WATERFORD & WEXFORD EDUCATION & TRAINING BOARD

Proposed Carpark Upgrades and Alterations at Waterford Training Centre, Waterford Industrial Park, Cork Road, Waterford

Project Specification (PS01)
Civil / Structural

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CONTENTS:

Section	Title
S4	Site Works

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S4: Specification for Civil Enginering Works

CONTENTS:

1.0 INTRODUCTION 1
1.1 General 1
1.2 Statutory Authority Specifications 1
1.3 Scope of Works 1
1.4 Building Regulations 2
1.5 Construction Products Regulations 2013 2
1.6 Quality Assurance / CE Marking 2
1.7 Prohibited Materials 2
1.8 Standard Codes of Practices 2
1.9 Health and Safety 3
2.0 GENERAL CLAUSES 4
2.1 General Clauses Common to all Sections 4
2.2 Terms & Definitions 4
2.3 Contract Document 5
2.4 Materials 5
2.5 Standard of Work 5
2.6 Setting Out, Levels and Reference Points 5
2.7 Tolerances 6
2.8 Inspection 6
2.9 Variation to the Design 7
2.10 Progress and as Constructed Drawings 7
2.11 Protection of Existing Trees and Hedges 7
2.12 Diversion and Control of Traffic 8
2.13 Reinstatement of Surfaces 11
2.14 Temporary Works 11
2.15 Site Clearing 12
2.16 Work not to be Covered 12
2.17 Protection of the Works 13
2.18 Survey or Inspection of Roadways, Properties and Lands 13
2.19 Site Fencing 13
2.20 Site Security 13
2.21 Welfare Facilities 14
2.22 Protection against Damage 14
2.23 Public Utility and Other Services 14
2.24 Protection to Existing Sewers, Drain Ducts and Services 15
2.25 Tidiness of Site 15
2.26 Wheel Washing 16
2.27 Noise Control 16
2.28 Information Regarding Soil Conditions 16
2.29 Dealing with Water 16

2.30 Use of Explosives 16
2.31 Destruction of Weeds 17
2.32 Specific Items 17
2.33 Workmanship 18
2.34 Testing 18
3.0 MATERIALS 19
3.1 Standards and Submission of Materials 19
3.2 Storage of Materials 20
3.3 Handling and Use of Materials 20
3.4 Water 20
3.5 Recycle Aggregates 20
3.6 Aggregates for Concrete 21
3.7 Sand 21
3.8 Cement 21
3.9 Concrete Mixes 21
3.10 Cement Additions 22
3.11 Mortar 22
3.12 Lean Mix Concrete 23
3.13 Concrete 24
3.14 Ready Mixed Concrete 25
3.15 Air Entrainment 25
3.16 Precast Concrete Kerbing 26
3.17 Natural Stone Kerbing 26
3.18 Edging 27
3.19 Precast Concrete Paving Slabs 27
3.20 Reconstituted Stone Paving Slabs 27
3.21 Natural Stone Paving Slabs 27
3.22 Precast Concreter Block Paving 27
3.23 Clay Block Pavers 27
3.24 Bedding for Paving Slabs, Block Paving and Pavers 27
4.0 WORKMANSHIP & TESTING 28
4.1 Concrete 28
4.2 Mortar 28
4.3 Turf and Topsoil 28
4.4 General Excavation 29
4.5 Precast Concrete Kerbs and Channel Blocks 29
4.6 Paving Slabs 30
4.7 Block Paving 30
4.8 Footway / Footpath Edging 31
4.9 Footway / Footpath Level 31
4.10 Footway / Footpath Alignments 31

4.11 Cold Weather Work 32
4.12 Electrical Works for Road Lighting and Traffic Signs 33
4.13 Location of Lighting Units and Feeder Pillars 33
4.14 Aggregate Testing 34
4.15 Concrete Testing 34
4.16 Mortar Testing 35
5.0 EARTHWORKS 36
5.1 Scope of Works 36
5.2 Setting Out 36
5.3 Inspection 36
5.4 Site Clearance 36
5.5 Topsoil and Subsoil 38
5.6 Materials - Definitions 38
5.7 Materials Grouping 39
5.8 Requirements for Testing and Acceptability Limits 39
5.9 Grading Requirements 42
5.10 Testing Requirements 44
5.11 Geotextile Material 45
5.12 Slope Stabilisation 46
5.13 Requirements for Dealing with Unacceptable Material 46
5.14 Workmanship 46
5.15 Use of Plate Compactors for Drainage Backfill. 51
5.16 Tolerance 52
5.17 Rectification 52
5.18 Use of Surfaces by Construction Traffic 52
5.19 Geotextile Material Installation 52
6.0 DRANIAGE 53
6.1 General 53
6.2 Standards and Submission of Materials 53
6.3 Storage of Materials 53
6.4 Handling and Use of Materials 53
6.5 Prohibited Materials 53
6.6 Backfilling Materials for Drains and Services 54
6.7 Pre-Formed Drainage Channels 55
6.8 Water 55
6.9 Aggregates for Concrete 55
6.10 Sands for Mortar and Grout 55
6.11 Cement 55
6.12 Concrete Mixes (Refer to Section 10.0 Also) 56
6.13 Mortar 56
6.14 Pipe Bedding 56

6.15 Precast Concrete Setting Blocks for Pipes 57
6.16 Cast Iron Pipes and Fittings 57
6.17 Vitrified Clay Pipe and Pipeline Fittings 57
6.18 Concrete Pipes and Fittings 57
6.19 Porous Pipes 57
6.20 Thermoplastic Structured Wall Pipes 57
6.21 Unplasticizied PVC Pipes and Fittings 58
6.22 Compressible Filler and Packing for Pipelines 58
6.23 Puddle Clay 58
6.24 Precast Concrete Manholes 58
6.25 Polypropylene Inspection Chambers 59
6.26 Precast Concrete Cover Frame Seating Rings 59
6.27 Manhole Covers and Frames 59
6.28 Manhole Step Rungs 59
6.29 Gullies 59
6.30 Gully Grates and Frames 59
6.31 Linear Drainage Channel Systems 60
6.32 Brick and Blocks 60
6.33 Proprietary Drainage Systems 60
6.34 Petrol/Oil Interceptors 61
6.35 Attenuation System & Hydrobrake 61
6.36 Workmanship 61
6.37 Excavation of Pits and Trenches 62
6.38 Timbering of Excavations 62
6.39 Backfilling of Drainage and Excavation Works 63
6.40 Gullies, Grates and Frames 64
6.41 Cold Weather Work 64
6.42 Pipe Bedding Laying and Jointing 64
6.43 Junctions and Connections 66
6.44 Marker Posts 67
6.45 Crossing of Pipelines 67
6.46 Manhole and Catchpit Construction 67
6.47 Precast Concrete Manholes 68
6.48 Polypropylene Inspection Chambers 69
6.49 Building-in Pipes 69
6.50 Sealing of Disused Manholes, Sewers and Drains 69
6.51 Interference with Flows 70
6.52 Exclusion of Water from Sewers 70
6.53 Water Tightness of Manholes and Chambers 70
6.54 Testing and Inspection of Drainage Works 70
6.55 Air Test 70

6.56 Water Test 71
6.57 Sewer Survey by Closed Circuit Television (CCTV) 71
6.58 Existing Local Authority Sewers 72
6.59 Petrol Interceptors and Bypass Units 72
6.60 Drainage Channels 73
6.61 Land Drainage 73
7.0 WATERMAINS 74
7.1 General 74
7.2 Inspection 74
7.3 Materials 74
7.4 Pipes and Special Castings 74
7.5 Services Pipes & Fittings 75
7.6 Boundary Box 75
7.7 Sluice Valves 75
7.8 Hydrants 76
7.9 Hydrants and Meter Chambers 76
7.10 Surface Covers 76
7.11 Hydrant and Valve Indicator Plates 76
7.12 Storage, Handling and Use of Materials 76
7.13 Depth and Position of Pipes 77
7.14 Trench Width 77
7.15 Thrust Blocks 77
7.16 Warning Mesh 78
7.17 Pipe Joints 78
7.18 Cleaning Pipes 78
7.19 Bedding Material 78
7.20 Backfilling Material in or Adjacent to Roadways 79
7.21 Location of Other Utility Equipment 79
7.22 Desing Criteria 79
7.23 Tests 79
7.24 Pressure Test 79
7.25 Chlorination Test 80
7.26 Bacteriological Test 80
7.27 Connection to Public Mains 80
7.28 Flushing 80
7.29 As Constructed Drawings 81
7.30 Health and Safety 81
8.0 ROADS 82
8.1 Standards and Submission of Materials 82
8.2 Storage of Materials 82
8.3 Handling and Use of Materials 82

8.4 Capping and Sub-Base Materials 82
8.5 Testing Requirements 83
8.6 Bituminous Base/Binder Course 83
8.7 Surface Course 83
8.8 Coated Chippings 83
8.9 Pre-Cast Concrete Kerbing 83
8.10 Pre-Cast Concrete Edging 83
8.11 Paving Slabs, Setts and Cobbles 84
8.12 Bedding for Paving Slabs 84
8.13 Bituminous Emulsion Tack Coat 84
8.14 Water 84
8.15 Aggregates for Concrete 84
8.16 Sand and Mortar and Grout 84
8.17 Cement 84
8.18 Concrete Mixes 84
8.19 Mortar 84
8.20 Dowel Bars and Tie Bars 84
8.21 Bond Breaking Compound for Dowel Bars 85
8.22 Joint Sealing Compound and Sealants 85
8.23 Waterproof Membrane 85
8.24 Joint Filler 85
8.25 Road Marking Materials 85
8.26 Ducting 85
8.27 Regulating Course (Asphalt Concrete) 85
8.28 Lean Mix Concrete 86
8.29 Excavations 86
8.30 Granular Road Base/Sub-Base Materials 86
8.31 Base/Binder Course 87
8.32 Surface Course 87
8.33 Carriageway/Footway Level 87
8.34 Pre-Cast Concrete Kerbs and Channel Blocks 87
8.35 Block Paving 88
8.36 Footway/Footpath Edging 88
8.37 Alignments 88
8.38 Surface Regularity 88
8.39 Rectification 88
8.40 Use of Surfaces by Construction Traffic 89
8.41 Road Markings 89
8.42 Traffic Signs 89
8.43 Road Markings and Studs 89
9.0 CONCRETE 91

9.1 General 91
9.2 Aggregates 91
9.3 Reinforcement 91
9.4 Formwork 91
9.5 Mixing Concrete 91
10.0 CERTIFICATION AND TESTING 93
10.1 General 93
10.2 Roads 93
10.3 Footpaths 94
10.4 Kerbs 95
10.5 Private Drainage 95
10.6 Watermain 97
10.7 Utilities 98

1.0 INTRODUCTION

1.1 General

1.1.1 Each section of this specification is intended as standalone, however there is a need to also refer to the general and specific sections as appropriate. Any clauses that are not relevant are deemed not to apply.

1.1.2 Users of this specification are advised that alternative more sustainable and environmental advantageous, reclaimed materials may be available for substitution for some of the naturally occurring materials envisaged in this specification.

1.2 Statutory Authority Specifications

1.2.1 Uisce Eireann Code of Practice and design standards now apply to all water supply and wastewater installations. In this regard the contractor should fully familiarise themselves with the following documents:

- Uisce Eireann – Code of Practice for Wastewater Infrastructure
- Uisce Eireann – Code of Practice for Water Infrastructure
- Uisce Eireann – Wastewater Infrastructure Standard Details
- Uisce Eireann – Water Infrastructure Standard Details

1.2.2 The above documents are available from the Uisce Eireann website – www.water.ie.

1.2.3 Where this specification differs from the Uisce Eireann Standards outlined above, the Uisce Eireann Standards shall be applied and the difference advised to the Consulting Engineer.

1.3 Scope of Works

1.3.1 The Works shall be executed in accordance with the Engineer's drawings and Specification. Unless specifically stated all materials and workmanship shall comply with the latest edition of the relevant Irish and British Standard. The Contractors shall examine all drawings and report any discrepancies, dimensional anomalies or any other technical questions in good time before the execution of the works. All works shall be carried out in accordance with the requirements of the Health and Safety Authority.

1.3.2 The outline of work is as follows:

- The construction of the infrastructure required to service a proposed development including all necessary roads, parking areas, footpaths, drainage and water supply infrastructure as indicated on the drawings.

1.3.3 The following is a non-exhaustive list of particular conditions pertaining to the site and the Contractor's attention is drawn to the requirement for taking these conditions into consideration during the execution of the works.

- Access to the site is from the North of the development.
- All necessary precautions to prevent the discharge of materials and water from the site on to the surrounding road networks will be required to be undertaken.

- The Contractor's attention is drawn to the existing live campus and road, services and sewers around the site.
- The Contractor shall comply with restrictions on site working hours as may be set out in the planning permission for the works being undertaken.

1.3.4 See each section for the detailed scope of works relating to that section.

1.4 Building Regulations

1.4.1 All works must comply with the Building Regulations and any amendments thereto whether these have been implied or not in the tender documentation.

1.5 Construction Products Regulations 2013

1.5.1 All construction products used in the works shall comply with the European Community (Construction Products) Regulations 2013.

1.6 Quality Assurance / CE Marking

1.6.1 All materials and specialist suppliers are to have been assessed and certified by an approved independent third-party quality assurance scheme and are to have CE marking on their products in accordance with the Construction Products Regulation (CPR) 305/2011/EU. The Contractor is to ensure that all products have CE marking prior to ordering and is to forward evidence of same to the Engineer prior to installation. Contractor to be responsible for providing all "Declarations of Performance" for materials delivered to the site.

1.7 Prohibited Materials

1.7.1 The following materials shall not be specified or employed in the works:

(i) Calcium chloride additives

(ii) High alumina cement

(iii) Woodwool permanent formwork

(iv) Asbestos

(v) Biodegradable void formers

(vi) Urea formaldehyde

(vii) Calcium silicate bricks

(viii) Any materials that are in anyway detrimental to the life or construction of the development or any part of it.

1.8 Standard Codes of Practices

1.8.1 Reference herein to Irish, British or other National Standards or Codes of Practice are to be adhered to and where a standard or code of practice has been superseded, the latest edition of the superseding publication shall apply.

1.8.2 For products/materials certified to an Irish Standard Specification the product/material shall either be certified as complying with the relevant Irish Standard Specification No. in accordance with the Irish Standard Mark Licensing Scheme run by NSAI and shall bear the Irish Standard Mark or shall be certified to an international standard or a national standard of another Member State of the European Community which provides an equivalent guarantee of safety and suitability. Manufacturers' or suppliers' certificates of compliance with the Standard shall be provided when requested by the Design team.

1.8.3 Where a British or Irish Standard incorporated in the Contract has been superseded by a Harmonised European Standard, or a European Standard, issued prior to the date stated in the Contract then such Harmonised European Standard or European Standard shall be substituted for the British or Irish Standard and any amendments thereto contained in the Specification.

1.8.4 If any other relevant standards become updated then the new standard shall be referred to.

1.9 Health and Safety

1.9.1 The Contractor shall comply with all enactments, regulations, and working rules relating to the safety, health and welfare of workpeople and other persons authorised to be on the site. The site shall be kept tidy and clean at all times and safety helmets shall be provided for the use of all visitors.

1.9.2 The Contractor shall ensure that no damage beyond fair wear and tear is caused to public or private roads and footpaths by site traffic and that they shall be kept clean.

1.9.3 The attention of the contractor is drawn to the Provision of the Safety, Health and Welfare at Work (Construction) Regulations 2013 and any amendments thereof. The regulations are in addition to existing legislation and regulations in the area of Health and Safety at Work, most notably:

- Safety, Health and Welfare at Work Act, 2005.
- Safety, Health and Welfare at Work (General Application) Regulations, 2007.

1.9.4 The tenderer shall allow an appropriate sum in the tender for the purpose of complying with all Health & Safety legislation.

1.9.5 During the evaluation of tenders, if requested the tenderer shall submit a signed copy of their companies Safety Statement pursuant to Section 12 of the Safety, Health and Welfare at Work Act, 2005.

1.9.6 The Contractor shall detail on the form of tender the period within which it is proposed to carry out the works if the proposed substantial completion dates cannot be achieved and written confirmation may be required of the allowances made for the safe completion of the works. Notwithstanding the above, the successful tenderer will be required to provide a signed copy of the company's parent and any ancillary safety statement. The contractor will also be required to provide safety statements from all sub-contractors who enter the site pursuant to the Health, Safety and Welfare at Work Act, 2005.

2.0 GENERAL CLAUSES

2.1 General Clauses Common to all Sections

2.1.1 Each section of this specification has a sub-section covering general clauses that are only pertinent to each different section. However, there are general clauses that are relevant to all sections and they are consequently included in this section.

2.2 Terms & Definitions

2.2.1 The following terms and definitions apply:

- The term “Client or Employer” in this Specification refers to **Waterford Wexford Education Training Board,**
- The term "Engineer" in this Specification refers to **MPA Consulting Engineers**
- The term "Architect" in this Specification refers to **MPA Consulting Engineers**
- The term "Landscape Architect" in this Specification refers to **MPA Consulting Engineers**
- The term "Authority" refers to " **Waterford City & County Council** and Uisce Eireann / Irish Water as appropriate".
- The term "Contractor" refers to the Trade Contractor appointed for a particular section of the works.
- The term “PSDP” in this Specification refers to the Project Supervisor Design Process.
- The term “PSCS” in this Specification refers to the Project Supervisor Construction Stage and may be the Contractor appointed to carry out the works.
- The term “he” refers to the Contractor and should be read as he or she as appropriate.
- The term Contract Document refers to the contract agreement document between the Client & the Contractor.

2.2.2 The specification is based on:

a. Transport Infrastructure Irelands “Specification for Road Works ”,
b. The “Greater Dublin Regional; Code of Practice for Drainage Works Version 6.0”,
c. “Uisce Eireann Code of Practice for Wastewater Infrastructure”
d. “Uisce Eireann Code of Practice for Water Infrastructure”
e. Department of Environment’s “Building Regulations Technical Guidance Documents”.

2.2.3 Where any item of this Specification is subject to the Engineer's comment, the Contractor may proceed with this item only after all matters arising from such comment have been fully taken into account by the Contractor, and when authorised in writing by the Engineer .

2.2.4 The approval of a sample of materials and/or workmanship does not constitute approval of the actual materials and/or workmanship employed in the works, but only approval of the particular sample.

2.2.5 The Contractor shall be responsible for co -ordinating the works to ensure all interface details are in accordance with the specifications for the contract.

2.3 Contract Document

2.3.1 If there is a conflict between the Contract Document and the Clauses, including General Clauses, in this specification then the Contract Document shall prevail.

2.3.2 If there is a conflict between the specification and the drawings, then the Contractor shall give seven days' notice in writing to the Engineer who will clarify each case.

2.4 Materials

2.4.1 Each section of this specification has its own sub-clauses describing the requirements for the relevant materials. The requirements common to all sections are described in the General Section 3.1.

2.4.2 Where a Clause in the Specification relates to work goo ds or materials that are not required for the Works, it shall be deemed not to apply.

2.5 Standard of Work

2.5.1 The whole of the Works shall be carried out in a proper and thoroughly workmanlike manner to the satisfaction of the Project Manager / Engineer and in accordance with the latest available editions at the time of construction of the various relevant British, Irish and European Standards and Codes of Practice.

2.6 Setting Out, Levels and Reference Points

2.6.1 Each section of this specification has its own sub-clauses describing the additional requirements for the relevant setting out.

2.6.2 The Contractor shall agree with the Engineer the actual levels across the site before any excavation works are commenced. The lines and levels of the proposed Works shall be set out by the Contractor by means of wooden pegs or steel pins in accordance with the Construction Drawings.

2.6.3 The Contractor shall supply and agree with the Engineer details of the value and location of the temporary benchmarks and reference points that he proposes to use.

2.6.4 The Contractor shall be responsible for establishing and maintaining setting out station points and temporary benchmarks for the duration of the works and to make the station points available to the Employer on the completion of the Contract. The general requirements are as set out below.

(i) The Contractor shall supply to the Engineer details of the value and location of the temporary bench marks and reference points which he proposes to use.

(ii) The Contractor shall satisfy himself that the existing levels as indicated on the drawing are correct. Should the Contractor wish to dispute any levels he shall submit to the Engineer a schedule of the position of the levels considered to be in error and a set of revised levels. The existing ground relevant to the disputed levels shall not be disturbed before the Engineer's decision as to the correct levels is given.

(iii) The Contractor shall check the locations, invert levels and sizes of existing drains, sewers, catchpits and manholes before the commencement of any works and shall notify the Engineer immediately if the declared invert levels or sizes are found to be inaccurate or at variance with the drawings or documents.

(iv) The Contractor shall check the locations of all utilities, underground and overground and shall record the location of all existing and new utilities.

2.7 Tolerances

2.7.1 Unless otherwise stated the constructional tolerances shall be no greater than listed below.

a) **Position on Plan**

± 10mm for superstructure and ground beams, relative to building grid lines.

± 35mm for foundations, relative to building grid lines.

b) **Verticality**

Plumbness in height of:

Up to and including 1.5m	:	± 5mm
1.5m to 4.0m	:	± 15mm
Over 4.0m	:	± 20mm

c) **Level**

Deviation from the specified level of the upper or lower surface of any element, from the nearest T.B.M. ± 10mm.

d) **Cross Section of Site Constructed Members**

Dimensions of beams, slabs, columns, piers and walls:

Up to and including 500mm ± 5mm over 500mm ± 1%.

2.7.2 Please note that tolerances cannot be cumulative for the purpose of this specification. The above tolerances are to be regarded as the maximum permitted by the Structural Engineer for general purposes. However, the Contractor must allow for closer tolerances if required for the purposes of items specified by the Architect, Service Engineer, or for any building component.

2.8 Inspection

2.8.1 The Contractor will liaise with the Local Authority or any Statutory Authorities including Uisce Eireann on inspections required for the proposed taking in charge of the works, or to meet pre-connection requirements.

2.8.2 The Contractor shall give 24 hours' notice upon completion of each stage of the works for the Engineer to carry out an inspection. Work shall not proceed with the next stage until this inspection has been made and approval of the works given in writing.

2.8.3 Refer to each section for the detailed inspections relating to that section.

2.8.4 These inspections shall be in addition to all routine day to day checks and inspections.

2.8.5 The Engineer shall be informed a minimum of 48 hours prior to existing structures and new foundations being exposed, to permit inspections to be carried out. A similar period shall apply to all reinforced concrete, prior to placing of the concrete, and new steelwork prior to placing of the

fire protection. On completion the Contractor shall notify the Engineer who will carry out a final inspection prior to the issue of the Certificate of Practical Completion by the Supervising Officer. A further inspection shall be carried out at the expiry of the defects liability period.

2.8.6 Notwithstanding the above the contractor shall review the projects BCaR Preliminary Inspection Plan for the requirement for number and notification periods for site inspections.

2.9 Variation to the Design

2.9.1 The Contractor shall set all the Works in the positions and for the materials as shown on the drawings or described in this specification.

2.9.2 Before the Contractor varies any material, component or detail of construction he shall notify the Architect and the Engineer of the total effect that these variations will have on the design and performance of the installation and all other services.

2.9.3 Permanent works constructed in the wrong position or with incorrect material or to incorrect levels according to the drawings shall be demolished and new works installed correctly unless otherwise approved by the Engineer.

2.10 Progress and as Constructed Drawings

2.10.1 The Contractor shall retain on site at all times one complete set of progress drawings marked up in colour to indicate the current progress and variation to the works. These progress drawings shall be available throughout the Project duration for inspection by the Architect, Engineer or others. Immediately upon completion of the installation, the Contractor shall prepare a set of "as con structed" drawings of the Work s and deliver them to the Engineer.

2.10.2 The Contractor shall provide record drawings digitally in the latest AutoCAD dwg format that shall indicate all revisions to the detailed design. The record drawings shall be issued within 21 days of issue of the Completion Certificate.

2.10.3 The Contractor should note that the provision of the above drawings forms part of the information to be included in the Health and Safety File required under the Health and Safety Regulations.

2.11 Protection of Existing Trees and Hedges

2.11.1 Trees, hedges, walls and fences shall not be removed except as agreed by the Landscape Architect.

2.11.2 Every precaution shall be taken to avoid damage during operations and particular care shall be exercised at all times to safeguard all trees, vegetation and the features required to be preserved.

2.11.3 Branches to be dealt with only as agreed by the Landscape Architect and b y approved tree surgeons.

2.11.4 Should the roots of any tree project into an excavation, great care shall be taken to avoid damage to the root. If the cutting of any roots be deemed necessary, the approval of the Landscape Architect must be sought.

2.12 Diversion and Control of Traffic

Scope

2.12.1 The contractor is to provide a construction stage Traffic Management Plan, in accordance with these requirements and submit the Plan to the Employer for their review prior to carrying out any works. It is the contractor's responsibility to obtain all necessary road opening permits/ licenses.

Traffic Management Criteria and Considerations

2.12.2 The Contractor shall appoint a Temporary Traffic Management Designer and a certified Temporary Traffic Operations Supervisor.

2.12.3 The Temporary Traffic Management Designer when working on the public road shall liaise with the Local Authority and shall in all works on public or private roads prepare detailed Temporary Traffic Management Plans as required in accordance with Chapter 8 of the Traffic Signs Manual.

2.12.4 The Temporary Traffic Operations Supervisor shall oversee the implementation of the Traffic Management Plans.

2.12.5 The Temporary Traffic Operations Supervisor shall immediately notify the PSCS and the Local Authority of any issues that arise. Where issues are notified to the PSCS, the PSCS shall consult with the PSDP and the Contractor's Traffic Management Designer to revise or modify the Traffic Management Plan, as necessary.

2.12.6 Warning Signs and temporary illumination - Appropriate warning signage, including temporary illuminated signage, shall be provided.

2.12.7 The Contractor shall submit and agree details of any Stop and Go system with the Local Authority and with the Garda Síochána (on public roads) prior to the implementation of STOP and GO battens. Battens used shall be in accordance with sign numbers RUS060 and RUS061 as detailed in Traffic Signs Manual - Chapter 8.

2.12.8 Manually operated methods, STOP and GO battens can be used at plant crossover locations.

2.12.9 For short works (less than 20m) manual control at one end or in the middle may be sufficient. For short works at site crossing points or exits, a single operator may use a double -sided STOP batten to control traffic.

2.12.10 Signing and coning for the STOP and GO batten method should be in accordance with Temporary Traffic Management Operations Guidance (2019 or as amended). Temporary Traffic Management layout design should be in accordance with Temporary Traffic Management Design Guidance (2019 or as amended) and particularly items listed below should be taken into account:

- Sight Lines, Taper Requirements and Positioning – Sight lines need to be considered from both the traditional road design perspective where road users' need are considered, and also from the operatives' point of view (e.g., design of works, site access and egress).
- Tapers, where required, should be situated where sight lines in both the horizontal and

Vertical planes are favourable. The location of the taper should not be decided without the benefit of a risk assessment and full appreciation of the sit e. Safety issues pertaining to placing, erecting and removing advanced warning signs and cones in the taper and the availability of safe off -road parking for traffic management vehicles may also be factors in deciding the taper position. When the works are situated near a bend, and especially a left hand bend, it is essential that adequate advance warning is given to the approaching drivers because of reduced visibility. An early indication should be given of the path that must be followed to avoid any obstruction in the carriageway.

- Safety Zones – Longitudinal and lateral safety zones to be provided around a defined works area in order to provide a safe system of working at road works. The appropriate length and width of the safety zones are to be in accordance with the latest guidance from the DoT.
- Signing – signs should be in accordance with Traffic Signs Manual - Chapter 8. All temporary signs should be located in appropriate advance. Additionally temporary signage should be used on approach roads. It should be noted that too many signs can be confusing for the driver. The signing must always convey accurately to road users, including pedestrians, exactly what is happening and what is expected of them.
- Lane Widths – recommended traffic lane for shuttle traffic to be a minimum of 3.0m and maximum of 3.75m.
- Temporary Lane Delineation – Obstruction of part of a road may require drivers to carry out unusual manoeuvres, so drivers must be given a clear indication of path they should take.
- Temporary delineation in the form of traffic cones, cylinders or barriers etc. should be used to for this purpose. Existing road markings and studs in conflict with any temporary lane alignment should be removed or mask ed, unless traffic is to be continued to a single lane delineated by cones on each side. Required minimum cone height to be 450mm.
- Maximum cone spacing should be in accordance with Temporary Traffic Management Operations Guidance and Temporary Traffic Management Design Guidance.
- Temporary Safety Barriers – obstructions and excavations should be adequately guarded at all times. Barriers shall be used to protect all persons from roadside hazards, obstructions, excavations and/or for the protection of the workforce from errant vehicles.
- Where it is evident that the temporary safety barriers will be necessary to protect the workplace and road users, their use should be specified. A need to flare approach lengths of barriers away from oncoming traffic should be take n into account. The implication for emergency service of wide load vehicles arising from the use of barriers, the duration of the works, and the risk associated with the installation of the barriers themselves are other factors that should be considered.
- The performance parameters of the safety barrier (containment level, impact severity level and working width) should be selected to suit the particular requirements of the site.
- The barriers must conform to EN 1317. At most locations, safety barriers with Temporary

Containment Levels T1, T2 and T3 or Normal Containment Levels N1 or N2 would be appropriate, although Higher Containment Levels H1 or H2 may be required. See TII TD 19 and IS EN 1317.

- The carriageway still in use alongside temporary safety barriers should be clearly defined by temporary road markings, studs or other appropriate means (e.g. row of cones between barrier and live traffic). Where the length of temporary barrier exceeds 50m, reflective strips or lanterns should be placed at 12m intervals along the line of the barrier. Steady lantern should be used in unlit areas (blinking/flashing lanterns should be only used at an isolated hazard location).
- The position of the barrier should allow for the required lateral safety zone. The width of the lateral safety zone should be per the design parameters set out in Temporary Traffic Management Design Guidance (2019) or the deflection width required for the safety barrier, whichever is greater.
- The design and layout should adhere to the manufacturer's requirements to ensure the temporary safety barrier acts as intended on impact. Once in position, site staff shall not remove safety barriers without prior agreement of the designer of temporary traffic measures.

2.12.11 Use of Temporary Surfaces – Limited traffic may be exposed to temporary sealed surfaces during road works where traffic is required to travel on construction layers or where traffic is directed over areas of the carriageway not normally used to convey traffic.

2.12.12 Where traffic is required on construction layers, the skid resistant properties of such temporary surfaces (e.g. road base and binder course surfaces) may not match those of surface courses. The temporary traffic management arrangements must Warn and Inform Road User of the condition of the temporary surface.

2.12.13 Where areas of the carriageway that are not normally used to convey traffic are brought into operation the adequacy of such temporary surfaces should be also considered with respect to the following:

- Cross fall / road camber
- Location of gullies, channels, manhole covers and other ironwork
- Clearances where traffic runs on edge strengthening or hard shoulder (e.g. proximity of safety
- barrier, light standards etc.),
- Surface condition (e.g. need to sweep the surface, skid resistance, planed out sections etc.) and Impact of expected temporary traffic loads (e.g. hard shoulders may need strengthening, manhole covers may need to be upgraded, etc.) .
- The primary methods of ensuring the safe passage of road traffic through the site should be by use of appropriate signage and lane delineation. All temporary road works signs shall be used with the requirements of Traffic Signs Manual - Chapter 8.
- A temporary speed limit can also be used in conjunction with road works signs when the appropriative travel speed through the works site is below the permanent speed limit prevailing.

- The appropriate travel speed through the site is to be less than the permanent speed limit if temporary traffic management arrangements result in reduced geometric or surface condition standards. Appropriate travel speeds for temporary surfaces should be based on guidance issued or authorised by the DoT and TII (in this case maximum of 30 km/h speed limit).
- Traffic management geometry should be in accordance with the design parameters prescribed in Traffic Signs Manual - Chapter 8. Some examples of appropriate use of signage and temporary speed limits are outlined below:
    - The “Slippery Road” sign (WK 072) should be considered for use in conjunction with the “Unfinished Road Surface” p late (P 085) and/or cautionary speed limit signage indicate that final surfacing has not yet been laid.
    - The “Hump of Ramp” sign (WK 070) should be used to warn the approaching driver of the presence of a hump in road alignment due to road works or traffic calming measures. When used as a traffic calming measure, the gradient and length of the ramp will be dictated by the speed at which vehicles are expected to traverse it and, where possible, the ramp should be constructed at right angles to the vehicle path.
    - Where traffic is exposed to different layers of overlay material, the “Uneven Surface” sign (WK 071) should be used to indicate that there is an uneven surface for vehicles. Where newly laid unbound material is exposed to live traffic, the “Uneven Surf ace” sign should be used in conjunction with a cautionary speed limit of 25km/h. It may also be accompanied by Plate “Slow” (P 080). Short duration exposure may be unavoidable due to the nature and sequence of the works, however, works should be scheduled to minimise any such exposure.
    - Emergency Procedures - The Contractor shall provide the name and the details of person who can be contacted in emergency situations. This information shall be circulated to the Employer and the Emergency Services.
    - The Contractor shall also manage and set out procedures for the routing of emergency vehicles through the works at all times.
    - Traffic Volumes - Traffic volumes along the road fronting the site is anticipated to be high during peak times with medium to high speeds at all times.

2.13 Reinstatement of Surfaces

2.13.1 The Contractor shall ascertain the Authority's requirements where any new sewer or drain passes under a road or pavement area and include for the provision and maintenance of a temporary surface, if required, and for the permanent reinstatement of the surface in accordance with the Authority's requirements to the satisfaction of the Authority and the Engineer.

2.14 Temporary Works

2.14.1 The Contractor shall provide and be fully responsible for all temporary works, including their design and the adequacy of their construction for the purpose intended.

2.14.2 The Contractor shall have sole responsibility for the design and installation of all temporary works. The Contractor shall, if required, prepare and submit in ample time for checking before

the execution of the works, detail drawings and calculations of any temporary works he may wish to use which shall also show the location of such temporary works and their order of construction, together with a method statement. These shall be submitted to the Engineer, prior to commencement. Comments made by the Engineer (if any) shall not relieve the Contractor from his sole responsibility for temporary works. It must be anticipated that vertical temporary supports will be required.

2.14.3 All temporary works are to be removed on completion and all necessary repairs and reinstatements carried out.

2.14.4 The Contractor shall plan, design and install all necessary temporary works required to execute the works. If the contractor appoints a temporary designer, then he should notify the PSDP of the appointment. All Health & Safety documents, including temporary works risk assessments and temporary design certificates should be issued to the PSDP for review and approval prior to commencement of temporary works on site. The PSCS should liaise with the PSDP for implementation of above.

2.14.5 Where existing walls are to be supported in a temporary condition the following criteria shall apply:

- Wind Loading - IS EN 1991-1-4 Actions on Structures
- plus Lateral Loading - 5% of dead load
- plus Eccentricity Loading - H/600 overall or in any storey height, unless otherwise agreed by the Engineer.

2.14.6 All faces of excavations shall be fully strutted during the works, and all excavations shall be dewatered as necessary. All fine material shall be retained in position by use of sheeting and a filter membrane.

2.14.7 Planking and Strutting: the sides of excavations shall be battered back or planked and strutted in accordance with statutory requirements and to the approval of the Engineer.

2.15 Site Clearing

2.15.1 The contractor shall demolish, break up and remove buildings and structures as described in Appendix 2/1 of the TII specification and as per drawings.

2.15.2 Underground structures, chambers and foundations described in Appendix 2/1 of the TII specification shall be demolished to the depths prescribed, properly cleaned out and filled.

2.15.3 The contractor shall clear each part of the site at times and to the extent detailed in the works requirements.

2.16 Work not to be Covered

2.16.1 The Contractor shall not backfill nor cover any works until they have been inspected and, if necessary, measured by the Engineer and he must give reasonable notice when the work is ready for inspection and measurement. Should the Contractor cover up any work contrary to this

stipulation, he shall uncover the same and in the case of refusal, the Engineer may cause such work to be uncovered and may charge the cost to the Contractor.

2.17 Protection of the Works

2.17.1 All works shall be properly and adequately protected from the detrimental effect of any type of weather.

2.18 Survey or Inspection of Roadways, Properties and Lands

2.18.1 Where appropriate, the Contractor shall arrange for surveys or inspections to be carried out in conjunction with the Engineer, owners or occupiers, of the condition of roadways, properties, construction works and lands that may be affected by the Works.

2.18.2 Before any work affecting such roadways, properties or lands is commenced, the Contractor shall confirm in writing to the Engineer that the relevant survey is a true and accurate record of their condition.

2.18.3 A pre -works condition survey is required to be carried out by the Contractor of the works area and any sensitive surrounding receptors including the adjacent roads, footpaths and boundary walls and any access routes for HGV vehicles.

2.18.4 This condition survey is to be submitted to the Engineer before any works commence on site.

2.18.5 Condition surveys are to be conducted by the Contractor both prior to and after the works. Copies of the pre work report and photographic survey are to be presented to the Employer promptly upon completion of the survey.

2.19 Site Fencing

2.19.1 Where temporary site fencing is required the Contractor shall erect such fencing as soon as he is given possession of the relevant portion of the Site. The Contractor shall regularly inspect and maintain all such fencing, any defects being made good without delay.

2.19.2 Access shall be provided in temporary site fencing as necessary for the use of the occupiers of adjacent lands. Temporary site fencing shall be of appropriate height and rigidity and shall remain in position until either it is replaced by permanent fencing or the Works are sufficiently completed to enable that portion of the Site to be brough t into use.

2.20 Site Security

2.20.1 The Contractor is to provide the Employer and Engineer with 24 hour contact details. The emergency contact details are to be posted at the site gate.

2.20.2 The Contractor must take all reasonable measures to ensure that no unauthorised persons, especially children, are able to enter the work areas.

2.20.3 All the works are to be adequately fenced or barriered off. Hoardings are to be provided to segregate the contractors and other users of the site.

2.20.4 Fencing and barriers are required to protect against theft and damage, and to protect against

accidents to anyone entering the site with and without authority, including children.

2.21 Welfare Facilities

2.21.1 The Contractor is to provide welfare facilities in accordance with the appropriate regulations. No other facilities are to be used unless provided by the Client and of a sufficient standard.

2.22 Protection against Damage

2.22.1 The Contractor shall take all necessary and reasonable precautions to avoid causing any unwarranted damage to roads, lands, properties, trees and other features and, during the currency of the Contract, shall deal promptly with any complaints by the Authority, owners or occupiers to the satisfaction of the Project Manager.

2.22.2 Where any portion of the Works is close to, across or under any existing apparatus of Public Utilities or other parties, the Contractor shall temporarily support and work round, under or adjacent to all apparatus in a manner designed to avoid damage, leakage or danger and to ensure uninterrupted operation.

2.22.3 Should any leakages or damage be discovered, the Contractor shall at once notify the Engineer and the relevant authorities or owner concerned, and the Contractor shall afford every facility for the repair or replacement of the item or apparatus affected.

2.23 Public Utility and Other Services

2.23.1 The Contractor shall consult all relevant Statutory Authorities, Public Utility Companies and service owners before commencing any excavations, and shall satisfy himself as to the exact position of existing services that may affect or be affected by the construction of the Works.

2.23.2 The Contractor shall make his own arrangements at his own expense for any diversion or removal of services which he may require for his own convenience or because of his proposed method of working, and shall, in all cases, inform the Engineer in advance of his proposals.

2.23.3 Should any service be found to exist that is not indicated by the Statutory Authority and Service owners, the Contractor shall be given written notification immediately.

2.23.4 The Contractor shall examine such documents as are available at the offices of the Engineer, Utilities and Local Authorities showing the positions, size and levels of all Public Utility Services.

2.23.5 The Contractor shall determine the location, level and number of existing drains or other services within the boundary of the site and shall include in his price for their removal, diversion, reinstatement or associated works as required or directed by and to the satisfaction of the Engineer and the Public Utility Authority.

2.23.6 The Contractor shall, in all cases where new works pass under or near to existing pipes or cables, temporarily support them in a manner such that leakage or damage will not occur.

2.23.7 The Contractor shall provide, install, maintain and remove when no longer required, such temporary supports or precautions as the relevant authorities may consider necessary. The Contractor shall be responsible for the protection of all existing services and any damage that

may be caused to these services during the duration of the contract.

2.23.8 Should any leakage or damage occur, notice in writing shall at once be given to the relevant Utility Authority concerned and the Engineer. The Contractor shall provide for properly accredited agents of such an authority, all available facilities and access to their services situated on, over or under the site as may be necessary for inspection, repair, maintaining, removing or renewing of these services or for any other purpose.

2.23.9 The Contractor shall give the Authority and Utility Authority one month's written notice in advance for the works and shall give no less than seven days' notice for the exact start date. The Contractor shall co -operate fully with t hem at all times during the Contract.

2.24 Protection to Existing Sewers, Drain Ducts and Services

2.24.1 Protection to any existing sewers, drains, ducts and services shall be to the requirements as described in the Contract.

2.24.2 Before protection works are carried out the existing sewer, drain or service shall be located by means of hand dug trial holes except where otherwise permitted by the Engineer.

2.24.3 Excavation and backfilling for the protection work shall be carried out in accordance with the requirements stated in the Contract. Where excavation is required around an existing sewer, drain, duct or service then this shall be carried out carefully by hand to avoid damage to the sewer, drain, duct or service.

2.24.4 The Contractor shall ensure that the sewer, drain, duct or service is adequately supported during the carrying out of the protection works.

2.24.5 Any damage to the sewer, drain, duct or service occurring during the protection works shall be made good by the Contractor.

2.24.6 Protection to the sewer, drain duct or service shall be carried out in accordance with the appropriate Specification Clauses and as agreed with the Project Manager and relevant Authority.

2.25 Tidiness of Site

2.25.1 The contractor shall, prior to commencement of works on site prepare a waste management plan which shall be submitted to the employer/ engineer. The contractor will be responsible for agreeing the Waste Management plan with the Local Authority where such agreement is required as part of the planning permission for the development.

2.25.2 The Contractor shall be responsible for maintaining the Site and the Works in as clean and tidy a condition as possible and shall remove from the Site rubbish, other waste and surplus material as it accumulates. Materials and equipment shall be positioned, stored and stacked in an orderly manner.

2.25.3 Watercourses, channels and gullies must at all times be kept free of all materials that would impede their efficiency.

2.25.4 The Contractor shall be re sponsible for maintaining public and all access roads to the site in a clean and tidy condition and shall not permit parking of construction traffic on these roads

2.25.5 On completion of the works, the Contractor shall leave the site in a clean and tidy condition to the satisfaction of the Engineer.

2.26 Wheel Washing

2.26.1 No vehicles shall leave the site with earth, mud etc. adhering to the wheels in a quantity which may result in it being deposited on the public highway or footpath and creating nuisance or hazard to vehicles and pedestrians. The Contractor shall liaise with the Engineer on the provision, operation and maintenance of this requirement.

2.26.2 All public roads should be maintained free of mud/dirt. The contractor should employ the use of road sweepers/ wheel wash facilities as appropriate.

2.27 Noise Control

2.27.1 The Contractor shall comply with the recommendations set out in BS 5228 Parts 1 and 2: 2009 Code of Practice for Noise and Vibration Control on Construction and Open Sites.

2.27.2 The Contractor shall ascertain the requirements prior to commencing work and shall advise the Project Manager of such requirements in writing.

2.28 Information Regarding Soil Conditions

2.28.1 Information regarding soil conditions in the area of the Contract is included under separate cover as part of the Engineering documents for this project, but it should not be assumed that such information covers all soil conditions that may be encountered in the Works.

2.28.2 The Contractor may undertake such additional investigation as he deems necessary at no expense to the contract, should he so desire.

2.28.3 Refer to The Ground Investigation Report: included with the project documents.

2.29 Dealing with Water

2.29.1 The Contractor shall, unless specifically stated elsewhere, keep the whole of the Works free from water and/or sewage during the course of construction. Water shall not be discharged into existing drainage systems, including ditches, without the prior written consent of the Engineer/ Local Authority , and such consent, if given, will be conditional upon the Contractor taking precautions to prevent solid or suspended material entering such drainage systems, as well as the subsequent clearing of these systems from deposits of silt.

2.29.2 Where a license (discharge, foreshore etc.) is required for disposal of water from the construction site during the construction works, it shall be the contractors responsibility to arrange same at his own expense.

2.30 Use of Explosives

2.30.1 The Contractor shall not use any explosives without permission in writing from the

Employer/Engineer, who will require evidence that the Contractor has complied with the requirements of the Explosives Acts 1875 and 1923, and "The Health and Safety (Miscellaneous Amendments and Revocations) Regulations 2009". The Employer/ Engineer may refuse to permit the use of explosives for any other reason, and this shall not constitute grounds for a claim.

2.30.2 Note that the use of explosives (including pyrotechnic s) in the workplace is regulated under Health and Safety legislation and not under the Explosives Act. The following legislation, inter alia, is relevant:

- Safety Health and Welfare at Work Act 2005
- S.I. No 299 of 2007 (Safety, Health & Welfare at Work (General Application) Regulations 2007
- S.I. No. 123/1972: Mines (Explosives) Regulations, 1972; (Currently being redrafted by HSA)
- S.I. No. 237/1971: Quarries (Explosives) Regulations, 1971 as amended by S.I. No. 1/1976: Quarries (Explosives) (Amendment) Regulations, 1976
- S.I No 28 of 2008: Safety, Health and Welfare at Work (Quarries) Regulations 2008
- S.I. No. 29 of 2008: Safety, Health and Welfare at Work Act 2005 (Quarries) (Repeals and Revocation) (Commencement) Order 2008
- S.I. No. 481 of 2001: Safety, Health and Welfare at Work (Construction) Regulations, 2001 as amended by S.I. No. 277/2003: Safety, Health and Welfare at Work (Construction) (Amendment) Regulations, 2003.

2.31 Destruction of Weeds

2.31.1 The Contractor shall take all necessary precautions against the growth of weeds on the site of the works from the date of commencement until the termination of the maintenance period.

2.31.2 Particular attention in this respect shall be paid to the sub grade footways and verges. Perennial weeds shall be destroyed by an application of a non-toxic trans locatable, non -residual herbicide approved for total weed control and shall be applied in accordance with the manufacturer's instructions, at the required locations and frequency. Care shall be taken not to apply weed killer in close proximity to vegetation, trees, etc., and only an approved non-toxic selective weed killer shall be used on verges.

2.32 Specific Items

2.32.1 The Contractor should particularly note the following specific items that are more fully listed in the specification.

(a) Certain surfacing material is a specialised application available from approved suppliers and a suitable performance guarantee is required by the Client.

(b) At the point of handing over, the polished stone value (psv) must be shown to meet the specified requirements. Surface treatment may be needed to expose the polished stone value of the aggregate to achieve the required skid resistance.

(c) Any changes by the Contractor (as built) must be fully notified and detailed for inclusion in

the Health and Safety File.

(d) The testing regime specified that includes test certificates shall be required as these will be needed at hand over.

2.33 Workmanship

2.33.1 Each section of this specification has its own sub-clauses describing the requirements for workmanship. The requirements common to all sections are described in the Workmanship Section 4.0.

2.34 Testing

2.34.1 Each section of this specification has its own sub-clauses describing the requirements for testing.

2.34.2 The requirements common to all sections are described in the Testing Section 5.0.

3.0 MATERIALS

3.1 Standards and Submission of Materials

3.1.1 Wherever, in respect of any Irish, European or British Standard, a Scheme of Supervision and Control or similar is available, all goods and materials required are to comply with that Standard. All construction products used in the works shall comply with the European Community (Construction Products) Regulations 2013.

3.1.2 This requirement shall not apply where the Engineer is satisfied and confirms to the Contractor in writing that certified materials are not readily available. In such a case and where materials are required to comply with other Irish, European or British Standards, the Contractor shall submit to the Engineer or Authority, test certificates furnished by the supplier or manufacturer of the materials, indicating compliance with the relevant Standard.

3.1.3 All materials and specialist suppliers are to have been assessed and certified by an approved independent third-party quality assurance scheme and are to have CE marking on their products in accordance with the Construction Products Regulation (CPR) 305/2011/EU. The Contractor is to ensure that all products have CE marking prior to ordering and is to forward evidence of same to the Engineer prior to installation. Contractor to be responsible for providing all “Declarations of Performance” for materials delivered to the site.

3.1.4 As soon as possible after the Contract has been awarded, the Contractor shall submit to the Engineer for his approval a list of his proposed suppliers and sources of materials required for the execution of the Works.

3.1.5 Samples shall be taken in accordance with the appropriate Irish / British Standard where applicable.

3.1.6 The materials subsequently supplied shall conform to the quality of samples that have been approved by the Engineer.

3.1.7 Names of additional suppliers and sources may be submitted by the Contractor during the execution of the Contract, but no source of supply shall be changed without the Employers/Engineers approval. The Contractor shall maintain a record of the suppliers from whom he proposes to purchase the goods and materials necessary for the execution of the Works. Where a choice of goods or materials is listed in the Contract, the Contractor shall inform Employers/Engineers of the goods or materials he proposes to use.

3.1.8 All materials, workmanship and tests (where required) shall comply with the appropriate British Standard, the Building Regulations, the Bye -Laws of the Authority, and be in accordance with the drawings and the Specification.

3.1.9 Materials required for performance of work shall be new, the best of their respective kind and shall be of uniform pattern throughout the work.

3.1.10 Items of materials and equipment not specifically mentioned on the contract drawings but that are necessary to make a complete and operating installation shall be included.

3.2 Storage of Materials

3.2.1 Materials and components shall be stored neatly in such a manner as to preserve their quality and condition to the standards required by the Contract. Materials shall be supported appropriately so that no contamination by natural ground material occurs.

3.2.2 All materials and equipment including manhole covers, pipes and fittings required to complete the construction shall be thoroughly inspected by the Contractor upon arrival at the site.

3.2.3 Those that are inferior in quality or those that have been damaged in transit shall be set a side and removed from the site.

3.2.4 Materials and equipment found to be sound in all respects shall be stored in accordance with the manufacturer's recommendations where applicable. They shall be protected at all times from damage or deterioration whilst in storage. A final inspection shall be made prior to use or installation.

3.2.5 The quantity of materials and components stored on the site shall be consistent with that necessary for efficient working.

3.3 Handling and Use of Materials

3.3.1 Goods and materials shall be handled in such a manner as to avoid any damage or contamination, and in accordance with all applicable recommendations of the manufacturers.

3.3.2 Unless otherwise described in the Contract, the use, installation, application or fixing of materials and components shall be in accordance with all applicable recommendations of the manufacturers. Where appropriate, the Contractor shall make use of any technical advisory services offered by manufacturers.

3.4 Water

3.4.1 Water for use with cement or bituminous materials shall be of potable standard.

3.5 Recycle Aggregates

3.5.1 Where recycled concrete aggregate is used as constituent materials for concrete pavement layers, only crushed concrete resulting from reclamation or processing of concrete previously used in construction which originates from appropriately identified structures with a known history of use shall be used.

3.5.2 In order to detect substances and chemicals harmful to the durability of concrete, appropriate tests based on current relevant advice shall be carried out on recycled coarse aggregate and recycled concrete aggregate, and the results reported to the Engineer .

3.5.3 Where recycled concrete aggregate is used as constituent materials for earthworks, the material shall be aggregate resulting from the processing of material used in a construction process.

3.5.4 Where recycled aggregate is used as constituent materials for drainage pipe and bedding combinations, the material shall consist of recycled coarse aggregate or recycled concrete

aggregate.

3.5.5 Where recycled concrete aggregate is used as constituent materials for road pavements containing unbound, cement and other hydraulically bound mixtures, the material shall consist of recycled coarse aggregate or recycled concrete aggregate.

3.6 Aggregates for Concrete

3.6.1 Aggregates for concrete shall comply with the relevant provision s of BS EN 12620:2002.

3.6.2 Sea dredged aggregates shall not be used.

3.6.3 The nominal size of aggregate shall be 20 mm.

3.6.4 Aggregate for granolithic concrete shall be crushed granite complying with BS EN 12620 .

3.7 Sand

3.7.1 Sands for mortar and grout shall be washed sand complying with BS EN 13139:2002 and graded in accordance with Table 1 of that Standard.

3.7.2 Bedding sand shall comply with Table D.3, Category II [change to category I if no heavy vehicles] of BS 7533 -3 and shall be certified Sterilised. The stockpile of sand shall be protected by covering with polythene sheeting or tarpaulin and allowed to drain down so that sand for use from the top of the pile shall be dry. Similarly the sand is to be kept free of contaminants, weeds and their seeds so that it remains sterilised.

3.8 Cement

3.8.1 Cement shall comply with the provisions of the appropriate Standard, as set out below:

TYPE	
Normal Portland (CEM II)	IS EN 197-1
Sulphate-Resisting Portland (CEM I)	IS EN 197-2

3.8.2 Except for concrete having an equivalent compressive strength less than 20 N/mm2, Sulphate - Resisting Portland cement shall be used in all cases (including precast concrete products), unless the Contractor can satisfy the Engineer that any attack from soils or groundwater will adequately be resisted by the use of cement to IS EN 197-1.

3.8.3 The use of high alumina cement or concrete is prohibited.

3.9 Concrete Mixes

3.9.1 Formwork, reinforcement and concrete materials are to comply with the requirements of BS 5328 – Methods of specifying concrete, including ready-mixed concrete for the standard and designated mixes and grades of concrete detailed are:

3.9.2 Class of Concrete

(a) ST4 (C20) - Uses as below.

i. Precast pipe setting blocks.

ii. Protection to pipes.

iii. Surround to manholes.

iv. Manhole inverts and benching.

v. Thrust blocks.

(b) ST5 (C25) -Uses as below .

i. Bedding and backing to kerbs.

ii. Bedding and backing to drainage channels.

(c) PAV 1 - Class Pav1 shall have air-entraining and be brush finished. The total air voids shall not be more than 5.5% for 20mm aggregate. An air -entraining admixture complying with BS 025 shall be used in at least the top 50mm.

(d) Class 32/40 -Surface slabs in accordance with BS EN 13877 -2.

(i) Unreinforced concrete (URC).
(ii) Jointed reinforced concrete (JRC).
(iii) Continuously reinforced concrete pavement (CRCP).
(iv) Continuously reinforced concrete base (CRCB).

(e) Granolithic - Granolithic Concrete shall be strength class C32/40 with maximum aggregate size 4/10mm.

3.10 Cement Additions

3.10.1 Ground Granulated Blastfurnace Slag (GGBS) is permitted in IS EN 206-1:2007 to be used as a Type II addition to CEM I or CEM II cements in concrete. Where GGBS is added it replaces the CEM I or CEM II cement on a one-for-one basis; the total cementitious material content of the concrete mix does not change, and the GGBS counts fully towards the total cement content and water/cement ratio in concrete. GGBS shall comply IS EN 15167-1.

3.10.2 A cement combination comprising up to 70% GGBS and 30% CEM I or CEM II can be used for the Project, unless otherwise specified on the drawings or by the Engineer.

3.10.3 The Contractors supplier shall select the mix proportions and, unless otherwise specified, the workability in order to satisfy the strength and other requirements of the Contract, including maximum aggregate size, maximum free water/cement ratio and minimum cement content all mix designs to be approved by the Engineer.

3.11 Mortar

3.11.1 Mortar shall be 3:1 Sharp sand; Ordinary Portland Cement or Sulphate Resisting Cement.

3.11.2 Mortar for bedding and jointing clay pavers shall be strength class M12 to BS EN 998 -2.

3.11.3 High Strength mortar (50N/mm2) to comply with BS 7533 Parts 7 & 12 shall be used for bedding and jointing granite paving in areas subject to traffic loading.

3.12 Lean Mix Concrete

3.12.1 Wet lean concrete for bases and subbases shall comply with BS EN 13877 -1 and as follows:

Grades and Constituents

The strength for wet lean concrete shall be as shown on the drawings with the following constituents:

(i) Ordinary Portland Cement or Sulphate Resisting Cement to BS EN 197 -1 (cement), BS EN 15167 -1 (blast furnace, BS EN 450 -1 and BS EN 450 -2 (pulverised fuel ash) as appropriate.

(ii) The maximum free water/cement ratio shall be 0.60 for strength classes C16/20 and C12/15 or as directed by the Project Manager;

(iii) Aggregate shall comply with BS EN 12620 and BS EN13877 -1.

The aggregate shall consist of either coarse and fine aggregate batched separately or an all-in one aggregate, having a maximum nominal size not exceeding 40mm, nor less than 20mm.

Mix Proportions

The ratio of cement to aggregate by weight (including any absorbed moisture but excluding free water in the aggregate) shall be sufficient to produce an average crushing strength to the requirements of this clause. The ratio of cement to aggregate by weight shall not, however, be more than 1:15 nor less than 1:20 except with the approval of the Engineer.

Crushing Strength Requirements:

Test cubes shall be made and tested in accordance with BS EN 12390 and shall conform to the minimum characteristic cube strength given for 150 mm cubes in BS EN 206 -1:2000, Table 7. If the test cubes do not attain the minimum compressive strength the Contractor may without expense to the Contract elect to cut cores from locations selected by the Engineer to determine the equivalent 28 days cube strength and density of the concrete in the Works.

Concrete represented by these cores that fails to meet the minimum requirements of the Specification shall be broken out and replaced with further material. Core holes for sampling that remain in the Works shall be reinstated in concrete Grade ST4.

Consistence (Workability)

(i) The consistence shall be determined by the Degree of Compatibility (Compaction Index) test in accordance with BS EN 12350 -4, or the Vebe test in accordance with BS EN 12350 -3. Alternatively for concrete class C16/20 or below, consistence may be determined by the slump test in accordance with BS EN 12350 -2. The sampling for all concrete classes shall be undertaken in accordance with BS EN 12350 -1 and the rate of testing in accordance with Table 12 of BS EN 206 -1. Consistence shall be carried out at the point of placing, in conjunction with tests for strength and any tests for air content. The consistence

shall be maintained at the optimum within the limits specified in BS EN 206-1.

(ii) If any determination of consistence gives a result outside the tolerance, a further test shall be made immediately on the next available load of concrete. The average of the two consecutive results and the difference between them shall be calculated. If the average is not within the tolerance or the difference is greater than 0.1 for CI or 20 mm for slump, or 6 seconds for Vebe, subsequent samples shall be taken from the delivery vehicles, which shall not be allowed to discharge into the Works until compliance with the Specification has been established.

3.13 Concrete

3.13.1 Concrete shall either be a designed mix in accordance with the Specification or a Designated or Standard Mix in accordance with BS 5328, all as indicated on the Drawings.

3.13.2 Aggregates for the concrete shall comply with the requirements of BS 882 and the fine aggregate shall be limited to grading zones 1 to 3. The source of the aggregate shall not be varied without the Engineers consent. Certificates of aggregate quality and source shall be provided to the Engineer .

3.13.3 Air entrainment or the use of admixtures or other similar chemicals is not generally permitted except for usage on road slabs to achieve an exposed aggregate finish if required. The Engineer may consider proposals for the use of admixtures, chemicals, etc., but there is no guarantee that such proposals will receive approval. Admixtures, chemicals, etc. shall be submitted for the Engineer's approval at least 2 weeks before they are intended to be used.

3.13.4 Drying shrinkage of the concrete tested in accordance with BS 1881 shall not exceed 0.04%.

3.13.5 Ready mixed concrete shall be in accordance with BS 5328. The Contractor shall provide details of the supplier and mixes as set out below.

3.13.6 For fair faced concrete the use of concrete from different suppliers is not permitted within discrete areas.

3.13.7 The Contractor shall give 24 hours' notice to the Engineer when reinforcement is ready to receive concrete unless otherwise agreed by the Engineer.

3.13.8 All formwork and its supports shall be sufficiently strong and rigid to carry and maintain the concrete for construction traffic, so that the shape and finish of the completed structure is as shown on the Drawings. All form work and its supports shall be sufficiently rigid and tight to prevent loss of grout or mortar from the concrete. The type of formwork used shall produce concrete surfaces suitable for the application of the particular type of finish specified. Surfaces of formwork in contact with concrete shall be well wetted or treated with a release agent that is subject to the Engineer's approval.

3.13.9 All Contractor's Equipment and formwork shall be clean and contamination of the concrete shall be avoided at all stages. Concrete shall be discharged from the delivery vehicle within the periods stated in BS 8500 Part 2:2002. Any concrete that has commenced to set before being finally placed shall be rejected. Unless otherwise directed, concrete shall be compacted by

mechanical vibration so as to ensure a dense and homogeneous mass throughout every part of the works and to produce a good surface finish.

3.13.10 Concrete used below ground shall utilise sulphate -resisting cement unless otherwise approved by the Engineer.

3.14 Ready Mixed Concrete

3.14.1 Information to be provided by the Contractor will be as follows:

a) Proposed ready mixed concrete supplier.

i. Name
ii. Address
iii. Postcode
iv. Telephone No.

b) Location of depot

c) If supplier is a BRMCA member (yes / no)

i. Category of depot

d) Name of cement manufacturer

e) Name of aggregate supplier

f) Detail of design mixes proportions proposed by the Contractor to comply with the Specification. Qualities of cement and aggregate to be given must be totally dry and relate to one cubic metre of fully compacted fresh concrete:

Concrete grade	**C20**	**C30**	**C35**	**C40**	**C45**	**C50**
Cement content (Kg)						
20mm max. aggregate (Kg)						
Fine aggregate (Kg)						
Water (Kg)						
Slump (mm)						

3.15 Air Entrainment

3.15.1 Road Pavements – Concrete Materials

Admixtures

Concrete in at least the top 50 mm of surface slabs shall incorporate an air -entraining admixture complying with BS EN 934 -2 where specified on the drawings.

Air Content

a) The concrete shall meet the requirement for exposure class XF4 in BS EN 206 -1. This shall be achieved by the use of an air -entraining agent. The minimum quantity of air in air -entrained concrete as a percentage of the volume of the concrete shall be as in the following table:

Maximum aggregate size Mm	**Minimum air content %**
20	3.5
40	3

b) The air content shall be determined at the point of delivery to the paving plant by the pressure gauge method in accordance with BS EN 12350 -7, at the rate of one determination per 300m² of slab or at least 6 times per day, whichever is the greater, in conjunction with tests for consistence and strength. For areas less than 300m² the rate shall be at least one determination to each 20m length of slab or less constructed at any one time or at least 3 times per day. If the air content is outside the specified limits in BS EN 206 -1 the Contractor shall remove the concrete from the Works.

c) The air -entraining agent shall be added at the mixer, by an apparatus capable of dispensing the correct dose within the tolerance for admixtures given in BS EN 206-1, to ensure uniform distribution of the agent throughout the batch during mixing.

3.15.2 Freestanding In-Situ Concrete Kerbs, Channels and Edge Details

The concrete shall be a strength class C28/35 to BS 8500 -2 and air -entrained in accordance with BS 5931.

3.15.3 Brickwork, Blockwork and Stonework

Mortar Work Other Than Unreinforced Masonry Arch Bridges.

If the work is to be carried out in frosty weather and the bricks are wet when laid, then a cement sand mortar with an air entraining plasticiser shall be used. Admixtures shall conform to BS EN 934 -3 and shall not contain calcium chloride.

3.16 Precast Concrete Kerbing

3.16.1 PCC kerbing shall comply with BS 7533 Part 6 and BS EN 1340:2003 for granite aggregate, hydraulically pressed, pre -cast concrete to the dimensions and types as indicated on the drawings. Radius kerbs shall be purpose -made where the radius is 12 metres or less with taper kerbs and crossing kerbs to match the straight kerbs.

3.17 Natural Stone Kerbing

3.17.1 Natural stone kerbing shall comply with the following:

(i) BS 7533 Part 6 and BS EN 1343:2001 for natural granite to the dimensions and types as indicated on the drawings. Radius kerbs shall be purpose -made where the radius is 12 metres or less with taper kerbs and crossing kerbs to match the straight kerbs.

(ii) Granite setts shall be as indicated on the drawings.

3.18 Edging

3.18.1 PC Edging shall comply with BS 7533 Part 6 and BS EN 1340:2003 to the types and sizes shown on the drawings.

3.18.2 PC Dished channel blocks shall comply with BS 7263 to the types and sizes shown on the drawings.

3.19 Precast Concrete Paving Slabs

3.19.1 PCC paving slabs shall comply with BS 7533 Part 12 and BS EN 1339:2003 to the types and sizes indicated on the drawings.

3.20 Reconstituted Stone Paving Slabs

3.20.1 Reconstituted stone slabs shall comply with the specification shown on the drawings.

3.21 Natural Stone Paving Slabs

3.21.1 Natural stone slabs and jointing materials shall comply with BS 7533 Part 12 to the types and sizes indicated on the drawings.

3.22 Precast Concreter Block Paving

3.22.1 Precast concrete paving blocks shall comply with BS EN 1338 and as shown on the drawings.

3.23 Clay Block Pavers

3.23.1 Clay pavers shall conform to BS EN 1344 and as shown on the drawings.

3.24 Bedding for Paving Slabs, Block Paving and Pavers

3.24.1 Mortar - Where shown on the drawings PCC paving and blocks shall be bedded on mortar in accordance with this Section. Mortar for bedding and jointing pavers shall be strength class M12 to BS EN 998 -2.

3.24.2 Sand - Where shown on the drawings PCC paving and blocks shall be bedded on mortar in accordance with this Section.

3.24.3 Waterproof Membrane - Where specified on the drawings, a waterproof membrane is required to prevent ingress of water to the underlying structure.

4.0 WORKMANSHIP & TESTING

4.1 Concrete

4.1.1 All structural concrete and workmanship shall be in accordance with BS EN 13670:2009 and this Specification.

4.1.2 In the interests of health and safety to site personnel, the Contractor is to ensure that the ends of reinforcing bars left temporarily protruding from all concrete elements have suitable safety covers to prevent impalement. In the case of bars 12mm diameter or greater, this protection may take the form of a purpose made plastic cap or by other similar effective means of shielding.

4.1.3 All bars of 10mm diameter or less where hooked ends have not been provided are to be temporarily protect ed with boarding or similar protection placed over the ends of the bars and fixed securely in position together with a clear warning notice where a hazard is not obvious.

4.1.4 Granolithic concrete shall be laid on base concrete that has been prepared in the following manner. The laitance on the base concrete shall be removed by wire brushing and by hosing with water. This shall be done after the initial set of the base concrete but before hardening and without disturbing the aggregate. Granolithic concrete shall be laid not later than three days after placing the base concrete. After compaction the surface of the render or screed shall be trowelled to a smooth finish to the required levels, profiles and contours and shall present a surface finish Class U3.

4.2 Mortar

4.2.1 Mortar shall be mixed mechanically until its colour and consistency are uniform. The constituent material shall be accurately measured.

4.2.2 Where ready mixed mortars are specified, their use shall be in accordance with the manufacturer's instructions and BS EN 998 -1 and BS EN 998 -2.

4.2.3 Mortar shall be made in small quantities only as and when required. Mortar which has begun to set, or which has been mixed for a period of more than one hour shall be discarded.

4.2.4 When additives or admixtures are specified, their use shall strictly follow the manufacturer's instructions and shall be demonstrated in the trial panel.

4.3 Turf and Topsoil

4.3.1 Turf or other material, as directed, over the area of the Works and those areas affected by the Contractor's plant shall be stripped, removed separately and stacked in stockpiles to a height not greater than 1.5m as directed by the Landscape Architect before construction commences.

4.3.2 Topsoil stockpiles may be allowed to exceed the maximum height for short periods but in no case for longer than one season. Existing turf and topsoil shall remain the property of the Client and shall either remain stacked or be used on the Site as directed by the Landscape Architect.

4.4 General Excavation

4.4.1 The Contractor shall excavate for the Works in any material encountered to the net lines, widths, lengths and levels indicated on the Drawings or to such other dimensions as may be directed by the Engineer.

4.4.2 No excavated acceptable material other than that surplus to the requirements of the Works shall be removed from the Site except on the direction or with the permission of the Employer/ Engineer, who may require material which is unacceptable, only by reasons of being frozen, to be retained on site when in that condition. Should the Contractor be permitted to remove acceptable material from the Site to suit his operational procedure, then he shall make good at his own expense any consequent deficit of filling arising there from.

4.4.3 If any acceptable material excavated from within the Site is, with the permission of the Employer/ Engineer taken by the Contractor for purposes other than the forming of embankments and other areas of fill, sufficient acceptable filling material to occupy after full compaction, a volume corresponding to that which the excavated material occupied shall, unless otherwise directed by the Employer/ Engineer , be provided by the Contractor from his own resources.

4.4.4 Acceptable material surplus to the total requirements of the Works and all unacceptable material shall, unless the Employer/ Engineer directs otherwise, be run to spoil in tips provided by the Contractor. Where the excavation reveals a combination of acceptable and unacceptable materials the Contractor shall, unless otherwise agreed by the Employer/ Engineer , carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the Works without contamination by the unacceptable material.

4.4.5 The Contractor shall make his own arrangements for stockpiling of acceptable or unacceptable material, and for the provision of sites for the purposes where his method of working requires.

4.5 Precast Concrete Kerbs and Channel Blocks

4.5.1 Precast concrete kerbs, channels and quadrants shall be laid true to line and level within a tolerance of + 3mm or - 3mm. Any unit out of tolerance shall be re -laid. The kerbs shall be laid directly onto a 150mm thick bed of grade ST5 concrete and backed with 150mm wide grade ST4 concrete to within 50 mm of the top of the kerb, or as indicated on the Drawings. The kerbs shall be haunched with 150mm wide grade ST5 concrete as indicated on the Drawings.

4.5.2 A 2 mm joint shall be left between all units. Specially cast radius kerbs and channels shall be used for work on curves where the radius is 12.0m or less. Work of radius between 12.0m and 30.0 m shall be laid in kerbs and channels which are 0.60m straight units. Where the joint is in excess of 3mm it must be mortared with a granolithic cement sand mortar.

4.5.3 Kerbs shall be backed with concrete Grade ST5 to within 75 mm of the top of the kerb as shown on the Drawings, and not less than 24 hours after completion , the space between the back of the kerb and the face of the excavation shall be filled and rammed. No cut length of kerb or channel shall be less than 0.60m long.

4.5.4 Where a concrete kerb race has been previously constructed, onto a 12mm thick cement mortar bed and haunched with concrete to within 75 mm of the top of the kerb to the lines and levels shown on the drawings. Purpose made radius kerbs, taper kerbs, crossing kerbs and quadrants complying with the BS shall be used wherever appropriate. Straight kerbs shall be laid to radii above 12m.

4.5.5 Channel blocks shall be laid directly onto 200 thick bed of ST5 concrete 200 wider than the block and haunched.

4.6 Paving Slabs

4.6.1 Sub-Base - The subbase for paving slabs shall be l aid and compacted in accordance with this section and BS 7533 Part 4 on the previously approved formation to give a compacted thickness of the material to the dimensions shown on the drawings.

4.6.2 Laying Course - The laying course for paving slabs shall be laid and compacted in accordance with BS 7533 Part 4 on the previously approved formation to give a compacted thickness of the material to the dimensions shown on the drawings.

4.6.3 Natural stone or concrete paving slabs shall be laid in accordance with BS 7533 Part 4 in the pattern as indicated on the drawing. They shall be placed firmly together without disturbance to the laying course and the order of placing blocks shall ensure this.

4.7 Block Paving

4.7.1 Sub-Base - The subbase for block pavements shall be laid and compacted in accordance with this section and BS 7533 Part 3. At the time of laying the sand, the subbase shall be structurally sound and free from contamination.

4.7.2 Sand Laying Course - Precast block pavers shall be laid on a specified thickness of compacted sterilised sand which should be struck off with sufficient surcharge to ensure the laying course thickness so that when the blocks have been vibrated the upper face of the blocks shall be true to the finished levels of the Contract drawings. Before the blocks are laid the laying course shall not be subjected to any form of traffic movements, before, after, or during screeding.

4.7.3 Generally, the surcharge to achieve a 50mm compacted nominal thickness shall be about 15mm but this should be checked by vibrating some of the blocks as soon as a sufficiently large area is available.

4.7.4 If the levels are not achieved the laid paving blocks are to be taken up. The sand laying course shall then be raked, additional sterilised sand being then placed, the whole then re-screeded to a revised thickness. The process being repeated as necessary until the surcharge is found that produces the required finished levels.

4.7.5 Laying Blocks - Blocks shall be laid in the pattern as indicated on the Architect's or Landscape Architect's drawing. They shall be placed firmly together without disturbance to the laying course and the order of placing blocks shall ensure this. The proposed layout, if different coloured blocks are to be used, is to be approved by the Architect/ Landscape Architect.

4.7.6 At edges or obstructions such as gully or manhole covers and frames, blocks shall generally be cut to fit. Cutting may be carried out with a hydraulic splitter, a hammer and bolster, or by sawing. Where it is not possible to cut blocks to fit neatly to an obstruction, the obstruction shall be surrounded by concrete ST4. The concrete must be placed after the blocks have been brought as close to the obstruction as possible, to fill the irregular space, which is left. Pigment in accordance with BS EN 12878 shall be used in the concrete to match the colouring of blocks.

4.7.7 Vibration - The surface course shall be subjected to passes of a vibrating plate compactor which shall have a centrifugal force of approximately 15 -20kN and a frequency of 75 -100Hz and a plate area of between 0.2 and 0.5 square metres. Sufficient passes shall be made to compact the laying course and produce an even surface. Vibration shall not be carried out within one metre of an unrestrained edge.

4.7.8 After initial vibration appropriate dry sand shall be brushed into joints and further passes of the vibrating plate compactor made to fill the joints, more sand being spread over the surface if required.

4.7.9 Wet sand shall not be used for vibrating into joints.

4.7.10 Edges - Small gaps left at the edges of block paving, including against obstructions within a paved area which cannot be filled and compacted to the full depth of the paving block with a sand cement mortar not leaner than 3:1. Pigment in accordance with BS EN 12878 shall be used in the mortar to match the colouring of the blocks.

4.8 Footway / Footpath Edging

4.8.1 Pre-cast concrete edging is to be laid flush with the finished surfacing level on a bed and haunch of 100mm thick ST4 concrete. Where the edging is to be laid to a radius it may be cut with a disc cutter to half lengths or exceptionally 1/3rd lengths. No broken or edging of irregular lengths will be accepted.

4.9 Footway / Footpath Level

4.9.1 Before the surface course is laid, all covers, boxes, etc., shall be accurately set to the correct level and crossfalls.

4.10 Footway / Footpath Alignments

4.10.1 Horizontal alignments shall be determined from the centre line of the carriageway pavement surface and/or as shown on the drawings.

4.10.2 The levels of pavement courses shall be determined from the true finished road surface calculated from the vertical profile and crossfalls and/or as shown on the drawings. The vertical depth below the true pavement surface of any point on the constructed surface of the formation or pavement courses shall be within the appropriate tolerances stated in **Table 4.1**.

4.10.3 However, the combination of permitted tolerances in different pavement levels shall not result in a reduction of the surface course thickness by more than 5 mm from that specified nor a reduction

in the thickness of the whole pavement, excluding the sub-base, by more than 15 mm from the specified thickness.

4.10.4 For checking compliance with Table 4.1, measurements of surface levels shall be taken at points to be selected by the Project Manager at 10m centres longitudinally and at 2m centres transversely.

4.10.5 In any length of pavement, compliance with the requirements of **Table 4.1** shall be regarded as met when not more than one measurement in any consecutive ten longitudinally or one in any transverse line, exceeds the tolerances permitted, but this one measurement shall not exceed 5mm more than the tolerance for the layer concerned

Surface Course General Adjacent to a surface water channel*	 ± 6mm + 10mm - 0 mm
Binder Course*	± 6mm
Base*	± 15mm
Sub-bases other than above	+10mm - 30mm
Formation	+ 20mm - 30mm

* Where a surface water channel is laid before the adjacent pavement layer the top of that layer, measured from the top of the adjacent edge of the surface water channel, shall be to the tolerances given in Table A.

TABLE 4.1: TOLERANCES IN SURFACE LEVELS

4.11 Cold Weather Work

4.11.1 No material in a frozen condition shall be incorporated in the works but shall instead be retained on the Site for use if acceptable when unfrozen.

Concreting in Cold Weather: Concreting at ambient temperatures below 2oC may be carried out only if all of the following conditions are met:

a) the aggregates and water used in the mix shall be free from snow, ice and frost;

b) before placing concrete, the formwork, reinforcement and any surface with that the fresh concrete will be in contact shall be free from snow, ice and frost and be at a temperature above 0oC;

c) the initial temperature of the concrete at the time of placing shall be at least 5oC;

d) the Contractor shall take precautions to prevent the temperature of any concrete falling to 0oC during the first 5 days after placing.

4.11.2 Curing:

Concrete shall be protected from drying and freezing for at least 5 days by methods that shall ensure that cracking, distortion and efflorescence are minimised.

In cold weather, when the temperature of freshly placed concrete may approach 0oC, water curing shall not be employed.

4.11.3 Brick -laying & Block -laying in Cold Weather:

Materials used in bricklaying or block laying shall be frost -free, and no bricks or blocks shall be laid when the ambient temperature is below 3oC, unless special precautions are taken. Completed work shall be protected adequately during cold weather.

4.11.4 Road Pavements:

Material for use in road pavements shall not be laid on any surface which is frozen or covered with ice.

Except for rolled asphalt surface course the laying of materials containing bitumen binders, shall cease if the temperature of the surface to b e covered is at or falls below 2°C. However, where the surface is dry, unfrozen and free from ice, laying may proceed at temperatures at or above -1°C on a rising thermometer.

Unless otherwise agreed by the Engineer the laying of rolled asphalt surface course shall cease when the temperature of the surface to be covered falls below 5°C or the air temperature falls below 8°C.

Laying of roadworks materials containing cement shall cease when descending air temperature in the shade falls below 3°C and shall not be resumed until the ascending air temperature in the shade reaches 3°C.

If material used in the road pavement contains cement and frost occurs during the first 20 days, or 14 days as appropriate to the time of year, after placing concrete slabs or the first 7 days in the case of their cemented materials, one day shall be added to the period which would otherwise be required before running of traffic of any sort on it for each night on which the temperature of the surface of the layer in question falls to 0°C or below.

4.12 Electrical Works for Road Lighting and Traffic Signs

4.12.1 All street lighting and other electrically supplied street furniture shall be earthed and bonded in compliance with BS 7430.

4.13 Location of Lighting Units and Feeder Pillars

4.13.1 The position of lighting units and feeder pillars is shown on the drawings. The exact location shall be agreed on site before commencement of any associated groundwork. The Contractor shall be responsible for recording the actual location.

4.13.2 In cases where the location of an item has been determined as indicated above and it is impossible because of underground obstruction to install the item then any excavation shall be backfilled and reinstated to its original condition.

4.14 Aggregate Testing

4.14.1 Tests shall be carried out on three samples taken at random from the source prior to use. Tests shall also be carried out during stockpiling or paving, once a week, or at a lesser rate when authorised by the Engineer.

4.14.2 Testing for Constituent Materials in Recycled Aggregate and Recycled Concrete Aggregate.

(i) Quality Control Procedure

The quality control procedure shall be in accordance with the 'Quality Protocol for the production of aggregates from inert waste' and the 'Producers' compliance checklist' published by the Waste and Resources Action Program me (WRAP). The results of all quality control checks carried out by the Contractor shall be compiled in accordance with the procedure set down in the above document and with those in this Clause. These shall be delivered promptly to the Engineer on request.

(ii) Test Method

The constituents of a sample of recycled aggregate shall be classified by hand -sorting the coarse aggregate particles in accordance with BS EN 933 -11. The test shall be carried out by a suitably trained laboratory technician who has demonstrated competence in classifying the constituent classes in accordance with the test method.

4.15 Concrete Testing

4.15.1 A minimum of four cubes shall be made from each structural concrete pour, two of these shall be crushed at seven days and two crushed at twenty -eight days, all in accordance with BS 1881 and BS 5328.

4.15.2 All tests required shall be carried out by a n independent laboratory approved by the Engineer and appointed by the Contractor. The laboratory shall submit test results directly to the Engineer.

4.15.3 A record of all tests shall be kept on site identifying the tests with the corresponding part of the Works.

4.15.4 Should the Contractor either fail to carry out any test described in the Specification or fail to produce the relevant test certificate, further tests shall be specified and carried out at the Contractor's expense.

4.15.5 If the strength of the works cubes fails to comply with the requirements of this Specification, or if the concrete placed in the Works is, in the opinion of the Engineer, unsatisfactory in any other way, the relevant mix must no longer be used, and the concrete work is liable to be rejected. The Contractor shall cut out and re -execute the defective work or take such other measures as directed by the Engineer.

4.15.6 The rubble and all other materials of failed cubes shall be kept by the laboratory for inspection and further instructions by the Engineer.

4.16 Mortar Testing

4.16.1 Mortars shall be tested in accordance with BS EN 998 -2, BS EN 1015-11 and BS 5628-1 as directed by the Engineer.

4.16.2 Mortar shall be mixed thoroughly either by hand or mechanically until its colour and consistency are uniform. The constituent materials shall be accurately gauged, allowance being made for bulking of sand. Mortar shall be made in small quantities only as and when required. Mortar which has begun to set or which has been mixed for a period of more than one hour shall be discarded.

4.16.3 Mortar shall have a 28 -day mean compressive strength in N/mm² within the following limits:

Minimum 9.9 N/mm²

Maximum 11.5 N/mm².

4.16.4 As soon as possible after the Contract has been awarded, the Contractor shall submit to the Engineer for his approval a list of his proposed suppliers and sources of materials required for the execution of the Works.

4.16.5 The materials subsequently supplied shall conform to the quality of samples which have been approved by the Engineer.

4.16.6 Names of additional suppliers and sources may be submitted by the Contractor during the execution of the Contract, but no source of supply shall be chang ed without the Engineer's approval.

4.16.7 All materials, workmanship and tests (where required) shall comply with the appropriate Irish and British Standards, meet the requirements of the Local Authority and be in accordance with the Drawings and the Specification.

5.0 EARTHWORKS

5.1 Scope of Works

5.1.1 This Section of the specification is based on BS 6031 in addition to the standards described in Section 2 above and relates to.

- Cut and fill of earthworks as necessary to formation levels for hard landscaping to levels indicated on the drawings.
- Removal of unacceptable or contaminated material from the site.
- Removal or relocation of excess material.
- Removal of tree stumps and hedges where specified
- Back fill of excavations around substructures such as foundations retaining walls, trenches pits etc.
- Removal of soft spots and other areas of unacceptable ground and backfilling with acceptable material.
- Removal and clearance of obstructions in the ground and existing hard standing surfacing as shown on the drawings and as required.
- Hard landscaping works as identified on the drawings.

5.2 Setting Out

5.2.1 Site specific setting out requirements for the works are shown on the drawings, general setting out requirements are covered in Section 2.6 of this specification. The Contractor shall deliver sufficient information to the Engineer for carrying out any checks deemed necessary.

5.3 Inspection

5.3.1 The Engineer will inspect the work at the following stages:

(i) when the lines of the proposed Works have been set out by the Contractor;

(ii) when excavation has been completed and prior to the deposit of any material on it;

(iii) at any stage that the Engineer may have previously instructed.

5.3.2 The Contractor shall give 24 hours' notice to the Engineer before his inspection of each of the above stages. Work shall not proceed until this inspection has been made and approval given in writing.

5.3.3 These inspections shall be in addition to all routine day to day checks and inspections.

5.4 Site Clearance

5.4.1 Trees, shrubs and hedges shall only be removed as specified on the drawings including the grubbing up of roots. The Contractor shall cut down and remove from the site all branches and foliage, including cutting any useful timber into lengths, loading and transporting, stacking and disposing of, as instructed by the Engineer / Landscape Architect.

5.4.2 The Contractor shall ensure that individual trees, shrubs and other features and areas stated on

the Drawings to be preserved, are suitably identified and protected. Should any trees, shrubs and other planting features and planting areas that it is intended to preserve be killed, removed or damaged by the Contractor during the course of the Works, they shall be replaced by the Contractor with plants of the same species and equal in size to those killed, re moved or damaged, all in accordance with the Architect's, Landscape Architect's or Arboriculturist's specification as appropriate.

5.4.3 The Contractor shall be responsible for making good any slips, fault s, or loose earth, digging out soft spots, grubbing up old drains, for all double handling from and in the formation of temporary soil heaps and for transporting the materials as required.

5.4.4 The Contractor is to break up and remove old concrete or rock foundations, drains or manholes, old wells and cesspools or obstructions found during the process of excavation, to the depth shown on the drawings, or as indicated by the Engineer.

5.4.5 Where old cellars, wells etc., are found to exist on the site, they shall, when instructed, be completely excavated and cleaned out before commencing fill operations. Fill material to be as defined in the contract or as specified by the Engineer . All walls shall be reduced in height so that the dimensions from the top of the walls to the underside of any overreaching construction are not less than 600mm.

5.4.6 If any excavation is carried out in excess of the requirements as shown on the drawings or as directed on site, such excess excavation shall be filled in with materials in accordance with this specification at no additional cost to the Contract.

5.4.7 The Contractor shall allow for stockpiling of acceptable fill materials for future use by the Engineer. Areas of stockpiling for this purpose shall be as designated in the Contract, or as agreed prior to stockpiling being carried out by the Engineer .

5.4.8 The Contractor shall break up and remove all superficial obstructions on the site as described in the Contract and indicated on the drawings.

5.4.9 The method of filling voids shall be agreed with the Engineer and carried out in accordance with the Specification.

5.4.10 All disused pipes, culverts etc., over 1m below formation, that are to remain, shall either be sealed or grouted at the direction of the Engineer.

5.4.11 Existing drain runs and connections that are not required or become disused by reason of the works shall be 'grubbed out' and removed. Where this is impracticable, they shall be water jetted and cleansed, plugged with a purpose made stopper then filled with acceptable material e.g. ST2 concrete, cement grout or similar to prevent their collapse and effectively permanently se al them against ingress of water and vermin. Pipes of 450 mm internal diameter or greater shall be sealed as shown on the drawings or as instructed by the Engineer.

5.4.12 Materials arising from site clearance that are to be retained shall be as listed in the Contract Documents and / or shown on the drawings.

5.4.13 Voids left by items that have been removed shall be filled with acceptable material within one week following excavation, unless otherwise directed or otherwise shown on the drawings.

5.5 Topsoil and Subsoil

5.5.1 Topsoil shall wherever practicable be used immediately after its stripping and if not shall be stored in stockpiles of heights not exceeding 1.5m or as directed by the Landscape Architect . Topsoil shall not be stockpiled for more than two years unless directed otherwise by the Landscape Architect. Topsoil shall not be unnecessarily trafficked either before stripping or when in a stockpile. Stockpiles shall not be surcharged, or otherwise loaded and multiple handling shall be kept to a minimum.

5.5.2 Reference should be made to the Architect's, or Landscape Architect's specification as appropriate.

5.5.3 Topsoil shall be required within the extent of the new works wherever soft landscaping areas require reinstatement. This includes the reinstatement to the rear of kerbs and edgings, around signposts and light columns, and wherever soft landscaping has been disturbed during the works.

5.5.4 Topsoil shall be re -used in new works including soft landscaped areas and verges. Additionally, any site won topsoil shall be reuse d as reinstatement to the works and site compound.

5.6 Materials - Definitions

5.6.1 The following definitions of earthworks materials shall apply to this and other clauses of the Specification where reference is made to the defined materials:

(i) acceptable material: material excavated from within the Site or imported on to the Site that meets the requirements of this section of the specification and Table 6/1 and Appendix 6/1 of the TII Specification for Road Works for acceptability for use in the Works. It must be in accordance with the Contract for use in the Works and be capable of being compacted in the manner specified to form a stable fill having side slopes as indica ted on the Drawings;

(ii) unacceptable material: material Class U1 shall be:

(a) material that does not comply with the permitted constituents and material properties of this section of the specification and Table 6/1 and Appendix 6/1 of the TII Specification for Road Works for acceptable material; and

(b) material, or constituents of materials, composed of the following unless otherwise described in Appendix 6/1 of the TII Specification for Roadworks:

- peat, materials from swamps, marshes and bogs;
- logs, stumps and perishable material;
- materials in a frozen condition (these materials if otherwise acceptable shall be classified as acceptable when unfrozen;
- clay having a liquid limit determined in accordance with BS 1377 : Part 2,

exceeding 90 or plasticity index determined in accordance with BS 1377 : Part 2, exceeding 55;

• material susceptible to spontaneous combustion;

• non-hazardous materials other than those permitted in Table 6/1 and Appendix 6/1 of the TII Specification for Road Works

(iii) unacceptable material Class U2 shall be material having hazardous chemical or physical properties requiring special measures for its excavation, handling, storing, transportation, deposition and disposal.

(iv) topsoil shall mean the top layer of soil that can support vegetation.

(v) rock shall be defined as stone i n solid beds or masses in its original position or artificial hard material, the excavation of which, in the opinion of the Engineer, requires the use of pneumatic tools, explosives or other approved means. Shale, coal, boulders less than 0.1 m3 in size in trenches or headings or under 0.2 m3 in size in general excavation, or loose or laminated rock, which can be removed by pick and shovel, or by mechanical excavation, will not be included under the definition of rock.

(vi) “Rock fill” shall con sist of hard durable inert material of acceptable size for deposition and compaction as given in Clause 4.3.7 and may comprise rock as defined in this Clause, broken stone, hard brick, concrete or other comparable hard inert materials

(vii) “Soft material” shall mean acceptable material with the exception of rock fill.

5.7 Materials Grouping

5.7.1 'Cohesive soil’ includes clays and marls with up to 20% of gravel and having a moisture content not less than the value of the plastic limit (determine d in accordance with BS 1377 Part 2: 1990) minus 4; also chalk having a saturation moisture content of 20% or greater.

5.7.2 'Well -graded granular and dry cohesive soils’ includes clays and marls containing more than 20% of gravel and/or having a moisture content less than the value of the plastic limit (determined in accordance with BS 1377 Part 2: 1990) minus 4, well -graded sands and gravels with a uniformity coefficient exceeding 10, chalk having a saturation moisture content within the range 15-20% and all shales, clinker -ash and spent domestic refuse.

5.7.3 'Uniformly -graded material’ includes sands and gravels with a uniformity coefficient of 10 or less, and all silts and pulverised fuel ashes. Any soil containing 80% or more of material in the particle size range 0.06 – 0.002mm will be regarded as silts for this purpose.

5.8 Requirements for Testing and Acceptability Limits

5.8.1 The Contractor shall use only the following permitted classes of acceptable material in construction of the works.

5.8.2 The following tests are required to classify and determine the acceptability of earthworks materials. Each class shall only comprise material with properties within the acceptability limits

prescribed in **Table 5.1** (extracted from Table 6/1 of the TII Specification for Roadworks).

Class	**General Material Description and Typical Use**	**Permitted Constituents**	**Material Properties Required for Acceptability (in Addition to Requirements on Use and Testing of Infill Materials in this specification)**			
			Property (See Exceptions in Previous Column	**Defined and Tested in Accordance with:**	**Acceptable Limits Within:**	
					Lower Upper	**Lower Upper**
1A	Well graded granular material. General fill	Any material or combination of materials	(i) Grading	BS 1377 : Part 2	Table B / Table 6/2	Table B / Table 6.2
			(ii)Uniformity coefficient	See Note 2	10	-
			(iii) Mc	BS1377:Part 2	App 6/1	App 6/1
			(iv) MCV	Cl632	App 6.1	App 6.1
1B	Uniformly graded granular material. General Fill	Any material or combination of materials	(i) Grading	BS 1377 : Part 2	Table B / Table 6/2	Table B / Table 6.2
			(ii)Uniformity coefficient	See Note 2	10	-
			(iii) Mc	BS1377:Part 2	App 6/1	App 6/1
			(iv) MCV	Cl632	App 6.1	App 6.1
2C 1/2	Stony cohesive material. General Fill	Any material or combination of materials	(i) Grading	BS 1377 : Part 2	Table B / Table 6/2	Table B / Table 6.2
			(ii) Mc	BS1377:Part 2	App 6/1	App 6/1
			(iii) MCV	Cl632	App 6/1	App 6/1
			(iv) Undrained shear strength of remoulded material	Cl633	App 6/1	
			(v) Effective angle of internal friction(Ø') and effective cohesion (c')	Cl636	App 6/1	App 6/1
5A	Topsoil or turf, existing on site Topsoiling	Topsoil or turf designated as Class 5A in the Contract	(i) Grading	See Notes 3 to 5		See Notes 3 to 5
5B	Imported topsoil Topsoiling	General purpose grade complying with BS 3882				
6A	Selected Well graded granular material.	Natural Gravel, crushed gravel, crushed rock other than argillaceous rock, or gravel, crushed	(i) Grading	BS 1377:part 2	Table B / Table 6/2	Table B / Table 6/2
			(ii) Uniformity	See Note 2/5	10	
			(iii) plasticity	BS 1377:Part	Non-plastic	

		concrete or any	index	2		
	Below Water	combination thereof (Properties (v) and (vii) in next column, only apply where material is described as argillaceous as defined by CI601.5)	(iv) Coefficient	CI635	-	50
			(v) Slake durability	CI634	95%	
6F1	Selected granular material (fine grading)	Any material or combination of materials – including recycled aggregates with not more than 50% by mass of recycled bituminous plannings and granulated asphalt, but excluding materials that contain tar and tar-bitumen binders, unburnt colliery spoil, argillaceous rock and chalk. Property (vi) in the next column shall not apply if the Class Ra (asphalt) content of any recycled aggregate is 20% or less	(i) Grading	BS 1377:Part 4 (vibrating hammer method)		
			(ii) optimum mc	BS 1377:Part 2	Optimum mc – 2%	Optimum mc
	Capping		(iii) mc	BS EN 1097-2	-	60
			(iv)Los Angeles Coefficient	BS EN 933-11 See Note 6	-	50%
			(v) Class Ra (asphalt) content	BS EN 12697-1 or BS EN 12697-39	-	2.0%
			(vi) bitumen content	BS 1377:Part 2	Table B	Table B
6F2	Selected granular material (course grading)	Any material or combination of materials – including recycled aggregates with not more than 50% by mass of recycled bituminous plannings and granulated asphalt, but excluding materials that contain tar and tar-bitumen binders, unburnt colliery spoil, argillaceous rock and chalk. Property (vi) in the next column shall not apply if the Class Ra (asphalt) content of any recycled aggregate is 20% or less	(i) Grading	BS 1377:Part 4 (vibrating hammer method)		
			(ii) optimum mc	BS 1377:Part 2	Optimum mc – 2%	Optimum mc
	Capping		(iii) mc	BS EN 1097-2	-	60
			(iv)Los Angeles Coefficient	BS EN 933-11 See Note 6	-	50%
			(v) Class Ra (asphalt) content	BS EN 12697-1 or BS EN 12697-39	-	2.0%
			(vi) bitumen content	BS 1377:Part 2 (on-site)	Table B	Table B
6N	Selected uniformly	Natural gravel, natural sand, crushed gravel,	(i) Grading	BS EN 933-2 – See note 2	Table B	Table B

	graded granular material. Fill to structures	crushed roc, crushed concrete, slag, well burnt colliery spoil or any combination thereof. None of these constituents shall include any argillaceous rock. Recycled aggregate except recycled asphalt.	(ii) uniformity coefficient	BS EN 1097-2	-	40
			(iii) Los Angeles coefficient	BS 1377:Part 8	Ø = 35 C = 0	
			(iv) effective angle of internal friction (Ø) and effective cohesion (c)	As director	10^5 m/s	
			(v) Permeability	BS1377:Part 4 (Vibration hammer method)		
			(vi) optimum	BS1377:Part 2 and Note 1	Optimum mc -2.5%	Optimum mc +2%
			(vii) mc			

Notes.

1. Where BS 1377: Part 2 is specified for mc, this shall mean BS 1377: Part 2 or BS EN 1097 -5 as appropriate.
2. Uniformity coefficient is defined as the ratio of the particle diameters D60 to D10 on the particle -size distribution curve, where:
   D60 = particle diameter at which 60% of the soil by weight is finer.
   D10 = particle diameter at which 10% of the soil by weight is finer.
3. Topsoil shall have stones and other debris removed and disposed off Site which have:
   (a) dimensions greater than 100 mm equivalent diameter, unless otherwise permitted by the Project Manager; and
   (b) dimensions greater than 50 mm equivalent diameter which lie within 50 mm of the surface.
4. Topsoil shall be graded to smooth contours, eliminating all mounds and depressions where water may collect.
5. Topsoil shall not have stones or other debris protruding above the sur face by more than 30 mm.
6. The quality control procedure for recycled materials shall be in accordance with the 'Quality Protocol for the production of aggregates from inert waste' and the 'Producers' compliance checklist' published by Waste and Resources Action Programme (WRAP).

TABLE 5.1 – TESTING REQUIREMENTS AND ACCEPTABILITY LIMITS FILL MATERIALS

5.9 Grading Requirements

5.9.1 All fills and embankments shall be constructed of general fill of classes 1A, 1B, 2C and 6A as defined in this clause and **Table 5.2** of the Specification, except where stated otherwise in the contract.

BS SIEVE SIZE	PERCENTAGE BY MASS PASSING
Class 1A	
300mm 150mm 63 microns	100% 100% 0-15%
CLASS 1B	
125mm 63 microns	100% 0-15%
CLASS 2C1	

125mm	100%
2mm	35-80%
63 microns	35-80%
CLASS 2C2	
125mm	100%
2mm	15-80%
63 microns	15-35%
CLASS 6A	
500mm	100%
100mm	60-90%
20mm	0-70%
2 mm	0-20%
63 microns	0.5%
Class 6FI	
100mm	100%
75mm	65-100%
37.5mm	45-100%
10mm	15-80%
5mm	10-70%
600 microns	0-30%
63 microns	0-10%
Class 6F2	
100mm	100%
75mm	65-100%
37.5mm	45-100%
10mm	15-80%
5mm	10-70%
600 microns	0-30%
63 microns	0-10%
CLASS 6N	
100mm	100%
75mm	65-100%
37.5mm	45-100%
100mm	15-75%
5mm	10-60%
600 microns	0-30%
63 microns	0-15%

TABLE 5.2 – MATERIAL GRADING REQUIREMENT

5.9.2 For each approved material a sample of at least 3m3 shall be retained on site as a sample against which subsequent loads can be checked.

5.10 Testing Requirements

5.10.1 The Contractor shall, at least 7 working days before commencement of construction of the earthworks material, submit to the Engineer for approval the following test certificates for both on site and imported materials:

1) Grading

2) Uniform coefficient

3) Moisture content

4) Moisture condition value (MCV)

5.10.2 The minimum frequency of testing to be carried out by the contractor is as follows in **Table 5.3**:

Material Class	Type of Test	Relevant Standard	Rate of Testing
1A 1B 2C	Grading	BS 1377	Source approval and two per week per source
	Optimum Mc	BS 1377	Source approval and one per week per source
	Mc	BS 1377	Two per day per source
	10% Fines Value	BS 812	Source approval and one per week per source
	Soundness	BS 812	Source approval and one per week per source
	Plasticity Index	BS 1377	Source approval and one per week per source
	Plate Bearing Test (C.B.R.)	BS 1377	One per 250 sq.m
	Field Density Test	BS 1377	Where required to verify compaction of material outside optimum moisture content range
5A	Grading	-	Source approval and 1 per 400 tonnes
6F1	Grading	BS 1377	Source approval and two per week per source
	Uniformity Coefficient	BS 892	Source approval and one per week per source
	10% Fines Value	BS 812	Source approval and one per week per source
	Mc	BS 1377	Two per day per source
	Plate Bearing Test (C.B.R.)	BS 1377	One per 500 sq.m

TABLE 5.3 – RATE OF TESTING

5.10.3 In areas where fill material is placed at least 1m deep, the Contractor shall allow for 1 no. plate loading test to be carried out for each 500m2 plan area of such fill. A minimum of 3 no. plate loadings tests shall be carried out. The tests shall be carried out immediately after completion of the fill operation in the positions designated by the Engineer . The results shall be documented in the form of a load/settlement curve and issued to the Engineer within 48 hours of the completion of the test. A CBR value shall be given for each plate load test performed.

5.10.4 The Contractor shall provide and maintain full details and drawings showing the locations of all samples taken and tests carried out on the site. Copies of these shall be provided for the Engineer on his request during the Contract.

5.11 Geotextile Material

5.11.1 The geotextile material shall be manufactured from engineering grade of polyester, polyethylene, polypropylene sheet, or a combination or approved alternative. It must be used strictly in accordance with the manufacturer's recommendations and comply with the strengths and properties specified on the drawings. Any conflict between the manufacturer's guidelines and the drawings shall be resolved by the Engineer.

5.11.2 It shall also be subject to the following requirements: -

1. It shall be inert to all chemicals naturally found in soils.
2. It shall have no solvents at ambient temperature.
3. It shall not be susceptible to hydrolysis.
4. It shall be resistant to aqueous solutions of salts, acids and alkalis.
5. It shall be non -biodegradable.
6. It shall have a life in excess of 120 years.

5.11.3 The Contractor shall refer to the drawings for the location and type of material.

5.11.4 Alternative equivalent products may be proposed by the Contractor for the approval of the Engineer .

5.11.5 When requested one sample for each 1000m2 plan area shall be taken from the consignment of geotextile to be used in the works. From each sample taken test pieces shall be cut in order to comply with the tests for tensile strength, flow rates of water and pore size distribution. The tests to prove that the geotextile meets the following criteria shall be at the Contractor's expense:

(i) The geotextile shall sustain a tensile load of not less than that value shown on the drawings, determined in a 'wide strip' tensile test carried out in accordance with BS 6906: Part 1. The characteristic strength shall be taken as the value of the strength of the material below which not more than 5% of the test results may be expected to fall. This represents the strength at 1.64 standard deviations below the mean strength.

(ii) The geotextile shall allow water to flow through it, at right angles to its principal plane, in either direction, at a rate of not less than 10 litres/m2/s under a constant head of water of

100 mm, determined in accordance with BS 6906: Part 3. The flow rate determined in the test shall be corrected to that applicable to a temperature of 15°C using published data on variation in viscosity of water with temperature.

(iii) The geotextile shall have a size distribution of pore openings such that the mean 090, is between 100 microns and 300 microns, determined in accordance with BS 6906: Part 2.

5.12 Slope Stabilisation

5.12.1 Where existing slopes, or new embankments are to be stabilised using geotextile fabrics or otherwise, the materials to be used must comply with the relevant standards, and be used strictly in accordance with the manufacturer's recommendations and as specified on the drawings

5.13 Requirements for Dealing with Unacceptable Material

5.13.1 Should the Contractor encounter any Class U2 unacceptable material during his earthwork operations he shall immediately inform the Engineer. Class U2 material shall be stored separately at a location determined by the Engineer. The Contractor shall make all necessary arrangements including licences for the removal of the material in accordance with the requirements of the Environmental Health Officer and any other interested parties if the Engineer should decide that the material is to be removed from the site.

5.13.2 Unacceptable material (by virtue of moisture content) arising from the site may be stored (subject to space being available) until the moisture content is such that the material becomes acceptable.

5.13.3 Should the Contractor encounter any Class U1 unacceptable material whilst excavating to achieve a formation level then that material (even if meeting the requirements of CBR or bearing capacity defined for the location) shall be removed to a depth instructed by the Engineer and replaced with approved materials.

5.14 Workmanship

5.14.1 Topsoil and Turf: Topsoil and turf shall, wherever practicable, be used immediately after stripping over the area of the works and any areas affected by the Contractor's plant. It shall be stripped, removed separately and stacked in stockpiles to a height not greater than 1.5m as directed by the Landscape Architect before construction commences. Topsoil stockpiles may be allowed to exceed the maximum height for short periods but in no case for longer than one season. Existing topsoil and turf shall remain the property of the Client and shall either remain stacked or be used on the Site as directed.

5.14.2 General Excavation: The Contractor shall excavate for the Works in any material encountered to the net lines, widths, lengths and levels indicated on the Drawings or to such other dimensions as may be directed.

No excavated material shall be removed from the Site without the appr oval of the Engineer.

Where the excavation reveals a combination of acceptable and unacceptable materials the

Contractor shall carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the Works without contamination by the unacceptable material.

The Contractor shall make his own arrangements for stockpiling of acceptable or unacceptable material, and for the provision of sites for the purposes where his method of working requires. The Contractor shall inform the Engineer , giving 24 hours' notice, as to when foundation formation levels will be ready for inspection.

5.14.3 Excavation of Cuttings: Hauling of material from cuttings or borrow pits to the embankments or other areas of fill shall proceed only when sufficient compaction plant is operating at the place of deposition to ensure compliance with the requirement of this section.

Construction traffic shall not use the surface of the bottom of a cutting unless the Contractor maintains the level o f the bottom surface at least 300mm above formation level. Any damage to the sub -grade arising from such use of the surface shall be made good by the Contractor, with material having the same characteristics as the material that has been damaged. From the time the Contractor begins to trim the remaining material to formation level on any given area, the movement and use of construction plant thereon other than that used to complete this operation shall be in accordance with the requirements of this section for geotextiles.

5.14.4 Benching: Where an embankment is to be placed on appreciably sloping ground, this surface shall be benched in steps or trenched, as shown on the Drawings, including if necessary any under - draining of the affected part of the Site.

The benching or trenches shall be kept free of water in accordance with Section 3.2 for cold weather working.

5.14.5 Excavation Below Embankments and Below Formation Level in Cuttings: Where any material below the natural ground level under embankments or below formation level in cuttings is required to be excavated, it shall be removed to such depth and over such areas as are shown on the Drawings and disposed of in such a manner depending on its nature and condition at the time. The resultant excavation shall be backfilled with acceptable material as defined in this section all material being deposited and compacted as specified for the forming of the embankments. Nevertheless when in these circumstances such backfill has to be deposited below standing water or where shown on the Drawings, the Contractor shall use only an approved free -draining granular material of maximum size not greater than 37.5mm and that on analysis by sieving complies with the requirements of Table A or other approved material. Such materials may be deposited below water without the associated use of compaction plant, except as required by Section 2. Where shown the Drawings 'acceptable material' may be deposited below water level.

If, after the removal of material as specified in the first paragraph of this clause, the Contractor allows the material so exposed to reach a condition where compaction of backfilling is impracticable, he shall make goo d either by additional excavation and fill in the manner specified in this clause, or by waiting until the condition of the exposed material is fit to receive the approved backfill.

5.14.6 Forming of Embankments and Areas of Fill: Embankments and other areas of fill shall be formed of material defined as 'acceptable material' in Section 4.2.

All earthworks material placed in or below embankments, below formation level in cuttings or elsewhere in the Works shall be deposited and compacted as soon as practicable after excavation in layers of thickness appropriate to the compaction used as permitted in this section or as a permitted departure therefrom. Embankments shall be built up evenly over the full width and shall be maintained at all times, with a sufficient camber and a surface sufficiently even to enable surface water to drain from the embankments. The Contractor shall control and direct construction traffic uniformly over their full width. Damage to compacted layers by construction traffic shall be made good by the Contractor.

If the material deposited as fill subsequently reaches a condition such that it cannot be compacted in accordance with the requirements of the Contract, the Contractor shall either:

(i) Make good by removing the material off the embankment until it is in an acceptable physical condition for re -use, and/or replacing it with acceptable material; or

(ii) Make good the material by mechanical or approved chemical means to improve the stability; or

(iii) Cease work on the material until its physical condition is again such that it can be compacted as described in the Contract.

Isolated boulders each within the range 0.015 to 0.085m3 in size may be incorporated in embankments provided that the specified compaction requirements are met and no stone exceeding 0.015m3 shall be placed less than 600mm below finished level.

In areas of shallow fill where after removal of top soil the ground level is within 300mm of formation level, construction traffic shall not use the surface unless the Contractor brings up and maintains the surface level at least 300mm above formation level. An y damage to the sub - grade arising from such use shall be made good by the Contractor with material having the same characteristics as the damaged material.

5.14.7 Compaction of Embankments and Areas of Fill: Compaction for areas indicated on the drawings shall be undertaken to the requirements of this clause and Table 6/4 of the TII Specification for Road Works by approved plant, except where the Engineer directs or permits a departure from the requirements of this Table.

5.14.8 For confined conditions such as in trenches, compaction plant shall be such that the compacting surface will apply effort up to, or in excess of, the overall width of the item of plant and further be able to compact the fill material against the undisturbed trench wall unrestricted by any trench supports system in use in such location.

5.14.9 Variations from the methods given in Table 6/4, or the use of plant not included therein, shall be permitted only if the Contractor demonstrates at site trials that a state of compaction is achieved by the alternative method equivalent to that obtained using the approved methods.

5.14.10 The procedure to be adopted for these site trials shall be agreed with and approved by the Engineer.

5.14.11 Earthmoving plant shall not be accepted as compaction equipment under this Clause.

5.14.12 The Contractor may at any time be required to carry out comparative field density tests determined in accordance with BS 1377 Part 9: 1990 on material that is considered to have been inadequately compacted (refer to **Table 5.3**). If the test results, when compared with the result of similar tests made on adjacent approved work in similar materials, shows the state of compaction to be inadequate, or if the test results when compared with the density obtained by a single compaction test carried out on the same material at natural moisture content by the method described in BS 1377 Part 4: 1990 is shown to be less than 95%, and this is held to be due to failure of the Contractor to comply with the requirements of the Specification, the Contractor shall carry out such further work as may be required for compliance.

Type of Compaction Plant	Category	CLASS 1A CLASS 2C (Method 2)		CLASS 1B (Method 3)		CLASS 6F1 CLASS 6F2 (Method 6)		
		D	N#	D	N#	N for D = 110 mm	N for D = 150 mm	N for D = 250 mm
Smooth-wheeled roller	Mass per metre width of roll:							
	Over 2100 kg up to 2700kg	125	10	125	10*	Unsuitable	Unsuitable	Unsuitable
	Over 2700kg up to 5400kg	125	8	125	8*	16	Unsuitable	Unsuitable
	Over 5400kg	150	8	Unsuitable		8	16	Unsuitable
Grid Roller	Mass per metre width of roll:							
	Over 2700 kg up to 5400kg	Unsuitable		150	10*	Unsuitable	Unsuitable	Unsuitable
	Over 5400kg up to 8000kg	125	12	Unsuitable		20	Unsuitable	Unsuitable
	Over 8000kg	150	12	Unsuitable		12	20	Unsuitable
Deadweight tamping roller	Mass per metre width of roll:							
	Over 4000kg up to 6000kg	150	12	250	4	12	20	Unsuitable
	Over 6000kg	200	12	300	3	8	12	20
Pneumatic-tyred roller	Mass per wheel:							
	Over 1000kg up to 1500kg	Unsuitable		150	10*	Unsuitable	Unsuitable	Unsuitable
	Over 1500kg up to 2000kg	Unsuitable		Unsuitable		Unsuitable	Unsuitable	Unsuitable
	Over 2000kg up to 2500kg	125	12	Unsuitable		Unsuitable	Unsuitable	Unsuitable
	Over 2500kg up to 4000kg	150	10	Unsuitable		Unsuitable	Unsuitable	Unsuitable
	Over 4000kg up to 6000kg	125	10	Unsuitable		12	Unsuitable	Unsuitable
	Over 6000kg up to 8000kg	150	8	Unsuitable		12	Unsuitable	Unsuitable
	Over 8000kg up0 to 12000kg	150	8	Unsuitable		10	16	Unsuitable
	Over 12000kg	175	6	Unsuitable		8	12	Unsuitable
Vibratory tamping roller	Mass per metre width of vibrating roll:							
	Over 700 kg up to 1300kg	100	12	150	12			
	Over 1300kg up to 1800kg	125	12*	175	12*			
	Over 1800kg up to 2300kg	150	12*	200	12*			

	Over 2300kg up to 2900kg Over 2900kg up to 3600kg Over 3600kg up to 4300kg Over 4300kg up to 5000kg Over 5000kg	150 12*	250 12*			
	COMPACTION METHOD					
CLASS 6A	No Compaction					
CLASS 6N	End product 95% of maximum dry density to BS1377:Part 4 (vibrating hammer method)					

Notes.

(i) The minimum number of passes N is the minimum number of times that each point on the surface of the layer being compacted shall be traversed by the item of compaction plant in its operating mode, or struck by power rammers or falling weight compactors. D is the maximum depth in mm of the compacted layer.

(ii) In column headed N# the number of passes shown is to be doubled for material Classes 1A, 1B, and 2C when such materials occur within 600 mm of sub -formation (if capping is required) or formation. Such extra compaction shall, unless otherwise directed by the Engineer , either be carried out for the full width of the embankment or, in other areas of fill which are to receive a pavement, between the outer extremities of the verges.

(iii) The compaction plant in Table D is categorised in terms of static mass. The mass per metre width of roll is the total mass on the roll divided by the total roll width. Where a smooth wheeled roller has more than one axle the category of the machine shall be determined on the basis of the axle giving the highest value of mass per metre width.

(iv) A grid roller is a machine with a compacting roll or rolls constructed of heavy steel mesh of square pattern.

(v) A deadweight tamping roller is a machine with a roll or rolls from which 'feet' project and where the projected end area of each 'foot' exceeds 0.01 m² and the sum of the areas of the feet exceeds 15% of the area of the cylinder swept by the ends of the feet. The requirements for t amping rollers apply to machines that have 2 rolls in tandem. If only one tamping roll traverses each point on the surface of the layer on any one pass of the machine, the minimum number of passes shall be twice the number given in Table D plus any further doubling required to satisfy (ii) above.

(vi) For pneumatic -tyred rollers the mass per wheel is the total mass of the roller divided by the number of wheels. In assessing the number of passes of pneumatic -tyred rollers the effective width sha ll be the sum of the widths of the individual wheel tracks together with the sum of the spacings between the wheel tracks provided that each spacing does not exceed 230 mm. Where the spacings exceed 230 mm the effective width shall be the sum of the widths of the individual wheel tracks only.

(vii) A vibratory tamping roller, which may be self -propelled or towed, is a machine having a means of applying mechanical vibration to one or more rolls. The roll or rolls have projecting feet where the height of each foot exceeds 10% of the radius of the roll drum,

the projected end area of each foot exceeds 0.1% of the roll drum surface area, and the sum of the areas of the feet exceeds 10% of the area of the cylinder swept by the ends of the feet . The requirements for the operation of vibratory tamping rollers shall be the same as those stated for vibratory rollers in sub -Clause (viii) except that vibratory tamping rollers operating without vibration shall be classified as deadweight tamping rollers.

(viii) For items marked * in Table D the roller shall be towed by track -laying tractors. Self -propelled rollers are unsuitable.

(ix) Where combinations of different types or categories of plant are used, the following shall apply:

(a) the depth of layer shall be that for the type of plant requiring the least depth of layer; and

(b) the number of passes shall be that for the type of plant requiring the greatest number of passes.

(x) The single point compaction comparison test shall not be used to deduce the compaction requirements of Table 5.4.

(xi) When materials of widely divergent characteristics are used in embankments and fill areas, they shall be spread and compacted in separate clearly defined areas in such a manner as to comply with the requirements of Table 5.4.

(xii) If more than one class of material is being used in such a way that it is not practicable to define the areas in that each class occurs, compaction plant shall be operated as if only the material that requires the greatest compactive effort is being compacted.

(xiii) Where the Contractor uses plant to provide assistance in the use of vibro-compaction plant, this shall be disregarded in assessing the above requirements.

TABLE 5.4 – COMPACTION REQUIREMENTS FOR EMBANKMENTS & AREAS OF FILL

5.15 Use of Plate Compactors for Drainage Backfill.

5.15.1 Vibrating-plate compactors are machines having a baseplate to which is attached a source of vibration consisting of one or two eccentrically weighted shafts and:

5.15.2 The mass per square metre of the baseplate of a vibrating -plate compactor is calculated by dividing the total mass of the machine in its working condition by its area in contact with compacted material;

5.15.3 Vibrating-plate compactors shall be operated at the frequency of vibration recommended by the manufacturers. They shall normally be operated at travelling speeds of less than 1 km/h but if higher speeds are necessary the number of passes shall be increased in proportion to the increase in speed of travel.

5.16 Tolerance

5.16.1 The levels shall be determined from the point on the constructed surface of the general fill courses and shall all be within a tolerance of +20mm or –30mm. The Contractor shall be required to carry out to ensure 95% compaction, in the ratio of 1 test per 500m2 plan area of fill material compacted. Refer to Section 4.2.

5.17 Rectification

5.17.1 Where any tolerance is exceeded the Contractor shall make good in the manner described below.

5.17.2 If the surface is too high it shall be re-trimmed and re-compacted in accordance with the specification. If the surface is too low the deficiency shall be corrected by the addition of fresh acceptable material of the same classification laid and compacted to Specification, or as otherwise directed by the Engineer.

5.18 Use of Surfaces by Construction Traffic

5.18.1 The wheels or tracks of plant moving over the various courses of general fill shall be kept free from deleterious materials. Any damage to the subgrade arising from construction traffic shall be made good by the Contractor with material of the same or better quality than the material that has been damaged.

5.19 Geotextile Material Installation

5.19.1 The Geotextile material shall be located as indicated on the drawings and pl aced directly on the prepared and approved surface level.

a. Geotextiles shall be laid to the correct orientation and length and shall be installed within 50mm of the levels indicated on the drawings.

b. The placing and positioning of the geotextiles, lap lengths and joint details shall be in full accordance with the manufacturer’s details and the contract documents.

c. No traffic or site plant shall be permitted to travel on the geotextile prior to placing a minimum of 150mm of fill on top of the geotextile.

6.0 DRANIAGE

6.1 General

6.1.1 All drainage works should comply with Uisce Eireann and / or the Local Authority requirements applicable for the location of the construction site.

6.2 Standards and Submission of Materials

6.2.1 As soon as possible after the Contract has been awarded, the Contractor shall submit to the Engineer for his approval a list of his proposed suppliers and sources of materials required for the execution of the Works.

6.2.2 The materials subsequently supplied shall conform to the quality of samples which have been approved by the Engineer.

6.2.3 Names of additional suppliers and sources may be submitted by the Contractor during the execution of the Contract, but no source of supply shall be changed without the Engineer's approval.

6.2.4 All materials, workmanship and tests (where required) shall comply with the appropriate Irish and British Standards, meet the requirements of the Local Authority/ Irish Water and be in accordance with the Drawings and the Specification.

6.3 Storage of Materials

6.3.1 Materials and components shall be stored in such a manner as to preserve their quality and condition to the standards required by the Contract.

6.3.2 The quantity of materials and components stored on the site shall be consistent with that necessary for efficient working.

6.4 Handling and Use of Materials

6.4.1 Materials and components shall be handled in such a manner as to avoid any damage or contamination, and in accordance with all applicable recommendations of the manufacturers.

6.4.2 Unless otherwise described in the Contract, the use, installation, application or fixing of materials and components shall be in accordance with all applicable recommendations of the manufacturers. Where appropriate, the Contractor shall make use of any technical advisory services offered by manufacturers.

6.5 Prohibited Materials

The following materials shall not be specified or employed in the works:

(i) Material from swamps, marshes or bogs;

(ii) Peat, logs, stumps and perishable material;

(iii) Material susceptible to spontaneous combustion;

(iv) Material in a frozen condition;

(v) Clay of liquid limit exceeding 90 and/or plasticity index exceeding 65;

(vi) Material having a moisture content which will not permit compaction in the manner specified.

(vii) Any materials that are in anyway detrimental to the life or construction of the development or any part of it.

6.6 Backfilling Materials for Drains and Services

6.6.1 Acceptable Excavated:

Fill, whether selected from locally excavated material or imported, shall consist of uniform, readily compactable material.

Backfill to trenches in open spaces shall be suitable excavated material.

6.6.2 Granular Materials:

In roads and footpaths backfill to be Clause 808, as specified and defined in the TII Specification for Road Works.

All aggregates used on site should be in accordance with SR 21 and the relevant SR 21 Annex's as follows:

- Annex A should be referred to for specifying aggregates for pipe bedding, haunching and surround.
- Annex B should be referred to for specifying aggregates for backfilling of filter drains.
- Annex C should be referred to for specifying aggregates for general fill material.
- Stone for under roads should be Cl 808 and in accordance with SR 21, in particular SR 21 Annex D (unbound sub-bases for road pavements).
- Annex E should only to referred to for under concrete floor and footpaths adjacent to buildings (up to 500mm)

6.6.3 All certs for the above stone should come with a complete suite of test results from the supplier.

6.6.4 Testing Requirements for Materials:

The Contractor shall, at least 7 working days before commencement of construction of the granular material, submit to the Engineer for approval the following test certificates for both on site and imported materials:

1) Grading

2) Uniform coefficient

3) Moisture content

4) Moisture condition value (MCV)

5) Plasticity Index

6.6.5 Materials having a soluble sulphate content exceeding those set out in the TII Specification for

Road Works when tested in accordance with Test 10 of BS 1377 shall be classed as unacceptable materials.

6.6.6 Pyrite Testing:

All fill material shall be in compliance with I.S.EN 13242:2002 Aggregates for Unbound and Hydraulic ally Bound Materials for use in Civil Engineering Work and Road Construction and SR21: 2004+A1:2007 Guidance on the use of I.S.EN 13242:2002.

The Contractor shall issue to the Engineer a copy of an up to date Certificate from the stone supplier making reference to the quarry and the date for which the Certificate is relevant. The Contractor shall issue to the Engineer a copy of all delivery dockets for all materials delivered to the site for inspection.

Note: In addition to the testing of material the contactor's attention is drawn to the chemical testing of backfill material. All backfill material shall comply with the provisions of SR21 and IS EN 13242:2002.

6.7 Pre-Formed Drainage Channels

6.7.1 Where specified pre-formed drainage channels shall comply with TII Specification for Road works and shall be installed to the manufacturer's instructions.

6.8 Water

6.8.1 Water for use in the works shall be of potable quality.

6.9 Aggregates for Concrete

6.9.1 Aggregates for concrete shall comply with the relevant provisions of IS EN 12620:2002 (refer to SR 16, 2004).

6.9.2 Marine aggregates may not be used.

6.9.3 The nominal size of aggregate will be 20 mm.

6.9.4 All sands shall comply with BS EN 12620:2002 or BS 1199 and shall be washed sands.

6.10 Sands for Mortar and Grout

6.10.1 Sands for mortar and grout shall be washed sand complying with BS 1200 and graded in accordance with Table 1 of that Standard.

6.11 Cement

6.11.1 Cement shall comply with the provisions of the appropriate Standard, as set out below:

TYPE	
Ordinary Portland	IS EN 197
Sulphate-Resisting Portland	IS EN 197

6.11.2 Except for concrete having an equivalent compressive strength less than 20 N/mm2, sulphate -

resisting Portland cement shall be used in all cases (including precast concrete products), unless the Contractor can satisfy the Engineer that any attack from soils or groundwater will adequately be resisted.

6.12 Concrete Mixes (Refer to Section 10.0 Also)

6.12.1 Formwork, reinforcement and concrete materials are to comply with the requirements of BS EN 206 – Concrete – Specification, performance production and conformity.

6.12.2 Grade of Concrete C16/20 to be used for the following

Precast pipe setting blocks

Surround to manholes

Manhole inverts and benching

Bedding and backing for drainage channels

6.12.3 Manufacturer's test certificates for the cement incorporated into the concrete shall be provided to the Engineer.

6.12.4 Each concrete mix shall be approved by the Engineer. Quantities and sources of materials in each mix shall be approved by the Engineer.

6.13 Mortar

6.13.1 Shall be 3:1 Sharp sand; Ordinary Portland Cement/Sulphate Resisting Cement or similar approved by the Engineer.

6.14 Pipe Bedding

6.14.1 Pipe bed and surround shall be as specified on the drawings and as defined below:

(i) In the case of backfill of foul sewers trenches, the Irish Water Code of Practice for Wastewater Infrastructure shall be consulted.

(ii) Pipe bedding, haunch side fill and surround material for buried pipelines shall comply with WIS 4 -08-02 and its associated guidance note, IGN 4 -08-01, UK Water Industry Specifications. Granular material shall be 14mm to 5mm graded aggregate or 10mm single sized aggregate, complying with the requirements of IS EN 13242 and should have a compaction value not greater than 0.2 when measured in accordance with BS EN 752. The grading shall be to BS 882 (Table 4) as follows: -

BS SIEVE SIZE (mm)	PERCENTAGE BY WEIGHT PASSING
50	100
37.5	85 – 100
20	0 – 25
10	0 - 5

(iii) Class 'A' bed and surround shall consist of C16/20 concrete surround to pipes with flexibility maintained by leaving a gap at each pipe joint filled with 18mm thick soft

compressible material. Extent of the bedding shall be as shown on the drawings.

(iv) Class 'S' bed and surround shall consist of granular material from natural sources to BS 882:-

NOMINAL BORE OF PIPE IN mm	AGGREGATE SIZE IN mm
100	Single size 10mm
Over 100 to 150	Single size 10mm to 14mm
Over 150 – 500	Single size 14mm

6.14.2 The material shall have a compaction fraction value not exceeding 0.15 when determined in accordance with BS EN 752. Extent of the bedding shall be as shown on the drawings.

6.14.3 For ductile iron or steel pipelines only aggregates conforming to BS 882 are permitted.

6.14.4 The Contractor may, with the approval of the Engineer and Local Authority / Irish Water, as appropriate, use a free all -in mixture of similar maximum and minimum particle size.

6.14.5 The Contractor will be required to show, either by Suppliers' Certificate or regular batch sieve testing on site that the material complies with the grading and that uniformity is maintained.

6.15 Precast Concrete Setting Blocks for Pipes

6.15.1 Laying of pipes on concrete blocks is not permitted.

6.16 Cast Iron Pipes and Fittings

6.16.1 Refer to Uisce Eireann Specification.

6.17 Vitrified Clay Pipe and Pipeline Fittings

6.17.1 Refer to Project Particular Specification.

6.18 Concrete Pipes and Fittings

6.18.1 Surface water concrete pipes and fittings to be in accordance with the Greater Dublin Regional Code of Practice for Drainage Works and comply with the Local Authority requirements for taking in charge.

6.18.2 Foul water concrete pipes and fittings to be in accordance with the Irish Water Code of Practice for Wastewater Infrastructure and comply with Irish Waters requirements for taking in charge.

6.19 Porous Pipes

6.19.1 Pipes to be used for land drainage shall comply with either BS 1194 for porous concrete pipes, BS 1196 for clayware pipes or BS 4962 for plastic pipes.

6.19.2 Pipes of other materials than specified but incorporating perforations may also be used, provided they comply in all respects other than water tightness with the relevant specification clauses.

6.20 Thermoplastic Structured Wall Pipes

6.20.1 Thermoplastic structured wall pipes for use in foul or surface water sewer systems shall be in

accordance with the Irish Water Code of Practice for Wastewater Infrastructure. Pipes to be of Stiffness Class 8kN/m2 and to be capable of demonstrating a jetting resistance of 4,000 psi (280 Bar) without damage when tested in accordance with Section 6.10 of WIS 4 -35-01. (Pipe diameters 150mm up to 450mm)

6.21 Unplasticizied PVC Pipes and Fittings

6.21.1 Foul Water

6.21.2 Unplasticized PVC pipes and fittings for use in foul water sewer systems shall be in accordance with the Irish Water Code of Practice for Wastewater Infrastructure. Pipes to be of Stiffness Class 8kN/m2 and to be capable of demonstrating a jetting resistance of 4,000 psi (280 Bar) without damage when tested in accordance with Section 6.10 of WIS 4 -35-01. (Pipe diameters 150mm up to 450mm)

PVC pipes, joints and fittings for service connections shall comply with the provisions of BS 4660 and BS EN 1401 – Part 1. Push fit joints shall be spigot and socket. (Pipe diameter 100mm).

6.21.3 Surface Water

PVC pipes shall be used in accordance with the Greater Dublin Regional Code of Practice for Drainage Works and shall comply with the requirements of Local Authority who's approval of the pipe is to be obtained by the Contractor in writing and submitted to the Engineer prior to commencing of the works.

6.22 Compressible Filler and Packing for Pipelines

6.22.1 Not required

6.23 Puddle Clay

6.23.1 Puddle clay to comply with TII Specification for Road Works as required.

6.24 Precast Concrete Manholes

6.24.1 Precast concrete manholes shall be in accordance with the Greater Dublin Regional Code of Practice for Drainage Works and Irish Water Standard Details and comply with Local Authority requirements for taking in charge.

6.24.2 Precast concrete manhole wall units completed with rubber sealing ring gasket between units, complying with the requirements of IS EN 1917 and BS 5911 – Part 3, subject to specific approval of Irish Water, complete with a 150mm minimum thickness cast in situ concrete surround, C16/20, in accordance with IS EN 206, 20mm aggregate size, in accordance with IS EN 12620, with either or cast in -situ concrete base (225mm minimum thickness beneath channel), both constructed of C30/37 concrete, in accordance with IS EN 206, 20mm aggregate size, in accordance with IS EN 12620 reinforced with high tensile steel bar reinforcement, with a minimum 40mm concrete cover.

6.24.3 For joints between units and the underside of slabs, joint profiles shall be capable of withstanding

applied loadings from such slabs, and spigot -ended sections shall only be used where the soffit of the slab is recessed to receive them.

6.25 Polypropylene Inspection Chambers

6.25.1 Inspection chambers shall be permitted in private areas only and shall be provided in accordance with BS EN 13598, with minimum B125 covers.

6.26 Precast Concrete Cover Frame Seating Rings

6.26.1 Where specified pre-formed drainage channels shall comply with TII Specification for Road works and shall be installed to the manufacturer's instructions.

6.27 Manhole Covers and Frames

6.27.1 Manhole covers and frames shall comply with the relevant provisions of BS EN 124. They shall be of a non-rocking design which does not rely on the use of cushion inserts.

6.27.2 Class D400 covers and frames shall be used throughout except on heavily trafficked main roads where E600 covers and frames shall be provided.

6.27.3 All manhole covers shall be the non-ventilating type and shall have closed keyways, in accordance with the requirement of the Local Authority and with the Regional Code of Practice for Drainage Works or Irish Water Code of Practice, as appropriate.

6.27.4 Manhole covers and frames to be in accordance with the Greater Dublin Regional Code of Practice for Drainage Works, or Irish Water Code of Practice, as appropriate, and comply with the Local Authority requirements for taking in charge.

6.28 Manhole Step Rungs

6.28.1 Steps are to be provided in manholes up to 2.5m and in shallow chambers. Manhole steps shall comply with the requirements of IS EN 13101, Type D, Class 1.

6.28.2 Steps, 20mm diameter, shall be galvanised mild steel and plastic encapsulated steps.

6.28.3 Manhole step rungs to be in accordance with the Greater Dublin Regional Code of Practice for Drainage Works and Irish Water Standard Details and comply with the Local Authority requirements for taking in charge.

6.29 Gullies

6.29.1 Precast concrete gullies shall comply with the relevant provisions of EN124, BS 5911, Part 6 and shall be Class D400 in accordance with the Greater Dublin Regional Code of Practice for Drainage Works and comply with the Local Authority requirements for taking in charge.

6.29.2 Unless specified otherwise gullies shall be 450 mm internal diameter and 900 mm deep with a 150 mm diameter outlet trapped and fitted with a rodding eye, approved stopper and chain.

6.30 Gully Grates and Frames

6.30.1 Gully grates and frames shall be of one pat tern and shall be manufactured from ductile iron or

cast iron, and comply with BS EN 124, Class D400 or as shown on the Drawings.

6.31 Linear Drainage Channel Systems

6.31.1 Where specified linear drainage channel systems shall conform to IS EN 1433 and with the other requirements as set out on the drawings.

6.31.2 Linear drainage channel systems shall be suitable for their intended use and place of installation in the Works. The Contractor shall submit evidence of such suitability to the Engineer in accordance with this specification.

6.31.3 Design flows given on the drawings shall be accommodated without surcharge within the main channel section and beneath the underside of any inlet slot sections. Where applicable, the width and depth of linear drainage channel system units shall not exceed the dimensions given in on the drawings.

6.31.4 Dimensions of inlet slots shall comply with IS EN 1433. When used adjacent to porous asphalt surfacing materials, units shall also incorporate side entry inlets to permit drainage of water held within the porous asphalt and shall have the capacity to drain porous asphalt.

6.32 Brick and Blocks

6.32.1 Concrete bricks or blocks to be used in manholes and chambers shall be precast concrete masonry units manufactured in accordance with BS 6073 containing a minimum of 360 kg/m3 of sulphate resisting cement, having a maximum water cement ratio of 0.45, a minimum compressive strength of 50 N/mm2, and a maximum water absorption of 7%.

6.32.2 Clay bricks to be used in manholes and chambers shall be Class B engineering complying with the relevant provisions of BS EN 771 and BS EN 772

6.32.3 The shape s and dimensions of special bricks shall comply with the relevant provisions of BS 4729.

6.32.4 All bricks shall be frost resistant category F.

6.32.5 The Contractor shall ensure that all brick and block work are to IS EN 1744 -1 2009, to ensure the brick / blockwork is not susceptible to pyrite. The Contractor shall ensure that all brick and block work meets the following criteria:

Acid Soluble Sulphate Content < 5% expressed as a percentage of mass of the total cement content

Total Sulphur < 0.25%

Cement Content > 5%

6.32.6 All relevant documentation should be sought from the Contractor and forwarded to the Engineer for review prior to the works.

6.33 Proprietary Drainage Systems

6.33.1 Where proprietary drainage systems are specified or proposed by the Contactor they are to fully

conform to the standards and quality specified and be installed in strict accordance with the drawings and manufacturer's recommendations.

6.34 Petrol/Oil Interceptors

6.34.1 Interceptors shall be as specified on the drawing and surrounded in mass/reinforced concrete as specified on the drawings.

6.35 Attenuation System & Hydrobrake

6.35.1 An attenuation system is to be provided within the site as shown on the drawings. The capacity required in the system is as shown on the drawings or as confirmed by the Engineer. The systems are located below ground, with levels generally as shown on the drawings.

6.35.2 Contractor to include for attenuation system manufacturer/installer completing a water tightness test on the completed attenuation system.

6.35.3 Hydrobrake vortex flow control device to be provided at the outfall manhole of the site. Hydrobrake to limit flow as per drawings.

6.35.4 Contractor to include for installation of the attenuation system with build -up and backfill as detailed on the relevant contract drawings and in accordance with the attenuation system manufacturer's requirements.

6.36 Workmanship

6.36.1 The Contractor shall excavate for the Works in any material encountered to the net lines, widths, lengths and levels indicated on the Drawings or to such other dimensions as may be directed by the Engineer.

6.36.2 No excavated suitable material other than that surplus to the requirements of the Works shall be removed from the Site except on the direction or with the permission of the Engineer who may require material which is unsuitable only by reasons of being frozen to be retained on site when in that condition. Should the Contractor be permitted to remove suitable material from the Site to suit his operational procedure, then he shall make good at his own expense any consequent deficit of filling arising therefrom.

6.36.3 If any suitable material excavated from within the Site is, with the permission of the Engineer taken by the Contractor for purposes other than the forming of embankments and other areas of fill, sufficient suitable filling material to occupy after full compaction, a volume corresponding to that which the excavated material occupied shall, unless otherwise directed by the Engineer, be provided by the Contractor from his own resources.

6.36.4 Suitable material surplus to the total requirements of the Works and all unsuitable material shall, unless the Engineer directs otherwise, be run to spoil in tips provided by the Contractor. Where the excavation reveals a combination of suitable and unsuitable materials the Contractor shall, unless otherwise agreed by the Engineer, carry out the excavation in such a manner that the suitable materials are excavated separately for use in the Works without contamination by the

unsuitable material.

6.36.5 The Contractor shall make his own arrangements for stockpiling of suitable or unsuitable material, and for the provision of sites for the purposes where his method of working requires.

6.37 Excavation of Pits and Trenches

6.37.1 The sides of pits and trenches shall be adequately supported at all times.

6.37.2 Trenches and pits shall be kept free of water.

6.37.3 The bottom of all excavations shall be levelled carefully and stepped or benched horizontally including removing unsuitable material as directed by the Engineer from the bottom of trenches and other excavations, which shall then be refilled to formation level with the same material as the permanent Work which is also to rest on that formation. Any void which results from over - excavation below formation level shall be refilled in the same manner.

6.37.4 All excavations for pipelines and manholes shall be to the lines and levels shown on the Drawings and with vertical sides or as directed by the Engineer and trench widths below a level of at least 300 mm above the crown of the pipe shall not be greater than those indicated on the drawings.

6.37.5 All excavated materials from such excavations not required for filling on the site shall be disposed of to an approved tip.

6.37.6 The Contract or shall make good with suitable material or concrete as directed by the Engineer;

(a) Any excavation greater than the net volume required for the Works as described in the Contract;

(b) Any additional excavation at or below the bottom of foundations to remove material which the Contractor allows to become unsuitable.

6.37.7 The Contractor shall carry out his operations in such a manner as to avoid damage to, or deterioration of, the formations of excavations. If after the removal of mate rial as specified in the first paragraph of this Clause, the Contractor allows the material so exposed to reach a condition where compaction of backfilling is impracticable, he shall make good at his own expense either by additional excavation and filling in the manner specified in this Clause, or by waiting until the condition of the exposed material is fit to receive the approved backfill.

6.37.8 Excavation in roads and streets shall be carried out in accordance with Local Authority requirements.

6.38 Timbering of Excavations

6.38.1 The term ‘timbering' shall cover all normal methods of support, including the use of timber, concrete, steel or such other materials. The Contractor shall supply and fix strong and sufficient timbering to support the sides and/or bottom of the excavations when necessary and shall maintain the same until the constructional work is sufficiently advanced to permit the timbering to be withdrawn, which shall be conducted only under the personal supervision of a competent

foreman.

6.38.2 Should any part of the trenches through insufficient or careless timbering or any other cause, collapse or give way the Contractor shall forthwith remove all the material which has fallen in, and if in the opinion of the Engineer, there is a possibility of the newly constructed work having been damaged or disturbed by such collapse, the work shall, at the expense of the Contractor, be laid bare, examined and tested. Any damaged work shall be reconstructed to the Engineer's satisfaction and at the Contractor's expense. The Contractor shall be responsible for any injury to the work and any consequential damage caused or arising out of the removal of the timbering and any advice, permission or approval given by the Engineer relative to the removal of timbering, shall not relieve the Contractor from the responsibility of making good any damage at his expense.

6.38.3 Battering the sides of the excavation in order to dispense with the timbering to trenches shall not be allowed without the prior approval of the Engineer. Every precaution shall be taken by the Contractor to ensure the stability of the Works.

6.39 Backfilling of Drainage and Excavation Works

6.39.1 Main backfilling of excavation shall not proceed until pipes and their bedding and construct ion works have been approved by the Engineer. Unless otherwise specified on the drawings, backfilling shall normally be carried out to the requirements of the Greater Dublin Strategic Drainage Study Code of Practice or Irish Water Code of Practice, as appropriate, with approved suitable material obtained from the excavation or from imported stone. The compaction equipment and its effects should not produce an overload on the pipes at any stage of the filling.

6.39.2 In the case of manholes, care should be taken to raise the fill equally around the manhole shaft so as to avoid unbalanced lateral loading.

6.39.3 If any filled excavations subside, the depressions so formed shall be filled with approved material and compacted.

6.39.4 The Contractor will be required to make good at his own expense any settlement, including road surfacing, arising from his operations which may take place before the expiration of the period of maintenance.

6.39.5 Filling material shall be as described on the drawings or elsewhere in this specification, deposited in layers not exceeding 225mm uncompacted thickness and then fully compacted to form a stable backfill by means of at least six complete passes of a smooth wheel roller weighing at least 8 tonnes or a vibratory roller of at least 3 tonnes static weight.

6.39.6 Where the excavation is within 1m of the edge of the carriageway, or proposed carriageway, the fill material shall be such as to permit adequate drainage.

6.39.7 Where the excavations have been supported and the supports are to be removed, these where practicable, shall be withdrawn progressively as backfill proceeds in such a manner as to minimise the danger of collapse and all voids formed behind the supports shall be carefully filled

and compacted.

6.39.8 Backfilling and reinstatement in roads and streets shall be carried out in accordance with the Local Authority requirements.

6.40 Gullies, Grates and Frames

6.40.1 The gully grates and frames shall be set 6mm below finished carriageway level to suit the longitudinal and cross fall of the road on a cement mortar bed on two courses of 225 mm Engineering brickwork built onto the gully pots. The pots are to be set on 150 mm bed and surround of C16/20 Concrete.

6.41 Cold Weather Work

6.41.1 General

No material in a frozen condition shall be incorporated in the works but shall instead be retained on the Site for use if suitable when unfrozen.

6.41.2 Concreting in Cold Weather

Concreting at ambient temperatures below 2oC may be carried out only if all of the following conditions are met: -

a) the aggregates and water used in the mix shall be free from snow, ice and frost;

b) before placing concrete, the formwork, reinforcement and any surface with which the fresh concrete will be in contact shall be free from snow, ice and frost and be at a temperature above 0oC;

c) the initial temperature of the concrete at the time of placing shall be at least 5oC;

d) the Contractor shall take precautions to prevent the temperature of any concrete falling to 0oC during the first 5 days after placing.

6.41.3 Curing

a) Concrete shall be protected from drying and freezing for at least 5 days by methods that shall ensure that cracking, distortion and efflorescence are minimised.

b) In cold weather, when the temperature of freshly placed concrete may approach 0oC, water curing shall not be employed.

6.41.4 Bricklaying & Blocklaying in Cold Weather

Materials used in bricklaying or blocklaying shall be frost -free, and no bricks or blocks shall be laid when the ambient temperature is below 3oC, unless special precautions are taken. Completed work shall be protected adequately during cold weather.

6.42 Pipe Bedding Laying and Jointing

6.42.1 Pipe bedding and trench dimensions are to be as shown on the drawings. Before placing pipe bedding material the trench bottom shall be prepared. All loose stones, lumps of clay, rock

projections, boulders and other hard spots shall be removed. Where necessary, joint holes shall be neatly cut to permit the barrel of the pipe to be properly supported throughout its length, and shall not be larger than is required for making the joint.

6.42.2 Granular bedding material as specified shall be laid over the full width of the trench to such depth that after the pipe s have been laid to line and level, the thickness of bed beneath the pipes shall not be less than that specified on the drawings or as directed by the Engineer. The bedding material shall be evenly spread and carefully compacted and where the bedding beneath the pipe exceeds 200 mm in thickness it shall be placed and compacted in two separate equal layers. Any clay, large stones and other unsuitable material falling on to or into the granular bed from the trench sides or from other source shall be immediately removed.

6.42.3 Should hand ramming fail to produce adequate compaction, the Engineer may require mechanical compaction to be used, and the Contractor shall not be entitled to claim any extra payment on such account.

6.42.4 Timbering or any other form of trench support should be withdrawn, whenever possible, as the bedding material is placed so as to avoid disturbance of the bedding by later removal.

6.42.5 Pipes shall be laid to the line and level as shown on the Drawings with a maximum permitted tolerance of + or – 12 mm between manholes, provided that no pipe shall have a reverse gradient and with minimum disturbance to the bedding material. Points on either side of a joint shall not err from true line and level by differing amounts.

6.42.6 All adjustments to line and level must be made by adding or removing bedding material properly compacted under the body of the pipe and not by wedging and blocking. Where the pipes are too large to be easily manhandled into position a crane must be used. During the pulling operation the pipe shall remain suspended from the crane. If necessary, additional bedding material shall be added to prevent the pipe setting after the release of its weight.

6.42.7 The use of pipes produced by different manufacturers will not be permitted in the same sewer length, and all faulty and damaged pipes shall be rejected and no pipe shall be disturbed after setting and jointing.

6.42.8 Pipe jointing surfaces and components shall be kept clean and free from extraneous matter until the joints have been made or assembled. Care should be taken to ensure that there is no ingress of grout or other extraneous material int o the joint annulus after the joint has been made.

6.42.9 Pipes shall be cut by a method which provides a clean square profile, without splitting or fracturing the pipe wall. Where necessary, the cut ends of the pipes shall be formed to the tapers and chamfers suitable for the type of joint to be used.

6.42.10 When pipe laying stops, such as overnight, at a manhole or at junctions, a suitable stopper must be inserted in the pipe to prevent ingress of foreign matter.

6.42.11 After the pipe has been laid, granular bedding material shall be brought up to the level of the horizontal diameter of the pipe, compacted as before. Care shall be taken not to disturb the pipeline from its approved position.

6.42.12 Concrete Bedding:

Grade C16/20 concrete shall be placed and compacted to form a surround to the pipe of minimum thickness at the invert of the pipe of not less than one quarter of the external diameter of the pipe, with a minimum of 100 mm. The minimum dimensions of the cradle shall be in accordance with the drawings. The vertical sides of the concrete shall be properly shuttered or the concrete extended across the full width of the trench. The concrete shall be physically separated at each pipe joint by bitumen impregnated board to BS 1142 or other suitable compressible material. Any space between the concrete and the trench side shall be filled and compacted with specified backfill material. Backfilling shall not be carried out until the compressive strength of the concrete has reached 14 N/mm2.

6.42.13 Granular Bedding:

Granular bedding material' as specified and as used for the bed shall be brought up in layers and compacted by hand until the specified amount of material as shown on drawings covers the pipes. Care must be taken not to disturb the pipeline from its approved position. Remaining backfill is to be carried out in accordance with the materials specified on the drawings.

Pipes shall be laid on setting blocks only where a concrete bed or cradle is used.

6.43 Junctions and Connections

6.43.1 Where shown on the Drawings or directed by the Engineer, junction pipes shall be inserted during the construction of the sewers. Junctions on the sewers which are not immediately connected up shall be closed and made watertight with stoneware disc stoppers set in and filled up to the end of the socket with puddled clay or similar approved by the Engineer.

6.43.2 Where it is necessary to make a stoneware saddle connection to an existing sewer a hole shall be neatly cut to the shape required as near as practicable such that junctions lead in soffit to soffit and the saddle shall be inserted with its junction pipe leading in the direction of flow of the main pipeline. The saddle shall be bedded in 1:3 cement mortar, care being taken to clean all surplus mortar from the inside of the junction piece or any which may have fallen into the sewer.

6.43.3 Where ordered by the Engineer, sewers and junction pieces shall be surrounded with C16/20 concrete to a thickness of 150 mm.

6.43.4 Where it is necessary to make a saddle connection to an asbestos cement pipe or a plastic pipe the saddle junction shall be of the same material as the pipe and shall be fixed and cemented to the pipeline in strict accordance with the manufacturer's instructions. Particular attention should be paid to Health & Safety when dealing with asbestos.

6.43.5 Saddles when authorised shall be of an approved type with flanged s eating on to main pipes.

6.43.6 All saddles and junction pipes shall have flexible joint type sockets.

6.43.7 No saddle junctions shall be provided without the prior approval of the Engineer and the Local Authority.

6.44 Marker Posts

6.44.1 Marker posts are required as per the requirements of the Local Authority and / or Irish Water.

6.45 Crossing of Pipelines

6.45.1 Where pipelines cross at different levels the pipes shall be supported at the point of crossings to the full width of the trench by granular bedding as previously specified. This bedding shall be carefully compacted in 150 mm layers from the lower formation level to half pipe height of the upper pipe.

6.46 Manhole and Catchpit Construction

6.46.1 Manholes and chambers shall be built in accordance with the Greater Dublin Regional Code of Practice for Drainage Works and comply with the Local Authority requirements for taking in charge and Irish Water Code of Practice, as appropriate. Manhole s and chambers shall be built to the dimensions shown in the Drawings and shall be watertight.

6.46.2 Base slabs shall be constructed of in situ concrete grade C16/20 or as indicated on the Drawings, placed and compacted as specified elsewhere. Where required, bases will be reinforced as directed by the Engineer.

6.46.3 Invert channels shall be straight or curved special semi -circular channel pipes, tapered, where necessary and constructed from material similar to the main pipeline wherever possible and laid to allow smooth flow.

6.46.4 Benching consisting of concrete grade C16/20 or as indicated on the Drawings shall be taken up vertically from the springing level to the soffit of the pipes where it shall be rounded at a radius of 75 mm and shaped off to the sides of the chamber at a gradient of 1 in 30. All internal benching is to be rendered with a 2:1 sand-cement mortar and brought to a smooth trowelled finish.

6.46.5 Where channels are to be cast in situ the benching shall be cast against the approved formwork to the curves, slopes and levels shown on the Drawings and brought to a smooth finish with a layer of granolithic concrete, to a thickness as stated on the drawings and in accordance with BS 8204 Part 2.

6.46.6 Where directed by the Engineer or as shown on the Drawings, inlet and outlet pipes of the required diameter shall be built into the walls or bases of manholes. Where flexible jointed rigid pipes are used the length of pipe which is built into the manhole shall be restricted in length (by cutting or by obtaining purpose made short lengths) so that first and second joints are provided on the connected pipeline at distances of not more than 150 mm and 750 mm respectively from the outside face of the chamber wall. Where directed by the Engineer or shown on the Drawings, provision for inlet and outlet pipes shall be boxed out in the concrete surround of the manholes.

6.46.7 Manholes which incorporate a backdrop connection shall be constructed as shown on the detail Drawings and generally in accordance with the preceding Clauses. The high level pipe shall be continued at its normal gradient to connect with the manhole as a rodding eye. Where possible in

concrete ring manholes, suitable lengths of chamber shall be provided so that the position of the rodding eye does not occur at or near a joint between chamber rings.

6.46.8 The vertical backdrop pipe shall terminate in a 90o bend built into the manhole base and the whole of the backdrop connection from the upper junction shall be surrounded with concrete grade C16/20 or as indicated on the Drawings, not less than 150 mm thick to form a monolithic structure with the manhole chamber.

6.46.9 Courses of 230 mm Engineering brickwork jointed in Cl B to IS 91 : 1983 set in 1:3 cement mortar shall be built on the cover slab to take the manhole cover and frame. The frame shall be set in 1:3 cement mortar to the required level as directed by the Engineer, the final adjustment in level being made in this brickwork by using between two and four courses.

6.46.10 In carriageways and other paved areas, rectangular manholes and all frames shall be placed so that covers are square to the kerb or edging. Covers should not be located in the wheel tracks of vehicles.

6.47 Precast Concrete Manholes

6.47.1 Manholes and chambers shall be built in accordance with the Greater Dublin Regional Code of Practice for Drainage Works and comply with the Local Authority requirements for taking in charge and Irish Water Code of Practice, as appropriate.

6.47.2 Manholes and chambers shall be built to the dimensions shown in the Drawings and shall be watertight.

6.47.3 Precast concrete manholes shall be constructed in accordance with the details shown on the Drawings and the manufacturer’s instructions.

6.47.4 The base and benching shall be formed in situ as described previously and the chamber shaft and cover slab formed in purpose -made precast concrete components. Joints on chamber and shaft rings shall be ogee or such other type as approved by the Engineer.

6.47.5 In jointing the chamber and shaft ring the lower ring or the base slab shall be ‘buttered' with 1:3 cement mortar and the next ring lowered in a horizontal position and carefully adjusted to be truly vertical and with the step irons in correct vertical alignment. Excess mortar shall be struck off immediately and a neat flush joint formed on the interior of the rings. No cracked or damaged rings or components shall be used. Lifting holes in chamber and shaft rings shall be made good with trowelled 1:3 cement mortar. Unless otherwise instructed, the whole length of the manhole chamber and shaft shall be surrounded to a depth of 3 m with a minimum thickness of 150 mm and over 3 m deep w ith a minimum thickness of 225 mm of Grade C16/20 concrete or as indicated on the Drawings, properly shuttered where necessary and adequately vibrated to give a dense concrete. Step irons shall be fixed into the concrete rings at the manufacturer's work s in accordance with the spacings shown on the detail Drawings. Step irons are not to be used for moving, hoisting or lowering the rings. The cover slab shall be bedded in cement mortar as above on the top shaft ring leaving a clear gap over the concrete surround.

6.48 Polypropylene Inspection Chambers

6.48.1 To be provided in accordance with BS EN 13598, with minimum B125 covers and in accordance with the Building Regulations, Part H.

6.49 Building-in Pipes

6.49.1 Unless the Engineer order s in writing to the contrary, pipes are to be built into concrete structures as concreting proceeds. The pipes shall be rigidly held in position to prevent loss of line or level and the concrete shall be well rammed round the pipe so as to prevent any ingress or egress moisture occurring around the joint.

6.49.2 Where flexible jointed rigid pipes are used the length of the pipe which is built into the structure shall be restricted in length (by cutting or by obtaining purpose made short lengths) so that first and second joints are provided on the connected pipeline at distances of not more than 150 mm and 750 mm respectively from the outside face of the wall.

6.49.3 The length of the next pipe (rocker pipe) away from the structure shall be in the range 0.5m to 0.75m for pipes up to 450mm nominal diameter and shall not exceed 1m for pipes up to 750mm nominal diameter and shall not exceed 1m for pipes up to 750mm nominal diameter. Where pipes are to pass through the wall of the structure and are not built in as the concreting proceeds, a rebated rectangular or square opening shall be formed in the walls, all in accordance with the drawings. The sides of openings in the concrete shall be well protected from possible subsequent damage during the installation of the pipe by timber battens of adequate size to line and level, the concrete infilling shall be placed in the opening and the concrete well rammed around the pipe and vibrated so as to be completely watertight. Before placing concrete infilling, the faces of the joints shall be thoroughly cleaned and washed down with clean water. Where pipes pass through watertight structural walls they shall be fitted with puddle flanges as indicated on the drawings. The Contractor will be responsible for ensuring that they are fixed in the correct positions at the required levels and also that they are watertight after installation.

6.50 Sealing of Disused Manholes, Sewers and Drains

6.50.1 All existing on-site pipe work is to be grubbed up under this contract, and the resultant trenches backfilled with suitably excavated material in landscaped areas, and in Cl808 material, compacted in 150 mm layers to original ground level.

6.50.2 Where pipes are to be abandoned or where directed by the Engineer, the length may be sealed in the following manner. Pipes less than 450 mm internal diameter shall be broken back to a suitable collar and then sealed by means of a vibrated clay stopper set in 1:3 cement mortar and surrounded with 150 mm of concrete grade C16/20. All other pipes shall be sealed by means of 225 mm thick wall of grade C16/20 concrete or engineering bricks in 1:3 cement mortar.

6.50.3 Where pipes are to be filled with grout, they shall be sealed at both ends as above, leaving suitable holes for the grout filling to escape. Grout shall then be pumped in at sufficient pressure to ensure complete filling.

6.51 Interference with Flows

6.51.1 The Contractor shall so organise his work to ensure that the flow of sewage in any existing sewer, channel or drain shall not be obstructed and no sewage or drainage effluent shall be conveyed into new sewers without the Engineer's authorisation.

6.52 Exclusion of Water from Sewers

6.52.1 The Contractor is to ensure the exclusion of surface water and water from other sources from sewers by providing a stopper at the outfall manhole on the outlet side where possible on the site sewerage system and this stopper shall not be removed until the drainage system has been completed and accepted as watertight by the Engineer. Any water that collects in the system before acceptance must be pumped out and any deposits in the sewers removed, all at the expense of the Contractor.

6.53 Water Tightness of Manholes and Chambers

6.53.1 Manholes and chambers shall be substantially watertight, with no identifiable flow of water penetrating the permanent works.

6.54 Testing and Inspection of Drainage Works

6.54.1 The Contractor shall carry out all testing in accordance with the cleansing and testing procedures set out in the Greater Dublin Regional Code of Practice for Drainage Works, the Building Regulations (Part H) and in accordance with the Local Authority requirements or the Irish Water Code of Practice, as appropriate. The Contractor shall provide clean water and all assistance and appliances for testing during the progress of the Contract and for the final testing procedure.

6.54.2 All works shall be inspected, tested and approved as specified before backfilling of excavations are commenced.

6.54.3 The Contractor shall locate and remedy all defects found during testing and shall repeat the test to the satisfaction of the Engineer. The remedying of all defects will be at his own expense.

6.54.4 The Contractor shall ensure that all sections of the drainage system are completely clear of any obstructions, debris and superfluous matter before any tests are applied.

6.54.5 Tests, as necessary, shall be made of sections of pipeline as works proceed to suit the Contractor's programme. Such testing shall not absolve the Contractor from his liability for any defects found during subsequent or final testing.

6.54.6 The Contractor shall give at least three days' notice to the Inspector from the Local Authority and Engineer for all testing so that they can be inspected and signed off.

6.54.7 All test results shall be issued to the Engineer on a weekly basis.

6.55 Air Test

6.55.1 Air test should be carried out for all new private and public drainage pipes in accordance with the

Dublin Regional Code of Practice for Drainage Works.

6.55.2 Public foul sewer pipes should be tested in accordance with the Irish Water Code of Practice for Wastewater Infrastructure.

6.55.3 For an air test expanding plugs shall be moistened and applied to both ends of pipe and lateral connections (no connections should be made to the pipe before the air test is carried out). Air shall then be pumped by bellows or manual pump into the pipe at the lower end until a pressure equal to 100 mm water gauge is recorded on a U-tube at the upper end. Allow 5 minutes for stabilisation of air temperature.

6.55.4 Adjust the test air pressure to achieve 100 mm water gauge.

6.55.5 Without further pumping, the water gauge should not fall by more than 25 mm in a period of 5 minutes.

6.55.6 After the testing period has elapsed, the pressure shall be released from the lower end and this shall be indicated by a fall of pressure in the manometer, proving continuity throughout the pipe.

6.55.7 All drain and sewer lines are to be the subject of an air -test under this contract and the Contractor shall include the cost of same in his rates.

6.56 Water Test

6.56.1 Water test should be carried out in accordance with the Irish Water Code of Practice for Wastewater Infrastructure for foul, and the Dublin Regional Code of Practice for surface water Drainage Works.

6.56.2 For a water test, all outlets shall be plugged and at the top end a plug shall be inserted into the pipe and a pipe connected to the plug to enable a minimum pressure of 1.5 meters head of water to be exerted on the crown of the pipe at the top end.

6.56.3 The testing head of water should not exceed 6m head at the lower end.

6.56.4 After filling the pipework with testing water and ensuring that there are not pockets of entrapped air, fill the standpipe to the requisite level.

6.56.5 Leave for a minimum of 2 hours to enable the pipe to become saturated, topping up as necessary.

6.56.6 This testing water level shall be maintained for 30 minutes with the standpipe being topped up at regular intervals of 5 minutes.

6.56.7 The rate of loss of water should not be greater than 1 litre per hour per metre of pipe run.

6.57 Sewer Survey by Closed Circuit Television (CCTV)

6.57.1 A CCTV survey is required for all new private and public drainage pipes. All lines should be jetted clean prior to CCTV. The Contractor should allow for CCTV of drainage lines at the time of Construction and again at the end of the maintenance period / taking in charge. The Contractor should also allow for CCTV of any existing drainage lines that pass through the site.

6.57.2 When a CCTV survey and associated report is required, the Contractor when necessary shall provide and float lines through the sewers and shall carry out their recovery. The Contractor shall include for the provision of all necessary equipment including cameras, video equipment etc., in order to provide the information required. The inspection shall be by mobile equipment, details of which shall be submitted to the Engineer for his approval.

6.57.3 Where directed by the Engineer, photographs of the interior of each manhole shall be enlarged to half-plate monochrome pictures, dated and stating the manhole number referenced for easy location on the plan and on site.

6.57.4 Where directed by the Engineer photographs of the TV screen showing junctions, pipe joints, faults etc. shall be enlarged to half -plate monochrome pictures, dated and numbered with the position of the vi deo camera indicated, to provide easy reference to its position on plan and on site.

6.57.5 The Contractor shall provide a detailed as constructed topographical survey of the completed drains and sewers indicating the invert level of each pipe at the manholes, the cover level of the manholes and the line and gradient of all pipe work.

6.57.6 The Contractor shall provide a completed SUS25 survey of all sewers to be taken into charge by the Local Authority.

6.57.7 The record of the surveys shall be provided on CD. The CD will be suitably titled to relate the picture to its location on plan and on site and clearly dated and titled.

6.57.8 The Contractor shall include for supplying two fair bound copies and two CD's of the complete surveys, reports, and drawings which are to be provided in AutoCAD format. The written content of the report is to identify the site, the sewer sections between manholes using the manhole numbers on the construction drawings and the precise chainage to locate connections, defects, debris, water level and any other relevant items of note.

6.58 Existing Local Authority Sewers

6.58.1 All Local Authority / Irish Water Sewers which will be affected by the proposed works shall be surveyed by CCTV

(1) before any works commence,

(2) upon completion of the works

(3) at the end of the maintenance period,

All at the expense of the Contractor.

6.59 Petrol Interceptors and Bypass Units

6.59.1 Shall be installed in strict compliance with the manufacturer's instructions and drawing details. The method of installation shall be discussed with the Engineer prior to works commencing.

6.59.2 By-Pass units shall be installed to the size and formation indicated on the drainage drawings and details. The vent pipes shall be independently routed to a suitable position located nearby.

6.59.3 Under no circumstances shall petrol interceptor vent pipes be interconnected below ground.

6.59.4 The pipes shall be interconnected immediately above ground level and be carried up in a common vent pipe whereupon it shall discharge to the atmosphere by means of a return bend.

6.59.5 Manhole covers shall be to BS EN 124 ductile iron, locking and ventilating pattern.

6.59.6 Petrol interceptors and vent pipes shall be as indicated on the drawings.

6.59.7 The Contractor shall provide to the Engineer complete details of the petrol interceptor including O&M Manual prior to installation of the interceptor on site.

6.60 Drainage Channels

6.60.1 Drainage channels and gratings shall be provided to the sizes and in the positions indicated on the drawings. All channels shall be laid to true and even falls and be bedded in concrete, in accordance with the manufacturer's recommendations and standard drawings.

6.60.2 In tarmac areas the concrete shall be levelled off as shown on the detail drawings and the tarmac taken up to the channel block.

6.60.3 The channel shall be laid in straight lines, to the gradient shown, with the grating in place during concreting. The grating level shall be located 3mm below finished surface level. The 3mm shall be taken up by an increase in the surface gradient 1.0m either side of the grating.

6.60.4 Any grating found to be distorted, twisted, not seated level or showing signs of corrosion shall be rejected.

6.61 Land Drainage

6.61.1 All land drainage shall be installed on the centre line of the previously prepared trench, to the sizes, positions and levels indicated on the Drawings.

6.61.2 The drains shall be laid on a granular bed and surround as described elsewhere.

6.61.3 The previously prepared trench shall be lined with a single layer of Terram Type 1000 or similar approved with a 200mm lap joint.

6.61.4 The ‘Terram' shall be of sufficient width to be returned up the sides of the trench and lapped over the granular surround, so as to prevent the ingress of fines or soil particles, a ll as indicated on the drawing. The granular bed and surround shall be laid in full accordance with the appropriate clause of this Specification.

7.0 WATERMAINS

7.1 General

7.1.1 The Contractor shall comply with all national legislation and any relevant Code of Practice as issued by Irish Water, the provisions of which take precedence over this Specification.

7.1.2 Contractors and their employees are expected to be competent in the basic elements of designing and constructing water systems such as water main and service pipe laying; service connections; health and safety; understanding materials selection; regulatory requirements; principles of water supply hygiene; customer care and environmental issues.

7.1.3 This specification refers to watermains up to and including 300mm in diameter.

7.1.4 The Contractor shall submit an as constructed drawing, in hard copy and DXF CAD format within four weeks of completion of the watermain.

7.2 Inspection

7.2.1 The Contractor shall notify the Local Authority / Irish Water Inspector of any works being carried out on the water supply system and shall ensure that all pressure, swabbing, chlorination and bacteriological testing is carried out to the approval of the Local Authority / Irish Water.

7.3 Materials

7.3.1 No materials shall be used without the prior approval of Irish Water. It is the responsibility of the Contractor to ensure that all materials/fittings to be used on the site have been approved for use by Irish Water in writing in advance of work commencing. The Contractor shall submit to the Engineer prior to commencement of any of the works on site a written report setting out all the materials, fixtures and fittings proposed by the Contractor complete with the confirmation by Irish Water of their approval for these materials.

7.3.2 In the event that ground conditions in any part of the site prove to be anything other than inert material, the Contractor shall inform Irish Water accordingly and take whatever precautions are deemed necessary by Irish Water to deal with the situation. These precautions may include, but not be restricted to, the laying of watermains which are specially designed for use in contaminated ground. Such mains shall also be laid in specially designed trenches as approved by Irish Water.

7.4 Pipes and Special Castings

7.4.1 Pipes shall be approved by the Local Authority / Irish Water and shall be only:

MDPE up to and including 300 mm diameter:

Type PE-80 and an SDR rating of 11. They shall conform to IS EN 12201: Part 2:2011 (Plastic Systems for Water Supply, Drainage and Sewerage Under Pressure – Part 2, Pipes) and I.S. EN 12201 - 3:2011 (Plastic Systems for Water Supply, Drainage and Sewerage Under Pressure – Part 3: Fittings).

HPPE and HDPE up to and including 600mm diameter for HPPE up to and including 300mm diameter for HDPE:

Type PE -100 and an SDR rating of 17. They shall conform to IS EN 12201: Part 2:2011 (Plastic Systems for Water Supply, Drainage and Sewerage Under Pres sure – Part 2, Pipes) and I.S. EN 12201 - 3:2011 (Plastic Systems for Water Supply, Drainage and Sewerage Under Pressure – Part 3: Fittings).

Ductile Iron Conforming to Class K9 of EN 545.

All ductile iron pipework shall be coated internally with a centrifugally applied cement mortar lining containing a sulphate resistant cement and shall be sealed with an approved bitumen or epoxy resin seal coat in accordance with BS 4722:2010. External protection shall include a zinc coating to EN545:201 0 under bitumen based coating to BS 3416: 1991.

7.4.2 All plastic water pipes shall be blue in colour.

7.5 Services Pipes & Fittings

7.5.1 The Contractor shall refer to the Mechanical and Electrical Consultants specification for details on acceptable service pipe and fittings arrangements. Each unit shall be provided with a private connection from the main watermain in accordance with the Local Authority requirements. The Contractor shall issue to the Engineer a report setting out in detail all the materials and procedures that are proposed to be used in the tapping and installation of water services pipes prior to commencement of any works on site.

7.6 Boundary Box

7.6.1 The boundary box comprises of a concentric meter box compatible with the Local Authority / Irish Water meters with telescopic body and circular plastic sealed lid complete with isolation valve, non - return valve and push-fit outlets. The minimum depth from lid to the top of the meter is 250mm. The lid and boundary box should have a loading resistance to match their location.

7.6.2 The boundary box may not be practical in all situations, however as a rule, the boundary box must be located in non-trafficked areas and within 225mm of the property boundary.

7.6.3 Contractors shall consult with the Local Authority / Irish Water in relation to approved types of boundary box. The only approved types of boundary box at the moment are the Talbot range and the Atlas range.

7.7 Sluice Valves

7.7.1 Sluice valves shall comply with the Irish Water Code of Practice for Water Infrastructure Specification for sluice valves. They shall be double flanged; ductile iron resilient seal gate valves for use in Water Mains and shall comply with the relevant requirements of EN1074 . The number of turns to open/close the valve must be n=2N + 1 where N = the equivalent diameter in inches. All flanges shall be drilled to P.N. 16. The spindle shall be fitted with a cast iron square

false cap (complete with grub screw) of standard Irish Water pattern.

7.7.2 All sluice valves shall be ANTI -CLOCKWISE CLOSING.

7.8 Hydrants

7.8.1 Hydrants shall comply with the Irish Water Code of Practice for Water Infrastructure. Hydrants shall be manufactured in accordance with the requirements of IS EN 14339, IS EN 1074:Part 6 and BS 750: 2012 , Type 2 and shall incorporate a screw -down valve, underground, “guide in head” type, with bayonet lug outlets and false spindle cap. A contractor may not use hydrants (which are provided for emergency supply) without the written permission of Irish Water .

7.8.2 The hydrant valve shall be CLOCKWISE CLOS ING i.e. the opposite of a sluice valve.

7.8.3 Note: Both sluice valves and hydrants shall be coated with an electrostatic epoxy powder spray, or bitumen – trichloroethylene solution to U.K. National Water Council and Local Authority approval.

7.8.4 Hydrants shall only be located in paths or open space or other approved areas. Where a waterman is located in a road, the hydrant shall be legged into the nearest suitable path.

7.9 Hydrants and Meter Chambers

7.9.1 Chamber floors shall be Grade C25 /30 concrete, 20mm aggregate size, with a minimum thickness of 100mm, with 215mm thick solid block walls. Alternatively, proprietary prefabricated chamber units may be used, subject to the approval of Irish Water.

7.10 Surface Covers

7.10.1 Valves and hydrants when installed shall be covered with approved heavy-duty metal surface covers to I.S EN 124: 1994. These approved metal covers shall conform to the Irish Water Code of Practice for Water Infrastructure Specification for valve and hydrant covers.

7.10.2 Where a chamber is located in grass, the cover shall be surrounded by a 200mm concrete plinth and 100mm deep.

7.11 Hydrant and Valve Indicator Plates

7.11.1 Hydrant indicator plates and baseboards shall comply with B.S. 3251 while sluice valve indicator plates and baseboards shall comply with the Irish Water Code of Practice. They shall be mounted at the boundary of the public thoroughfare nearest to the hydrant or valve.

7.11.2 Marker posts shall be concrete, comply with IS EN206 -1 and be set 450mm deep into concrete base.

7.12 Storage, Handling and Use of Materials

7.12.1 All pipes and fittings shall be stored off the ground in a clean environment to prevent any contamination of materials prior to use. All pipes shall be capped at either end until they are used in the Works to prevent vermin entering them and contaminating these materials before their use.

7.12.2 All fittings supplied in sealed bags shall remain bagged until immediately prior to installation.

7.12.3 Materials and components shall be handled in such a manner as to avoid any damage or contamination and in accordance with all applicable recommendations of the manufacturers.

7.12.4 Pipes and fittings, including any lining or coating, shall be examined for damage before laying. Plastic pipes shall be carefully examined for flaws; particular watch shall be kept for signs of impact damage and scoring. No polyethylene pipe shall be installed with scores or cuts penetrating more than 10% of the wall section. If, after installation, scores or cuts penetrating more than 10% of the wall section are found, the affected lengths of pipe shall be removed.

7.13 Depth and Position of Pipes

7.13.1 All pipe s shall have a minimum depth of cover of 900mm and maximum depth of 1200mm measured from the top of the pipe to the finished ground surface. There shall be a minimum clear horizontal distance of 300mm between the distribution watermain and other utilities, cabinets, poles, junction boxes or chambers. No other service shall be laid above along the line of the watermain. There shall be a minimum vertical clearance of 300mm where other services cross over the watermain. Pipes/ducts, cabinets, poles, junction boxes or chambers shall not be constructed on top of a watermain.

7.14 Trench Width

7.14.1 The trench should be kept as narrow as possible, but must allow adequate room for pipe jointing and placing and compaction of backfill, a width of 300mm greater than the outside diameter of the pipe being laid will normally be found adequate for these purposes. The trench width should normally not exceed the diameter by more than 500mm. A guideline for trench width is shown below.

Diameter of main (mm)	Trench Width (mm)
<80mm	<500mm
100mm	500mm
150mm	600mm
200mm	600mm
250mm	750mm
300mm	750mm
350mm	900mm
400mm	900mm
450mm	90mm

7.14.2 Initial lines in bituminous or concrete roads and footpaths shall be cut using a concrete saw or equivalent mechanical means.

7.15 Thrust Blocks

7.15.1 Appropriate thrust blocks shall be designed and installed on the main and comply with the Irish Water Code of Practice for Water Infrastructure . Except where self -anchoring joints are used,

thrusts from bends and branches in mains shall be resisted by concrete thrust blocks cast in contact with undisturbed ground. Concrete support blocks shall be cast to hydrant tees and sluice valves installed in plastic pipelines in order to resist the torque forces imposed on the fittings during operation. Support blocks shall be cast in such a manner so as not to interfere with the operation or maintenance of the apparatus.

7.15.2 In general, support blocks should not cover any pipe or fitting joints. Plastics pipes shall be wrapped with a layer of plastic sheeting having a composition in accordance with BS 6076 before being surrounded by concrete.

7.15.3 Thrust blocks shall be allowed to develop adequate strength before any internal pressure is applied to the pipeline.

7.16 Warning Mesh

7.16.1 All pipework shall have a 400mm wide water warning mesh, - Plyage HR 40D blue polyethylene warning mesh or similar – laid directly over the centreline of the pipeline and tied to valves, at a depth of 350mm below the finished ground surface. Supply pipes shall have a mesh 200mm wide laid at the same depth.

7.17 Pipe Joints

7.17.1 Pipe joints shall be in accordance with the manufacturer's instructions and will generally be one of the following types:

- Push -in rubber ring joint.
- Bolted flanged joints.
- Flexible couplings, e.g. Viking Johnson couplings with Risan coating, or similar approved types.
- Fusion welded joints. Site fusion jointing shall be carried out strictly in accordance with UK WIS 4-32-08 using equipment to UK WIS 4 -32-16.

7.17.2 All joints shall be made strictly in accordance with the manufacturer's instructions.

7.18 Cleaning Pipes

7.18.1 All pipes shall be examined internally for dirt, stones, or any foreign matter and shall be thoroughly cleaned before laying in final position.

7.18.2 To prevent foreign matter or vermin entering the main as it is being laid, all open ends of laid pipes shall be plugged until the next pipe is ready for insertion.

7.19 Bedding Material

7.19.1 All pipes shall be laid in accordance with the Irish Water Code of Practice for Water Infrastructure. This generally consists of a 150mm min bed of rounded single sized pebble of 10mm nominal diameter and haunched and covered to a depth of 150mm with similar material. Pipes shall not be supported by stone or rock at any point. Rock shall be excavated to a depth of 150mm below the actual depth of trench required and backfilled with DOE Clause 808 prior to

laying the pebble bed.

7.19.2 In ground that contains ash es or chemicals or anything other than inert material, the material to be used and method of laying shall be agreed in writing with Irish Water prior to laying.

7.20 Backfilling Material in or Adjacent to Roadways

7.20.1 All trenches in or near roadways shall be back filled with TII Clause 808, which shall be compacted to Local Authority / Irish Water requirements in layers not exceeding 225mm compacted by hand vibrators. Mechanical compactors should not be used until the total depth of backfill over the pipe exceeds 450mm.

7.21 Location of Other Utility Equipment

7.21.1 Any available records and proprietary cable locators shall be used prior to excavations taking place.

7.21.2 Due diligence shall be used when making excavations for watermains and services and care shall be taken to protect and support all existing services (water, gas, telecommunications, drainage and electricity mains) and other works so as not to interfere with the working arrangement of same.

7.21.3 Any damage shall be made good to the satisfaction of the utility or other authority concerned.

7.22 Desing Criteria

7.22.1 All mains must terminate in a ring or loop of sufficient size to accommodate at least one hydrant (See Standard Details if necessary).

7.22.2 Sluice valves shall always be inserted on branch lines and also as necessary to ensure that no more than 40 properties need be isolated at a time.

7.22.3 The watermain shall be located a minimum of 1m from the boundary of private property.

7.22.4 Watermains shall not be laid under walls or areas designated for trees/shrubs/flowers.

7.22.5 No domestic property shall be more than 46 m from a hydrant. Hydrants serving non -domestic properties shall be subject to the approval of the Fire Officer.

7.22.6 The location of hydrants should be such that they can be accessed in an emergency. Hydrants should not be located in roads or parking areas.

7.22.7 The minimum size of watermain shall be 100mm nominal internal diameter.

7.23 Tests

7.23.1 After the pipes have been laid and jointed, the main shall be tested as per the Irish Water Code of Practice for Water Infrastructure and as outlined below: -.

7.24 Pressure Test

7.24.1 Mains shall be subjected to 10 bar (or 1.5 times its normal working pressure , whichever is the greater pressure) for 1 hour in the presence of a representative of Irish Water. Details of the

testing procedure shall be submitted to the Engineer prior to carrying out the test. Testing shall be carried out between suitably supported blank end pieces. Testing between “live” shut valves will not be accepted.

7.25 Chlorination Test

7.25.1 All mains shall be swabbed and disinfected before being put in to supply. The pipelines shall be disinfected with water having a minimum concentration o f 20mg/l of free available chlorine. This can be achieved using a sodium hypochlorite solution. Many hypochlorite solutions are available on the market, such as Chloros, Eirochlor, Chemchor, Sodium Hypochlorite etc. and these contain 10 – 14 % of available chlorine by weight. These may be purchased in any good chemical supply company.

7.25.2 The recommended dosage of sodium hypochlorite solution is as follows:

Main Diameter	Vol. of sodium hypochlorite per 100m of main	
	10%	14%
100mm	150ml	110ml
150mm	350ml	250ml

7.25.3 Other dosage figures can be extrapolated from these figures.

7.25.4 The chlorinated water shall be left in the main for a period of at least 24 hours. Chlorine residual tests shall be taken at the end of the main furthest from the point of injection. The sterilisation process shall be repeated if the chlorine residual is less than 10mg/l.

7.25.5 The chlorinated water shall be discharged into a foul sewer and never into a surface water sewer or watercourse and shall be subject to the prior approval of Irish Water.

7.26 Bacteriological Test

7.26.1 The main shall then be refilled and a sample of the water shall be taken for Bacteriological Analysis. Great care shall be taken when obtaining samples for testing and only sterile containers shall be used. This sampling shall be carried out in the presence of the Local Authority and Engineer. Samples shall be tested within 6 hours of collection. Water samples must be tested in any approved or accredited laboratory.

7.26.2 The Contractor shall submit a copy of the satisfactory bacteriological test report to the Engineer and to Irish Water for approval.

7.27 Connection to Public Mains

7.27.1 Connections to any live mains, which are the property of the Local Authority / Irish Water may be made by the Local Authority / Irish Water only. No other person shall interfere in any way with these mains.

7.28 Flushing

7.28.1 When mains have been satisfactorily tested and connected by the Local Authority / Irish Water,

they shall be flushed out with potable water through a standpipe placed on the end hydrant before the main is brought into use.

7.29 As Constructed Drawings

7.29.1 The Contractor shall prepare and submit to the Engineer and to the Local Authority / Irish Water accurate as -constructed drawings in both hard copy and DWG or DXF format.

7.30 Health and Safety

7.30.1 A Safety statement prepared in accordance with the Health Safety and Welfare at Work Act 2005 and subsequent regulations must be kept on site at all times.

8.0 ROADS

8.1 Standards and Submission of Materials

8.1.1 As soon as possible after the Contract has been awarded, the Contractor shall submit to the Engineer for his approval a list of his proposed suppliers and sources of materials required for the execution of the Works.

8.1.2 The materials subsequently supplied shall conform to the quality of samples which have been approved by the Engineer.

8.1.3 Names of additional suppliers and sources may be submitted by the Contractor during the execution of the Contract, but no source of supply shall be changed without the Engineer's approval.

8.1.4 All materials, workmanship and tests (where required) shall comply with the appropriate Irish and British Standards, meet the requirements of the Local Authority and the TII Specification for Roadworks and be in accordance with the Drawings and the Specification.

8.2 Storage of Materials

8.2.1 Materials and components shall be stored in such a manner as to preserve their quality and condition to the standards required by the Contract.

8.2.2 The quantity of materials and components stored on the site shall be consistent with that necessary for efficient working.

8.3 Handling and Use of Materials

8.3.1 Materials and components shall be handled in such a manner as to avoid any damage or contamination, and in accordance with all applicable recommendations of the manufacturers.

8.3.2 Unless otherwise described in the Contract, the use, installation, application or fixing of materials and components shall be in accordance with all applicable recommendations of the manufacturers. Where appropriate, the Contractor shall make use of any technical advisory services offered by manufacturers.

8.4 Capping and Sub-Base Materials

8.4.1 Capping material shall be comprised of either crushed rock, natural gravel, crushed gravel (all excluding argillaceous) or crushed concrete. The material shall be in accordance with SR 21 and Class 6F1 or 6F2 as defined in the TII Specification for Road Works Tables 6/1 and 6/2.

8.4.2 Sub-Base material shall comprise of granular material, in accordance with Clause 808 of the TII Specification for Road Works and SR 21. The material shall lie within the grade limits set out in Table 8/6 of the Specification for Roadworks, TII. Certs from the supplier for all imported stone should be provided to the Engineer for review ahead of the works. Particle size distribution should be determined by the washing and sieving method of BS 812: Part 10 3. All material used shall be frost resistant.

8.4.3 CBR's should be provided on top of the capping layer / subbase at every 50 linear metres of roadway.

8.4.4 Pyrite Testing:

All fill material shall be in compliance with I.S.EN 13242:2002 Aggregates for Unbound and Hydraulically Bound Materials for use in Civil Engineering Work and Road Construction and SR21: 2004+A1:2007 Guidance on the use of I.S.EN 13242:2002.

The Contractor shall issue to the Engineer a copy of an up to date Certificate from the stone supplier making reference to the quarry and the date for which the Certificate is relevant. The Contractor shall issue to the Engineer a copy of all delivery dockets for all materials delivered to the site for inspection.

8.5 Testing Requirements

8.5.1 Testing requirements for capping and subbase materials shall be in accordance with the requirements of Table 6/1 of the TII Specification for Road Works.

8.6 Bituminous Base/Binder Course

8.6.1 Dense Macadam Binder course shall comply with Clause 906 and Table 9/1 of the TII Specification for Roadworks for 20mm nominal size crushed rock.

8.7 Surface Course

8.7.1 Surface or Wearing Course shall be approved by the Local Authority. The Surface Course shall be used as shown on the Drawings and shall consist of Dense Macadam Surface Course complying with Clause 909 of the TII Specification for Road Works or Rolled Asphalt Surface Course complying with Clause 910 of the TII Specification for Road Works.

8.7.2 The composition of the Surface Course Mixes shall be in accordance with Table 9/2 of the TII Specification for Road Works.

8.8 Coated Chippings

8.8.1 The chippings and the manner of coating when used for rolling into the surface of rolled asphalt, shall be in accordance with BS594-1 and shall comply with the requirements of Clause 915 of the TII Specification for Road Works.

8.9 Pre-Cast Concrete Kerbing

8.9.1 Kerbs shall be in accordance with the Recommendations for Site Developments for Housing Areas and meet with the requirements of Local Authority. Precast concrete kerbs shall be 250mm by 125m, complying with BS 197-1 and should be laid on a concrete bed and haunch as indicated on the drawings.

8.10 Pre-Cast Concrete Edging

8.10.1 Precast Concrete edging where required shall be as specified on the drawings.

8.11 Paving Slabs, Setts and Cobbles

8.11.1 Paving Slabs, Setts and Cobbles, where required, shall be as specified on the drawings by the Architect / Landscape Architect.

8.11.2 Paving slabs, Setts and Cobbles shall be laid in accordance with the manufacturer's requirements and as per the construction drawings.

8.12 Bedding for Paving Slabs

8.12.1 To be appropriate to the traffic loading and as per the drawings.

8.13 Bituminous Emulsion Tack Coat

8.13.1 Shall be applied in accordance Clause 920 of the TII Specification for Roadworks.

8.14 Water

8.14.1 Water for use with cement shall be of potable quality.

8.15 Aggregates for Concrete

8.15.1 Aggregates for concrete shall comply with the relevant provisions of BS EN 12620 and SR 16.

8.15.2 Marine aggregates may not be used.

8.15.3 The nominal size of aggregate will be 20 mm.

8.16 Sand and Mortar and Grout

8.16.1 Sands for mortar and grout shall be washed sand complying with BS 1200 and graded in accordance with Table 1 of that Standard.

8.17 Cement

8.17.1 Cement shall comply with the provisions of the appropriate Standard, as set out below:

TYPE	
Ordinary Portland	IS EN 197
Sulphate-Resisting Portland	IS EN 197

8.18 Concrete Mixes

8.18.1 Refer to Section 10.0

8.19 Mortar

8.19.1 Shall be 3:1 Sharp sand; Ordinary Portland Cement/Sulphate Resisting Cement.

8.20 Dowel Bars and Tie Bars

8.20.1 Dowel Bars and Tie Bars shall comply with Clause 1011 and Clause 1012 respectively of the TII Specification for Road Works.

8.21 Bond Breaking Compound for Dowel Bars

8.21.1 Bond Breaking compound for Dowel Bars and Tie Bars shall comply with the TII Specification for Road Works.

8.22 Joint Sealing Compound and Sealants

8.22.1 Joint Seals shall comply with Clause 1017 of the TII Specification for Road Works

8.23 Waterproof Membrane

8.23.1 Waterproof membranes shall comply with the TII Specification for Road Works.

8.24 Joint Filler

8.24.1 Joint Fillers shall comply with Clause 1015 of the TII Specification for Road Works.

8.25 Road Marking Materials

8.25.1 Road marking materials shall be:

(i) Thermoplastic material in accordance with BS EN 1824 or BS EN 1871;

or

(ii) Road marking paint. It shall be suitable for applying by brush or mechanical means to concrete or bituminous pavement to give a chemically stable film of uniform thickness.

8.25.2 Where required to be reflectorised, the relevant Clauses of BS EN 1824 or BS EN 1871 shall apply.

8.25.3 The material shall be white or yellow as described in the Contract. Yellow paint shall be standard colour to BS 381C No. 355.

8.26 Ducting

8.26.1 Ducts for cables shall be laid in accordance with the Utility Providers requirements and sh all be in the positions shown on drawings or where directed by the Engineer / M&E Consultant with not less than 600mm cover. Unless otherwise directed, ducts shall be laid to project 1m beyond the edge of the carriageway.

8.26.2 Ducts shall be constructed using clay or synthetic material pipes complying with the following table and of a diameter indicated on the drawing. They shall be provided with a draw -wire cord of not less than 3mm diameter secured to a toggle or crosspiece to prevent accidental withdrawal. All duct ends shall be plugged with a wooden plug.

TYPE	BS
Vitrified Clay	BS 65 or BS EN 295
Unplasticised PVC	BS 4660 or BS EN 1401-1

8.27 Regulating Course (Asphalt Concrete)

8.27.1 The material shall comply with Clause 906 & Table 9/3 of the TII Specification for Roadworks for

20mm nominal size crushed rock with 40/60 pen binder, constructed in layers, where required.

8.28 Lean Mix Concrete

8.28.1 As per section 3.0

8.29 Excavations

8.29.1 When formation/sub -formation level has been reached, the sub-grade shall be inspected and further excavation carried out to remove any soft spots. These shall be filled with General Backfill as Clause Type 6F1 or as directed by the Engineer.

8.29.2 The capping/extra sub-base required where the ground is weak or frost susceptible, shall be Granular Sub -Base Material, or 6F1 as directed by the Engineer, and shall be compacted in layers not exceeding 225 thick with four passes of a 3000kg vibrating roller. Th e sub-grade shall not be left exposed to the weather and shall comply with SR 21.

8.30 Granular Road Base/Sub-Base Materials

8.30.1 Shall be thoroughly compacted in uniform layers with a roller of at least 6 tonnes.

Type of compaction plant	**Category**	**Number of passes for layers not exceeding the following compacted thicknesses**		
		110mm	**150mm**	**225mm**
Smooth-wheeled roller (or vibratory roller operating without vibration)	Mass per metre width of roll: Over 2700 kg up to 5400 kg Over 5400 kg	 16 8	 Unsuitable 16	 Unsuitable Unsuitable
Pneumatic-tyred roller	Mass per wheel: Over 4000 kg up to 6000 kg Over 6000 kg up to 8000 kg Over 8000 kg up to 12000 kg Over 12000 kg	 12 12 10 8	 Unsuitable Unsuitable 16 12	 Unsuitable Unsuitable Unsuitable Unsuitable
Vibratory roller	Mass per metre width of vibrating roller: Over 700 kg up to 1300 kg Over 1300 kg up to 1800 kg Over 1800 kg up to 2300 kg Over 2300 kg up to 2900 kg Over 2900 kg up to 3600 kg Over 3600 kg up to 4300 kg Over 4300 kg up to 5000 kg Over 5000 kg	 16 6 4 3 3 2 2 2	 Unsuitable 16 6 5 5 4 4 3	 Unsuitable Unsuitable 12 11 10 8 7 6
Vibrating-Plate	Mass per square metre of base			

Compactor	plate: Over 1400 kg/m^2 up to 1800 kg/m^2 Over 1800 kg/m^2 up to 2100 kg/m^2 Over 2100 kg/m^2	 8 5 3	 Unsuitable 8 6	 Unsuitable Unsuitable 12
Vibro-Tamper	Mass: Over 50kg up to 65kg Over 65kg up to 75kg Over 75kg	 4 3 2	 8 6 4	 Unsuitable 12 10
Power Rammer	Mass: 100kg – 500kg Over 500kg	 5 5	 8 8	 Unsuitable 12

8.31 Base/Binder Course

8.31.1 Shall be laid with a mechanical spreader/compacter and rolled with an 8/10 tonne smooth wheeled roller or a vibrating roller giving the same effective compaction, to the compacted thicknesses, profile and levels shown on the drawings and in accordance with Clause 906 of the TII Specification for Road works.

8.32 Surface Course

8.32.1 The basecourse, if it has been used by vehicular traffic or where required by the Engineer, shall be thoroughly cleaned and then sprayed with Bitumen Emulsion which shall be applied in accordance with Cl 920 of the TII Specification for Road Works.

8.32.2 The Surface Course shall be laid and rolled to the compacted thickness on carriageway to the finished levels and profile shown on the approved drawings and in accordance with Clause 909 or 91 2 of the TII Specification for Road works.

8.32.3 Where a vibrating roller is used, the final passes shall be with the roller in non -vibrating mode.

8.32.4 Any joints in the surfacing shall be cut back to a vertical line and the vertical face coated with hot bitumen before the laying proceeds.

8.33 Carriageway/Footway Level

8.33.1 Before the Wearing Course is laid, all covers, boxes, etc., shall be accurately set to the correct level and cross falls.

8.34 Pre-Cast Concrete Kerbs and Channel Blocks

8.34.1 Kerbs shall be laid directly onto a 150 thick bed of Grade C16/20 Concrete 150 wider than the kerb on each side and haunched, or

8.34.2 Where a concrete kerb race has been previously constructed, onto a 12mm thick cement mortar bed and haunched with concrete to within 75 mm of the top of the kerb to the lines and

levels shown on the drawings. Purpose made radius kerbs, taper kerbs, crossing kerbs and quadrants complying with the BS shall be used wherever appropriate. Straight kerbs shall be laid to radii above 12m.

8.34.3 Channel blocks shall be laid directly onto 150 thick bed of Grade C16/20 concrete 150 wider than the block and haunched.

8.35 Block Paving

8.35.1 Block paving shall be laid in accordance with the manufacturer's requirements and as per the drawings.

8.36 Footway/Footpath Edging

8.36.1 Shall be laid to line and level as indicated on the drawings and in accordance with Local Authority Requirements for taking in charge.

8.37 Alignments

8.37.1 To Local Authority Requirements for taking in charge.

8.38 Surface Regularity

8.38.1 To Local Authority Requirements for taking in charge.

8.39 Rectification

8.39.1 Where any tolerance is exceeded the Contractor shall make good the surface of the pavement course or formation in the manner described below:

(i) Formation Level

If the surface is too high it shall be r e-trimmed and re -compacted in accordance with the specification. If the surface is too low the deficiency shall be corrected by the addition of fresh suitable material of the same classification laid and compacted to Specification, or as otherwise directed by the Engineer.

(ii) Roadbases and Subbases

Where these consist of unbound material, the top 75 mm shall be scarified, reshaped, with added material as necessary, and re -compacted all to Specification. The area treated shall normally be no less than 30m long and 2m wide or such less length to be determined by the Engineer as necessary to obtain compliance with the Specification.

Where the courses consist of cement treated material, except concrete slabs, the method of correction will depend on the period which has elapsed between detection of the error and the time of mixing of the material. If this is less than 2 hours, the surface shall be scarified to a depth of not less than 50 mm supplemented with freshly mixed material as necessary and re -compacted, all to Specification. If the period is 2 hours or more than full depth of the layer shall be removed from the pavement and replaced to specification. In either case the area treated shall not be less than 5 m long by 2 m wide. For areas corrected within 7 days of laying, no

construction traffic or compaction plant shall use the surrounding satisfactory areas.

8.40 Use of Surfaces by Construction Traffic

8.40.1 Construction traffic used on pavements under construction shall be suitable in relation to the thickness of the courses it traverses so that damage is not caused to the subgrade or the material already constructed.

8.40.2 The wheels or tracks of plant moving over the various pavement courses shall be kept free from deleterious materials.

8.40.3 Bituminous material shall be kept clean and uncontaminated for so long as it remains uncovered by succeeding layers or surface treatment. The only traffic permitted access to the basecourse material shall be that engaged in laying and compacting the wearing course or, where the basecourse is to be blinded and/or surface dressed that engaged on such surface treatment.

8.40.4 Should the basecourse become contaminated, the Contractor shall make good by cleaning it to the satisfaction of the Engineer and if this proves impracticable, by removing the layer and replacing it to Specification.

8.41 Road Markings

8.41.1 Road markings shall be applied as indicated on the drawings and to Local Authority Requirements for taking in charge.

8.42 Traffic Signs

8.42.1 Traffic Signs shall be as shown on the drawings in accordance with the Traffic Signs Manual and shall be installed as per the TII Specification for Road Works.

8.43 Road Markings and Studs

8.43.1 Permanent Markings

The locations and details of permanent road markings are indicated on the contract drawings. Permanent road markings shall be of white or yellow or other colour indicated on the Drawings, thermoplastic screed material complying with BS 3262:Parts 1 -3:198 9, Class A, unless otherwise shown on the drawings. Road markings shall be reflectorised in accordance with Clause 1212.3 and BS 3262: Parts 1 -3:1989.

8.43.2 Temporary Markings

Any temporary road markings which may be required due to the wearing course on any carriageway being constructed at a later date shall be the responsibility of the Contractor to install to the satisfaction of the Engineer. However, the likely minimum requirement will be markings of a similar disposition to the permanent road markings. The materials used for such markings shall be suitable for the time span that the road will be open to traffic prior to laying the final road course(s).

8.43.3 Removal or Concealment of Road Markings

Permanent obliteration

Where existing road markings are to be permanently obliterated, they shall be completely removed by hot air jet blasting or other approved method. Obliteration of road markings using either bituminous or resinous paint shall not be permitted.

Temporary obliteration

Where existing road markings are to be temporarily obliterated for traffic management or any other purpose the markings shall be completely covered by black tape or covering which shall be able to withstand the traffic load upon it for the required period. Upon removal of the black tape or covering the original markings are to be upgraded to the standard apparent before the temporary obliteration.

9.0 CONCRETE

9.1 General

9.1.1 All materials, workmanship and tests (where required) shall comply with the appropriate Eurocodes, British Standard, the National Building Regulations, the Bye Laws of the Local Authority and be in accordance with the drawings and this specification all in accordance with the Contract.

9.1.2 The use of additives or other chemicals is generally not permitted unless specific approval is obtained from the Engineer in writing.

9.2 Aggregates

9.2.1 Aggregates shall not be used containing materials that are deleteriously reactive with alkalis in cement in an amount sufficient to cause excessive and damaging expansion of mortar or concrete. In particular, aggregates are to comply with the conditions of BS EN 12620:2002.

9.2.2 Marine Aggregates (sea dredged) are not permitted.

9.3 Reinforcement

9.3.1 Reinforcement is to be bent, supplied and fixed in accordance with BS 4449, BS 4482 or BS 4483 and BS EN 1992 -1-1:2004.

9.4 Formwork

9.4.1 All formwork and its supports shall be sufficiently strong and rigid to carry and maintain the concrete for construction traffic, so that the shape of the completed structure is as shown on the drawings. All formwork shall be sufficiently rigid and tight to prevent loss of grout from the concrete.

9.4.2 Props must be placed vertically over other props or onto surfaces sufficiently strong to carry the load without causing unacceptable deflection, damage or ground movement.

9.4.3 Minimum striking times are to be in accordance with BS EN 1992.

9.5 Mixing Concrete

9.5.1 The concrete shall be mixed in machines for at least two minutes, but not less than that recommended by the manufacturer of the mixer.

9.5.2 The quantities of cement and aggregates shall be measured by weight and every mixing machine shall be equipped with an accurate measuring device for water. Water is not to be added after the concrete has left the mixer.

9.5.3 Where ready mixed concrete is proposed, details of the supplier must be submitted to the Engineer and approval obtained prior to commencing concrete work on site.

9.5.4 Concrete mix design sheets are to be submitted by the Contractor prior to commencing work and the slump of each mix is to be detailed. In the case of prepacked dry mixes, the supplier's name

is to be stated.

9.5.5 Minimum cement contents are to be in accordance with the following table:

Mix Ref.	Grade (cylinder strength : cube strength	Normal Maximum Size of Aggregate	Cement Type	Minimum Cement Content	Maximum Free Water Cement Ratio	Typical Use
A	C28/35	20	SRC	300	0.55	RC foundations and structure below ground including ground slabs, kerbs and footpaths
B	C25/30	20	SRC	290	=	RC beams, columns, wall and slabs.
C	C16/20	20	SRC	220	=	Mass concrete foundations, manhole foundations, bedding, haunch, concrete surround
D	C12/15	20	SRC	220	=	Mass concrete fill.

Note: The maximum cement content of 550 kg/m3 must not be exceeded.

TABLE 10.1: MINIMUM CEMENT CONTENT OF CONCRETE MIX STRENGTHS

9.5.6 No mix must be used on site unless the mix concerned has been tested and thereafter sanctioned by the Engineer.

9.5.7 All testing shall be carried out by an independent laboratory approved by the Engineer and appointed by the Contractor. The Contractor shall submit test reports to the Engineer direct.

9.5.8 Cubes shall be made and cured in accordance with BS 1881. A minimum of 4 cubes is to be taken per pour. 2 are to be crushed at 7 days plus 2 are to be crushed at 28 days.

10.0 CERTIFICATION AND TESTING

10.1 General

10.1.1 Outlined below is a non-exhaustive list of the principle materials for which certification is required, together with a non-exhaustive summary of the principle testing to be undertaken as part of the works.

10.2 Roads

Work Element	Criteria / Spec / Cert	Testing / inspection Requirements	Frequency of Testing / Inspection	Specification Reference	Document Reference
Setting Out		Get contractor to confirm station points and check some coords and levels of surveyed stationary objects	Once Off	2.8	
Subgrade Strength	Concrete's	Below 5 – refer to Capping/Sub-base Table	Every 50/100m depending on ground conditions	7.3, 7.5	
Capping	Class 6F1/6F2 and CI808 to Table 6/1 and 6/2 of TII specification for roadworks	Check delivery dockets, measure depth, compaction and location of capping	Check when on site CBR Testing	7.5	Table 6/1 TII Specification for Road Works, SR 21
Sub-base	Class 6F1/6F2 and CI8008	Check sockets EN 13285:2003/SR 21 Quarry	Fortnightly Check of dockets CBR Testing	7.5, 7.31	Table 6/1 and 6/2 of TII specification for Road Works, SR 21.
Bituminous	DBM, CI 906	Check delivery dockets, check temp of bituminous base	Check when on site	7.7	Tabel 9/1 of TII specification for roadworks
Binder	DBM, CL 903,	Check delivery	Check when on site	7.7, 7.32	CI 903, CL

Base	CI 906	dockets, check temp of blacktop			906 of TII specification for road works.
Setting Out & Built Levels	CL 909, CI 910	Contractor to pick up some levels (minus wearing course)	Once off	2.8, 2.11	
Surface Course	HRA	Check delivery dockets, check temp of blacktop	Check when on site	7.8, 7.33	CI 909, CI 910, CL 912 of TII specification for road works.
Setting Out & Built Levels		Contractor to pick up some final as built levels	After final construction	2.8, 2.11	
Inspect Finish		Inspect a few days after construction during wet weather for ponding	Once off	2.9	

10.3 Footpaths

Work Element	Criteria / Spec / Cert	Testing/inspection Requirements	Frequency of Testing / Inspection	Specification Reference	Document Reference
Setting Out		Get contractor to confirm station points and check some co-ords and levels of surveyed stationary objects	Once Off	2.8	
Sub-base	CI8008	Check sockets EN 13285:2003/SR 21 Quarry	Fortnightly Check of dockets CBR Testing	7.5	CL 808 TII specification for road works.
Concrete	C28/35	Check dockets, cube tests,	Check when on site, 4 cube per	8.5 8.6	

		ensure depth on site, 150mm at vehicle crossover.	pour		
Black-top					
Inspect Finish		Brush finish joints	Once off		

10.4 Kerbs

Work Element	Criteria/Spec/ Cert	Testing/inspection Requirements	Frequency of Testing/Inspection	Specification Reference	Document Reference
Base Kerb	C28/35 Concrete	Check dockets, cube tests, measure depth on site	Check when on site, 4 cube per pour	7.10, 7.35, 9.3	Recommendations for Site Developments for Housing areas.
Full Kerb	C28/35 Concrete	Check dockets, cube tests, measure depth on site	Check when on site, 4 cube per pour	7.10, 7.35, 9.3	Recommendations for Site Developments for Housing areas.
Inspect Finish		Measure height, Inspect for construction vehicle damage	Once off		

10.5 Private Drainage

Work Element	Criteria / Spec / Cert	Testing/inspection Requirements	Frequency of Testing/Inspection	Specification Reference	Document Reference
Pipes and Inspection Chambers	Building Regs. Manufacturer Spec	Inspection Plan, SR 21 Quarry	Once off check of spec sheets	5.24, 5.46	Greater Dublin Regional Code of Practice for Drainage Works

Granular Bedding	Washed Pea Gravel	Inspection Plan, 16mm and retained by 4.75mm sieve	Check when on site and delivery docs	5.13	SR 21 Annex A
Bed / Haunch / Surround	Building Regs	Check dockets, Cube tests, Measure depth on site	Check when on site, 4 cube per pour	5.5	Greater Dublin Regional Code of Practice for Drainage Works
Concrete Foundations & Surround for Manholes	30N	Check dockets, Cube tests, Measure depth on site	Check when on site, 4 cube per pour	5.13	Greater Dublin Regional Code of Practice for Drainage Works
Fill for pipes in open space	Suitably selected excavated material ?	Check on site, Compaction	When on site	5.13	SR 21 Annex A
Air Tests	Moylan Engineer to witness sample tests	Tested to 100mm air pressure for 5 mins. Max drop in pressure allowed is 25mm. Test before connections / gullies	Every pipe length requires testing	.5.3	Greater Dublin Regional Code of Practice for Drainage Works
Inspection Chamber Sign Off Sheets	Moylan Engineer to sign off Inspection Chambers	Building Regs	Every manhole requires signing off		
CCTV	Check for defects	Issue report to Contractor following review of CCTV	When laid and within 6 months before TIC	5.55	SUS 25 Survey

As Built	CL's IL's and EIL's and pipe sizes.	CAD format	Once off at end, Review as built info on an on-going basis		

10.6 Watermain

Work Element	Criteria / Spec / Cert	Testing/inspection Requirements	Frequency of Testing/Inspection	Specification Reference	Document Reference
Pipe Material	Co Co taken in charge:- MOPVC, HPPE, HDPE, MDPE, DI	Require material spec sheets	Once off	6.3	BS5750 Part 2 (EN29002), IS EN 112201-Part 2:2003 BS 4722:1998
Pipe Bedding and Surround	Washed Pea Gravel	5-10mm pea gravel	Check when on site and delivery docs	6.19	
Fill for pipes under roads / footpaths	CL 808	Check dockets EN 13285:2003 / SR21, Quarry	Fortnightly Check of dockets	6.20	CI 808 TII specification for road works.
Fill for pipes in open space	CL 808	Check dockets EN 13285:2003 / SR21, Quarry	Fortnightly Check of dockets	6.20	CI 808 TII specification for road works.
Pressure Test	10batr for 1 hour	Water services inspector to witness / carry out	Need to do short pieces of pipe at a time	6.23	
Chlorination & Bacteriological Test	Residual chlorine to be less than 20mg/l. Lab testing	Water services Inspector to witness / carry out	Need to do short pieces of pipe at a time	6.23	
As built	To SDCC requirements for TIC	CAD format	Once off at end. Review as-built info on an on-going basis	6.26	
Valve / Meter	Clockwise or Anticlockwise	Inspect valves, inspect chamber	Once off during snagging		

Inspection	closing				

10.7 Utilities

Work Element	Criteria / Spec / Cert	Testing/inspection Requirements	Frequency of Testing/Inspection	Specification Reference	Document Reference
Pipe bedding and surround	Washed Pea Gravel or Utility Provider Requirements	5-10mm pea gravel	Check when on site and delivery dockets		
Fill for pipes under roads / footpaths	CL 808 or Utility Provider Requirements	Check dockets EN 13285:2003 / SR21, Quarry	Fortnightly Check of dockets		CI 808 TII specification for road works.
Fill for pipes in open space	CL 808 or Utility Provider Requirements	Check on site, Compaction	When on site		CI 808 TII specification for road works.
Adequate Cover	Utility Provider Requirements	Water services inspector to witness / carry out	When on site		
As Built	Check against utility design	CAD format	Once off at end. Review as-built info on an ongoing basis.		
Chamber Inspection	Utility Provider Requirements	Inspect valves, inspect chamber	Once off during snagging.		