

PLACE
+
Urbanism

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VOLUME A1.1 – CIVIL STRUCTURAL SPECIFICATION

TIPPERARY COUNTY COUNCIL

**Wastewater Treatment Plant & Process Water Storage Works
at Lisheen Mine,
Lisheen, Co. Tipperary**

Revision	Date	Comment (<i>project specific revision</i>)
T1	20.11.2025	Tender Issue

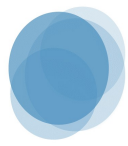
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(C.Eng./ Project Director)

CONTENTS:

Section	Title
S4	Site Works



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S4: Specification of Siteworks

SPECIFICATION FOR SITEWORKS

PREAMBLE

- 1 The Specification for Site Works is based on "The Specification for Road Works" published by the National Roads Authority and extended by any Clauses or Sub-Clauses referred to below.
- 2 The sections to be adopted for this siteworks specification are all sections as per the master document "The Specification for Road Works" with additions as follows:

Series	100	-	General
	200	-	Site Clearance
	500	-	Drainage & Service Ducts
	600	-	Earthworks
	800	-	Sub-bases and Road-bases

SERIES 100

General Clauses

100 OPERATIVES FOR THE ENGINEER'S STAFF

- 100.1** The Contractor shall supply the Engineer, free of expense, with all poles; pegs; templates; labour and other things necessary for measuring up or checking the Works. The Contractor shall provide men equal to the tasks required and maintain continuity of staff.

101 NOISE CONTROL

- 101.1** The Contractor shall employ the best practical means to minimise noise produced by his operations, including plant maintenance, and shall comply with the recommendations in BS 5228: Part 1: 1997 (Noise and Vibration Control on Construction and Open Sites).
- 101.2** All vehicles and mechanical plant used on the Works shall comply with requirements of BS 5228: Part 1: 1997.
- 101.3** Sound levels shall be monitored by methods set out in Appendix E of BS 5228: Part 1: 1997.
- 101.4** Any plant such as generators and pumps that are required to work outside the hours of 08.00 - 19.00 shall be placed in an acoustic enclosure to the approval of the engineer. The resultant noise level of all such sources on site shall be at least 5dB(A) below the existing background noise level.
- 101.5** The Contractor shall organise his operations with regard to the positioning of plant and the location of haul routes, etc., so it minimises construction noise to adjacent properties.
- 101.6** Piling including temporary piling shall be carried out by recognised noise reduced systems. General guidance should be taken from BS 5228: 1992 (Noise control on construction and open sites - Part 4. Code of Practice for noise and vibration control applicable to piling operations).
- 101.7** The period referred to as 'night' in Clause 45 of the Conditions of Contract shall be from 19.00 hours to 08.00 hours.
- 101.8** The Contractor shall ensure that at all properties outside the site boundaries, the sound levels arising from activities, do not exceed the following volumes:-

	Leq (1 hour) dB(A)	Peak dB(A)
Mon. - Fri. (08.00 - 19.00)	75	85
Mon. - Fri. (19.00 - 22.00)	60	65
Saturdays (08.00 - 16.30)	70	80

Sundays & Bank Holidays (09.00 - 16.00)

60

65

101.9 At all other times, the sound level of 50 dB(A) L10 (18 hour) and a maximum noise level of 55 dB(A) must not be exceeded unless the existing ambient noise levels are higher.

101.10 Compliance with sub-Clauses of this Clause does not confer immunity from relevant legal requirements.

102 PROGRESS MEETINGS

102.1 The Contractor, or a responsible official from his organization, shall attend progress meetings which will be held at the discretion of the Engineer. The Contractor shall inform such Sub-Contractors and Suppliers as are necessary that their attendance at progress meetings shall be required. All tendered prices shall allow for attendance on site by the Contractor or any of his Sub-Contractors.

103 TRESPASS

103.1 The Contractor shall take adequate precautions to prevent trespass on or interference with adjoining properties by employees or by Sub-Contractors' employees.

104 CONTRACTORS PROGRAMME

104.1 Prior to the commencement of the works, the Contractor shall prepare and agree with the Engineer a detailed programme for the execution of the component activities of the works so as to achieve contract completion within the construction period.

He shall complete all the works in an orderly, expeditious and workmanlike manner in accordance with the drawings and the specification.

105 REMOVAL OF RUBBISH

105.1 The Contractor is to remove all surplus materials as they accumulate during the execution of the work and to leave the whole of the lands, roads, streets, etc, underfaced at the completion and to the satisfaction of the Engineer.

105.2 The Contractor shall keep all roads adjoining the site clear of spoil arising from the site.

105.3 All public and private roads which are being used by the Contractor, Sub-Contractors or supplies vehicles for the construction of the works shall be kept clean and free of dirt and mud arising from the works.

105.4 The Contractor shall take all reasonable measures, which shall include the provision and use of adequate water spraying equipment to minimise dust nuisance.

106 SITE OFFICES

106.1 All site offices, stores etc required for execution of the works shall be located in the "extent of contract" area shown on drawing.

107 HOURS OF WORKING

107.1 Works other than pumping from excavations, watching or emergency work necessitated for the safety of the works, shall not be executed outside normal working hours. Normal working hours are defined in this instance as from 08.00 to 19.00 hours, Monday to Friday and 08.00 to 16.30 hours on Saturday.

107.2 The Contractor shall seek the written permission of the Engineer to carry out shift work. Such permission should be sought by the Contractor at least 7 days before his proposed commencement date for shift work. The Contractor shall not commence shift work without the written permission of the Engineer, which permission may be withdrawn at any time.

The same proviso shall apply for night and Sunday work. In cases where overtime and shift work are approved, the carting of spoil and deliveries of materials to the works shall be prohibited outside normal working hours. Furthermore, the noise restrictions given in Clause 112 (Noise Control) shall apply at all times.

108 PLANT AND MACHINERY

108.1 The contractor shall submit, post Tender, a list of all the plant proposed for use for the satisfactory execution of the works.

109 MATERIALS AND WORKMANSHIP

109.1 The Contractor shall provide everything necessary for the proper execution of the works according to the true intent and meaning of the Specification and drawings, provided same is reasonably to be inferred therefrom including all diesel fuels, sleeve pipes, packing materials.

The Contractor shall keep a competent Foreman on the contract works at all times when work is being done in connection with the Contract. The Foreman shall be authorised to receive instructions on behalf of the Contractor.

Nothing in this Specification shall be construed to relieve the Contractor from making good and perfect in all details the construction nor shall the omission of any detail absolve him from his liability in this respect.

110 SETTING OUT THE WORKS

- 110.1** Before the commencement of the Works the Contractor will be supplied with the information necessary to establish the lines and levels of the Works. The Contractor shall establish reference pegs and temporary bench marks of approved design in, locations appropriate for setting out and checking the Works. All reference pegs shall be carefully preserved except where construction requires their removal, and before such removal the approval of the Engineer shall be obtained.

All levels will be to Ordnance Datum Malin Head unless noted otherwise and the Contractor shall set up a T.B.M. on site with the O.D. clearly marked on it.

The Contractor shall, as soon as practicable, supply the Engineer with records in approved form relating to all reference pegs and temporary bench marks and shall keep such records up to date by formal notice to the Engineer.

The Contractor shall protect all triangulation stations from damage during the course of the Works. If the Contractor displaces or otherwise damages an ordinance survey station the Contractor shall engage at his own expense the ordinance survey office, (or an alternative surveying contractor of equivalent expertise and acceptable to the Engineer) to reinstate the marker at its original location. Should the Contractor displace or otherwise damage the survey stations, the Contractor shall be liable for the cost of reinstatement of the triangulation station, and this sum shall be deducted from the final account payable to the Contractor.

111 CONTRACTOR RESPONSIBLE FOR CARRYING OUT THE ENTIRE CONTRACT

- 111.1** The Contractor shall be and shall continue to be, until the works are handed over to the Employer, solely and absolutely responsible for carrying out all the works as well as for all injury or damage to the said works, or any part thereof, or to any persons, any livestock, or property of any description whatever which may be caused by or result from the execution of the works, whether they have been carried out skilfully and carefully and strictly in conformity with the provisions of this Specification or not.

- 111.2** The Contractor will be responsible for the adequacy, stability and safety of all site operations and methods of construction (except the permanent works design and specification) which shall be in accordance with relevant health and safety procedures and current legislation.

112 OWNERSHIP OF MATERIALS

- 112.1** Materials and things excavated, cut down or removed in the course of any operation arising out of this Contract whether on public or private property shall generally become the property of the Contractor. All such materials which are surplus to or unsuitable for use in the works shall be disposed of by the Contractor either off the site or if agreed by the Engineer, on the site in an approved manner.

113 SOCIAL WELFARE REGULATIONS

- 113.1** By law, Employers in the construction industry must register with the Department of Social Welfare all employees whose employment commences on or after the 1st January, 1989 or the engagement of sub-contractors whose employment commences on or after the 1st January, 1990.

A sub-contractor is also legally bound to notify the Department of Social Welfare of any person engaged to perform any service either with him or on his behalf whether under a contract or any arrangement made or to be made by him.

All notifications must be sent to the Department of Social Welfare within one month of the new employee, sub-contractor or other person being taken on.

Social Welfare (Notification by Employees of Commencement of Employment) Regulations, 1988: (S.I. 296 of 1988).

Social Welfare (Commencement of Employment) Regulations 1989: (S.I. 339 of 1989).

114 OFFENSIVE FUMES

- 114.1** All statutory regulations in relation to exhaust emissions from plant shall be adhered to. Any plant emitting offensive fumes will be stopped immediately. No claims will be entertained for aforementioned stoppages.

115 INTERNATIONAL AND NATIONAL STANDARDS

- 115.1** Nothing stated in this Specification is to be construed as discriminating against products and materials manufactured in any of the Member States of the European Community. Where items to an Irish Standard Specification, a British Standard Specification, or any other standard specification of a Member State of the European Community are called for, this requirement shall be read as including items to a national standard of any Member State of the European Community which provides an equivalent guarantee of safety and suitability.

Where items certified by the National Standards Authority of Ireland as complying with an Irish Standard are called for, the provisions of Circular Letter BC 14/92 shall apply, i.e. the requirement shall be read as either certified by the National Standards Authority of Ireland as complying with the Irish Standard Specification and shall bear the Irish Standard Mark or shall be certified as complying with a national standard of another Member State of the European Community, which provides an equivalent guarantee of safety and suitability - certification by the National Standards Authority of Ireland.

116 HISTORICAL FINDS

- 116.1** During excavation and site clearing, the foreman and workmen shall watch out for objects that may be of archaeological or historical interest. All such articles whether coins, pottery, fossils, tools, utensils, weapons, bones, urns, vases, stone lined graves or the like shall be considered the property of the Local Authority.

The position of any such object in the strata should be specifically noted on discovery and marked on the layout plan. On any find being made, an immediate message shall be sent to the Engineer to that effect and the find shall not be disturbed until written instructions are given as to its disposal.

117 DEMOLITION

- 117.1** Before commencing any demolition works, the Contractor shall satisfy the Engineer with respect to:
- (a) The order and procedure for carrying out the Works.
 - (b) That this insurances are in order.
 - (c) That the personnel are experienced in this type of work.
 - (d) That the work shall comply with BS 6187 Code of Practice for Demolition.

118 IONISING RADIATION

- 118.1** Nuclear gauges or other sources of ionising radiations shall be used only where permitted or required by the engineer.

The Contractor shall advise the Engineer of his designated >radiation protection adviser= and provide the Engineer with a copy of the Contractor=s > local rules =covering the use of nuclear gauges or other sources of ionising radiation; these expressions having the meaning given in the Ionising Radiations Regulations 1985.

119 As-Built Drawings

- 119.1** The routes of any existing and as installed underground drainage / services are to be recorded by the contractor and are to be shown on as-built site plans. The contractor shall supply all as-built drawings to the engineer at the conclusion of the project as part of the BCaR submission.

SERIES 200

SITE CLEARANCE

200 CLEARING

- 200.1** Excluding items specifically mentioned in the Bill of Quantities, all materials arising from site clearance that are surplus or unsuitable for use in works shall become the property of the Contractor and shall be disposed of by him either off the site to his tip or if agreed by the Engineer on the site in an approved manner. The Contractor shall advise the Engineer in writing as to the location of his tip prior to the removal of material from site.
- 200.2** All demolition shall be carried out by workmen skilled in such work and shall be in accordance with BS 6187 (1982).
- 200.3** Where the line of an existing fence, hedge or wall is cut by the site boundary the severance shall be made good unless otherwise described in the Contract; either by the continuation of the fence, hedge, or wall in a different direction or by its termination at the boundary and tied into the new boundary. In the case of a strained wire or chain-link fence a straining post shall be installed, unless otherwise directed and the fence restrained.

201 EXISTING TREE STUMPS AND ROOTS

- 201.1** Where shown on the Drawings or directed by the Engineer trees shall be uprooted or cut down as near to ground level as possible. All felled timber shall be removed from the site.
- 201.2** Stumps and tree roots shall be grubbed up and deposited off the site in dumps to be provided by the Contractor. Holes left by the stumps or roots shall within one week be filled with suitable material as in defined in Cl 601 of " The Specification for Road Works " and compacted in accordance with Cl. 609 of " The Specification for Road Works ".
- 201.3** Where it is necessary to cut branches from trees that are to be preserved, the lopped ends so exposed shall receive an application of an approved sealant.
- 201.4** Blasting for Site Clearance shall not be employed

SERIES 500

DRAINAGE & SERVICE DUCTS

500 TYPE OF PIPELINE**500.1 Pressure Pipes**

Plastic pipes (UPVC, HDPE or MDPE) shall comply with BS3505 and BS 6572 as appropriate and if conveying portable water shall be coloured blue.

Ductile iron pipes, fittings and joints shall comply with the relevant provisions of BS EN 545: 1995 and BS EN 598 : 1995.

500.2 Pipes for Watermain shall comply with Clause 1734.**501 EXCAVATION FOR PIPELINES AND DRAINAGE STRUCTURES**

501.1 Trenches in rock for pipes up to 100mm normal bore shall be excavated to provide a minimum clearance of 100mm around the outside of pipe barrels and joints. For pipes with nominal bore exceeding 100mm, the minimum clearance shall be increased to 150mm, the minimum clearance shall be increased to 150mm for flexible pipelines and to 200mm for rigid pipelines.

501.2 In excavating for pipe and culverts in or adjacent to existing stream beds, the contractor shall provide for all difficulties due to water flow and ground water ingress to the excavations, including all damming, pumping, etc. Culverts crossing the carriageway coincide with ditches or watercourses; the rate for constructing piped culverts shall include for all difficulties associated with these ditches including the continuation of flow in the stream.

502 BEDDING, LAYING & SURROUNDING OF PIPES

502.1 Each pipe shall be carefully examined on arrival, any defective pipes shall not be used and shall be segregated and marked in a conspicuous manner.

Drains shall be laid in straight lines and to even gradients as shown on the drawings. Care shall be exercised in setting out and determining the levels of the pipes and the contractor shall provide suitable instruments and set up and maintain all sight rails, boning rods and bench marks, etc., necessary for the purpose.

All drains shall be kept free from earth, debris, surplus jointing materials and other obstruction during laying and until the completion of the works when they shall be handed over in a clean condition.

Drain laying will generally proceed from the downstream end and pipes shall be laid with the sockets leaning uphill and shall rest on solid and even foundation for the full length of the barrel. Socket holes shall be formed in the foundations as short as practicable but sufficiently deep to allow the pipe jointer room to work right round the pipe.

- 502.2** Plastic pipes shall be wrapped with a layer of plastic sheeting, 125um thick before being surrounded by concrete.

503 JOINTING OF PIPES

503.1 Joints in pressure pipes

Plastic pipes shall have mechanical, socket welded or fusion welded joints and be jointed in accordance with manufacturers instructions.

Flange adaptors, where required for connection to metal pipes, shall be fusion welded unless otherwise directed by the Engineer.

Ductile iron pipes shall have flanged or push fit joints and be jointed in accordance with the manufacturers instructions.

504 MANHOLES, CATCHPITS, INSPECTION CHAMBERS AND DRAW PITS.

504.1 In-Situ Concrete Manholes

In-situ Concrete Manholes, chambers and outfall works shall be constructed to the locations, levels, dimensions and construction details shown in the Contract Documents.

In-situ manhole walls shall be constructed of Grade 30/20 mass concrete, reinforced concrete or solid concrete blocks, fair faced internally, free from honeycombing, and of a high standard of surface finish. Manholes shall be constructed on a concrete Grade 30/20 foundation slab.

The walls shall be brought up vertically to receive a roofing slab formed of concrete Grade 30/20 reinforced in accordance with the Drawings and Specification for Structural Concrete.

In-Situ Manhole Channels, bends and junctions shall be formed from half-round pipe sections with close butt joints bedded on the base and pointed flush with 3:1 sand-cement mortar. All concrete work shall be carried out in accordance with Clauses in "Specification for Structure Concrete for Highway Works. All manholes shall be watertight on completion, to the satisfaction of the Engineer

504.2 Where the depth to invert of chambers exceeds 900mm below the finished surface of the carriageway or the adjacent ground, step-iron steps complying with BS 1247 and shall be built in as specified in BS 5911: Part 1. Steelwork used for ladders, handholds and other fittings shall comply with BS970 and be galvanised in compliance with BS 729 after fabrication.

504.3 Foundation slabs for precast manholes shall be cast in concrete Grade 20/20 to the dimensions shown on the drawings. The top surface of the slab is to be grooved at the time of casting to receive the lowest precast segment. Certificates of compliance with BS 5911 including test results shall be submitted to the Engineer for his approval covering all deliveries of precast units.

Precast concrete manholes, catchpits and inspection chambers shall comply with the requirements of BS 5911: Part 1 except for any special requirements for cement described in the Contract.

The relevant absorption tests required by BS 5911: Part 1 shall be carried out on materials from 1 section in every 50 of those required under the Contract.

Precast units shall be free of all significant damage or defects on delivery, and shall be stored and handled so as to avoid subsequent damage and excessive strain.

Protective slings and timber protective pieces shall be used where necessary in all handling operations. Damaged and defective units shall be immediately removed from site when so directed by the Engineer.

All precast units shall be bedded onto the top surface of the base or on to the next lower unit in Class 1 mortar. The mortar shall be made to a moderately stiff consistency and placed over the full lower face of the joint. The unit shall be brought into place and lowered vertically on the mortar and gently tapped or vibrated so as to evenly compress the mortar over the full joint face and so as to eliminate voids in the mortar. After plumbing in position the units shall be kept undisturbed until the mortar has hardened. Both faces of the joint being formed shall be dampened before joint formation to promote adhesion. Precast units shall be aligned on placing so as to provide the proper locations for step irons and manhole access. Internal mortar shall be struck flush and finished with metal trowel finish.

505 Gullies and Pipe Junctions

505.1 Gullies and Frames

1 Precast concrete gullies shall be un-reinforced and conform with BS 5911 Part 230 (1992).

- 2 Clayware gullies shall comply with the requirements for round street gullies of BS65.
- 3 Cast iron gullies shall be manufactured from either grey iron or ductile iron and shall conform with the requirements of BS EN 124 (1994).
- 4 Gullies made of polypropylene, polyethylene, UPVC or other approved plastic materials of a pattern approved by the Engineer shall be permitted when used as permanent formwork to an insitu concrete gully as described in Clause 508.
- 5 Cast iron and cast steel gully gratings, cast iron kerb type gully covers and cast iron frames shall comply with the requirements of BS EN 124(1994). Prefabricated steel or bolted steel gratings shall be as described in the Contract.

506 TESTING AND CLEANING

506.1 Testing - Sewers

Testing shall be carried out from manhole to manhole. Testing shall follow immediately after pipelaying and in no circumstances will pipelaying be permitted in excess of 300 metres ahead of a satisfactory leakage test.

Short branch drains connected to a main sewer between manholes shall be tested as one system with the main sewer. Long branches shall be tested separately.

Pipes not exceeding 750 mm nominal internal diameter shall be tested in one of the following ways:

1. Water Test

A test pressure of 1.2 metres head of water above the soffit of the sewer shall be applied at the high end by means of a standpipe. The length of the section under test shall be such that the head at the lower end does not exceed 6 metres. Steeply graded sewers shall be tested in stages where the above maximum head will be exceeded if a whole section is tested at once. A period of 1 hour shall be allowed for absorption. The loss of water over a period of 30 minutes shall be measured by adding water from a measuring vessel at regular intervals of 10 minutes and noting the quantity required to maintain the original water level in the standpipe.

The average quantity of water added shall not exceed 0.05 litres per hour per 100 lineal metres per mm of nominal bore of the sewer.

2. Air Test

The length of sewer under test shall be effectively plugged and air pumped in by suitable means e.g. a hand pump, until a pressure of 100 mm head of water is indicated in a U-tube connected to the system. The air pressure shall not fall to less than 75 mm head of water during a period of 5 minutes, without further pumping, after a period for requisite stabilisation.

Sewers shall be tested:

1. after laying, including the placing of concrete if any, but before backfilling, and
2. after backfilling has been completed.

Sewers constructed of steel, spun iron or other material designed for high pressure shall be tested in accordance with the provisions of Clause 902.

Pipes exceeding 750 mm nominal diameter shall be tested in accordance with Clause 901.2.2 and by visual inspection.

After backfilling the sewer shall be tested for obstruction by the insertion and pulling through of twin-coupled rubber plungers of the same diameter as the sewer.

Sewers shall be tested for infiltration after backfilling. All inlets to the system shall be effectively closed and the residual flow shall be deemed to be infiltration. The amount of infiltration shall not exceed 0.05 litres per hour per 100 lineal metres length per mm of nominal bore of the sewer.

Infiltration to manholes shall not exceed 5 litres per hour per manhole.

506.2 Testing - Pressure Pipelines

Pipelines shall be tested hydraulically in sections during the course of construction.

Testing shall follow immediately after pipelaying and in no circumstances will pipelaying be permitted in excess of 1,000 metres ahead of a satisfactory Interim Test.

Testing shall be applied to prove the structural soundness of the various units in the line, including pipes, valves and anchorages and to prove the watertightness of the line.

The Contractor shall provide pumps, gauges, jacks, struts and all apparatus necessary for carrying out the tests and shall keep them in good order. The gauges shall be not less than 300 mm diameter, calibrated in metres head of water, and a dated certificate of its accuracy shall be provided.

The Contractor shall provide for transmitting the unsupported end thrusts to solid ground at the ends or into the sides of the trenches. Before testing, he shall ensure that the anchorage of bends is complete and that all branch outlets taking end thrust are properly stayed.

Testing shall not be permitted against a closed valve. In-line valves shall be left open. Terminal valves, hydrants, scour valves and the isolating valves of air valves shall be open, and shall be fitted with blank flanges except that where air valves are already fitted they shall be in service during the test. Scourtail pipes shall be connected only after pipeline testing is complete.

Water required for filling and testing the main shall be obtained from an approved source.

The Contractor shall give the Employer's Representative not less than twenty-four hours notice of his intention to test a section of main.

The test pressure shall be as in the following Table for the various sections of the Permanent Works.

TABLE OF TEST PRESSURE

Pipe Type	Class	Test Pressure
PVC and other materials to Imperial dimensions	BS Class 'B'	9 bar
	BS Class 'C'	13.5 bar
	BS Class 'D'	13.6 18 bar
		13.7
Grey Iron	BS Class 1	16 bar
	BS Class 2	20 bar
	BS Class 3	25 bar
Ductile Iron	Class K9	1.5 times the working pressure subject to a minimum of 25 bar and a maximum of :
	Diameter : 80 - 300mm :	45 bar
	Diameter : 350 - 1200mm:	30 bar
Asbestos Cement	Class 15	12 bar
	Class 20	15 bar
	Class 25	18 bar
Steel		1.5 times the working pressure

When testing the pipeline shall be charged with water and all air released. Care shall be taken during the charging of the mains to provide free outlets for air to prevent surging and water-hammer. The pipeline shall be brought up to and maintained at operating pressure and left for a period of 24 hours to allow for absorption and to achieve stable conditions. Thereafter water shall be added by pumping until the test pressure is reached in the lowest part of the section. The pump shall then be disconnected and no further water shall be pumped into the pipeline for a period of one hour for interim test and four hours for final test. At the end of each of these periods the original pressure shall be restored by pumping, and the loss measured by drawing off water from the pipeline until the pressure as at the end of the test is reached. The permissible loss shall not exceed

2 litres per metre nominal bore per kilometre length per metre head (calculate as the average head applied to the section) per 24 hours.

Interim tests shall be applied to sections of all continuous pipelines in lengths not exceeding 1000 metres and subject to the conditions set out in Clause 105.3. After the satisfactory completion of the first such sectional test on each continuous pipeline, such length may, at the Employer's Representative's discretion, be increased to 1500 metres. The first sectional interim test on each continuous length of pipeline shall be carried out after the bedding of the pipeline and after such partial backfilling as is necessary to provide 300 mm depth of material over the crown of the pipe, subject to the joints being left exposed.

Subsequent interim tests may, at the discretion of the Employer's Representative, be carried out with the trench backfilled (except for the replacement of soil or turf).

On completion of each continuous length of pipeline and completion of service connections, the pipeline shall be subject to a final test as a whole or such parts of the whole as the Employer's Representative may require.

If in the course of any test, the amount of make-up water in the specified test period exceeds the specified quantity, the Contractor shall locate and remedy the leaks causing such exceedence and shall repeat any such test until the specified degree of water tightness shall have been obtained. Remedial measures to stop leakage shall not infringe or be inconsistent with any relevant part of the Specification.

In the case of short sleeved welded joints on steel pipes, a porosity test to each joint shall be applied by the Contractor under an air pressure of 40 metres head of water. Testing shall be carried out as work on pipelaying and backfilling of trenches proceeds. This preliminary test on each joint shall be acceptable provided there is no loss in the applied pressure over a period of 30 minutes. A tapped hole for the test connection shall be provided at the socket end of each pipe and a sealing run of welding added at the face of the socket. On completion of the pipeline, the hydraulic test described in Clause 902.9 shall be applied and if satisfactory, shall be deemed to satisfy the tests described in Clause 902.10.

The Contractor shall ensure that no erosion or silting occurs in water courses from the discharge of test water.

On completion of the interim test the pipeline shall remain full of water and a minimum pressure of 1 bar shall be maintained until the pipeline is handed over to the Employer.

506.3 Testing Water Mains

Pipelines shall be tested hydraulically in sections during the course of construction. Testing shall be applied to prove the structural soundness of the various units of pipelines including valves, fittings etc; the contractor is to provide all pumps, jacks, gauges, struts, etc, necessary for carrying out the test and the gauges shall be tested to the satisfaction of the engineer. The test pressures shall be 1.5 times the manufacturers stated maximum operating pressures for various classes of pipelines in the works. When testing the pipelines shall be charged with water and all air released. Care shall be taken during charging of the mains to provide free outlets for air and to prevent water hammer. Pipelines shall then be kept under a nominal pressure for a period of 24 hours to allow absorption. Thereafter for a period of 2 hours the amount of water pumped during the period of tests shall be measured and shall not exceed a rate of 0.1 litres per millimetre nominal internal diameter per kilometre length of main per 30m head for each 24 hour period. If the amount of make up water in a 2 hour test exceeds the specified quantity the contractor shall locate and repair the leaks and repeat the test.

506.4 Testing - Structures

All concrete water-retaining structures shall be tested prior to the application of all sealants.

For water-retaining structures containing two or more compartments / cells, each compartment / cell shall be tested as a separate structure.

After cleaning of structures in accordance with Clause 905 and before any earth or other filling is placed against the outside wall faces, the structure shall be filled with water at a rate approved by the Employer's Representative.

After allowing a period of three days or such other period as the Employer's Representative may decide, for absorption, the water level shall be recorded by a hook gauge with vernier attachment or other approved means, and the water shall be allowed to stand for a period of seven days, during which the total permissible drop after allowing for evaporation and rainfall shall not exceed 1/1000 of the average water depth of the full tank.

Visible leaks and workmanship which is defective shall be rectified notwithstanding the fact that the structure may have passed the hydraulic test. Any caulking or making good of cracks in the wall section shall, where practicable, be carried out from the inside face.

The above water level drop test for reservoirs as outlined above will be repeated at the expiry of the Defects Period along with a general inspection of all joints.

Roofs of service reservoirs shall be tested by thoroughly wetting by continuous hosing for a period of not less than six hours. No leaks or damp patches should show in the soffit.

506.5 Swabbing and Scouring of Pipelines

After filling of pressure pipelines with water the Contractor shall thoroughly swab the line with foam swabs in sections as directed. For the first pass the length to be swabbed shall not exceed 1500 metres. A minimum two passes of the swab shall be made. Swab velocity shall not exceed 1.1 metres/sec.

Swabbing shall be continued until the wash water runs clear and the Contractor shall ensure that no erosion or silting occurs in the watercourses into which the wash water is discharged.

The Contractor shall use gauging or proving discs unless otherwise directed in the Contract. The apparatus, made of wood or other approved material, shall consist of two parallel discs having a diameter 5 mm less than that of the pipe bore, fixed rigidly apart so that the gauge may be drawn through the pipeline without tilting. During pipe laying the gauge shall remain in the pipeline and shall be pulled by a stout rope or chain which shall be threaded through each successive pipe or tube so that the gauge is never more than one pipe length behind laying. Any debris collected in front of the gauge shall be regularly cleaned out before the next pipe is placed in position. For pipe diameters up to 150 mm, a brush shall be utilised.

506.6 Scouring of Structures

On the completion of the construction of structures and before sterilising, all internal surfaces shall be scoured and the structures flushed in such a manner as to remove all dirt and grit which may have accumulated during construction.

506.7 Sterilisation of Water Mains

Mains shall be sterilised after testing, swabbing and scouring.

Chlorine solution shall be applied at the charging point as the main is being filled and dosing shall be continued until the main is full and at least 50 milligrammes per litre of free chlorine have been made available. Chlorine gas shall not be injected direct to the main from a cylinder otherwise than through an approved chlorinator and care shall be taken to ensure that there is no flow back into the preceding sections of main.

The treated water shall be left in the main for a period as directed but not exceeding 24 hours and all valves in the system shall be operated at least once during this period.

Chlorine residual tests shall then be taken at the end of the main furthest from the point of injection. The sterilisation process shall be repeated until the chlorine residual is not less than 10 milligrammes per litre.

The Contractor shall dispose of the waste chlorine solution in such a manner as to avoid the pollution of natural waters and of reservoirs and artificial watercourses. The Contractor shall comply with any directions which the Employer's Representative makes in respect of such disposal.

On completion of the requirements of Sub-clauses 1 to 5 above the Contractor shall fill the mains with water from an approved source. He shall assist the Employer in taking water samples for bacteriological analysis. In the event of unsatisfactory results, the Contractor shall repeat the process outlined above until a satisfactory bacteriological result is obtained.

506.8 Sterilisation of Structures

Immediately before acceptance of any structure for potable water, hypochlorate solution shall be distributed over the floor so as to give a uniform concentration of not less than 20 mg/l of free chlorine in 200 mm minimum depth of water. This solution shall be used to spray the roof, soffit, walls and columns, ensuring that the whole of the exposed areas are covered. The solution shall then be run to waste and the structure flushed with potable water. The Contractor shall provide goggles and protective clothing for the men doing the work.

The Contractor shall dispose of the waste chlorine solution in such a manner as to avoid the pollution of natural waters and of reservoirs and artificial watercourses. The Contractor shall comply with any directions which the Employer's Representative makes in respect of such disposal.

507 BURIED SERVICES

- 507.1** All pipes, ducts, cables, mains and other services exposed by the excavations shall be effectively supported and protected by timbers or other means.

Where existing sewers and drains are exposed during excavation every joint and every part of them requiring support shall be packed up solid from the bed with concrete packing in such a way as to prevent settlement.

508 RESTORE SURFACES

- 508.1** Surfaces interfered with either on public or private property, are to be restored to their original condition.

509 SAFETY CHAINS

- 509.1** Safety chains are to be provided for all outlet pipes 600mm nominal bore and above. Safety chains should be made of low carbon galvanised steel or stainless steel, 10mm nominal size, short link, smooth welded chain to BS 4942: Part 2.

510 PIPES AND JOINTS ADJACENT TO STRUCTURES

- 510.1** A flexible joint will be provided as close as is feasible to the outside face of any structure into which the pipe is built, compatible with the satisfactory completion and subsequent movement of the joint.
- 510.2** The length of the next pipe (rocker pipe) away from the structure shall be in the range 0.5 - 0.75 m for pipes up to 450mm nominal bore and shall not exceed 1m for pipes up to 750mm nominal bore.

511 CONSTRUCTION TOLERANCES FOR PIPELINES AND CHAMBERS

WORK CATEGORY	DIMENSION OR ALIGNMENT	PERMISSIBLE DEVIATION
Pipeline	Line and level	20mm
Manholes and chambers	Vertically	1 in 300

512 THRUST BLOCKS

- 512.1** Except where self anchoring joints are used, thrusts from bends and branches in pressure pipelines shall be resisted by C22.5 concrete thrust blocks cast in contact with undisturbed ground.
- 512.2** Any additional excavation required to accommodate thrust blocks shall be carried out after the bend or branch is in position and the thrust face shall be trimmed back to remove all loose or weathered material immediately prior to concreting.

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

Rapid hardening cement shall not be used in concrete for thrust blocks to plastics pipe.

Plastics pipes shall be wrapped with a layer of plastic sheeting 125um thick before being surrounded by concrete.

513 PRESSURE PIPELINE FITTINGS AND APPURTENANCES

513.1 Sluice Valves

Sluice valves shall be cast iron all flanged sluice valves supplied by Glenfield and Kennedy or approved supplier in accordance with BS 5163 Class 1 and to the sizes shown on the drawings.

513.2 Air Valves

Air valves on watermain shall be double acting air valves kinetic type, Glenfield and Kennedy Catalogue No. 127101273 with inlet diameter 80mm. Air valves shall be fitted complete with all flanged tee piece and flanged/plain ended adaptors.

513.3 Water Meter

Water meter on service connection to factory units shall be to a pattern approved by the consulting engineer.

513.4 Hydrants

Hydrants on high density polyethylene water main shall be screwed down type hydrant squat, clockwise to close (Glenfield Kennedy or similar approved type) with male round thread 65 mm diameter outlet. Hydrant to be fitted complete with tee piece, flanged and plain ended adaptors and flanged distance pieces where necessary.

513.5 Surface Boxes

Each surface box shall be accurately set to conform to the surface of the adjoining ground. Sluice valve surface boxes shall not be less than 100mm deep. The base shall be flanged and the clear opening at the top shall not be less than 89 mm diameter. The cover shall be cast iron. Surface boxes of sluice valves to which extended spindles are fitted shall have a web or diaphragm in a base which shall not be less than 150 mm deep.

The base shall be flanged and the clear opening in each direction shall be not less than 25 mm greater than the overall dimension of the air valve. The cover shall be perforated to allow a free escape of air. Stopcock and metre surface boxes shall be not less than 100 mm deep. The base shall be flanged and the clear opening shall be not less than 600 mm x 300 mm

513.6 Indicator Posts and Plates

All sluice valves, air valves, hydrants, shall have indicator plates carrying appropriate letters located as near as possible to each item, and in accordance with IS 162. The indicator plates shall be 200mm square in cast iron with the appropriate letters in relief. The plates shall be painted black with bitumastic paint and letters shall be in white.

The indicating letters shall be as follows:

Sluice valve	SV
Air Valve	AV
Hydrant	H
Scour Valve	ScV

The plates shall be erected on either suitable permanent features or structures or special precast concrete marker posts.

514 MANHOLE COVERS AND FRAMES

514.1 Manholes covers, gully gratings and frames shall be manufactured from iron complying with BSEN 124 with a minimum 600mm diameter opening.

515 PIPES FOR DRAINAGE AND DUCTS

515.1 Cast Iron, Grey Iron or Ductile Iron Pipes and Fittings

Pipes shall be provided with spigot and socket joints. They shall comply with the requirements of BS 437-Cast Iron pipes. Ductile Iron pipes for sewage shall comply with BS EN 598.

515.1 Clay Pipes

- (i) Clay pipes to be used for sewage shall be 'British Standard' pipes and pipes for surface water shall be either 'British Standard' or 'British Standard Surface Water' all manufactured to the requirements of BS EN 295. Other than for French drains, the pipes shall have Type 1 sockets and be supplied complete with the manufacturer's recommended flexible joint, or

with Type 2 sockets for cement mortar joints or plain ended pipes supplied with sleeve couplings.

- (ii) Watertight flexible joints for clayware pipes except those for French drains shall comply with BS 65.

515.2 Clay pipes for French drains may be any one of the following generally to BS EN 295

- (i) Unperforated pipes not exceeding 1.5 m in length with Type 1 or Type 2 sockets:
- (ii) Perforated pipes of any length with Type 1 or Type 2 sockets:
- (iii) Perforated pipes of any length with plain or rebated ends and flexible sleeve couplings.

515.3 Concrete Pipes

Concrete Pipes for general drainage:

- (i) Pipes having an internal diameter less than or equal to 900 mm shall be:
 - (a) Concrete pipes to BS 5911:1992
- (ii) Pipes having an internal diameter greater than 900 mm shall comply with:
 - (a) Sub-clause 1.3.1(i) above except that the Contractor shall submit test certificates to the Engineer, furnished by the pipe manufacturer, confirming that the 28 day minimum works cube strength for concrete is not less than 50 N/mm² and that the pipes comply with the Requirements of this Clause and
 - (b) Submission, by the Contractor, of samples and test certificates of same except that the pipes shall bear the stamp of the registered certification trade mark of the National Standards Authority of Ireland or The British Standards Institution, and shall be clearly labelled for identification:
- (iii) Watertight Flexible Joints shall be so constructed as to tolerate a longitudinal movement of +/- 10mm without breaking the seal. They shall also tolerate deviations in any direction from a straight line not less than those given below:

Pipe Diameters (mm)	Movement Tolerances (degrees)
150 - 600	2
600 - 1200	1
over 1200	0.6

All ogee concrete surface water pipes, in surface water sewers and drains, shall be to BS 5911 Part 110.

Concrete sewer pipes with spigot and socket joints with flexible joints, where specified in the contract shall comply with BS 5911 Part 100.

Concrete pipes for use in French drains may be any one of the following:-

- (i) Porous concrete pipes to BS 5911 Part 110:
- (ii) Concrete pipes to BS 5911:Part 100:1992 with a maximum length of 1.5 m laid with open joints:
- (iii) Perforated concrete pipes complying with the strength and manufacturing requirements of BS 5911:Part 110:1992 of any length, with holes not greater than 10 mm nor less than 3 mm diameter. The total area of holes shall be not less than 1000 sq.mm per metre length of pipe:

The cement used in the manufacture of concrete pipes shall be one of those complying with Clause 1709 of the Concrete Specification except that supersulphated cement shall not be used. Sulphate resisting cement shall be used where described in the Contract.

515.4 Pipes of Plastic Materials

Pipes for French drains shall be perforated or slotted; if perforated, holes shall be not greater than 10 mm nor less than 3 mm diameter; if slotted, slots shall be no wider than 4 mm nor less than 0.6 mm, otherwise shall comply with the requirements of the specification for soil pipes, drains, sewers and fittings made with unplasticised polyvinyl chloride (uPVC) issued by the Department of the Environment. The total area of holes shall be not less than 1000mm² per metre length of pipe. Plastic pipes for light duty sub-soil drains for use as specified in the Contract shall conform to BS 4962.

515.5 Ducts

Service ducts shall have a smooth internal bore without any sharp edges to the ends of the pipes. Service ducts shall be constructed of any of the following, laid, bedded and surrounded as described in the Contract:

- (i) Vitrified clay ducts with self-aligning flexible sleeve joints manufactured in accordance with the tolerances, permeability and strength requirements of BS 65. The internal ends of ducts shall be radiused to 3 mm minimum;
- (ii) Unplasticised polyvinylchloride (uPVC) pipes complying with Class B or C of BS 3506 or with BS 4660;

516 uPVC. CLASS B DUCTING**515.1 Material**

The material from which the ducts are to be produced shall consist substantially of Polyvinyl Chloride, to which may be added only those additives which are needed to facilitate the manufacture of sound ducts of satisfactory surface finish and mechanical strength. Re-cycled material if used shall not exceed 33 1/3% by weight the balance being virgin material. It shall be uniformly mixed.

516.2 Finish

The bores shall be smooth and free from grooves, cracks and sharp protrusions. Ducts shall not be kinked but a slight uniform curvature is permissible. Ends shall be square in the duct axis. The colour of the ducts should be black or dark grey and be uniform throughout.

Nominal Diameter (mm)	Minimum Wall Thickness (mm) Class B
100	3.4

516.3 Lengths

The ducts shall be 6m effective lengths not including the socket.

516.4 Joints

Each pipe shall have a socket at the end. The socket, which shall be an integral part of the pipe, shall have a minimum length of 75mm and shall be of push fit type, with the non-socket end suitable prepared for an even smooth joint.

516.5 Testing

Samples for test, as prescribed in the following clauses, shall be taken at random during manufacture. Laboratory tests results shall be recorded and made available to the Engineer. The ducts shall comply with the following test requirements.

516.7 Tensile Strength

The tensile strength of the P.V.C. shall not be less than 45MN/m² and the elongation at break shall not be less than 80%.

516.8 Impact test

The ducts shall be tested in accordance with BS 4660. The duct shall withstand an impact load of 2 kilos dropped from a height of 2 metres. The ducts shall be sufficiently strong to withstand normal transit and handling loads without breaking or cracking when temperatures are within the normal ambient external experienced in this country.

516.9 Reversion Tests

A test piece of duct 150mm in length shall be immersed in ethylene glycol at 150°C for 15 minutes and then allowed to cool. The length of the specimen shall not change by more than 5%

516.10 Deformation

When a 200mm sample length is placed between two flat parallel horizontal plates the duct diameter shall not deform more than 3mm when a load of 95N is applied. The test load shall be applied in increments of 20N every 15 seconds at an ambient temperature of 20°C.

516.11 Time Deformation

When two lengths of pipe 0.5m long are continuously subjected to a uniformly distributed crown load of 150/kg/m/pipe at 20°C the average % deformation under load of the internal vertical diameter after 48 hours shall not exceed 5.5%.

516.12 Marking

The ducts shall be suitably marked at intervals of a minimum 1m with a figure designating the nominal diameter in mm, the manufacturers code letter or letters, and the last two figures of the year of manufacture. The marking shall be in characters of not less than 6mm and of contrasting

517 WATERMAIN**517.1** Watermains shall consist of:

- 1 Class C Hard Polyvinyl Chloride pipes.

All PVC pipes shall comply with IS 123 Class C and shall be jointed with type A non tension rubber ring type joints in accordance with manufacturer's instructions.

Handling and installation shall comply with the "Recommendations for handling and installation of uPVC pipes" issued by EOLAS.

Unplasticised PVC pipes for watermains shall also be certified by the National Standards Authority of Ireland (NSAI) and shall bear the appropriate mark of conformity. Proof of the Authority's declaration of equivalence, together with a copy in English of all the documentation and related test data confirming compliance, shall be furnished for the Engineers approval.

- 2 Ductile iron pipes made in accordance with BSEN 545.

The Contractor shall provide manufacturers test certificates for each pipe consignment making up the total order. Sockets and joints shall be painted a suitable colour for identification purposes.

- 3 Fibre cement pipes to the requirements of IS EN S12

- 4 Polyethylene pipes, type 50, to the requirements of IS: 135.

518 SERVICES PIPES

518.1 Service pipes in consumer connections shall be one of the following types:-

- (a) Annealed Copper Pipes to the requirements of IS EN 1057.
- (b) Heavy Gauge Polythene Pipes, type 32, to the requirements of IS: 134.
- (c) High Density Polythene Pipes, type 50, shall comply with IS 135: 1975.

519 HARD POLYVINYL CHLORIDE PIPES**519.1** General

Watermains shall be hard PVC pipes, approved quality and manufactured to IS 123, SR 3 and the Department of Local Government Provisional Specification so as to satisfy its requirements fully. They shall be manufactured from Polyvinyl Chloride without plasticisers, fillers or adulterants and shall be smooth, free from grooves, scratches, dents or other defects and the ends cut off smoothly and square to the pipe axis. The cross section of the pipe material at any cut shall be free from blisters, hollows or bubbles. The standard lengths of the pipe shall be 6 m., exclusive of any sockets, with a positive tolerance only of 100 mm being allowed. Where test pieces have been cut from pipes, the shortened pipe, provided it has a usable length of not less than 4 m shall be accepted to a maximum of 5% of the order. The requirements for straightness, diameter and thickness, with permissible tolerance as set forth in the above mentioned Specification, shall be satisfied. All pipes will be expected to meet the conditions specified for internal water pressure, impact, swelling, shrinkage effect on water, light transmittance and marking. The selection of samples for test and the facilities for testing shall be in accordance with the requirements detailed in the above specification and actual testing shall satisfy the conditions laid down therein.

519.2 Handling of uPVC pipes

The handling and installation of the pipe shall be in accordance with the recommendations prepared by Eolas in collaboration with the Department of the Environment. These recommendations cater for the handling, storage, installation, testing and repair of unplasticised PVC watermains and service pipes and the Contractor will be expected to make himself thoroughly acquainted with them and to observe them in detail.

The recommendations stress that it is of great importance that care should be exercised in the handling of pipes to avoid damage to the wall surface.

Pipes should not be dragged along the ground and they should be loaded and unloaded by hand and the use of skids should be avoided. They should be laid down gently and should never be dropped on a hard surface. Specific conditions relating to storage of pipes, both long term and temporary, stacking, transport, loading, unloading and site inspection on delivery have been detailed in the recommendations referred to above and these must be satisfied by the Contractor.

The Contractor shall observe the precautions relating to pipe installations as set out in the recommendations already referred to above. When work is carried out during very hot weather, final connections to fixed joints shall be deferred until the majority of the pipeline has been covered with backfill. Where pipes are encased in concrete, either as protection or anchorage, a membrane such as felt or polythene film shall be placed between the concrete and the PVC pipe.

The formation of bends on the site will not be accepted and all bends required shall be obtained from the pipe supplier. Under special circumstances approved by the Engineer, hot bending on the site will be permitted for pipes up to and including 40 mm size provided the work is carried out by a trained operator using suitable bending springs and other equipment.

519.3 Jointing of uPVC pipes

Jointing of pipes shall be carried out with approved collar type joints consisting of a PVC coupler with internal rubber sealing rings. Pipe ends shall be suitably chamfered for insertion in the couplers and jointing shall be done in accordance with the manufacturer's instructions. In the jointing of pipes, special care must be taken to protect the spigot ends of pipe and the couplers from contact with grit or dirt and approved lubricants must be used on the grooves and rings of the couplers and on the pipe ends. Care is to be taken to ensure that the correct type collar is used for the class of pipe being installed.

Where spigot and socketed cemented joints are required such as for service pipes, they shall be carried out in accordance with the manufacturer's detailed instructions. Where metal saddles are used for service connections, they shall be examined carefully for the presence of burrs or sharp edges which might damage the pipe surfaces. All such burrs shall be carefully removed and the edges of the saddle in contact with the pipe shall be suitably rounded. Saddles shall not be over-tightened.

519.4 Specials

Specials, such as tee pieces for branch lines, scour out branches and air valves shall be standard type "Wavintee" or equal CI tee pieces. Sluice valves fitted on the line of main shall be standard double flanged type. The joints between the PVC pipes and the flanges of the valves

and fittings shall be made by means of approved type of CI flanged and spigot adaptors with internal rubber sealing ring, PVC pipe ends shall be suitably chamfered for insertion in the adaptors and jointing shall be done in accordance with the manufacturer's instructions.

A one metre length of CI double flanged pipe shall be provided and fitted each side of the sluice valve. A block of Grade 15 concrete for the full width of the pipe trench and extending 75 mm under and over the barrel of each such double flanged, CI piece shall be placed centrally on the fittings for a length of 600 mm for anchorage against movement on a vertical arc.

519.5 Service Connections to uPVC pipes

Connections for services shall be made to the PVC mains by means of specially formed collar clamped on the main by means of a wedged shaped clamp. The position of the service connection shall be accurately marked on the main, the collar clamped over the main. The tap will be fixed in the collar by means of a pressure drilling apparatus.

Where tapping into the empty mains is permitted by the Engineer, the saddle shall first be clamped on the main and the position of the hole accurately marked. The saddle shall then be removed and the hole drilled in the pipe by means of a steel bit drill. The saddle shall then be replaced and the ferrule tap screwed on water seal between the pipe and the saddle shall be obtained by means of a rubber ring glued in place on the underside of the saddle.

520 IRON PIPES

520.1 General

Iron pipes shall be either ductile iron cast or spun, complying with BSEN 545. They shall be of best metal, tough and close grained and such that when broken shall not be white or mottled. There shall be no admixture of cinder iron or other inferior metal. The pipes shall be perfectly straight and truly cylindrical in the barrel, free from all imperfections of casting. They shall be perfectly smooth inside and no lumps or rough places shall be left in any part.

All pipes are to be protected by bitumen and coated thoroughly to fill the surface. Internally they shall be lined with concrete. Each consignment of pipes is to be accompanied by a certificate from the manufacturer giving the results of the transverse tensile and hydraulic test and certificate that the pipes and special casting have been manufactured in accordance with the BS for ductile iron.

All specials are to be provided by the Contractor and in his prices set out in the priced Bill of Quantities carried forward to tender, he shall provide for every bend, tee, valve, flange, piece,

reducer, puddle collar, bellmouth, rose, spindle, valve key, hydrant, surface box foundation and other necessary fittings shown on drawings and/or referred to in specification or reasonably necessary for the proper completion of the work.

All precautions necessary in the handling, storage or laying of pipes shall be strictly observed by the Contractor.

520.2 Concrete Lining

Concrete lined cast iron pipes shall be in accordance with BS EN 545, with a concrete lining spun on the pipe.

For pipes up to and including 250 mm in diameter, the thickness of the lining shall be at least 5 mm thick. From 300 to 600 mm inclusive, the lining shall be at least 6 mm thick. Greater than 600 mm, the lining shall be 9.5 mm thick. In no case shall thickness of the lining exceed the given figure by more than 3 mm.

520.3 Testing for Soundness

Before placing the pipe in the trench, each length shall be brushed out inside and then suspended at the centre of its length and struck with a hammer at both ends to find out whether it is sound. If the pipe is found to be defective it shall be discarded and removed from the vicinity of the Works. This test in no way relieves the Contractor from his responsibility for replacing any defective pipes discovered during subsequent testing.

520.4 Jointing of Iron pipes

All iron pipes shall be flexibly jointed, unless detailed otherwise. Joints shall be spigot and socket type and shall be completed in accordance with manufacturer's instructions and BS. The joint type to be used in each specified task will be referred to in the Bill of Quantities. Jointing rings shall comply with BS 2494.

Lead joints may, in certain circumstances, be required by the Engineer and shall be constructed as follows:

Each pipe shall be carefully inserted in the socket of the pipe previously laid and two strands of rope yarn shall be forced into the joint. When the yarn is well packed home with caulking tools, a space of not less than 50 mm shall be available for lead.

Molten lead shall be poured into this space in one operation and when cooled, shall be properly caulked and dressed. The weight of lead in any pipe joint shall be in accordance with the following table:

Pipe Dia mm.	Weight Lead Kg.
75	1.5
100	2.0
150	3.0
200	4.0
225	5.0

SERIES 600

EARTHWORKS

600 Definition, Classification and General Use of Earthwork Materials

600.1 (ii) A Suitable Material shall comprise all that which is acceptable for use in the Works excluding material described in S600.1(iii).

(iii) A Unsuitable Material@ shall mean other than suitable material. Unsuitable material may be incorporated in landscape areas or earth bunds. Unsuitable material shall include:-

- (a) material from swamps, marshes or bogs;
- (b) peat, logs, stumps and perishable material;
- (c) material susceptible to spontaneous combustion;
- (d) material in a frozen condition;
- (e) clay of liquid limit exceeding 80 and / or plasticity index exceeding 55;
- (f) materials having a moisture content greater than the maximum permitted for such materials in the Contract, unless otherwise permitted by the Engineer.
- (g) A Unsuitable material@ shall include silts defined for the purposes of this Contract as uniformly graded material having a uniformity coefficient of 10 or less and containing 80% or more in the particle size range 0.06 - 0.002 mm and having a moisture content greater than the optimum moisture content of the material. In excavating these materials the Contractor's attention is drawn to the requirements of Clause 601.10. The optimum moisture content shall be determined in accordance with BS 1377: Part 4 : 1990, (2.5kg rammer). The sieve analysis test shall be wet analysis in accordance with BS 1377: Part 2: 1990.

Material of Class (d) if otherwise suitable shall be classified as suitable when unfrozen.

(iv) Rock shall mean the following;

- (a) Silurian: Green - grey, fresh, massive to slightly cleaved Siltstone, strong. In upper horizons becoming brown, highly weathered, slightly cleaved Siltstone, moderately strong to moderately weak, in places becoming Shale.

(b) Carboniferous: Grey, fresh to slightly weathered crystalline Calcisiltite Limestone, strong interbedded with grey - brown, highly weathered, fissile, argillaceous Limestone to Shale, moderately weak to week. Calcite veining noted. In upper horizons becoming brown, highly to completely weathered, fissile, argillaceous Limestone to Shale, moderately weak.

(v) Argillaceous means a material containing clay minerals (for example argillaceous rocks include shales, claystones, siltstones and mudstones).

600.2 All material surplus to requirements shall only be disposed by the Contractor in accordance with the Planning Regulations.

600.3 Turf and all topsoil, not required for relaying, shall be removed from the area of cuttings and stockpiled for re-use (i.e. in the soiling of slopes of cuttings, embankments, berms, verges, central reserves and in the provision of beds for the cultivation of trees and shrubs). Clause 605.1 will apply if material is surplus to requirements.

Topsoil shall wherever practicable be used immediately after its stripping and if not shall be stored in stockpiles of heights not exceeding 1.5m. 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.

600.4 For the purpose of the Contract the maximum permitted moisture content in accordance with Clause S600.1(iii)(f) shall be as follows:-

(a) For all soft materials (excluding gravels having less than 15% of fines passing the 63 micron sieve) the maximum permitted moisture content shall be the optimum moisture content x 1.1. The optimum moisture content shall be determined in accordance with Test No. 12 (2.5kg rammer) of BS 1377:1975.

The sieve analysis test shall be wet analysis in accordance with Test No. 7(a) of BS 1377:1975(Vibrating Hammer Method). Sieve analysis shall be carried out as defined in (a) above.

600.5 Prior to the commencement of any earthworks the Contractor shall prepare and agree with the Engineer a detailed programme for the phasing of the Works. In addition, the Contractor shall, three working days prior to the opening of any cut area, inform the Engineer of his intention to commence Excavation. The determination of the moisture content in accordance with Clauses 600.1(iii)(f) shall be made from samples taken prior to the commencement of the excavation and from that part of the sample passing the 20mm BS sieve. The method of drying to be used shall

be by microwave oven or any other method approved by the Engineer. The results of these determinations shall be agreed by the Engineer and Contractor. In addition the Engineer shall determine the Classification of all earthworks materials prior to their use or disposal in accordance with the following categories;

- 1 Category 1: Granular Material shall be as described in this Clause.
 - (a) Type 1: Shall consist of non-argillaceous, well graded natural gravels or crushed rock with not less than 100% of the material passing a 25mm BS sieve, and at least 90% passing a 75mm BS sieve, at least 15% and not more than 60% shall pass the 5mm BS sieve, and not more than 10% shall pass the 75mm BS sieve. The material passing the 425 micron sieve when tested in accordance with Clause 5.4 of BS 1377: Part 2 :1990 shall have a plasticity index less than or equal to 8.
 - (b) Type II: Shall consist of non-argillaceous well-graded crushed rock with grading as for Type I except that not more than 5% shall pass the 75um BS sieve.
2. Category 2: Other suitable materials as defined in Clause 601.1(ii), including Rockfill, imported suitable material and materials excavated from areas of made ground, which are deemed by the Engineer to meet the requirements appropriate to suitable material.
3. Category 3: Unsuitable materials as defined in Clause 601.1(iii), and materials excavated from areas of made ground, which are deemed by the Engineer not to meet the requirements appropriate to suitable materials, together with Category 2 materials excess to the requirements of Category 2.

601 COMPACTION OF EMBANKMENTS AND OTHER AREAS OF FILL

601.1 The Engineer will require that comparative field density tests be determined in accordance with BS 1377:Part 4 using the 2.5kg rammer method or the vibrating hammer method as appropriate for the each of the fills he intends to use which meet the requirements of the permitted Class or Classes (where within any Class of material the fill contains material having different maximum dry density and optimum moisture contents the Class shall be subdivided, by extending the identification system, in order to monitor the compacted density).

These tests will be carried out on a regular basis at the discretion of the Engineer. The costs of any delays caused by such tests will be deemed to be covered by the prices entered in the Bill of Quantities for Earthworks.

If the test results, when compared with the results of similar tests made on approved work containing material of the same classification, having similar characteristics and within the Specification requirements for moisture content compacted in accordance with Table 6/2, show the state of compaction to be inadequate, and this is held by the Engineer to be due to failure of the Contractor to comply with the requirements of the Contract the Contractor shall carry out such further work as the Engineer may decide is required to comply with the terms of the Contract.

If, however, the Contractor has fully complied with the requirements of the Contract and the Engineer decides that further compaction is required, he will issue a variation order to cover the additional compaction order.

The field dry density referred to in this Clause shall be measured in accordance with BS 1377:Part 9 except that nuclear methods shall only be used where permitted by the Engineer. Where nuclear methods are used, the gauge shall be calibrated in accordance with BS 1377:Part 9. Use of nuclear gauges shall comply with Clause A130.

Nuclear gauges or other sources of ionising radiations shall be used only where permitted or required by the engineer.

The Contractor shall advise the Engineer of his designated radiation protection adviser and provide the Engineer with a copy of the Contractor's local rules covering the use of nuclear gauges or other sources of ionising radiation; these expressions having the meaning given in the Ionising Radiations Regulations 1985.

602 INSPECTION OF FINISHED EXCAVATION

602.1 No work shall be begun on any blinding layer or formation until the Engineer or his representative has seen and approved the formation surface. The Contractor shall notify the Engineer when the excavation is ready for inspection.

603 NORMAL EXCAVATION

603.1 Normal excavation shall mean excavation in all materials except solid rock. Boulders with a volume of 0.5cu m in trenches or 1.0cu m in mass excavation shall be regarded as normal excavation.

Old masonry culverts or drains and old masonry wall structure below the ground which can be removed by 0.5cu m backacter shall likewise be deemed to be normal excavation.

604 PUMPING AND BALING

- 604.1** The Contractor shall provide and perform as part of the Contract all pumping, baling, removing of water than may be required in executing the various Works and in maintaining the Works free from water and no water shall be allowed to accumulate in any trench or part of the works at any time.

605 DISPOSAL OF SURPLUS EXCAVATED MATERIAL

- 605.1** The Contractor shall provide for the disposal of all surplus excavated material not required for use in or on the works. The surplus material shall be properly removed and in no circumstances will the Contractor be allowed to leave spoil heaps on site.

606 PREPARATION OF SUB-GRADE

- 606.1** The formation shall be well cleaned, free from mud and slurry and properly shaped and compacted where necessary, to an even and uniform surface as shown on the drawings. All exposed formations shall be inspected by the Engineer and no sub-base materials shall be placed until the formation has been approved by the Engineer. Once the formation has been prepared, constructional traffic shall not be allowed to run thereon without the permission of the Engineer.

607 GEOTEXTILES

- 607.1** A suitable geotextile which conforms with the following

It will sustain a tensile load of not less than 5.0kN/m at break and have a minimum failure strain of 10% when determined in accordance with BS 6906: Part 1.

It will have a minimum puncture resistance of 1200 N when determined in accordance with BS 6906: Part 4;

It will have a minimum tear resistance of 200 N when determined in accordance with ASTM Standard D4533-85.

It will have a size distribution of pore openings such that the maximum O90 size when determined in accordance with BS6906: Part 2, is 100 microns.

It will allow water to flow through it, in either direction, normal to its principal plane at a rate of not less than 30 litres/m²/sec under a constant head of water of 100mm and a maximum breakthrough head of 50mm when determined in accordance with BS 6906: Part 3.

- 607.2** Geotextiles shall be protected at all times against mechanical or chemical damage. Those susceptible to damage by light shall not be uncovered between manufacture and incorporation in the Permanent Works. Temporary exposure shall not exceed 5 hours.
- 607.3** The geotextile shall be laid and where lapping is employed adjacent sheets or strips of geotextile shall be overlapped by at least 300mm.
- 607.4** The layer of material on which the geotextile is to be placed shall not have protrusions or sharp projections which are likely to damage the geotextile during installation or in service. The method of installation shall ensure that the geotextile is in continuous contact with the surface on which it is to be placed and the geotextile shall not be stretched or bridged over hollows or humps. Operation of construction plant directly on the installed geotextile will not be permitted and its covering with fill material shall take place immediately after its laying.

608 TESTING OF GEOTEXTILES

- 608.1** The 'wide strip' tensile strength test shall be carried out as follows by a method approved by the Engineer.
- (a) The test pieces shall be 200mm wide and have a gauge length of 100mm.
 - (b) A minimum of five test specimens shall be taken and tested in each of the two principal directions within the geotextile relating to its mode of manufacture, in order to determine the characteristic strength of the geotextile.
 - (c) The rate of strain shall be 10% plus or minus 3% per minute.
 - (d) 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.
- 608.2** The flow rate of water shall be determined as follows:-
- (a) Geotextiles shall be tested in an unloaded condition under a 100mm constant head of water.
 - (b) Flow shall be in a single direction.
 - (c) The area to be tested shall be circular and of between 50mm and 100mm diameter.

- (d) Before testing the test piece shall be conditioned in clean water for one hour.
- (e) The water used in the test shall:
 - (i) be as free of air as possible and the apparatus shall be supplied from a still tank and not directly from a mains supply.
 - (ii) not be contaminated with detergents or other substances and there shall be no recycling of the water.
 - (iii) have a temperature not less than 10°C nor in excess of 25°C. 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.
- (f) The quantity of flow to be collected shall not be less than 2 litres or alternatively the flow shall be collected for a period of time in excess of 15 s.
- (g) The number of test pieces shall be a minimum of 4 and the number of flow runs per test piece shall be a minimum of 4.
- (h) The flow shall be quoted in litres/m²/s. The standard deviation of the flow results shall be stated together with the mean.

608.3 The pore size distribution and determination of O90 shall be as follows:-

- (i) The pore size distribution shall be obtained by determining the percentages of each of a number of different designated sizes of glass spheres complying with BS 6088 (chosen so as to cover the range of pore sizes) which are retained on the geotextile when shaken through it employing the geotextile as a sieve.
- (ii) A cumulative frequency graph of percentage of spheres retained against designated size shall be plotted and the size corresponding to 90% retained is the required O90
- (iii) For each sieving at least 100g of the glass spheres shall be shaken for 10 min on a test piece of geotextile supported and clamped in place on a BS sieve of frame diameter 300mm and aperture size greater than 10mm.
- (iv) The sieve apparatus shall have a vibrational frequency of 50 Hz and a maximum vertical amplitude of 0.75mm.

- (v) 5 test pieces having dimensions exceeding the dimensions of the sieve shall be taken to provide a mean of O90 pore size.

SERIES 800

SUB-BASES AND ROADBASES

800 MATERIALS FOR SUB-BASES AND ROADBASES

800.1 Except where otherwise specified unbound material up to 210 mm compacted thickness shall be spread in one layer so that after compaction the total thickness is as specified. Unbound material of compacted thickness greater than 210 mm shall be laid in two or more layers and the minimum compacted thickness of any such layer shall be 100 mm. Where the layers of unbound material are of unequal thickness the lowest layer shall be the thickest layer.

801 CONSTRUCTION REQUIREMENTS FOR MATERIALS TO CLAUSES 803 TO 811 INCLUSIVE

801.1 At longitudinal or transverse construction joints, unless vertical forms are used, the edge of compacted cement-bound material shall be cut back to a vertical face where the specified thickness of properly compacted cement-bound material has been obtained.

801.2 Vibrating rollers are self-propelled or towed smooth- wheeled rollers having means of applying mechanical vibration to one or more rolls.

- (i) The requirements for vibrating rollers are based on the use of the lowest gear on a self-propelled machine with mechanical transmission and a speed of 1.5-2.5 km/h for a towed machine, or a self- propelled machine with hydrostatic transmission. If higher gears or speeds are used an increased number of passes shall be provided in proportion to the increase in speed of travel.
- (ii) Where the mechanical vibration is applied to two rolls in tandem, the minimum number of passes shall be half the number given in Table 8/1 for the appropriate mass per metre width of one vibrating roll. If one roll differs in mass per metre width from the other, the number of passes shall be calculated as for the roll with the smallest value. Alternatively, the machine may be treated as having a single vibrating roll with a mass per metre width equal to that of the roll with the higher value or, if appropriate, each roll may be assumed to be attached to a separate machine and the requirements of sub-clause 18 applied.
- (iii) Vibrating type rollers operating without vibration will be classified as smooth-wheeled rollers.
- (iv) Vibrating rollers shall be operated with their vibratory mechanism operating only at the frequency of vibration recommended by the manufacturers. All such rollers shall be equipped with or provided with a device that shall indicate the frequency at which

the mechanism is operating and the speed of travel. Both devices shall be capable of being read by an inspector alongside the machine.

- (v) Where compaction of material is required adjacent to structures vibration will be achieved by use of a Vibrating-plate compactor, complying with the requirements of Table 8/1 for number of passes for specific layer depths.

801.3 Power rammers are machines that are actuated by explosions in an internal combustion cylinder, each explosion being controlled manually by the operator. One pass of a power rammer shall be considered to have been made when the compacting shoe has made one strike on the area in question.

801.4 Combinations of different types of plant or different categories of the same plant will be permitted; in which case the number of passes for each shall be such proportion of the appropriate number in Table 8/1 as will together produce the same total compactive effort as any one operated singly, in accordance with Table 8/1.

802 GRANULAR MATERIAL TYPE B

802.1 The material passing the 425µm BS. sieve when tested in accordance with BS. 1377 shall be non-plastic. By "Non- Plastic" is meant that it is not possible to obtain a Plastic Limit in accordance with BS 1377.

802.2 The material shall have a 10% fines value of 130 kN or more when tested in compliance with BS 812 except that samples shall be tested in a saturated and surface dried condition. Prior to testing the selected test portions shall be soaked in water at room temperature for 24 hours without previously having been oven dried.

802.3 Where this material is crushed rock it shall be crushed from a non-argillaceous rock.

803 UNDER SLAB FILL MATERIAL

803.1 Unbound granular fill (crushed stone) to Annex E of S.R. 21:2014 should be used within 500mm of the permanent works or structural elements.

