square yard between courses.

### **WEARING COURSE**

Following completion of the leveling course or courses, the surface shall be treated with a bond coat of 0.10 gallon per square yard.

All joints in the bituminous pavements shall be vertical joints. Where the joints are allowed to set before the adjoining pavement is placed, such joints shall be treated with bond coat material.

Feathering to connect new pavement to an existing pavement will not be allowed.

### **QUALITY ASSURANCE**

All new pavement shall be of an acceptable workmanship and shall not exhibit conditions such as, but not limited to: broken aggregate, cracking, flushing, rutting, segregation, or roller cracking. When such conditions are observed by the City, the work shall be rejected or compensation acceptable to the City shall be provided. Disputes regarding the quality of work and the presence of any of the conditions listed above

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ENGINEERING STANDARDS  
ADOPTED: DECEMBER 11, 1989  
REVISED: March 13, 2006**

shall be resolved by utilizing MDOT's Special Provision for Pavement Acceptance for Bituminous Mixtures and Special Provision for Controlling Uniformity in Hot Mix Asphalt Pavement During Paving Operations.

## **CONCRETE PAVEMENTS**

Concrete pavements removed shall be replaced with concrete. Thickness shall be equal to that removed but in no case shall be less than 6-inches.

New concrete roads shall be constructed on a 4" MDOT 21AA base, over a 4" MDOT Class II sand free draining layer.

Concrete for pavements and bases shall be Class A concrete as specified under "Concrete". Cement shall be air entraining cement. Course aggregate shall meet the requirements of MDOT Specification 6AA with a 4% maximum of deleterious material.

As directed by the City, Class F Fly Ash or Ground Granulated Blast Furnace Slag (GGBFS) shall be added to all batch plant concrete to help control alkali-silica reaction (ASR) which has recently been detected in a few Metro Detroit area projects. This shall apply for concrete roads, curb and gutter and sidewalks or as determined by the City Engineer. Mix designs shall be submitted to the City Engineer specifying the amount per cubic yard of fly ash or GGBFS to use. If determined to be necessary by the City, the Contractor or Developer will perform Rapid Mortar-Bar Tests (ASTM C1260) to measure the potential aggregate reactivity to more specifically make a recommendation for fly ash/GGBFS or the quantity thereof. The Class F Fly Ash shall meet the requirements of ASTM C618 and shall not exceed a maximum of 1.5% available alkalis, as determined by ASTM C311.

Replacement of reinforcing steel shall be similar to that in existing pavement and shall provide the same cross sectional area of reinforcement per foot as the existing pavement.

The surface of concrete pavements shall be properly consolidated and struck off to such elevations so as to match adjacent pavement and made uniform by transverse floating. As soon as all excess moisture has disappeared, the pavement shall be given a final light brooming finish by dragging a seamless strip of damp burlap or cotton fabric. Edges of all joints shall be tooled.

As soon as concrete surfaces have hardened sufficiently to prevent marring, they shall be covered by an approved curing compound, or they shall be thoroughly wetted and cured by an approved method for a period of six days unless otherwise directed by the Engineer.

## **CONCRETE CURB AND GUTTERS**

Concrete curb and gutter to be replaced shall have the same cross section as that removed and shall be constructed using Class A concrete and in accordance with the City Standards.

Typical “rolled – high back curb”, concrete curb and gutter shall be utilized on all major thoroughfares, or as recommended by the City or City engineer. Mountable type concrete curb and gutter may be utilized on local collector streets only, upon review and approval of the City.

Concrete gutters to be replaced shall be determined by the Engineer and shall include any cracked or broken sections and any sections which have settled 0.25-inch or more.

Forms shall be complete front and back type. Back forms resulting in hand forming the curb and gutter will not be allowed. Forms shall be of metal, straight and free of distortion and of sufficient strength to resist springing during the placing of concrete. Forms shall be securely staked, braced and tied to the required line and grade. Flexible steel or adequately sized lumber may be used for short radius forms.

One-inch expansion joints shall be placed opposite expansion joints in an abutting pavement. If curb or curb and gutter does not abut a concrete pavement, place expansion joints at all spring lines of street returns. If intersecting streets are more than 300 feet apart, place expansion joints at 200 foot intervals. For MDOT Standard Details A, B, C5, C6 and D curb and gutter, place expansion joints in abutting pavement.

If the structure does not abut a concrete pavement or base, contraction joints shall be placed at approximately 100-foot intervals.

Intermediate plane of weakness joints shall be placed at approximately 10-foot intervals between other joints as called for above.

Curb returns and curb cuts for driveways shall be installed as required.

The gutter and top of curb shall not vary more than 3/16-inch in 10 feet when checked with a 10-foot straightedge.

After the back forms are removed, honeycomb and minor defects shall be filled with mortar, composed of one part Portland cement and two parts sand.

As soon as concrete surfaces have hardened sufficiently to prevent marring, they shall be covered by an approved curing compound, or they shall be thoroughly wetted and cured by an approved method for a period of six days unless otherwise directed by the Engineer.

## **CONCRETE SIDEWALKS**

Concrete sidewalks shall be replaced with walks a full four (4) inch thick (6-inches minimum at non-commercial driveway crossings) and to the same width as the existing walks, unless otherwise specified by the engineer or city. The sidewalk shall have a maximum 1/4" per foot slope from the property line, sloping towards the roadway. Concrete shall be Class A as specified under "Concrete Pavement." If a square or block of sidewalk is broken or cracked, the entire block or sequence shall be replaced. Forms shall be of metal or wood, straight and free of distortion, and of sufficient strength to resist springing during the placement of concrete. Forms shall be securely staked, braced and tied to the required line and grade. Flexible steel or adequately sized lumber may be used for short radius forms.

The walk subgrade shall be compacted to 95% compaction by tamping. After wetting the subgrade, the concrete shall be placed to the proper depth and spaded along the form faces.

Concrete shall be alternately tamped and screeded until all voids are removed and the surface has been brought to the required grade. The surface shall then be floated to produce a smooth dense surface, free from irregularities. All edges and joints shall be rounded to a radius of 1/4-inch with an edging tool and trowel. As soon as all excess moisture has disappeared, the surface shall be finished by light brooming.

Walks shall be divided into blocks approximately square, using slab division forms or by cutting joints after floating. These joints shall be 1/2-inch deep by 1/8 to 1/4-inch in width and shall be finished smooth and true to line. Bituminous expansion joints shall be provided at intervals of 50 feet and at junctions with structures and curbs. Control joints shall be located between expansion joints at intervals equal to the sidewalk width.

As soon as the concrete surfaces have hardened sufficiently to prevent marring, they shall be covered by an approved curing compound, or they shall be thoroughly wetted and cured by an approved method for a period of six days unless otherwise directed by the Engineer.

In commercial applications, such as business, shopping centers, apartment complex, etc., driveway crossings shall be eight (8) inches minimum thickness.



**PEDESTRIAN PATH  
(SOUTH LYON RAIL TRAIL NETWORK)**

Pedestrian paths proposed to connect to the existing rail trail network shall be a minimum of 10 feet wide. Such pedestrian paths should be comprised of a minimum 1.5-inch wearing course of bituminous mix No. 1100T (20AA), and a 1.5-inch leveling course of bituminous mix No. 1100L (20A). The bituminous pavement should be placed on top of a 6-inch (minimum) sub-base of 21AA aggregate. The sub-base shall be compacted to 95% of maximum density as determined by the Modifier Proctor Test. According to the 1996 Standard Specifications of Engineering Course bituminous mixes No. 1100T (20AA) and No. 1100L (20A) are most closely related to bituminous mixes No.13 and No. 11A respectively.

## **CONCRETE RAMPS**

Concrete ramps shall be constructed at all intersections.

Ramps in areas with curb and gutter shall be constructed using MDOT "Sidewalk Ramp Details", II-28G, using Class A concrete as specified under "Concrete Pavement". Surface texture of the ramp shall be obtained by a course brooming transverse to the slope of the ramp. The Contractor shall take care to assure a uniform grade on the ramp, free of sags and short grade changes.

Ramps in areas without curb and gutter shall be constructed with a minimum depth of 6" for a distance of two (2) feet minimum, or as directed by the engineer.

Ramps shall not be placed in line with catch basins or other obstacles.

## **"AS-BUILT" DRAWINGS - PROCEDURES AND REOUIREMENTS**

### **GENERAL**

"As-built" drawings shall be submitted to the engineer for review and approval:

1. In the case of a subdivision, before granting of the first building permit, exclusive of models;
2. In the case of a plan, before the granting of a final certificate of occupancy. No public utility, roadway or other improvement shall be accepted prior to the approval of "as-built" drawings.

### **SUBMISSION TO CITY**

Two (2-) sets of prints of "as-built" drawings shall be initially submitted for review and comment. Upon the approval of the "as-built" drawings by the City engineer, one (1) complete set of reproducible mylar drawings, a minimum of three (3) mils thick together with four (4) complete sets of paper prints, shall be submitted to the City.

"As-built" information must be provided in electronic format or as directed by the City.

### **ALTERNATIVE PREPARATION OF "AS-BUILT" DRAWINGS**

In lieu of the submission of "as-built" drawings by the developer pursuant to the above sections, the developer may pay the City an amount, as set by resolution of the City Council, for the preparation of such "as-built" drawings by the City. The decision to pay such amount in lieu of submission of "as-built" drawings shall be communicated to the City and such amounts paid prior to final plat approval or final site plan approval.

### **PLAN CRITERIA**

"As-built" drawings shall contain all the information shown on the approved construction drawings with the addition of but not limited to the following information.

1. Sanitary sewers and storm sewers
  - a. Plan location of all sewers with respect to Property and right-of-way lines.
  - b. A minimum of three (3) witnesses (dimensions) to all force main bends.
  - c. Length of sewer as measured from center of manhole to center of manhole (this information should be shown on both plan and profile).
  - d. Location of each service lead as measured from the nearest downstream manhole and noted as such.

- e. Length of stubs out of manholes.
  - f. The following "as-built" elevations on a U.S.G.S datum:
    - 1. Manhole, inlet, and catch basin covers;
    - 2. Invert elevations of pipes within each manhole;
    - 3. Invert elevations for the ends of sanitary and sump service leads.
    - 4. Changes in percents between manholes.
  - g. List of material used for construction. (Example)  
  
**Manholes:** Precast, concrete specialties, press wedge flex-joint,  
  
**Pipe:** Eight inch V.C.P. Clow, No Bell six inch V.C.P. Logan, 0-ring
  - h. Any changes in pipe and manhole locations of more than five (5) feet shall be redrawn on the plan and profile. The original plan locations of these facilities should be x-ed out on the plans.
  - i. Any changes to the total quantities shall be lined out and the correct "as-built" quantity indicated.
  - j. The following "as-built" information for all sanitary service leads:
    - 1. Station of wye;
    - 2. Length of lead;
    - 3. Length of riser;
    - 4. Tie from nearest manhole to end of lead,
2. Retention and detention ponds
- a. "As-built" of pond;
  - b. The following "as-built" elevations on a U.S.G.S datum:
    - 1. Overflow spillway;
    - 2. Inlet and outlet pipe inverts;
    - 3. Outlet structure cover;

4. Outlet and inlet ditch elevations
  5. Bottom and top of bank slopes.
  - c. A statement of final computed volume of the pond as measured from high water elevation to the invert of the outlet pipe.
3. Roadways
- a. Top of curb elevations (U.S.G.S. datum) at high and low points, edge of pavement elevations shall be provided in the case of open ditch road designs.
  - b. "As-built" profiles for any changes in road design.
4. Water mains
- a. Plan location of all water mains with respect to property lines.
  - b. Rim (cover) elevations on gatewells (U.S.G.S. datum).
  - c. Fire hydrant bury line elevations (U.S.G.S. datum)
  - d. Distances between gatewells, fittings, and fire hydrants.
  - e. Type of materials used in construction.
  - f. Any changes in pipe and structure locations exceeding five (5) feet shall be redrawn on the plan. The original plan locations of these facilities shall be "x-ed" out on the plan.
  - g. Any changes to the total quantities shall be lined out and the correct "as-built" quantity indicated.
5. Floodways
- "As-built" ground elevations of all areas located within a floodway.
6. Utility Quantity Table
- a. Total "as-built" lineal footage and material type shall be specified for water main, sanitary sewer, sanitary force main and storm sewer.
  - b. Total "as-built" quantities for all appurtenances (including but not limited to hydrants, manholes, etc.).

**CERTIFICATION**

All "as-built" plans shall bear the seal of a registered professional engineer or land surveyor, who is currently registered in the State of Michigan, certifying the drawings to be "as-built". All plans must also contain the seal and signature of such registered engineer or surveyor.