

## **Engineering Guidelines for Subdivisions and Development Standards**

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### **PART 7 TESTING**

JULY 2020



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## 1. INTRODUCTION

This section of the Engineering Guidelines for Subdivisions and Developments outlines Council's recommended practice for testing roads, water reticulation and sewer reticulation. It is in no way a comprehensive 'Testing Manual' and it is intended to be read in conjunction with relevant Standards that includes:

- Australian Standards
- RMS NSW Standards
- WSAA Standards for Water and Sewer
- State Government Authority Standards

The Subdivision and Development Guidelines comprise the following:

Part 1 General Requirements

Part 2 Guidelines for Design of Roads

Part 3 Guidelines for Stormwater Drainage Design

Part 4 Guidelines for Design of Water Reticulation

Part 5 Guidelines for Design of Sewerage Reticulation

Part 6 Guidelines for Landscaping, and Measures for Erosion, Sedimentation and Pollution Control

### **Part 7 Guidelines for Testing**

The developer is required to pay for all tests. Forty-eight hours' notice is required.

## 2. REFERENCE DOCUMENTS

The format of the guidelines has been simplified by making reference to both National and State Standards where applicable. Where these standards vary from the referenced standards the variations are highlighted and cross-referenced. The current version of the referenced standard will apply. The references below were current at time of publication of this standard. If any of the references are updated refer to the equivalent clause in the updated versions. These guidelines shall take preference over the referenced standards. In addition to the criteria outlined in this manual, any relevant acts, regulations and Australian Standards will apply.

In New South Wales, RMS referenced standards will apply

- AS 3798 Guidelines on earthworks for commercial and residential developments
- AS4130 Polyethylene (PE) pipes for pressure applications
- RMS QA Specification
- RMS test method
- RMS NSW specification
- Gravity Sewerage Code of Australia WSA02 – 2014 Version 3.1
- Water Supply Code of Australia WSA03 – 2011 Version 3.1
- Sewerage Pumping Code of Australia WSA04 – 2005 Version 2.1
- Conduit Inspection Reporting Code of Australia WSA05 – 2013 Version 3.1

### Abbreviations

NATA	National Association of Testing Authorities
NSW	New South Wales
RMS	Roads and Marine Services
WSAA	Water Services Association of Australia

### 3. ROADS

Test each layer of pavement material and obtain approval for each layer from Council prior to placing of subsequent pavement layers.

#### 3.1 SUBGRADE

Test the subgrade profile by template and make good any irregularities by the addition or removal of material, followed by further rolling as in Table 1

**Table 1: Subgrade Testing**

Subgrade compaction requirement as obtained in the standard compaction test	95% of maximum dry density
Test every 500mm lift at	Maximum spacing of 100m
Minimum number of samples per road	2 samples
Compulsory subgrade inspection	In accordance with the quality control checklist

All fill material shall comply with the requirements of AS 3798, Guidelines on Earthworks for Commercial and Residential Developments by the submission of test certificates prior to the commencement of work. Samples must represent a particular batch; lot or consignment and test certificates shall be no older than three months.

Every 500mm lift of subgrade shall be proof rolled. The subgrade shall be checked by proof rolling with a roller having an intensity loading of seven tonnes per metre width of roller. Any permanent deformation of the subgrade under the roller shall be deemed a failure.

Upon completion of final boxing of subgrade, the geotechnical testing authority shall inspect the exposed subgrade to ensure that the samples taken accurately represent the subgrade condition and shall certify in writing, to Council, that this is so, prior to the placement of the first pavement layer. Where boxing is provided it must drain freely to subsoil drainage or the road pavement materials must be extended to a free draining surface.

#### 3.2 SUB-BASE AND BASE

The sub-base and base shall be density tested at intervals along the road as directed by Council. The minimum requirements are:

**Table 2: Sub-base and Base Testing**

The sub-base and base shall be density tested at intervals	100m
Minimum samples per road to be tested	Two
Sub-base course compaction	95% of the maximum dry density as per the modified compaction test.
Base course	100% of the maximum dry density as per the modified compaction test.

### 3.3 DENSITY TESTING

All tests are to be undertaken and certified by an authorised representative of a laboratory registered by the National Association of Testing Authorities (NATA). The developer is to pay for all density testing with density test results supplied to Council for approval.

### 3.4 PAVEMENT DETAILS

Sub-base and base course material must be initially tested for suitability unless advised otherwise by Council.

The minimum thickness for base course is 100mm.

No pavement material shall be placed without the prior approval of Council.

All sub-base and base course gravel must comply with the following requirements:

**Table 3: Sub-base and Base Testing**

Sub-base and base course gravel	To RMS QA Specification 3051 Granular base subbase materials for surfaced road pavements
Sub-base Gravel Standard	To RMS DGS 40
Sub-base Gravel Max PI	10
Sub-base Gravel Min CBR	60
Base Gravel Standard	To RMS DGB 20
Base Gravel Max PI	6
Base Gravel Min CBR	120

### 3.5 ASPHALTIC CONCRETE

The supply and laying of asphaltic concrete must comply with RMS test method T612

#### 3.5.1 STABILITY OF MIXES

The stability of the job mix shall be between 16kN and 36kN, as determined by the modified 'Hubbard – Field Method' i.e. RMS Test Methods T601 and T603.

Mixes with stability of less than 8kN below the limit or more than 12kN above the upper limit shall be removed from the site. For mixes having stability outside the specified ranges, but within the above-mentioned limit for rejection, consideration will be given to acceptance of the mix subject to deduction in accordance with RMS test method T612.

### 3.6 VOIDS IN COMPACTED MIXES

The design of job mixes shall be such that between 65% and 85% of the air voids in the total mineral aggregate will be filled by the binder when determined in accordance with RMS Test Methods T601, T605 and T606.



### 3.7 SPRAYED BITUMINOUS SURFACING

Spray seals shall be in one or two applications as specified on the drawings and shall conform with the RMS specification for the supply and spraying of bituminous material (RMS QA Specifications: R11, R107, R109, R112 and R113.)

Aggregates shall conform to RMS NSW specification for cover of aggregates, RMS QA Specification 3151 with proof of compliance submitted prior to the commencement of work. Samples tested must represent a particular batch; lot or consignment and test certificates shall be no older than three months.

### 3.8 APPLICATION RATES

The designed application rates of binder, aggregates and average least dimension of aggregates is to be submitted for approval 48 hours prior to the commencement of works.

### 3.9 WORK RECORDS

Details of bitumen and aggregate applied are to be recorded immediately after each 'run' and submitted for approval prior to acceptance.

### 3.10 DEFECTIVE WORK OR MATERIALS

Remove defective materials including replacement of binder that has been overheated, deteriorated or contaminated prior to application to the road. Where the Council considers that work is not in accordance with the specification, whether caused by bad workmanship, defective materials or by materials made defective during construction, these materials shall be removed at the cost of the developer and contractor.

Alternatively, the Council may consider accepting defective work subject to conditions.

### 3.11 FINAL ROAD PROFILE

#### 3.11.1 PAVEMENT CROSSFALLS

The final road profile shall satisfy the following requirements (if not otherwise stated in the drawings):

Mean Crossfall	3 ± 0.25%
Maximum Crossfall	3.5% (5% in extenuating circumstances)
Minimum Crossfall	>2.5%
Standard Deviation of Crossfalls	0.35%

The above requirements do not apply where the road is super elevated.

#### 3.11.2 VERTICAL ALIGNMENT

The vertical alignment shall not deviate more than ± 0.25% from the value shown on the drawings.

### **3.12 CONCRETE**

Comply with AS 1012 Methods of Testing Concrete.

### **3.13 SUBDIVISION EARTHWORKS**

All earthworks associated with commercial and residential developments must comply with the requirements of AS 3798 'Guideline on Earthworks for Commercial and Residential Developments'.

Plans and specification for all earthworks are to be included with the Engineering Drawings and Construction Specification, for the Council's consideration.

Any material deemed to be unsuitable as described in the Australian Standard shall be disposed of from the site by the contractor. The contractor must advise Council, in advance, where any material exported from the site is to be taken.

Any documentation for earthworks, including Works-As-Executed details and testing shall comply with Sections 3 and 7 of AS 3798. A copy of the documentation and test results shall be supplied to Council. The approved subdivision plan will not be released prior to the receipt and approval of all earthworks documentation.

## 4. SEWERAGE RETICULATION

### 4.1 GENERAL (REFER WSA02-21.1)

This section relates to sewerage reticulation acceptance testing. The testing of sewerage reticulation shall generally be in accordance with the latest version of the Water Services Association of Australia (WSAA). However this part of the Council's 'Engineering Guidelines' takes precedence over the WSAA Standards. The 'Sewerage Code of Australia (WSA02) Part 3 Construction; Third Edition Version 3.1' has been cross-referenced.

All sewers and Maintenance Holes shall be subject to testing after construction (NATA accreditation is not mandatory). The tests shall be carried out before release of the 'approved subdivision plan'.

Should sewers or Maintenance Holes fail any test, defects shall be detected and repaired and the test repeated. The process of testing, detection and repair of defects and retesting shall continue until a satisfactory test is obtained.

All lines are to be clear and free from soil, slurry, liquids and other foreign substances at the notification of completion.

### 4.2 COMPACTION TESTING (REFER WSA02-21.3)

All trenches are to be compacted in accordance with WSAA standards.

### 4.3 AIR PRESSURE AND VACUUM TESTING OF GRAVITY SEWERS (REFER WSA02-21.4)

#### 4.3.1 GENERAL

The testing of gravitation sewers shall be in accordance with the relevant requirements and method of testing specified in Sections 21.4.

Before the test is performed, all pipe laying on the section shall be completed to the level of the centre of the pipe barrel, and the Developer shall have requested the Council to check the pipeline for line and grade.

The test may be carried out after risers and/or sidelines are constructed however Council will be reliant on the final test conducted immediately prior to acceptance into maintenance.

Any fault detected is to be rectified and a satisfactory test obtained before the remainder of backfill is placed.

#### 4.3.2 EQUIPMENT

All necessary equipment is to be supplied by the Developer and kept in a condition acceptable to the Council.

Pressure gauges are to be tested daily by static water column. At least one spare gauge per test rig is to be kept on the job at all times.

Compressed air is to be supplied by a compressor capable of supplying at least 1m<sup>3</sup>/minute at 35kPa. The air is to be fed through a pressure-reducing valve capable of reducing pressure from that supply to 28kPa ± 4kPa. The air is then to pass through an airtight line fitted with a

150mm Bourdon type pressure gauge reading from 0 to 50kPa, a pressure relief valve that may be set to blow off at 28kPa  $\pm$  4kPa and a gate valve to the pipeline to be tested.

#### 4.3.3 LOW PRESSURE AIR TESTING (WSA02-21.4.2.2)

The method of setting up and carrying out the test shall be in accordance with the requirements of WSA low-pressure air testing section WSA02-21.4.2.2.

Where the allowable pressure drop time cannot be attained and there are no visible leaks, a hydrostatic test is to be applied at the request of the Council.

#### 4.3.4 HYDROSTATIC TESTING WSA02-21.10.2

Where Council permits hydrostatic testing; the hydrostatic test shall be carried out in accordance with the specific requirements of Council.

### 4.4 TESTING OF CONCRETE MAINTENANCE HOLES (REFER WSA02-21.4.5)

Council may request the leakage testing of Maintenance Holes at its discretion.

Where a test is required, the test shall be carried out with the Maintenance Hole cover surround fitted with rendering of the channels and benches completed.

As an alternative to vacuum testing referred to in WSA02-21.4.5, subject to the approval of Council, water testing will be undertaken by plugging all pipe openings in the walls and by filling the Maintenance Hole with water to the lowest point on the top of the Maintenance Hole cover surround. The plugs shall be positioned in the pipes as near as practicable to the internal face of the Maintenance Hole.

After allowing 30 minutes for absorption, if not otherwise determined by Council, the Maintenance Hole shall be refilled and the loss of water during the following 30 minutes measured. The test on the Maintenance Hole will be considered satisfactory provided the water lost is less than 3mm depth in the top section of the maintenance hole for each 1m depth of the Maintenance Hole. The depth of Maintenance Hole is to be taken from the bottom of the Maintenance Hole cover recess in the cover surround to the invert of the outlet from the Maintenance Hole. The plug of the outlet shall be fitted with a suitable release for emptying the Maintenance Hole on satisfactory completion of the test.

### 4.5 VISUAL INSPECTION AND MEASUREMENT FOR INFILTRATION (REFER WSA02-21.5)

Whenever the pipeline is subjected to a significant head of groundwater (i.e. 1500mm or more above the obvert of the sewer main,) provided that groundwater is at least 150mm above any sideline, it shall be visually inspected for infiltration.

The Developer shall propose full details of the method by which the infiltration is to be measured and rectified.

The Developer, at his own expense, shall determine the head of groundwater by a method acceptable to Council.

#### 4.6 TESTING OF SEWER RISING MAINS

Rising mains shall be pressure tested in order to detect any leakage and defects in the pipeline including joints, thrust blocks and anchor blocks, if any.

Pipelines shall be tested in sections approved by Council as soon as practicable after each section has been laid, jointed and backfilled provided that:

- If so specified or if the Developer so desires, some or all of the pipe joints shall be left uncovered until the whole of the section has been successfully pressure tested to the satisfaction of Council
- The pressure testing shall not be commenced earlier than seven days after last concrete thrust or anchor block in the section has been cast

For the purpose of this clause, a section shall be defined as a length of pipeline, which can be effectively isolated for testing, e.g. by means of main stop valves. Unless noted otherwise or approved by the Council, the maximum length of a test section shall be 1,000 metres.

Unless otherwise approved by Council, pressure testing shall not be carried out during wet weather.

During pressure testing all field joints, which have not been backfilled, shall be clean, dry and accessible for inspection.

During pressure testing of a pipeline each stop valve shall sustain at least once, the full test pressure on one side of the valve, with no pressure on the other side for at least 15 minutes.

Before testing a pipeline section, it shall be cleaned to the satisfaction of Council and filled slowly with water (filling velocity not to exceed 0.05m/sec), taking care that all air is expelled. Purging of air from the main shall be via air release valves and throttling of the discharge end stop valve.

In order to achieve conditions as stable as possible for testing by allowing for absorption, movement of the pipeline and escape of entrapped air, the section shall be kept full of water for a period of not less than 24-hours prior to the commencement of the pressure testing.

All pipes shall be tested in the presence of the Council's representative.

The minimum hydrostatic test pressure, which shall be applied to each section of the pipeline, shall be 1,000 kPa, or 1.25 times the design pressure (whichever is greater).

For a given section of sewer rising main, the actual test pressure at any point in the test section will depend on its relative level. The system test pressure shall be chosen such that;

- a. At the highest point in the test section the system test pressure is greater than the design pressure, and
- b. At the lowest point in the test section the system test pressure is greater than 1.25 times the design pressure.

The hydrostatic test pressure specified above shall be maintained as long as required by Council's representative, while they examine the whole of the section, and in any case not less than four (4) hours for DICL, GRP, PVC and Mild Steel pipelines, and not less than five

(5) hours for PE, HDPE and ABS pipelines. For the purpose of determining the actual leakage losses, the quantity of water used during testing shall be carefully measured and recorded.

With the exception of PE and HDPE pipelines, test all sewer rising mains as follows;

1. Install blank flanges or caps at each end of the test section. Closed valves should not be tested against unless they are full restrained and it is possible to check for leakage past the valve seat. Temporarily strut or anchor mechanical ends that are not end load restrained to withstand the test pressures without movement.
2. Pressurise the line to 75% of the test pressure and leave for a minimum of 12 hours.
3. If no leaks are evident, steadily raise the pressure in the sewer rising main until the test pressure is reached.
4. Maintain the test pressure for four (4) hours. Measure and record, at one-hour intervals, the quantity of water added in order to maintain the pressure during the period of testing.
5. Visually inspect the line for leaks. If a leak is suspected but is not visible, use listening equipment to try and detect the point of failure.
6. Do not remove temporary struts or anchors until the line has been de-pressurised.

PE, HDPE and ABS pipelines shall be tested in accordance with WSA 01 and AS/NZS 2566.2. The simplified test procedure of PE and HDPE sewer rising mains is as follows;

1. Install blank flanges or caps at each end of the test section. Closed valves should not be tested against unless they are full restrained and it is possible to check for leakage past the valve seat. Temporarily strut or anchor mechanical ends that are not end load restrained to withstand the test pressures without movement.
2. Pressurise the line to the test pressure and leave for a minimum of 12 hours. The pressure will drop over this period due to expansion of the sewer rising main.
3. If no leaks are evident, steadily raise the pressure in the sewer rising main until the test pressure is reached.
4. Maintain the test pressure for five (5) hours. Measure and record, at one-hour intervals, the quantity of water added in order to maintain the pressure during the period of testing.
5. Visually inspect the line for leaks. If a leak is suspected but is not visible, use listening equipment to try and detect the point of failure.
6. Do not remove temporary struts or anchors until the line has been de-pressurised.

The pressure testing of a section shall be considered to be satisfactory if:

- (a) There is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component;
- (b) There is not visible leakage; and
- (c) The measured leakage rate does not exceed the permissible leakage rate.

The measured leakage rate for DICL, GRP, PVC and Mild Steel pipelines shall be determined in accordance with WSA 02 by the following formula:

$$Q_1 = 0.14 \times D \times L \times H / 1000 \text{ (L/hr)}$$

Where:

- $Q_1$  = permissible leakage rate (litres per hour)
- $D$  = nominal diameter of pipe (mm)
- $L$  = length of section tested (km)
- $H$  = average test head (m)

The measured permissible leakage rate for PE and HDPE pipelines shall be determined in accordance with WSA 01 by the following formula:

$$V_{4-5} \leq 0.55 \times V_{2-3} + 0.14 \times D \times L \times H \text{ (litres)}$$

Where:

- $V_{4-5}$  = volume of water added between 4<sup>th</sup> and 5<sup>th</sup> hour (litres)
- $V_{2-3}$  = volume of water added between the 2<sup>nd</sup> and 3<sup>rd</sup> hour (litres)
- $D$  = nominal diameter of pipe (m)
- $L$  = length of section tested (km)
- $H$  = average test head (m)

Any failure, defect or visible leak which is detected during the pressure testing of the pipeline or during the Defects Liability Period, including any failure of thrust or anchor blocks shall be made good by the Contractor at its expense.

The Contractor shall provide all material, labour and equipment required for the pressure testing, including approved pumps and pressure gauges. The test rig shall be fitted with two calibrated pressure gauges. Each pressure gauge shall have a range of 0-2,500kPa and shall have a current calibration certificate. The gauges shall read within  $\pm 5\%$  of the test head and each other. Use the gauge recording the lower of the two readings.

Water for testing is the responsibility of the Contractor.

All expenses in connection with testing shall be borne by the Developer. The Developer shall have no claim for compensation or damages in respect of any postponement of the testing.

#### **4.7 INSPECTION PRIOR TO BACKFILLING**

All sewerage lines shall be inspected and approved by Council after laying and jointing and prior to the placing of any backfilling.

#### **4.8 CCTV INSPECTION (REFER WSA02-21.8)**

At the conclusion of all construction activities and prior to lodgement of a survey certificate application, sewer/stormwater pipelines within the subdivision development that are proposed

to be handed over to Council, are to be inspected using closed circuit television (CCTV). The CCTV footage is to be presented to Council for assessment.

CCTV Inspections shall be completed in accordance with the requirements of WSA05–2013 and shall address both ovality (WSA02-21.6) and grade (WSA02-21.7) compliance with WSAA requirements unless other methods have already done so.

#### **4.9 TESTING OF SEWER PUMP STATIONS (REFER WSA04-36.0)**

All testing shall be in accordance with WSA requirements, which are mentioned in the preceding test clauses.

Wet wells and emergency storages shall be pressure tested by either vacuum or hydrostatic test methods. Infiltration testing shall also be completed on wet wells and emergency structures.

Compaction testing shall be completed on fill surrounding pump stations in accordance with the requirements as detailed in WSA04-36.0 and in accordance with the requirements of this document.



## 5. WATER RETICULATION

### 5.1 GENERAL (REFER WSA03-10.1)

This section relates to water reticulation acceptance testing. The testing of water reticulation shall generally be in accordance with the latest version of the Water Services Association of Australia (WSAA). However this part of the Council's 'Engineering Guidelines' takes precedence over the WSAA Standards. The 'Water Supply Code of Australia (WSA03) Part 3 Construction; Third Edition Version 3.1' has been cross-referenced.

All water reticulation shall be subject to testing after construction (NATA accreditation is not mandatory). The tests shall be carried out before release of the approved subdivision plan.

Should the water reticulation fail any test, defects shall be detected and repaired and the test repeated. The process of testing, detection, repair of defects and retesting shall continue until a satisfactory test is obtained.

### 5.2 ACCEPTANCE TESTING (REFER WSA03-19)

#### 5.2.1 HYDROSTATIC PRESSURE TESTING (REFER WSA03-19.4)

All pipelines including services shall be pressure tested to detect and repair leakage and defects in the pipeline including joints, thrust blocks and anchor blocks, if any. The method of setting up and carrying out the test shall be in accordance with the requirements of WSA pressure testing section 19.4.

Pipelines shall be tested in sections approved by Council as soon as practicable after each section has been laid, jointed and backfilled provided that:

- If so specified or if the Developer so desires, some or all of the pipe joints shall be left uncovered until the whole of the section has been successfully pressure tested to the satisfaction of Council
- The pressure testing shall not be commenced earlier than seven days after last concrete thrust or anchor block in the section has been cast

For the purpose of this clause, a section shall be defined as a length of pipeline, which can be effectively isolated for testing, e.g. by means of main stop valves. Unless noted otherwise or approved by the Council, the maximum length of a test section shall be 1,000 metres.

Unless otherwise approved by Council, pressure testing shall not be carried out during wet weather.

During pressure testing all field joints, which have not been backfilled, shall be clean, dry and accessible for inspection.

During pressure testing of a pipeline each stop valve shall sustain at least once, the full test pressure on one side of the valve, with no pressure on the other side for at least 15 minutes.

Before testing a pipeline section, it shall be cleaned to the satisfaction of the Water Agency and filled slowly with water (filling velocity not to exceed 0.05m/sec), taking care that all air is expelled. Purging of air from reticulation shall be prompted by opening hydrants.

In order to achieve conditions as stable as possible for testing by allowing for absorption, movement of the pipeline and escape of entrapped air, the section shall be kept full of water for a period of not less than 24-hours prior to the commencement of the pressure testing.

All pipes shall be tested in the presence of the Council's representative.

The minimum hydrostatic test pressure, which shall be applied to each section of the pipeline, shall be 1,000kPa, or 1.25 times the design pressure (whichever is greater).

For a given section of water main, the actual test pressure at any point in the test section will depend on its relative level. The system test pressure shall be chosen such that;

- c. At the highest point in the test section the system test pressure is greater than the design pressure, and
- d. At the lowest point in the test section the system test pressure is greater than 1.25 times the design pressure.

The hydrostatic test pressure specified above shall be maintained as long as required by Council's representative, while they examine the whole of the section, and in any case not less than four (4) hours for DICL, GRP, PVC and Mild Steel pipelines, and not less than five (5) hours for PE, HDPE and ABS pipelines. For the purpose of determining the actual leakage losses, the quantity of water used during testing shall be carefully measured and recorded.

With the exception of PE and HDPE pipelines, test all water mains as follows;

7. Install blank flanges or caps at each end of the test section. Closed valves should not be tested against unless they are full restrained and it is possible to check for leakage past the valve seat. Temporarily strut or anchor mechanical ends that are not end load restrained to withstand the test pressures without movement.
8. Pressurise the line to 75% of the test pressure and leave for a minimum of 12 hours.
9. If no leaks are evident, steadily raise the pressure in the water main until the test pressure is reached.
10. Maintain the test pressure for four (4) hours. Measure and record, at one-hour intervals, the quantity of water added in order to maintain the pressure during the period of testing.
11. Visually inspect the line for leaks. If a leak is suspected but is not visible, use listening equipment to try and detect the point of failure.
12. Do not remove temporary struts or anchors until the line has been de-pressurised.

PE, HDPE and ABS pipelines shall be tested in accordance with WSA 01 and AS/NZS 2566.2. The simplified test procedure of PE and HDPE water mains is as follows;

7. Install blank flanges or caps at each end of the test section. Closed valves should not be tested against unless they are full restrained and it is possible to check for

- leakage past the valve seat. Temporarily strut or anchor mechanical ends that are not end load restrained to withstand the test pressures without movement.
8. Pressurise the line to the test pressure and leave for a minimum of 12 hours. The pressure will drop over this period due to expansion of the water main.
  9. If no leaks are evident, steadily raise the pressure in the water main until the test pressure is reached.
  10. Maintain the test pressure for five (5) hours. Measure and record, at one-hour intervals, the quantity of water added in order to maintain the pressure during the period of testing.
  11. Visually inspect the line for leaks. If a leak is suspected but is not visible, use listening equipment to try and detect the point of failure.
  12. Do not remove temporary struts or anchors until the line has been de-pressurised.

The pressure testing of a section shall be considered to be satisfactory if:

- (d) There is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component;
- (e) There is not visible leakage; and
- (f) The measured leakage rate does not exceed the permissible leakage rate.

The measured leakage rate for DICL, GRP, PVC and Mild Steel pipelines shall be determined in accordance with WSA 03 by the following formula:

$$Q_1 = 0.14 \times D \times L \times H / 1000 \text{ (L/hr)}$$

Where:

- $Q_1$  = permissible leakage rate (litres per hour)
- $D$  = nominal diameter of pipe (mm)
- $L$  = length of section tested (km)
- $H$  = average test head (m)

The measured permissible leakage rate for PE and HDPE pipelines shall be determined in accordance with WSA 01 by the following formula:

$$V_{4-5} \leq 0.55 \times V_{2-3} + 0.14 \times D \times L \times H \text{ (litres)}$$

Where:

- $V_{4-5}$  = volume of water added between 4<sup>th</sup> and 5<sup>th</sup> hour (litres)
- $V_{2-3}$  = volume of water added between the 2<sup>nd</sup> and 3<sup>rd</sup> hour (litres)
- $D$  = nominal diameter of pipe (m)
- $L$  = length of section tested (km)
- $H$  = average test head (m)

Any failure, defect or visible leak which is detected during the pressure testing of the pipeline or during the Defects Liability Period, including any failure of thrust or anchor blocks shall be made good by the Contractor at its expense.

The Contractor shall provide all material, labour and equipment required for the pressure testing, including approved pumps and pressure gauges. The test rig shall be fitted with two calibrated pressure gauges. Each pressure gauge shall have a range of 0-2,500kPa and shall have a current calibration certificate. The gauges shall read within  $\pm 5\%$  of the test head and each other. Use the gauge recording the lower of the two readings.

Water for testing is the responsibility of the Contractor.

All expenses in connection with testing shall be borne by the Developer. The Developer shall have no claim for compensation or damages in respect of any postponement of the testing.

#### 5.2.2 DISINFECTION (WSA03-20)

All new or replacement water mains equal or greater than 100mm diameter must be disinfected prior to being brought into service. Bacteriological testing and disinfection procedures shall be in accordance with WSA03-19.7 and WSA03-20.

Disinfecting can only be carried out by appropriately authorised personnel to the Council's Disinfection Procedures. The details of the proposed sub-contractor for disinfection works including their history in regard to similar works shall be furnished to the Council and approval obtain prior to their commencement. Where the sub-contractor has not been previously inducted into Council's Disinfection Procedures, it is the Developers responsibility to ensure the sub-contractor completes the required inductions prior to undertaking disinfection works.

At the completion of installation and testing of works, and prior to commissioning the water main, the main shall be disinfected by super-chlorination. The disinfectant shall be sodium hypochlorite, preferably of 12.5-13% concentration approved for the treatment of potable water. Suitable procedures must be in place for the safe use, handling and storage of the chemicals.

During the disinfection process, the Contractor shall operate all valves, hydrants, water meters and other fittings to ensure complete disinfection.

Measures shall be taken to ensure the health and safety of workers, and protection on the environment.

The new or replacement water main shall be gradually filled with potable water with a solution of 25mg/L free chlorine.

Once filled, the chlorinated water shall be retained in the main for a minimum period of 24 hours. Records of free chlorine levels and their sample locations shall be recorded.

At the completion of the period, where the super-chlorinated water has a chlorine residual level below 5mg/L, the super-chlorinated solution shall be flushed from the main until free chlorine residual levels less than 1.0 mg/L are achieved throughout the reticulation system. De-chlorinator units shall be used to reduce chlorine levels in discharged water to less than 0.2mg/L.

Whilst still full of potable water with free chlorine residual levels of between 0.5-1.0mg/L, but prior to bring the section of main into service, samples shall be taken at the same locations as

free chlorine were measured and microbiologically tested for total coliforms and E. coli. Results for all testing shall be recorded. Sample results that comply with the requirements of the Australian Drinking Water Guidelines shall be deemed to be “compliant”.

Should microbiological testing fail to produce “complaint” results, the water main shall be flushed and the disinfection process repeated.

On receipt of “compliant” results for microbiological testing, with acceptable free chlorine residual levels and the water is at an aesthetically acceptable level (clear, no odour or offensive taste, etc.) the section of main can be brought into service.

<b>Version</b>	<b>Date</b>	<b>Changes/Amendments</b>
<b>1</b>	November 2018	Approved issue
<b>1.1</b>	July 2020	Minor Amendments