SECTION G
SEWERS (STORM, SANITARY AND FDC)

G-1 GENERAL

The Consulting Engineer is to monitor all specified pipe and granular materials, pipe slopes and run lengths and ensure the outlined criteria below is adhered during construction of underground sewers.

The Consulting Engineer is to co-ordinate and inspect to ensure all items outlined in Appendix IX - Underground Inspection Checklist are followed and completed during installation.

G-2 TRENCHING

- Trenching for placing sewers shall be in accordance to OPSS 401, outlined as follows:
  - Trenching shall be excavated to the lines, grades and dimensions specified.
  - The width of the trench at the bottom shall not exceed the width of the trench at the top.
  - The Consulting Engineer shall monitor the excavation to ensure the trench bottom is stable.
  - The trench shall be of sufficient width to provide free working space and to permit placing and compacting backfill material around the pipe; a minimum width of at least the width of the compaction equipment plus 0.5m and meet OHSA Standards for the given soil type. Trenching requirements are outlined based on pipe size and type, existing materials, bedding materials.
  - Trenches shall be excavated a minimum of 150mm below the bottom of the pipe. The additional depth below the bottom of the pipe shall be backfilled with granular material conforming to the Geotechnical Engineers recommendations and City Standards.
  - All trenching is to adhere to the requirements outlined in the Occupational Health and Safety Act. According to the soil type trench sloping should adhere to the following conditions outlined in Appendix V- Soil Type Definitions.

G-3 PIPE BEDDING

Pipe bedding shall be of the material and class specified, generally HL-6 stone, 19mm Crusher Run Limestone or Granular A, as recommended by the Geotechnical Engineer for dry and wet trench conditions. Per OPSS 401 and City of Markham standards:

- High performance clear stone pipe bedding shall not be permitted.
- Prior to use on site and during construction, all pipe bedding materials are to be inspected, sampled and approved by the Geotechnical Consultant.
Municipal Inspection and Construction Guidelines  
Section G – Sewers (Storm, Sanitary and FDC)

- Storm, Sanitary and FDC bedding to be as per OPSD 802.010 through 802.053.
- A minimum 150mm thickness of pipe bedding material is required under the pipe and shall extend to spring line of pipe for concrete and to the top of the pipe for PVC.
- Pipe shall not be laid in water or upon a wet trench bottom. The pipe shall not be used as a drain for the Contractor's operation. No length of pipe shall be laid until the preceding length has been embedded and secured in place.
- The pipe bed shall be shaped to the specified dimensions. When bell and spigot pipe is to be laid, recesses shall be shaped to receive the bells. Bedding material placed in the haunches must be compacted prior to continued placement of cover material.
- Bedding requiring compaction shall be placed in layers not exceeding 300mm in thickness, loose measurement, and compacted to 98% of the maximum dry density before a subsequent layer is placed. Bedding on each side of the pipe shall be completed simultaneously. At no time shall the levels on each side differ by more than a 300mm uncompacted layer.

G-4 PIPE MATERIAL

G-4.1 General

Sewers are to be constructed of materials as specified in the City approved drawings based on depth, sewer capacity, backfill materials and design slope. Prior to installation, pipe inspections on site should include verifying the pipe size, class and colour are per the design and City criteria.

According to OPSS 410, polyethylene gaskets shall be installed symmetrically about the pipe joint, between the coupler and the pipe, and should be of sufficient length to equal the circumference of the pipe.

If during construction the bell and spigot are damaged to the point of gasket exposure, the damaged pipe is to be removed and replaced. The Consultant Engineer is to identify the damaged pipe material (inside and out) with spray paint to ensure these items are marked and not used.

Any deformed section of the sewer that has been installed shall be uncovered and the Contractor shall re-bed and replace the sewer.

All pipe to be inspected to check condition, confirm size and class conform to approved drawings prior to installation.

G-4.2 Concrete Pipe Specifications

It is recommended that the Contractor follow the concrete pipe manufacture pipe installation requirements. If a deficiency is identified the concrete pipe is to be removed and re-laid.
Municipal Inspection and Construction Guidelines
Section G – Sewers (Storm, Sanitary and FDC)

G-4.3 PVC Profile (Rib) Pipe

PVC Profile wall pipe (commonly known as Rib pipe) is not approved for use in the City of Markham.

G-4.4 PVC Pipe

PVC sewer pipe to be installed in accordance with the manufacturers pipe installation requirements.

For all PVC pipe installations, lubricant is to be used to aid in joining of pipes and connections and prevent damage to the gasket.

G-5 COVER

Per OPSS 401 and City of Markham standards, the following is to be adhered and monitored by the Consultant Engineer:

- Pipe bedding shall extend to spring line for concrete pipe and to top of pipe for PVC sewers. Sewer pipes are to be covered with sand placed to a depth of 300mm to 600mm, above the top of pipe unless otherwise recommended by the Geotechnical Consultant and approved by the City.

- Cover material shall be placed so that damage to, or movement of, the pipe is avoided.

- Cover material requiring compaction shall be placed in layers not exceeding 300mm in thickness, loose measurements, and compacted to 98% of the maximum dry density before a subsequent layer is placed. Cover material shall be placed on each side of the pipe and shall be completed simultaneously. At no time shall the levels on each side differ by more than a 300mm uncompacted layer.

G-6 BACKFILL

Per OPSS 401 and City of Markham standards, the following is to be adhered and monitored by the Geotechnical and Consultant Engineers:

- Backfill material shall be placed in uniform layers not exceeding 300mm in thickness for the full width of the trench and each layer shall be compacted to 98% of the maximum dry density before a subsequent layer is placed.

- Backfill shall be placed to a minimum depth of 1.0m above the top of the pipe before bulldozers or other compaction equipment shall be used for compaction.

- Refer to OPSD 802.010 for flexible pipe backfill and OPSD 802.030 through 802.032 for rigid pipe trench backfill specifications.

- Temporary water-tight plugs shall be installed at the upstream/open end of the last pipe during periods when water or dirt may enter the pipe or during periods of temporary work stoppage. Pipe shall not be left in the trench overnight without backfilling.
In existing roadways unshrinkable fill is to be used as backfill and placed up to the underside of the granular sub-base material.

G-7 SERVICE CONNECTIONS

G-7.1 General

Service connections are to be installed in accordance with City standard MS-13, MS-14 and MS-15 (OPSD 1006.010 and 1006.020).

Service connections to the main pipe sewer shall be made using factory made tees or wyes, strap-on-saddles or other approved saddles. Factory made tees or wyes shall be used for all service connections where the diameter of the main sewer is:

a) less than 450mm; or
b) less than twice the diameter of the service connection.

Lateral connections are to be correctly set horizontally and vertically as per the approved City drawings.

All service connection leads are to be installed into the mainline above the spring line at a minimum positive grade of 2%.

Service connections shall be plugged at the property line with water and airtight caps or plugs. Plugs or caps shall be braced sufficiently. Sanitary sewer service connections to be air tested as part of mainline air testing, as per section G-14. The Consulting Engineer is to record and verify lateral locations and elevations, summarized in lateral service as-built tracking sheet in Appendix VIII – Lateral Service As-builts.

G-7.1.2 Lateral Extensions

The City endorses the practice of extending the service connection 1.5 to 3.0 metres beyond the property line as shown on City Standard drawing MS14, including the installation of a clean out at the property line and at the end of the extension. The clean out at the end of the connection is to be plugged/capped and braced to prevent leakage and enable the air testing of the main sanitary sewer and services.

The practice of requiring the City’s Building Department to issue a permit for the service connection extension and its subsequent inspection has been discontinued, subject to the City receiving written certification from the developers Consulting Engineer, confirming that the storm and sanitary service connection extensions have been inspected by them as part of the mainline sewer and lateral service connection installation works and that the extension comply with the City Standards and the requirements under the Ontario Building Code.

G-7.2 Saddles
Coring in the sewer pipe shall be undertaken with appropriate saddles and shall be the minimum diameter required to accept the service connection saddle. If mortar-on saddles are used for concrete pipes, the inside of the pipe shall be mortared at the connection.

G-7.3 Bedding and Backfill

Adequate bedding stone to be placed around all leads and leads to be supported throughout installation.

All services and structures located in a trench cut must be supported by compacted granular or structurally compacted fill to undisturbed ground.

G-7.4 Marking

A painted service connection location marker consisting of a 50mm x 100mm (2” x 4") stake shall be placed at the end of the plugged or capped service connection. The marker shall be placed from the invert and extended 1.5m above grade.

Service connections markers to be painted:

- Sanitary  - Green
- Storm     - Red
- FDC       - White

Service connections shall not be backfilled until they have been inspected and measurements of location and depth have been taken by the Consulting Engineer.

G-7.5 Risers

The Consulting Engineer is to ensure the sewer lateral risers are set at a maximum angle of 45° to the horizontal to ensure flows do not enter the mainline at too steep a slope. Where the mainline sewer is deep, the design drawings will specify a riser elevation at the property line to be achieved after deflections. The Consultant Engineer is to ensure the Contractor meets this specified elevation and verify the lateral risers from a mainline are set with adequate clearance from other mainline sewers or pipes laid or to be laid within the same trench. Refer to City standard drawing MS-14 and MS-15.

Where the main line sewer is deeper than 5 metres below finished grade the service lateral shall be video inspected.

G-8 SEWER MANHOLES

G-8.1 General

All sewer manholes are to be constructed in accordance with OPSS 407 and modifications set out in City of Markham Engineering Department Design Criteria and Standard Drawings. Concrete for cast-in-place structures shall be constructed in accordance with the detailed structural drawing and the approved engineering drawings. The Contractor shall provide shop drawings for review by the consultant and City a minimum of 14 days prior to installation.
shop drawings to contain two P. Eng. stamps. The Geotechnical Consultant must also obtain samples of the concrete material for quality testing.

Pre-cast units shall be according to City of Markham standards and OPSS 1351.

Prior to installation, inspection of manhole materials on site should include verifying the following as per the design and City criteria:

- manhole diameter and depth (riser sections suitably sized to achieve required depth)
- pipe inlet/outlet hole sizing
- pipe inlet/outlet structures are in place (i.e. boots for PVC pipe connections)
- rubber boot seals and gaskets (ensure these are not damaged)
- safety grates are set in manholes at proper locations

Granular “C” (sand) material compacted to 98% Proctor Density must be used for storm, FDC and sanitary manhole backfill.

The Consulting Engineer is to co-ordinate and inspects to ensure all items outlined in Appendix IX - Underground Inspection Checklist are followed and completed during installation.

For sanitary and storm manhole drop structures including sizing, configuration, installation and other specifications refer to City of Markham standards MS-1 and MS-2. For manhole lid markings, hole pattern and hole spacing refer to OPSD 401.010.

If during construction the bell and spigot are damaged to the point of gasket exposure, the manhole or pipe is to be removed and replaced. The Consultant Engineer is to identify the damaged materials (inside and out) with spray paint to ensure these items are marked and not used.

**Joints on Sanitary manhole sections to be wrapped with water resistant membrane (i.e.: Mel-Rol) extending to a minimum of 300mm on each side of each joint.**

For storm sewer manholes, a rigid HDPE perforated subdrain complete with geotextile sock 6 metres in length shall be installed at inlet invert as per OPSD 809.010.

**G-8.1.1 Safety Grates**

Safety grates (aluminum safety platforms) are to be installed where manhole depths exceed 5.0m and are to be placed no more than 5.0m apart. Wherever practical, safety grating shall be located 0.5m above the drop structure inlet pipe. Safety grates shall be according to OPSS 1351.

**G-8.1.2 Benching**

Per City of Markham standard and OPSS 407, the following is to be adhered to:

- The inside concrete bottom of the structures shall be benched and channeled to accommodate the pipe installed into them.
Municipal Inspection and Construction Guidelines  
Section G – Sewers (Storm, Sanitary and FDC)

- Sanitary and storm manholes shall be benched to the obvert level. The concrete channel wall shall be extended vertically from the springline to the top of the pipe.

- Top of benching is to be sloped no greater than 4:1 (horizontal to vertical) nor less than 8:1, with a minimum horizontal distance of 230mm.

- Benching shall have a wood float finish and channeling shall have a steel trow finish. Channeling shall be smooth and flush with adjacent pipe inverts.

G-8.1.3 Manhole Steps

Per OPSD 405.010, the following is to be adhered to:

- The first step from the top is to be a maximum 450mm below the finished grade elevation of the frame and cover. The last step shall be 300mm above the benching or 600mm above invert, whichever is lower.

- A distance of 300mm is to be maintained between the aluminum steps.

- Material for steps to be aluminum alloy 65 ST4 (Aluminum Co. of Canada specifications).

G-8.1.4 Bulkheads

The City of Markham requires bulkheads to be installed and monitored as follows:

- For storm sewers the Contractors shall install a "half" bulkhead at all outfalls or connection to existing sewers. The bulkheads to be cleaned periodically to control downstream sedimentation during the period of house construction.

- At the downstream end of all sanitary sewers, install a watertight bulkhead at the extreme lower end of the line. Periodic checks shall be made by the Contractor during the construction to ensure that this bulkhead is in place and has not become damaged. The Contractor is to ensure that all bulkheads are removed upon completion of roadwork or as directed by the City.

G-8.1.5 Manhole Frame and Cover

Manhole frame and covers are to be manufactured and installed per OPSD 401.010 and are to be installed a minimum of 7mm below asphalt surface. All adjustment units (moduloc) are to be parged on the outside only and wrapped in water resistant membrane (Mel-Rol or equivalent) with a minimum 300mm sealed overlap with the structure top section to prevent infiltration.

The moduloc on the bottom is to be mortared onto the precast using polymer reinforced high strength cement based mortar. The individual moduloc sections are to be fastened together using the manufactured supplied and recommended butal tape. The frame of the manhole cover is to be secured to the moduloc using polymer reinforced high strength cement based mortar.
Municipal Inspection and Construction Guidelines
Section G – Sewers (Storm, Sanitary and FDC)

G-8.2 Pipe Connections

G-8.2.1 General

Per OPSS 407, the inlet and outlet pipes shall be securely set into the structure’s concrete base or walls using grout or approved pipe connectors so that the structure is watertight. The installation of pipe connectors shall be according to the manufacturer’s recommendations.

G-8.2.2 Concrete Pipe Connections

Concrete pipes are to be connected to manholes with support provided by concrete bricks filling the extra opening space. Concrete must be placed on the outside of the manhole at the pipe connection and the inside of the manhole to be parged and sealed with a smooth finish.

G-8.2.3 PVC Pipe Connections

PVC pipe connections to manholes are to be done with either a rubber boot or a sanded adapter; no direct connections are to be made.

G-9 CATCHBASINS

G-9.1 General

Catchbasins are used to collect water flowing overland along the roads and divert the flow to the underground storm sewer. Catchbasins are to be installed in the correct location and elevation per the City approved design drawings. Generally a set of catchbasins is located on either side of the roadway at the lowest point of a road to ensure that no standing water remains on the roadway. Installation of a catchbasins in front of driveway locations are to be avoided where possible.

G-9.2 Consultant Inspection Responsibilities

Per City of Markham standard MS-5, MS-6 and OPSD 705.010 (and OPSS 402), the following is to be adhered and monitored by the Consultant Engineer:

- Adequate bedding stone has been placed under and around each catchbasin to undisturbed ground and compacted.
- Catchbasin leads are to be supported throughout installation.
- Catchbasin leads are to be sized per City standards and approved design drawings.
- Catchbasins are to be placed in the proper vertical and horizontal alignment per City approved design drawings.
- Adjustment units (moduloc sections) may be used to satisfy vertical elevations; 25mm to 75mm thick units may be used to a maximum total adjustment of 150mm. These sections are to be parged on the outside only and wrapped in water resistant membrane (Mel-Rol) or equivalent to prevent infiltration.
• The moduloc on the bottom is to be mortared onto the precast using polymer reinforced high strength cement based mortar. The individual moduloc sections are to be fastened together using the manufactured supplied and recommended butal tape. The frame of the catchbasin is to be secured to the moduloc using polymer reinforced high strength cement bases mortar and wrapped in water resistant membrane (Mel-Rol) or equivalent to prevent infiltration.

• All adjustment units (moduloc sections) on catchbasins are to be located plumb with the catchbasin inside walls and lids and cemented in place; shifting of moduloc and catchbasin lids can be seen as a deficiency and may be requested to be relocated to its correct position. A maximum horizontal adjustment of 75mm shall be permitted to allow alignment with the curb gutter line.

• Catchbasin and subdrain connections are to be parged both inside and outside to prevent infiltration.

• Each catchbasin to have sediment controls in place until such time as the catchment area is vegetated. Sediment controls (filter cloth or silt traps/sacs) to be monitored for effectiveness and corrected and cleaned if not functioning. All catchbasins shall be cleaned of sediment periodically to ensure their proper operation.

G-9.3 Rear Lot Catchbasins (RLCBs)

Rear lot catchbasins are to be constructed as per City Standard MS-4 and are used to collect overland flows that must be diverted to the underground storm sewers. Runoff from yards, parks and other green spaces may be collected through rear lot catchbasins. Grading must direct all runoff to collect in a low spot where the rear lot catchbasin is located.

On site review of installation of rear lot catchbasins is to be undertaken following the same guidelines outlined for catchbasin works noted above, see Section G-9.2. In addition to the specifications noted in the catchbasin section, the following are relevant:

• Leads are to be concrete encased from back of curb to installed rear lot catchbasin. PVC rear lot catchbasin leads are not acceptable.

• All RLCBs or pup catchbasins are to be sumpless to alleviate the possibility of standing water.

• Subdrains to be extended 2.0m out from either of side of the RLCB parallel to the lot line.

G-10 ROOF LEADERS

Please refer to the City of Markham building requirements which outline the commercial, industrial and institutional building requirements for roof drains.
Residential roof leaders are not to be connected to the storm sewer system unless design approved. These are to be set to outlet through downspouts onto splash pads and directed to sodded areas for infiltration with any overflow directed to side yard swales.

**G-11 FOUNDATION DRAINS**

Basement floor elevations must be at least 1.0m above the storm sewer obvert for gravity fed foundation drains. Sump pumps are required for situations where gravity connection of foundation drains cannot be met. Special care is to be taken to ensure that there are no foundation drain cross connections.

**G-12 MANDREL TESTING**

Prior to base asphalt the Consulting Engineer shall coordinate mandrel testing for the PVC sewers including storm, FDC and sanitary as per the following criteria:

- The mandrel and all necessary equipment and labour for the mandrel test shall be provided by the Contractor and checked by Consultant.

- The contact length of the mandrels arms shall equal or exceed the nominal inside diameter of the sewer to be inspected. Critical mandrel dimensions shall carry a tolerance of plus or minus 2.5mm. The mandrel device shall be cylindrical in shape and be desirably constructed with either nine (9) or sixteen (16) evenly spaced arms or prongs.

- Any section of the sewer not passing the mandrel shall be uncovered and the Contractor shall re-bed and replace the sewer to the satisfaction of the City. Any repaired section shall be retested. Sewer re-rounding is not permitted.

- Mandrel testing shall be completed prior to placement of base asphalt. Measured pipe deflection shall not exceed 7.5% of the pipe inside diameter.

**G-13 SEWER VIDEO INSPECTIONS**

**G-13.1 General**

A sewer video inspection program for all new storm sewers, sanitary sewers, foundation drain collectors, associated appurtenances and service connections, sewage forcemains and siphons constructed as a part of the municipal infrastructure for the plans of subdivision and site plans is required to be submitted to the City of Markham. These works shall be coordinated through the Consulting Engineer and undertaken by a qualified company and to be approved by the City prior to the work being undertaken. The Consulting Engineer shall review the sewer videos and report and submit to the City electronically on a USB memory stick a copy of all videos, reports and general plan marked to show the sewers that have been inspected, deficiencies identified, and proposed method of repair.

Sewer video inspections shall be carried out:
G-13.2 Sewer Flushing

The Contractor shall flush, clean and remove all debris, silt and foreign material from the sewer prior to the video inspection. All accumulated debris/silt or material shall be removed at every third downstream manhole or more often as required; but shall not exceed 350 meters of sewer length.

Prior to commencing sewer flushing works the Contractor or Consulting Engineer shall notify the area residences and the City of the planned works a minimum of 72 hours in advance. Hand delivered notices to each area resident shall be provided as set out in Appendix XXVI.

The sewer flushing Contractor and Consulting Engineer shall monitor the flushing operations to ensure no back up of sewage into the service connections, resulting in raw sewage discharge into the house through floor drains or toilets.

G-13.3 Sewer Inspection Requirements

Storm sewer, sanitary sewer, foundation drain collectors and associated appurtenances (including catch basin leads), service connections, sewage forcemains and sewage siphons are to be video inspected separately and to be submitted on separate reports containing the condition of the sewer and observations.

Each sewer run (ie. From manhole to manhole) shall be recorded in a separate digital file to allow direct searching of individual section of the sewer without having to review the entire sewer video.

Pan and tilt features are to be used on all service connections and defects. For sewers larger than 1200mm diameter or equivalent, and box culverts, the pan, tilt and zoom feature shall be used at all pipe joints, connections and defects.

All rear lot catchbasin sewer leads shall be video inspected for their entire length.

All catchbasin leads shall be video inspected prior to Building Permit issuance and additionally as required by the City.

All manhole/pipe connections to be panned prior to entering and exiting sewer line.
Sewer service connections 5.0 meters or more in depth (as measured at the mainline sewer) or as directed by the City shall be video inspected from the mainline sewer to the property line cleanout prior to Building Permits issuance, Acceptance for Maintenance and Assumption.

Sewer video inspections shall be completed for all site plan sanitary and storm sewer service connections and reports provided to the City for review and all repairs are to be completed to the City’s satisfaction and acceptance prior to security reduction or release by the City.

G-13.4 Video and Report Review

(a) Consulting Engineers Video Review

The Consulting Engineer for the project shall review all sewer videos and reports and identify and summarize all sewer deficiencies found and shall submit to the City a complete sewer video review package of information as set out below. The Contractor shall repair all sewer deficiencies identified and must re-video inspect the repairs to confirm the repair and to submit to the City the following:

- Electronic copy of original video inspection, report and general plan on USB memory stick
- Copy of Consulting Engineers video review summary, complete with a Professional Engineers stamp identifying all deficiencies and proposed method of repair
- Copy of general plan, highlighted to show all sewers video inspected
- Copy of sewer repair video showing repairs completed

The methods of repair for all sewer deficiencies unless otherwise approved in writing by the City shall be excavate and repair. “No dig” or robotic repair methods using liners must be approved by the City on a site specific/individual basis and prior to the repair being undertaken.

In the event that the Consulting Engineer is unsure as to the presence of a deficiency or the preferred method of repair, the Consulting Engineer shall review the video with the City to confirm.

(b) City Video Review

The City will review the sewer videos, repair videos and other information provided by the Consulting Engineer to confirm the sewer condition and that no defects or deficiencies exist. In the event that as part of the City’s review, three or more remaining deficiencies are identified or should the sewer video inspection be incomplete or a poor quality, the City shall stop its review and return the information to the Developer. In conjunction with this, the process for Building Permit release, Acceptance for Maintenance or Assumption of the Subdivision shall stop until such time that an acceptable resubmission of the sewer video reports and associated information is provided. The City reserves the right to charge the Developer for the time and associated cost incurred by the City in the review of the incomplete video submission.

G-14 Sanitary Sewer Air Testing

Prior to base asphalt placement the Contractor shall coordinate air testing for sanitary sewer lines as per the following criteria:
Municipal Inspection and Construction Guidelines  
Section G – Sewers (Storm, Sanitary and FDC)

- Air testing shall be coordinated through the Consulting Engineer and undertaken by a qualified company to be approved by the City prior to the work being undertaken.
- Tests shall be conducted between two consecutive manholes, including house service connections. The test section shall be plugged at each end. One plug shall be equipped with an air inlet connection to fill sewer system with air, as per OPSD 410.07.16.04.03.

- Sewers shall be repaired and retested, as required, until test results are within the limits specified in the City criteria. Visible leaks shall be repaired regardless of the test results.
- No part of the work shall be accepted until sewers are satisfactorily tested following completion of installation of service connections and backfilling.

G-15 DECOMMISSIONING

All storm, sanitary and FDC lines to be abandoned are to be removed or capped at the mainline. The Consultant Engineer is to record the pipe location(s) and elevation where capped, monitor the backfill material and compaction method and present these details in a site report and as-built drawings to the Developer, Contractor and City of Markham.

Internal pipe liners shall only be used upon the written direction, and approved by the City.

G-16 Section G Summary Checklist

- Consulting Engineer has verified that the approved pipe bedding is being used and is being placed correctly.
- Pipe inspections are carried out prior to installation verifying pipe size, condition, class and colour.
- Ensure bedding, cover and backfill material have been placed and compacted per Sections G-3, G-5 and G-6.
- Service connections shall not be backfilled until they have been inspected and measurements of location and depth have been taken by the Consulting Engineer.
- Record elevation of service connection at property line
- Storm (red), sanitary (green) and FDC (white) markers are installed at each unit lateral and extended 1.5m above grade.
- All manhole materials are inspected and verified prior to and during installation.
- Benching and manhole steps are installed correctly.
- PVC and concrete pipe connections are installed correctly.
- Ensure bulk heads are installed and removed as required.
• Ensure all items on *Appendix IX – Underground Inspection Checklist* have been completed up to and including those in manhole section.

• Catchbasins/Rear lot catchbasins are installed per OPSD 705.010 and City of Markham Standard MS-4 and MS-5. Inspector must verify bedding, alignment, maximum total adjustment of 150mm, parging, sediment control, concrete encasement and sumps.

• 150mm diameter rigid HDPE sub-drains with perforated sock are installed as per Section I-2.3.1.

• **Mandrel testing** has been completed as per the criteria outlined in Section G-12.

• **Sanitary sewer air testing** has been performed as per Section G-14.

• The Consultant Engineer has reviewed the sewer videos as per *Appendix VII - Sewer Video Review Checklist*.

• Decommissioning of storm, sanitary and FDC lines are carried out correctly.