SAMOA WATER AUTHORITY

STANDARD SPECIFICATION FOR WATER SUPPLY

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ABBREVIATIONS AND ACRONYMS

AS	Australian Standard
AWWA	American Water Works Association
BS	British Standard
EPC	Electric Power Corporation
ESW	(SWA) Engineering Standards (Water)
LS	Lump Sum
LTA	Land Transport Authority
MNRE	Ministry of Natural Resources and Environment
MOCIT	Ministry of Communications & Information Technology
NZS	New Zealand Standard
PE	Polyethylene (pipe)
PRV	Pressure Reducing Valve
PS	Provisional Sum
PUMA	Planning and Urban Management Agency
SSWS	(SWA) Standard Specification for Water Supply
SWA	Samoa Water Authority

DOCUMENT PRECEDENCE

The Technical Specification is divided into various sections for convenience and reference and no claims will be accepted in respect of work not specifically mentioned in a particular section but which is provided for, expressed or implied, elsewhere in the specification or drawings.

Should any ambiguities exist between the Technical Specifications, precedence shall be in the following order:

1. Project Specification
2. Standard Specification for Water Supply
3. Standards & Codes of Practice

PROJECT SPECIFICATION

1. PROJECT INFORMATION

2. PROJECTPARTICULAR SPECIFICATION

FOR THE PROJECT SPECIFICATION REFER TO THE PROJECT DOCUMENTS

STANDARD SPECIFICATION FOR WATER SUPPLY

3. GENERAL

3.1 SAMOA WATER AUTHORITY REGULATIONS AND STANDARDS

The Contactor shall at all times comply with all Samoa Water Authority Regulations currently in force.

All materials and workmanship shall generally comply with the most recent edition of the Samoa Water Authority Engineering Standards (Water) (ESW) except where superseded by the Standard Specification or elsewhere in the Contract.

Unless project specific standard design detail drawings are provided as part of the Employer's Requirements, the Samoa Water Authority "Water Standard Drawings" shall apply to the project as listed below:

W-000: Drafting Standards

W-000 Standard Symbols and Notation- Water Supply

W-000 to W-015: Water Supply and Distribution

W-001 Pipework Systems - Typical Details 1

W-002 Pipework Systems - Typical Details 2

W-003 Pipe Trench and Bedding Details

W-004 Anchor Blocks – Typical Details

W-005 Miscellaneous Pipework Details

W-006 Hydrant and Sluice Valves – Typical Details

W-007 Valve Chambers – Typical Details

W-008 (a) PRV Chambers Plan and Precast Lid Details

W-008 (b) PRV Chamber - Sections

W-009 (a) PRV Chambers Plan and Precast Lid Details – No Vehicle Load

W-009 (b) PRV Chamber – Sections – No Vehicle Load

W-010 Stream Crossings

W-011-015 Future Use

W-016- W-020: Service Connections

W-016 Property Service Connections - General

W-017 Property Service Connections – Typical Details

W-018-020 Future use

W-021 to W030: Miscellaneous Details

W-021 Pumped Bores – General Arrangement

W-022	Pre-Fabricated Storage Tank – Typical Arrangement
W-023	Break Pressure Tank – Typical Arrangement
W-024	Tank Hatch Covers – Typical Details
W-025	Access Roads, Tracks and Culverts
W-026	Fencing and Gates
W-027-030	Future Use

3.2 STANDARDS& CODES OF PRACTICE

The terms "New Zealand Standard" (NZS), "Australian Standard" (AS), "British Standard" (BS) and "AWWA Standard" shall refer to the latest standard specifications or Codes of Practice issued by the Standards Association of New Zealand, the Standards Association of Australia, the British Standards Institution, or the American Water Works Association respectively. The current addition of all such Standards referred to herein shall be deemed to form a part of this Specification and shall apply to all work carried out under this Contract. In particular, the pipes and fittings to be supplied, in order to be compatible with those in use by the Employer, shall be to the New Zealand Standards or Australian Standards that are generally compatible with British Standards. If the Contractor wishes to provide materials meeting other internationally accepted standards which ensure an equal or higher quality and meet the requirement for uniformity and standardisation within the Employer's water supply systems he shall first obtain the approval of the Engineer submitting full details of the alternative standard.

3.3 MATERIALS QUALITY ASSURANCE AND MANUFACTURING LICENCING CERTIFICATION

All manufacturers must be certified according to ISO9001 Quality Assurance Standard. All materials and equipment must be manufactured under a recognised product certification scheme and each item supplied must be marked in accordance with the certification body's requirements including the product standard and manufacturing licence details. Any materials or equipment supplied not properly marked will be rejected.

3.4 DELEGATION

The Engineer, appointed by the Employer in accordance with the Contract, may delegate any or all of the powers and responsibilities vested in him by the Contract to a Representative. The Engineer will inform the Contractor in writing seven (7) days prior to any such appointment setting out: the name and contact information of the Representative; the period for which the delegation of powers and responsibilities applies; and the powers and responsibilities delegated to the Representative. Any reference in this Specification, or elsewhere in the Contract, to the "Engineer" or the Engineer's Representative" shall be taken to mean the same subject to the limits of delegation of powers and responsibilities advised in writing to the Contractor.

3.5 SITE LIMITS AND ACCESS TO THE SITE

The Contractor shall establish the limits of the site as indicated in the contract documents and arrange suitable access with the Engineer before commencing the Works. The Contractor must be prepared to facilitate construction of the Works by means of the existing foot and plantation tracks as marked in the Drawings if the construction of machinery access tracks is not specifically scheduled in the Contract documents.

All costs associated with the completion of the Works by means of existing roads, plantation tracks and foot trails shall be allowed for in the tendered rates.

This includes the cost of additional clearing of vegetation along a plantation track or foot trail should the Contractor consider this necessary to facilitate machine or other access to such a site.

3.6 MOBILISATION

3.6.1 Preliminary

Unless otherwise noted Mobilisation shall include for the following requirements at all Sites specified for the Works.

3.6.2 Scope

Mobilisation shall include the following:

a) Mobilisation and demobilization of construction facilities, plant, materials and labour to the Site.

b) Taking possession of Employer-supplied materials (where applicable) and the provision of secure storage both on and off the Site and the return of excess materials to the Employer.

c) Site clean up on Completion.

3.6.3 Collection, Storage and Security of Materials

The Contractor shall provide a minimum of two days notice to the SWA Stores at Vaitele of the date they intend to take possession of any materials supplied under the contract. The Contractor shall provide lockable material storage containers or alternative secure arrangement for on and off site storage for all materials. The Contractor shall also make provision for transport of the containers from SWA Vaitele Office to and from the Site or the Contractor's office compound.

Following taking possession of any materials supplied by SWA the Contractor shall be solely responsible for their security. The Contractor shall maintain an inventory of all materials so supplied and shall report on the status of the inventory in each Progress Report noting the quantity of materials incorporated in the permanent Works (including any unavoidable wastage) versus the current inventory levels. The Contractor shall be responsible for the replacement of any unaccounted for materials. At Completion, any surplus material not incorporated in the permanent Works shall be returned to the SWA store.

3.6.4 Clean-up on Completion

Remove from Site all gear, rubbish and remaining debris on completion of the Works.

3.7 PERMITS

The Contractor shall be responsible for arranging with the relevant authorities and agencies for all required permits or approvals or consents for the implementation of the Works and shall submit copy of license or permit obtained to the Samoa Water Authority. The Contractor shall liaise with Employer, the Ministry of Natural Resources and Environment (MNRE), the Planning and Urban Management Agency (PUMA), the Electric Power Corporation (EPC), the Land Transport Authority (LTA), the Ministry of Communications and IT (MCIT), the Ministry of Works, Transport and Infrastructure (MWTI), Office of the Regulator (OOTR), and any other relevant authority as required for the duration of the Works.

3.8 HEALTH & SAFETY

Refer to Engineering Standards, Part 4, Section 4.4.1

In accordance with the General Conditions of Contract, the Contractor shall be responsible for its own safety and for seeing that its actions or failures to act do not harm any other person. The Contractor shall also be responsible for the effects of the work on safety and health of its employees, Sub-Contractors and to the public. In particular, but without limiting the obligations of the Contractor under this Contract, the Contractor shall, in complying with health and safety laws:

(a) Provide and maintain a safe working environment.

(b) Provide and maintain work facilities for safety and health.

(c) Ensure that equipment and plant is arranged and maintained so that it is safe for use.

(d) Ensure that no persons are unduly exposed to Hazards arising out of the arrangements, disposal, manipulation, organisation, working, or use of things in the place of work or near the place of work.

(e) Develop procedures for dealing with emergencies that may arise.

The Contractor shall indemnify the Employer for all losses arising directly or indirectly as a result of any breaches by the Contractor of this clause.

“Hazard” shall be defined as an activity, circumstance, occurrence, situation, or substance which may be an actual or potential cause of harm to a person (such as an employee of the Contractor) or another person (such as a member of the public).

Hazards may include, but are not limited to; those arising from traffic, machinery, materials and debris, poor personal technique and protection, falls, electrocution, suffocation, fire, tools, chemicals, flood, landslide and other natural events.

3.8.1 Monitoring of Safety

The Contractor's on-going responsibilities shall include:

(a) Recording all Near Hits (an incident where if the circumstances were different, harm to a person or persons may have occurred)

(b) Reporting in writing to the Engineer all;

- accidents and injuries involving death orpersonal injury (immediately by telephone or messenger and within 24 hours in writing)
- incidents such as slides, cave-ins, and the like creating a significant on-going potential hazard to another person, including members of the public (immediately by telephone or messenger and within 24 hours in writing)
- accidents involving loss of time (within 24 hours in writing)
- other incidents such as equipment failureand the like (within 48 hours in writing).

Failure to do so or to comply with any such request may result in the Works being required to cease until written reports and/or records are received by the Engineer.

Where the Engineer or Employer considers the work environment to be unsafe or deficient, in their opinion (and without assuming any of the responsibilities of the Contractor), after notifying the Contractor in writing where possible, the Engineer or Employer may instruct the Contractor to cease any operation or activity until such time as the work environment is made safe. Any such instruction shall not be a Variation nor be grounds for a claim for an Extension of Intended Completion Date.

3.9 INFORMATION TO BE SUBMITTED BY THE CONTRACTOR

3.9.1 Safety Plan

Within 10 days of acceptance of tender, the Contractor shall submit to the Engineer a Safety Plan, including Traffic Management, specific to the Works.

The Safety Plan shall be in two sections:

(i) Identify all Hazards associated with the Works that are common to all sites and;

Present details of the proposed methods of eliminating, isolating, or minimising the Hazards and/or their effects.

(ii) Identify all Hazards that are specific to each particular sites and;

Present details of the proposed methods of eliminating, isolating, or minimising the Hazards and/or their effects at each site.

No works on any site shall commence until the Contractor has submitted and received the approval of the Engineer to the Safety Plan.

3.9.2 Construction Schedule / Programme of Works

Within 10 days of acceptance of tender, the Contractor shall submit to the Engineer a detailed programme for the Works. The contractor shall demonstrate the ability to adequately resource the Works in order to satisfactorily achieve practical completion by the intended completion date.

Works on site shall be continuous during the normal hours of work.

The Contractor's programme is to make due allowance for seasonal conditions including weather and holidays that may affect the completion on time of all works included in the accepted Programme.

The Contractor is to accept that the order of works can be dictated by the Engineer, due to potential urgency requirements.

3.9.3 Quality Management Plan

Refer to Engineering Standards, Part 4, Section 3.1.2

The Contractor shall submit to the Engineer for approval an updated Quality Management Plan and Quality Assurance/Quality Control Procedures within 10 days of the date of the Letter of Acceptance taking full account of any comments on the Contractor’s quality management proposal in their Tender.

The Quality Management Plan and procedures shall comply with the Engineering Standards (Water) Part 4, and the particular requirements of Sections 3.19 and 3.20.

3.9.4 Contractor's Superintendence and Communication

Refer to Engineering Standards, Part 4, Section 3.2

Within 10 days of acceptance of tender, the Contractor shall submit to the Engineer the names of appointed Site Supervisors prior to the commencement of the Contract, including people who may be contacted after hours. An approved Site Supervisor is to be present on site during working hours and must be available by mobile telephone.

The Contractor's representative and the Site Supervisor acting for the Contractor shall carry a mobile telephone at all times so that communication can be maintained between the Contractor, the Engineer and the Employer.

The Contractor must also have the ability to send and receive emails to receive and acknowledge instructions and advise completion of repairs.

The Contractor shall maintain a daily (standard 5 day week minimum) liaison with the Engineer.

3.9.5 Daily Plant and Labour Records

The Contractor shall maintain a daily report of all plant and labour on Site. Signed copies of such reports shall be submitted to the Engineer weekly.

3.9.6 Progress Reports

The Contractor shall submit a fortnightly Progress Reportto the Engineer by the Friday following the previous fortnight's reporting period, commencing two weeks after the date of the Letter of Acceptance and continuing until Completion. The report shall be issued in two (2) hard copies and in PDF format via email to the Engineer. The Progress Report shall cover, as a minimum:

a) Progress in undertaking the Works in a format to be agreed with the Engineer including a comparison of planned and actual progress and photographs showing the status of progress on the Site

b) Any issues encountered in undertaking the Works including any events or circumstances that may jeopardize on-time Completion and the measures being taken or to be adopted to address them.

c) Detailed record of the Contractor's personnel and plant on the Site

d) A summary of Environmental Monitoring

e) Revised Traffic Management and emergency procedures, and

f) A Safety Summary including the particulars of any accident or unusual or unforeseen occurrences on the Site.

3.10 DRAWINGS

Only drawings which have been clearly marked as having been issued "FOR CONSTRUCTION" are to be used by the Contractor for setting out or construction of the Works.

The Contractor shall carry out works in accordance with the latest issued Drawings. The Contractor shall establish a control system to ensure the Works are carried out in accordance with the latest issued Drawings and to appropriately mark all superseded Drawings.

Where the layout of structures or other items are designated as diagrammatic only on the Drawings, the Contractor shall determine measurements based on a site survey, in consultation with the Engineer, before proceeding with the Works.

Locations, dimensions, material descriptions, contour lines, ground profile lines and the location of existing services and structures shown on the Drawings are approximate only.

Unless approved by the Engineer, dimensions should not be scaled from the Drawings.

3.11 SITE WALK-OVER

It is assumed that all Contractors will have inspected the Site (or Sites) for themselves and taken into consideration all aspects such as accessibility, ground stability, work and traffic control required, the extent of work in particular those being paid by a lump sum.

Before work begins on Site, the Contractor or a representative of the Contractor must complete a Site walkover inspection with the Engineer or the Engineer's Representative. No additional payment will be made for this.

The Contractor is to inform the Engineer prior to starting work on a new Site.

3.12 SETTING OUT

Setting out of the work shall be carried out by the Contractor and as shown in the Drawings (where applicable). As the work proceeds it may be necessary to adjust particular points that are in the opinion of the Engineer necessary to ensure satisfactory completion of the work. All costs associated with this requirement shall be included in the establishment item.

Prior to commencement with excavation works, the Contractor shall peg out the extents of the civil structures and the location of key pipelines at the request of the Engineer. The Contractor shall contact and meet (on Site) with the relevant personnel (including any affected land owners or communities) to view the alignment and take note of any concerns that any of the representatives may have with regards to their existing services. The Contractor is responsible for the searching of records for determining the existence and location of all existing utilities or structures on the Site.

The datum points to be used for setting out and levelling the works is the responsibility of the Contractor and shall be approved by the Site Supervisor. Levels shown on the maps and drawings are in metres and given for information only.

Prior to commencement of any work, the Contractor shall:

a) Verify all dimensions and elevations on site and clarify from the Engineer any discrepancy discovered.

b) Confirm all dimensions, boundaries, and offsets from the Engineer whose decision shall be final.

Final details of the setting out shall be agreed with the Engineer's Representative on site but the checking or setting out of any line or level by the Engineer or his representative shall not in any way relieve the Contractor of his responsibility for the correctness thereof.

The Contractor shall provide all labour, materials (including all instruments, measuring equipment, pegs and sight rails necessary) for the proper setting out and checking of the Works and any other assistance that the Engineer may require at any time to check the setting out of the work.

3.13 ACCESS ONTO THE SITE

Notwithstanding the granting of possession of the Site by the Engineer for the purpose of carrying out the Works, the Contractor shall arrange for access onto any part of the Site considered necessary. Access through private property or removal of any fence, wall, live tree or hedge in the line of the proposed work will require the written consent of the owner in conjunction with any affected land owners or communities.

The Contractor shall not enter upon any private property without first notifying the owner (or occupier) in advance of their intention to enter.

No significant customary land issues are anticipated as a result of the Works, however the Contractor must communicate clearly and accurately with the Employer's representatives regarding any part of the construction works that may affect sensitive community areas or are likely to cause damage to personal property.

On completion, the Contractor shall leave the Site in as good a condition as when first entered by the Contractor – including fences, walls or gates

3.14 ACCESS TO PROPERTIES

The Contractor shall ensure that pedestrian and suitable vehicular access is maintained at all times to all properties bordering the Works. Arrangements to the contrary made with individual owners or users of the property shall be notified to and approved by the Engineer.

Access to commercial properties shall be maintained unless essential work is being carried out at the entrance. The Contractor shall advise the owner/user of the duration of the disruption to the access.

The Contractor shall provide safe and suitable alternative pedestrian access through and/or around the work area.

3.15 SERVICES FOR THE SITE

The Contractor shall make his own arrangements to provide suitable water and electricity supplies and telephone or other services to all parts of the Works.

The costs of providing adequate water and electrical supplies, and telephone services including all connections and the payment of metered charges shall be included in the rates in the Bills of Quantity.

All electrical installation forming part of the temporary works shall comply with the electrical standard currently having force in Samoa.

The Contractor shall provide, maintain and keep clean sanitary facilities for his workers employed upon the Works if none is already available, to the satisfaction of the Supervisor and of the Department of Health. These facilities shall be located so as to prevent any pollution of groundwater, surface watercourses or the surrounding area, and the Contractor shall take all steps necessary to prevent any nuisance arising from the use thereof.

There is no mains drainage away from the Site though the Contractor may install a sealed cesspit.

The Contractor shall make arrangements for the emptying of the toilets and the sanitary disposal of their contents away from the Site, and shall remove all his sanitary facilities from the Site on completion of the Works.

3.16 CONTRACTOR'S WORK AREA

The Contractor shall provide at his own expense all necessary workshops and sheds for storage of materials etc, and clear away on completion and make good all areas disturbed. He shall also provide offices for his own resident staff, foreman, etc, including lighting and sanitary accommodation and fittings together with attendance and clear away on completion and make good all areas disturbed.

3.17 CLEANLINESS OF SITE

The Contractor shall be responsible for the proper upkeep and maintenance of the Site and the Works and shall remove from the Site rubbish and other waste as it accumulates. Materials and equipment shall be positioned, stored and stacked in an orderly manner.

The Contractor shall ensure that the Site and the Works including all public and private access roads are kept free of mud and soil from site traffic and provide regular cleaning throughout each working day to maintain this.

The Contractor shall take all practical measures to prevent contamination or pollution of the existing water supply facilities, arising from the construction of the works.

3.18 WORKS WITHIN THE ROAD CARRIAGEWAY

Refer to Engineering Standards, Part 4, Section 3.1.3

The Contractor is responsible for obtaining from the LTA any permits required for access to or use of public road reserves.

The Contractor shall carry out the work in a manner which will permit the safe passage of vehicular and pedestrian traffic over the whole lengths of roads included in the Contract and in within the hours of work set out in the Contract. This will necessitate the setting up, maintenance, alteration and removal of Traffic Management Systems.

All traffic ways shall be maintained firm, smooth and readily negotiable to traffic under all weather conditions. The Contractor shall (where practicable) maintain at least half the width of the roadway open and passable to all traffic at all times.

Interference with all traffic movements shall be minimised consistent with the nature of the work being undertaken, particularly as a proportion of the Works may be located alongside a public road. The Engineer reserves the right to suspend work if the safety of the motoring public is being affected.

Warning signs and controllers shall be provided at each end of the section of work to fully protect, advise, and/or divert passing vehicular and/or pedestrian traffic and to control speeds.

The Contractor must ensure that there is no complete disruption to traffic during construction. Necessary re-routing and other traffic management measures shall be put in to effect. The Contractor shall also inform the LTA for notification to the public prior to a disruption.

Work within the road carriageway shall, unless specified otherwise within the Contract, be carried out in full compliance with the requirements of all applicable laws.

The Contractor’s appointed Site Supervisors shall be entirely responsible for:

a) Liaison with the Engineer's Representative, Land Transport Authority and the Police in all matters relating to traffic management.

b) The management of traffic during periods when traffic restrictions are necessary and ensuring that all traffic management requirements are met, including the appropriate use of signage, cones, barriers.

c) Immediately notifying the Police of any accidents or emergencies.

d) Ensuring the safe working of plant, machinery and personnel and ensuring that all personnel engaged on the Works are aware of the Contractor's obligations and duties in respect of site safety when working on live highways.

e) Notifying the Engineer of any deterioration in Traffic Management Equipment and trafficked road surface.

As soon as possible after the Commencement of the Works and before any Traffic Management Operations take place the Contractor shall arrange a meeting with Police, the Land Transport Authority and the Engineer to discuss traffic management and emergency procedures. Thereafter, the Contractor shall arrange regular meetings throughout the Contract period with the Supervisor to review traffic management and emergency procedures.

Where 2-way traffic is maintained on existing carriageways, 750 mm high cones shall be provided over the full length of the Contractor's working, to separate opposing traffic streams.

Where road lighting exists over a length of road covered by a Traffic Management System, it shall be maintained or modified such that the standard of lighting is no worse than the existing.

A speed restriction of 20 kph shall be imposed over the entire length of the Contractor's working and the Contractor shall at the commencement of such Works, erect speed limit signs at each end.

Where a side road or private access connection to the operative road needs to be carried across part of the site it shall be maintained by means of temporary access unless an agreement has been reached with the owner of such private property.

No area of carriageway shall be operated to traffic until it has been cleared of all personnel, plant, items of equipment and materials, has been swept, and has been approved by the Supervisor.

3.19 QUALITY ASSURANCE

Refer to Engineering Standards, Part 4, Section 3.1

The Contractor is responsible for quality control measures which incorporate all techniques including checking and testing required to ensure the Works meet all the requirements of the Contract.

The Contractor shall develop and maintain an approved Quality Management Plan that meets the minimum requirements of the Engineering Standards (Water), the Contract including the Standard Specification and, any additional requirements specified in the Project Specification. The Engineer may consider alternative quality control systems submitted by the Contractor provided that these assure the required outcomes. The Engineer will carry out surveillance during the contract, which may include checks of the Contractor’s system and records.

Such plan shall identify the 'Inspection and Test Plans "covering the inspection and tests to be carried out by or on behalf of the Contractor to ensure proper performance in the carrying out of the Works.

The Contractor shall provide for routine inspections of its work by experienced employees of the Contractor. These employees shall be able to comprehensively observe conditions and make sound judgements as to the nature of any defects of workmanship or hazards and their degree of urgency for corrective action. Such inspections shall be allowed for in the tender price.

Details of all procedures shall be submitted to the Engineer for information before each stage of the Works is commenced. When any document is issued to the Engineer relevant signed quality statements shall accompany it. The Engineer shall be entitled to audit any aspect of the system and require corrective action to be taken.

Compliance with the quality plan shall not relieve the Contractor of any of its duties, obligations or responsibilities under the Contract.

The Employer may also audit the Contractor's quality procedures and quality control at any time.

3.20 QUALITY CONTROL INSPECTION

The Contractor shall be responsible for undertaking inspection and test work to verify that materials and workmanship forming part of the Works comply with the Contract. Personnel appropriately trained and experienced in the test to be performed shall undertake all testing.

All test and inspection results shall be made available to the Engineer within 24 hours of either completion of the test or inspection, or being issued by a third party testing / inspection agency, whichever is applicable, unless agreed otherwise in writing.

The Engineer is however, entitled in the course of surveillance of the Works, to take independent samples, tests, measurements or observations to confirm that the Contractor is complying with the specified requirements.

All of the Contractor's quality control records are to be readily available to the Engineer upon request.

3.21 APPROVALS

Where the Contract documents use the term Approved or Approval this shall mean the approval in writing by the Engineer.

3.22 ISSUE OF COMPLETION AND DEFECTS LIABILITY CERTIFICATES

The Contractor shall claim Completion and shall submit a certificate signed by the Contractor Manager stating that the works have been inspected and are free of omissions and defects. If there are omissions or defects that, in the opinion of the Contractor, do not impede the full use of the Works then these shall be listed on the certificate.

The Engineer may then undertake an inspection of the Works and add to or delete from the original defects list provided by the Contractor and the revised defect list will be given to the Contractor for rectification. If the defects list contains items that in the Engineer's opinion are significant or they affect the unimpeded use of the new works then the issue of the Completion Certificate or Defects Liability Certificate shall be delayed until such items have been rectified. If this defects list contains items that in the Engineer's opinion are insignificant and they do not affect the unimpeded use of

the new works then the Completion Certificate or Defects Liability Certificate shall be issued but the assessed value of the items requiring rectification shall be retained until such items have been rectified. The Engineer will place a reasonable time limit on the completion of the remedial work after which time, if not completed, the Engineer may carry out the work using others at the Contractor's expense.

3.23 RE-INSPECTION BY THE ENGINEER

Should the Engineer find evidence of non-conforming materials or workmanship or results at variance with any certified Quality Control form, the Quality Manager, on request from the Engineer, shall supply within one working day a written explanation for the variance detailing what remedial action has been taken.

Where the Contractor advises the Engineer that some aspect of the Works is complete and the Engineer finds on review and/or inspection that the work is either not complete or does not meet the requirements of the Contract Documents, then all costs of the subsequent reviews and/or re-inspections by the Engineer may be deducted from the Contractor's payments.

Failure to do so or to comply with any such request may result in the Works being required to cease until the requirements are met, to the satisfaction of the Engineer.

3.24 EMERGENCY ARRANGEMENTS AND REPORTING

The Contractor shall maintain arrangements whereby he can quickly call out labour outside normal working hours to carry out any work needed for an emergency associated with the Works. The Supervisor shall be provided at all times with a list of addresses and telephone numbers of the Contractor's staff who are currently responsible for organising emergency work.

The Contractor shall acquaint himself and his employees with any relevant local arrangements that are in existence for dealing with emergencies.

Notwithstanding the submission of the normal and regular monthly reporting, the Contractor shall report to the Engineer promptly and in writing the particulars of any accident or unusual or unforeseen occurrences on the Site, whether likely to affect the progress of the work or not; stating also the steps he has taken or is arranging to take in the matter.

3.25 SITE SIGN BOARDS

The Contractor shall provide and erect signboards at the entrance to the Works in accordance with instructions from the Employer and shall not be less than 4 m x 3 m in size. The Engineer shall define the exact location.

3.26 SITE FENCING

Around working areas and along access routes the Contractor shall provide maintain and afterwards remove such temporary fencing as may be necessary for the safety of persons and livestock. This clause shall not limit any of the Contractor's liabilities or obligations under the Contract.

3.27 REINSTATEMENT

Refer to Engineering Standards, Part 4, Section 10

The Contractor shall reinstate all works and make good any damage caused by its operation to as good as or better than original condition, matching the surrounding environment in every respect.

The Engineer will seek written confirmation from property owners for approval of the reinstatement work. Should there be issues raised by the owners or occupiers, which in the opinion of the Engineer require further reinstatement or remedial work to be undertaken by the Contractor, these shall be made good as instructed by the Engineer. Such work may be required to be completed prior to issue of either the Completion Certificate or the Defects Liability Certificate.

3.28 ENVIRONMENTAL

Refer to Engineering Standards, Part 4, Section 4.4.5

The Contractor is responsible at all times during the Contract to ensure that no person is inconvenienced or suffers nuisance as defined in the Health and Labour Acts from noise, vibration, dust or other processes arising from any means whatsoever from the Works. The Contractor shall be held responsible for any claim, in which may arise from the disregard of this clause. The effect of any such claim on the Contract, and any delays arising from any mitigating measures, shall not constitute grounds for a claim for an extension of time for completion. The Contractor is to allow for the prevention of such occurrences by the use of practicable means approved by the Engineer.

Allowances shall be made for dust control at all times including:

a) Dampening of surfaces of the source of such nuisance when required or as instructed by the Engineer.

b) Ceasing work in areas at times when climatic conditions prevail such that the previous measures proves to be unsatisfactory in the opinion of the Engineer.

The Contractor shall comply with all relevant consents, government laws and with all lawful direction made by the LTA, MNRE, PUMA or other relevant authority.

The Contractor shall exercise due care and responsibility to minimise damage to plants and animals and shall ensure that no polluting substance (including cement particles) shall be discharged onto the land or into the air or any water body. In particular, the Contractor shall:

a) Ensure silt and sediment originating from the Works cannot be eroded and/or carried by any water flowing into or through the Works and is not allowed to discharge without control into water bodies. This may require erosion and silt controls and these shall be maintained and remain in place until completion of the Works.

b) Not permit hydrocarbons to drain to ground during any operation; all leaks are to be collected in drain trays or collection vessels.

c) Store all petroleum products away from any water body. An oil tray and suitable absorbent material shall be placed on the ground under all petroleum product storage tanks, drums, etc. The oil tray and absorbent material shall be removed and disposed of by the Contractor prior to Contract completion.

d) Keep all valves, taps, pumps etc. on tanks containing petroleum products locked or secured at all times and all reasonable precautions against release of the contents due to vandalism shall be taken.

e) Ensure disposal sites for surplus material and construction rubbish have the prior approval of the Engineer.

No fires shall be lit at any time except with permission from the Engineer and the relevant authority. If permission is granted, fires shall be kept under control and within such areas as may be directed. All property, including buildings, fences and the like, and vegetation, including grass, crops, trees, bushland and the like, shall be protected from the harmful effect of any fire resulting from the work.

The Contractor shall (where consent for removal is not granted) protect trees, palms and other vegetation against damage caused by the Contractor's operations. This may require protective measures to be maintained and remain in place until completion of the relevant portion of the Works.

3.29 DAILY MAINTENANCE

Refer to Engineering Standards, Part 4, Section 4.4.3

At the end of each workday the following maintenance tasks shall be carried out by the Contractor:

a) Clear roadway of debris and sweep if requested by Engineer.

b) Place safety barriers next to excavated areas and maintain in place until reinstatement is complete.

3.30 TIP SITES

Unless noted otherwise or agreed by the Engineer, all excavated material not required for the completion of the Works, shall be removed from the Site. Prior to commencement of the Works the Contractor shall advise details of the proposed disposal site or facility to the Engineer.

All excavated material shall become the property of the Contractor on leaving the Site.

It shall be the responsibility of the Contractor to ensure that disposal of material is in accordance with all government laws.

3.31 PROTECTION AGAINST WEATHER

The Contractor shall take all necessary precautions, to the satisfaction of the Engineer, to protect the Works against the effects of any inclement weather that might adversely affect the quality of the Works, which precautions may include, suspension of all or any part of the Works. Suspension under this clause may entitle the Contractor to an extension of time for completion in accordance with the Conditions of Contract but does not constitute a Variation and additional costs will not be payable.

3.32 ALTERNATIVES

Where any item is mentioned by trade name or by any other specific reference, it shall be deemed to mean the type of article or material so mentioned, or any other approved by the Engineer, as equal thereto in price, quality, finish, durability and serviceability for the purpose intended. The quoting of a trade name shall not be construed as any desire to restrict the use of competitors'

articles or materials and the Contractor is at liberty to offer any equivalent article or material for the Engineer's approval. No warranty is expressed or implied that merchants regularly stock articles or materials specified. Should any articles or materials shown in the Drawings and/or Specification not be available, the Contractor shall notify the Engineer with the tender. All articles or materials not so listed shall be deemed to be available when needed for the prompt execution of the works and no claim will be entertained by the Employer for extra time and/or expense caused through delays in ordering such unlisted items or in obtaining equivalent substitutes for them, or through any consequential alterations to the works necessitated by the use of an equivalent substitute.

3.33 PROPRIETARY PROCESSES

If any proprietary process is used, the Contractor shall follow the proprietor's written instructions and recommendations strictly. Where no indication is given to the contrary, the process that ensures the best result shall be used, provided that no process shall be used which does not comply with the general intentions of this Specification.

3.34 HOURS OF WORK

Unless otherwise instructed or approved, the hours of work shall be 8.00 am to 5:00 pm on working days. The Engineer’s approval is required for work being carried out outside these limits.

Working days are defined as Monday to Friday inclusive, excluding proclaimed public holidays.

In the case of work being carried out affecting traffic flows on main roads during peak traffic periods, hours of work shall be 9.00 am to 3.00 pm on Working Days.

Approval of the Engineer to vary the working hours and working days may include conditions. The Contractor is to provide at least two days clear notice of any request to vary the hours of work or working days.

The Contractor may be required to work during night time for making of connections to existing live water supply mains or as required by SWA to minimize disruption of water supply to their customers. The cost of any night work is deemed to be included in the rates.

3.35 OTHER WORKS

During the course of the Contract the Employer, or others, may cause other works to be carried out on, through or adjacent to the sites. The Contractor shall at all times comply with the requirements of the General and Special Conditions of Contract in respect of these and any other works not included in the Contract and shall allow reasonable access as approved by the Engineer on and through the site of the Works to any other contractor or workmen engaged by the Employer to work on or near the site.

3.36 SITE SECURITY

Onsite Security arrangements shall be facilitated through the SWA and each respective community to protect facilities, equipment and materials assigned for the Works. All costs associated with security, should it be necessary, shall be the responsibility of the Contractor and included in the mobilisation item.

3.37 PROTECTION OF PROPERTY

The Contractor shall take all necessary precautions to avoid damage to road signs, property, or chattels. All damaged property shall be restored to its original condition at the Contractor’s

expense. All footpaths, fences, drives, etc. which are disturbed must be restored to their original condition within 48 hours of such disturbance.

3.38 CUSTOMER RELATIONS

Refer to Engineering Standards, Part 4, Section 4.3

The Works involve providing a service to the Employer's customers and shall ensure that the Works are completed in such a way as to provide a high standard of customer service to the Employer's customers.

The Contractor shall at all times act in a polite and responsible manner with customers (i.e. the general public) and shall respect private property. This shall apply to every person employed by or acting on behalf of the Contractor, including Sub-Contractors. The Contractor shall also ensure a good level of communication with customers and advise customers of any service delivery delays, and assist with information in a pro-active manner.

If there is a query that cannot be easily handled by the Contractor or the customer concerned then the Contractor shall contact the Engineer during business hours.

The Contractor shall not admit any liability on behalf of the Employer. However, if the customer has questions which require answering that are outside of the competency or authority of the Contractor, the Contractor shall immediately advise the Engineer during business hours.

In the event of an issue of significant concern to customers with regard to public health and safety which occurs outside of business hours, the Contractor shall contact the Engineer. If the Engineer is unavailable, the Contractor is to call the Employer's Call Centre and request that the issue be referred immediately to the Engineer.

3.39 NATURE OF GROUND

Refer to Engineering Standards, Part 4, Section 4.7

It is assumed that all Contractors will have inspected each site for themselves and taken into consideration ground stability. No claims for variations of the Contract Price or extensions of time in respect of differences in site conditions from those anticipated will be entertained except as elsewhere provided for in these documents. The Contractor shall excavate, fill and compact soft spots as directed by the Engineer.

3.40 EXISTING SERVICES

Refer to Engineering Standards, Part 4, Section 4.4.2

The position of existing underground services may affect the proposed route of pipelines or location of foundations, and where conflict arises the Engineer shall decide if the pipe shall be laid inside or outside the existing water main or other services. The information showing existing services (if any) is supplied in good faith to indicate to the Contractor that such services are likely to be encountered.

The Contractor shall liaise with SWA, EPC, LTA and MCIT and other owners of apparatus and shall be responsible for the location and protection of all services within the construction zone prior to commencing any pipe laying and/or excavation. Pipes shall not be laid under telephone or power cables unless specifically directed by the Engineer or the appropriate service authority.

The Contractor shall take due care to avoid damaging any utilities and services, including road, driveways, footpaths and road furniture. Particular care must be taken when working around telecommunication and electricity installations.

The Contractor shall notify the Engineer in advance of any diversion or removal of apparatus that he may require for his own convenience or because of his proposed method of working and shall comply with any requirements of the Engineer with respect to them.

Any trench excavation adjacent to electricity transformers or power poles shall be backfilled immediately after pipe is laid, and in no case shall the trench be left open overnight.

The Contractor shall immediately inform the appropriate authority and the Engineer of any damage resulting from the Works. Repairs to damage caused, as a result of the Contractor's works shall be arranged for repair at the Contractor's expense.

All costs associated with service utilities shall be allowed for in the tendered rates.

3.41 PROTECTION OF DRINKING WATER

When undertaking the Works, particularly in schemes with untreated water sources, the Contractor's staff shall maintain good hygiene practices and work cleanliness.

All pipe materials and fittings shall be handled, stored and installed in a manner that eliminates contamination by animal or human waste, soil or other contaminants.

Should any component to be installed as part of the Works become contaminated, the Engineer should be notified immediately and the necessary cleaning procedures, as determined by the Engineer, undertaken at the full cost of the Contractor under the supervision of the Engineer.

Before each section of a new main is commissioned in accordance with the contract specification, it shall be thoroughly flushed swabbed with clean water and disinfected under the direction of the Engineer and in consultation with the Employer's representatives. Due to supply shortages in the dry season within some schemes, flushing and cleaning shall not be undertaken during peak water demand periods, as determined by the Engineer in consultation with the Employer's representatives, and flushing shall avoid unnecessary water wastage.

3.42 MATERIALS AND STANDARDS

Unless otherwise specified the materials for which New Zealand or Australian Standard Specifications exist shall comply with the latest version of the relevant requirements of those standards.

Unless otherwise approved by the Engineer in writing all materials are to be new, shall bear the stamp with the manufacturer's license to produce products to that standard, shall originate from New Zealand, Australia or procured through an approved local Hardware Supplier and of first class quality, free from imperfections.

Particular attention shall be paid to the prevention of corrosion due to the proximity of dissimilar metals or ambient conditions. All parts shall be corrosion resistant or adequately protected against corrosion.

Should the Engineer find evidence of non-conforming materials or workmanship or results at variance with any certified Quality Control form, the Contractor on request from the Engineer, shall supply within one working day a written explanation for the variance detailing what remedial

action has been taken. Any product of material rejected due to non-conformance with the requirements of the Contract Documents shall be replaced at the Contractor's expense.

Where the Contractor advises the Engineer that some aspect of the Works is complete and the Engineer finds on review and/or inspection that the work is either not complete or does not meet the requirements of the Contract Documents, then all cost of the subsequent reviews and/or re-inspections by the Engineer will be deducted from the Contractor's payments.

3.43 DELIVERY AND STORAGE

Refer to Engineering Standards, Part 4, Section 5

All plant, pipes, fittings and materials, both temporary and permanent, necessary to complete the Works, whether detailed in the Specification or not, shall be provided by the Contractor. The Contractor shall make all arrangements for the purchase, cartage, shipping, loading, unloading, trans-shipping, expediting, permits and security necessary to ensure that the goods arrive on the site in good condition and in due time.

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

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

The Contractor shall ensure that all pipework and fittings are stored to the manufacturer's recommendations. PVC pipes, rubber gaskets, valves and other ultra violet light sensitive items shall be stored such that they are not subject to exposure to hot sun. Cement shall be stored in dry weather proof buildings with adequate ventilation, on wooden slats raised a minimum of 150 mm above ground level to allow effective circulation of air.

The Contractor shall make his own arrangements with landowners, occupiers or responsible Authorities for the provision of any temporary storage areas he may require.

3.44 LIKE ITEMS

All like items covering the complete range of diameters in the Bills of Quantity shall be from the same manufacturer, be similar in design and operation, and have interchangeable parts where applicable. Manufacturer's certificates shall be provided if required by the Engineer.

3.45 AS-BUILT DRAWINGS

Refer to Engineering Standards, Part 4, Section 11

All as-built drawings shall be submitted by the Contractor for approval by the Engineer. A Certificate of Completion shall not be issued until all as-built plans have been submitted and comply with the requirements of this Clause. The Engineer shall approve drawings before the final payment of total completed works is issued to the Contractor. The Employer will be the owner of these drawings.

All as-built plans shall show the following:

- The diameter of all new pipelines (excluding service connections less than 50 mm diameter). For all pipes except PE, the nominal internal diameter shall be stated and, for PE Pipe, the external diameter shall be stated.

- The jointing type used on all pipe e.g. for PE pipe “electrofusion welding”.
- Junctions and joints shall be located accurately and referenced to the appropriate boundary peg or significant point.
- The size and type of all valves installed.
- The location of all service connections onto the new pipe. The service connections shall be located either as a running chainage from a water supply surface structure (i.e. valve or hydrant) or referenced to the appropriate boundary peg or significant point.
- The location of all valves, hydrants, tees, bends, blank caps and road crossings referenced to the appropriate boundary peg or significant point.
- Pipe line routes where they deviate from the specified alignment

The contractor shall submit 2 x A3 sized copies of each of the above ‘as built’ plans on completion of works and prior to the final testing of the water supply systems. A copy of the ‘as built’ AutoCAD drawings shall also be provided in electronic format.

3.46 BILLS OF QUANTITY

This is an admeasure (measure and value) contract so the Contract Price is determined by the measured quantities of work actually carried out by the Contractor in accordance with the provisions of the Contract.

The quantities set out in the Bills of Quantity are estimates only and such quantities will not be considered as final measurements. All work will be measured in the field or from the Drawings and approved by the Engineer upon completion of the relevant work. Payment will be at the rates entered in the Bills of Quantity or at prices otherwise determined in accordance with the terms of the Contract.

3.46.1 Methods of Measurement

Except where qualified in the Preamble to the Bills of Quantity or otherwise in this Section and/or the Specification, measurements will generally be determined in accordance with NZS 4224, "Code of Practice for Measurement of Civil Engineering Quantities".

3.46.2 Abbreviations

The following abbreviations are used to describe ‘units’ on the Bills of Quantity.

Abbreviation	Meaning
ea	each
Hr	Hour
kg	kilogram
LS	Lump Sum
m	lineal metre

Abbreviation	Meaning
m^2	square metre
m^3	cubic metre
m^3 (solid)	cubic metre (compacted in place)
m^3 (truck)	cubic metre (excavated volume)
mm	millimetre
Mo.	Month
No.	number
PS	Provisional Sum
RO	Rate Only
t	tonne

3.46.3 Description of Scheduled Items

The descriptions entered against several items in the Bills of Quantity are given only to identify the items. Reference must be made elsewhere in the contract documents for a full description of the work and general liabilities covered by the rates and prices entered against each item.

3.46.4 Adequacy of Rates and Sums

The items in the Bills of Quantity together with the rates and sums entered against them cover everything necessary for the completion and maintenance of the Works to the complete satisfaction of the Engineer. Items have been provided in the Bills of Quantity for all major operations, and the rates and sums entered against them cover all accessories and minor items together with the cost of complying with all general obligations imposed by the Contract. Except where identified separately in the Bills of Quantity, all miscellaneous items, supervision, contingencies, maintenance, conveyance of plant and incidental work, plus general overhead administration are incorporated in the rates and sums entered in the Bills of Quantity. All rates and sums entered in the Bills of Quantity are proportioned, having regard to the special conditions of the work in each case. It will be deemed that all indirect costs, risk and profit are distributed among the rates and prices entered in the Bills of Quantity in proportion to the direct costs allowed for by the Contractor in each rate and price.

The positions shown on the drawings may be varied. Each price, rate or sum entered in the Bills of Quantity covers the scope of work defined regardless of where the work is performed on the Site.

3.46.5 Unscheduled Obligations

No claims will be entertained on the basis of omissions of items from the Bills of Quantity which are shown on or may be inferred from the drawings or which are referred to in the specification or which is an integral part of an item measured or referred to in the Bills of Quantity.

3.46.6 Preliminaries and General Items

The Preliminaries and General Bill of Quantities items are to include costs associated with the Contractor's mobilisation, establishment on site of all manpower, equipment, plant, vehicles, accommodation, temporary services, temporary drainage and fencing, and all overhead costs such as arise from mobilising resources and plant, arranging insurances and bond, and permit costs for all Sites in the contract schedule.

The items also include the provision of all notifications and information required before commencing work on the Site, and for all supervision costs associated with the contract.

General items also includes all costs associated with the preparation, supply, implementation and maintenance of the Safety Plan, Programme of Works and Quality Management Plan (including the programme), monthly reporting and all necessary Contractor costs related for the liaison related to the checking and approval of the plans by the Engineer.

Liaison and compliance with statutory authorities and utilities is to include all costs associated with the obtaining of any permits or approvals and; the location of utility services, ensuring utility service providers are informed as required with respect to the Works, and complying with the utility provider’s requirements. The cost of all applicable fees for permits and other compliance requirements shall also be included here.

Liaison and cooperation with affected landowners, tenants and SWA customers shall include all costs associated with compliance with Clauses 3.13 and 3.38.

The Engineer in accordance with the stage of Contract completion will assess the proportion of the sum to be certified from time to time. The final 25% of the Lump Sum for Mobilisation will not be paid until the Contractor has removed all facilities from the Site and a Certificate of Completion has been issued for the Contract.

3.46.7 Test and Commission

Payment will be made upon completion of a successful pressure test in accordance with the Technical Specification, to the satisfaction of the Engineer. The rate shall be in full compensation of all plant, materials and labour for the complete pressure testing and commissioning of the pipeline including but not limited to the supply, installation, and removal of all temporary blank caps, anchor blocks and tapping bends, and testing of the pipeline as specified.

3.46.8 Dayworks

Dayworks Labour

The rates for labour on dayworks are rates at which payment will be made for labour employed on dayworks on the instruction of the Engineer. Payment will be made in respect of the actual hours worked by the labour.

The rates allow for taxes (except VAGST), pensions, training, travelling time, insurances, holiday pay, payment in respect of time loss due to inclement weather, executive superintendence, non-working foremen, the use and maintenance of all small tools not classified as plant, all establishment charges, profit, overheads, and any other payments which the Contractor may be required to make to the workmen under the relevant employment agreements. Plant operators are included for under the rates for Plant where appropriate.

Plant

Full payments for working plant will only be for the actual hours worked. The rates for plant are for use of the plant inclusive of all fuel and consumable stores, overhauls, repairs and replacements, and for haulage to and from the site (except as stated above) and inclusive of operator.

The Dayworks Schedules provides for the pricing of an all-inclusive hourly rate (excluding VAGST) for the use of plant owned by the Contractor. The percentage rate entered in the Dayworks Schedules provides for a percentage addition to the net cost of hired plant used on dayworks and allows for all overhead charges, profit and all incidental costs whatsoever.

The time necessarily spent in moving plant within the Site as a result of the Engineer's instruction to use it on Dayworks will be added to the actual hours worked, provided that no time spent in moving for purposes of maintenance, repair or refuelling will be added.

Materials

The percentage rate entered in the Bills of Quantity provides percentage additions to the net cost of materials used on dayworks and allows for all overhead charges, profit and all incidental costs whatsoever.

The percentage addition will apply to all materials delivered to Site and instructed by the Engineer to be used in dayworks. The net quantities and weights actually used in accordance with the Engineer's instructions only, will be certified and paid for, together with any material necessarily and unavoidably cut to waste with the Engineer's knowledge and consent and any surplus material which the Contractor is unable to use for its own use and which the Engineer instructs to be delivered to the Employer’s store. The Contractor must provide copies of supplier invoices as evidence with any claim for materials under this item.

Provisional Sum

A provisional sum has been provided under Preliminaries and General Items for the payment of works instructed to be undertaken on a dayworks basis. No work on a dayworks basis shall be undertaken without a written instruction by the Engineer or his representative.

4. PIPEWORK AND FITTINGS

4.1 PIPEWORK GENERAL

All pipe work and jointing materials shall be suitable for use in contact with potable water. Pipe work shall be as detailed in the Specification or Drawings. Any screwed pipe work and fittings shall have pipe threads as specified in SWA Design Standards.

All pipe work and fittings shall be supplied complete with the necessary nuts, bolts, washers, gaskets, etc. All bolts to be buried in the ground shall be wrapped in an approved waterproof tape.

Pipes or fittings that have been dropped or damaged in any way shall be clearly marked and set aside for inspection. On no account shall they be installed until inspected and approved by the Engineer.

4.2 PIPEWORK SPECIFICATIONS

4.2.1 Modified PVC Pipe (mPVC)

Refer to Engineering Standards, Part 3, Section 2.2.

mPVC (PVC-M) Series 1 pipe shall conform to AS/NZS 4765 - Modified PVC (PVC-M) pipes for pressure applications. Unless otherwise approved, the following specifications shall apply:

- Pressure Class PN15 (Minimum)
- Pipe diameters of DN100 and above only
- Colour white
- Spigot and socket joints with Z-type rubber rings only. Solvent welded jointing cannot be used.

mPVC pipe of diameter less than DN50 may be approved by the Engineer for some limited applications using solvent welded joints.

mPVC pipe and fittings shall be used only where minimum cover requirements can be practically achieved. mPVC pipe is not approved for above ground use or where minimum pipe cover cannot be achieved due to rock or proximity of other utility service conduits.

4.2.2 Polyethylene Pipes

Refer to Engineering Standards, Part 3, Section 2.3.

Polyethylene pipe shall conform to AS/NZS 4130 (PE) pipes for pressure applications.

Polyethylene fittings shall conform to AS/NZS 4129 fittings for pipes for pressure applications.

Unless otherwise approved, the following specifications shall also apply:

- Compound PE 100
- Pressure rating PN 16
- Standard Dimension Ratio (SDR) 11
- Electrofusion welding, butt fusion welding or mechanical jointing system as specified
- Colour black with blue stripes

Note:

- Nominal Diameter (DN) refers to the outside diameter of the pipe
- Polyethylene pipes and fittings shall be used for all customer services from water main to meter assembly.

4.2.3 Cement Lined Ductile Iron Pipes And Fittings

Refer to Engineering Standards, Part 3, Section 2.4.

Ductile iron pipes and fittings shall conform to AS/NZS 2280 – Ductile Iron Pressure Pipe and Fittings.

Unless otherwise approved, the following specifications apply:

- Minimum Pressure Rating PN35
- Socket-spigot joints with Z rings to NZS/BS 2494 or flanged joints to AS 4087, Class 16, Figure B5 or Class 35, Figure B6 (or AS2129, Table D) as shown on the drawings.
- Fittings shall be coated externally by polymeric coating in accordance with AS/NZS 4158.
- Ductile Iron Pipe and fittings to be internally concrete lined.
- Screwed connections can be used for DN equal to and below DN40 only.

All pipework, fittings shall be carefully inspected prior to and after installation and any damage to the coating made good in accordance with the manufacturer's recommendations.

Where ductile iron pipes such as puddle pipes are to be built into concrete they shall be delivered externally bare over the area to be embedded and shall be thoroughly de-scaled and cleaned by wire brushing to the satisfaction of the Engineer before being embedded.

Approved pipe and fittings:

- CrevetGriptite (Licence # 943 & 950)
- Humes (Licence # 2029)
- Surecast
- Tyco Tyton Joint (Licence # PRD/R61/0412/1)

4.2.4 Galvanised Steel Pipe

Refer to Engineering Standards, Part 3, Section 2.6.

Galvanised steel pipe and fittings shall conform to NZS/BS 1387 Specification for screwed and socketed steel tubes and tubulars and for plain end steel tubes suitable for welding or for screwing to BS 21 pipe threads. Pipe wall thickness shall be Medium.

Pipes shall not be concrete lined. Pipes for underground service and stream crossings shall have an external coating of 3mm minimum thickness of Coal Tar Enamel and Fibreglass wrapping in accordance with NZS 4442. After assembly, joints shall be coated to match

the pipe. Pipes for the above ground service shall have 1 coat of primer and 2 coats of chlorinated rubber to achieve a dry paint film thickness of 150 microns.

Galvanised steel pipe shall NOT be used unless specifically scheduled for special sections of work such as water meter assemblies and above ground manifold pipe-work around reservoirs, bore casing and bore columns etc.

4.3 PVC PIPE JOINTS

4.3.1 Socket Joints

Refer to Engineering Standards, Part 3, Section 2.2

mPVC/uPVC (PVC) pipes shall be supplied with integral socket spigot with Z rings to NZS/BS 2494 (and covered byAS/NZS 4765). Connections to fittings larger than 50 mm shall be by socket spigot with Z rings or flanged gibault adaptors, anchored in accordance with the Drawings.

4.3.2 Unrestrained Mechanical Gibault Adapters

Refer to Engineering Standards, Part 3, Section 2.20

Mechanical Gibault Adapters & Couplings manufactured from Ductile Iron shall be used to join PVC pipelines to other materials or fittings to allow a dismantling point where specified in the Drawings. Refer to section 4.6 for material standards.

4.3.3 PVC Bends

Large radius PVC bends fabricated from PN16 pipe shall be permitted for PVC bends up to and including 150 mm diameter. Flanged ductile iron bends shall be used for PVC mains greater than 150 mm.

4.3.4 PVC Pipe Connections to Concrete Chambers

Where the PVC pipe passes through the wall of the concrete chamber, a water tight joint between pipe and chamber shall be made by coating the pipe with solvent cement for the full engagement length and dusting the wet solvent cement with dry sand. When this surface has set, it will key more readily to concrete or mortar. The engagement portion of the pipe shall be free of all scratches and damage to ensure a good watertight seal.

4.4 POLYETHYLENE PIPE (PE) ELECTROFUSION WELDING

The Contractor shall provide the Engineer with full details of his proposed welding equipment together with written confirmation from the pipe manufacturer that the equipment is suitable for the welding of the pipes.

Prior to commencing with any welding on site, the Contractor shall submit the names of all welding operators who will carry out field welding under this Contract together with details of their qualifications and/or relevant experience.

Before any production welding is commenced, the Contractor shall establish, document and submit detailed welding procedures to the Engineer. These welding procedures shall comply with the specification and shall include:

a) A copy of the manufacturer's instructions and welding parameters (e.g. heating temperature, time, cooling time).

b) The pipe diameter, material type and wall thickness.

c) The type of welding machine, its cylinder area and the weld procedure to be used (e.g. single phase or dual phase).

d) Contractor's proposed procedure for undertaking fusion welding

A sample test fusion weld shall be conducted at the Contractor's cost for each of his welding operators and approved by the Engineer.

No pipe is to be laid until testing has been completed to the satisfaction of the Engineer.

In the event that a weld does not meet the approval of the Engineer, then the Contractor shall repeat the test for the relevant welding operator. In addition to the above, the Engineer may randomly request further welding tests; the costs of testing shall be included in the pipe laying rate.

4.4.1 Joint Preparation

The pipe ends to be welded shall be cut and trimmed square to the pipes axis using a face plate trimmer. The trimmer should always be cleaned with a clean cloth and non-depositing alcohol prior to each trim.

The pipe ends shall then be peeled clean using a rotary peeler (Do not use a scraper of any kind) for a distance equal to half the length of the coupling to remove all dirt and oxidation layers. All swarf and rough edges shall also be removed. The pipe spigot ends are to be cleaned inside and outside with a non-depositing alcohol wipe. Ovality shall be removed with a re-rounding tool prior to welding.

4.4.2 Jointing for Electro-fusion Welding

All electro-fusion couplings shall be as recommended by the pipe manufacturer and joints shall be made in strict accordance with the couplings manufacturer's instructions.

Electro-fusion couplings are to be installed strictly in accordance with the manufacturer's instructions, and using the power source designed for the brand of couplings used.

Once welding has been completed the welded joints must not be moved until the nominated cooling time has been completed. The weld is not to be artificially cooled.

Each weld shall be given a unique number (the numbering system shall be approved in advance with the Engineer) which is to be marked on the pipe and the Contractor shall record the following information for each weld:-

- Welding operator's name
- Date
- Welding conditions
- Welding details (i.e. joint type, size, time etc)
- Any inspection details

These records shall be submitted to the Engineer following inspection and approval of the weld.

Approved PE electrofusion couplers:

- Frialen SDR11-17 PN16
- Georg Fischer ELGEF Plus

4.5 POLYETHYLENE PIPE (PE) MECHANICAL JOINTING SYSTEMS

Mechanical self-restraining (restraint) compression fittings, shall comply with AS/NZS 4129.

4.5.1 63PE and Smaller

For 63 mm diameter PE pipe or smaller, the following mechanical self-restraining compression fittings are approved as a pipe-to-pipe jointing system:

- Pushlok Fittings
- Easy Grip Fittings
- Philmac BSP threaded fittings (DN50 and below only)
- Georg Fischer Alprene A16 Easygrip Fittings

Note: Plasson and Sapphire Fittings shall not be accepted.

1.1.1 90PE and larger

Refer to Engineering Standards, Part 3, Section 2.3

Only Electrofusion Welding is acceptable.

4.6 FITTINGS

All fittings shall be supplied complete with the necessary nuts, bolts, washers, gaskets, etc and these are deemed to be included in the rates for supply, assembly and commissioning of such fittings. Pipes or fittings that have been dropped or damaged in any way shall be marked clearly and set aside for inspection. On no account shall they be installed until inspected and approved by the Engineer or his representative.

All joints, bends, tees, crosses, tapers, risers, connections, blank caps, and other fittings shall be manufactured, designed and constructed to withstand 16 bar working pressure. All fittings shall be flanged to AS/NZS4087 PN16 Fig 5 (or AS 2129 Table D).

The following fixtures and fittings standards are acceptable:

- mPVC – AS/NZS 4765
- uPVC - AS/NZS 1477
- PE - AS 4130, WIS 4-32-04, BS 6572, NZS 7610.
- Electro fusion couplers: International 39.5 volt system to comply with WIS 4-32-06 - 1989.
- Ductile Iron - AS 2280(protected accordingly).
- Welded Steel - NZS 4442 (protected accordingly).
- Cast Iron - BS 1452 (grade 220) or AS 1830 and BS 4622 or AS 2544 and BS 2494 (rubber rings) and AS 2129 Table D (for drilled flanges).

- Stainless steel (nuts and bolts etc) grade 316.
- Hot Dipped Galvanised Mild Steel (nuts and bolts etc) grade 4.6.
- Rubber seals - EPDM Rubber complying with AS 1646.

All cast iron fittings shall be nylon or epoxy coated in accordance with AS/NZS 4158.

All cast iron fittings shall be flanged and all connections to the pipeline pipe shall be flange-gibault adaptors or flange adaptor and gibault coupling. The use of plain end cast iron fittings shall not be acceptable unless specified in the Drawings.

4.7 GASKETS

Refer to Engineering Standards, Part 3, Section 2.1.8

Gaskets for flanged joints shall be of the inside-bolt-circle type, manufactured from high-grade synthetic rubber.

4.8 HAND-WHEELS

Hand-wheels shall be of cast iron with smooth and rounded machined rims. The hand-wheels shall have an arrow and the word 'OPEN' cast on to indicate the direction of opening. Any alternative direction arrows shall be neatly ground off.

4.9 PIPE JOINT LUBRICANTS

Refer to Engineering Standards, Part 3, Section 2.1.9

Pipe joint lubricants for sliding joints shall have no deleterious effects on either the joint rings or pipes. Lubricants shall not impart to water taste, colour, or any effect known to be injurious to health, and shall be resistant to bacterial growth.

4.10 VALVE/HYDRANT SURFACE BOXES

Refer to Engineering Standards, Part 3, Section 2.27 and 2.28

Surface boxes for valves and hydrants shall be heavy-duty cast iron or ductile iron to an approved pattern. They shall have hinged lids with the letters SV or FH cast into the upper surface as appropriate the dimensions shall be such to as to allow easy access to the fitting for all normal operations. Valve surface boxes shall be firmly bedded in concrete and accurately positioned. When finished the top surface shall protrude 10 mm above the top of the final surface except in roads when it shall be flush with surface and lie parallel to the plane of the surrounding surface. Rectangular valve surface boxes shall be laid so that the long side of the lid is parallel to the line of the main.

Surrounds shall be placed and constructed in such a way that no traffic load on the surface can be transferred directly through the surrounds or chamber on to any pipe or fitting. Under no circumstances shall the lowest precast unit bear on the valve or pipe.

Where a valve or other surface box is (with approval) located in a concrete surface (footpath, etc), the concrete surface shall be boxed to 150 mm larger than the surface box. Consolidated concrete shall be used to secure the valve box.

Unless otherwise approved, the following specifications shall apply:

- "SV" or "FH" in capital letters cast into the centre of the cover, lettering height 75 mm.
- "FH" 380 mm x 230 mm clear opening, "SV" 300x 200
- Material – Ductile Cast Iron grade AS 1831/700 or Cast Iron to AS 1830.
- Loading – Heavy Duty – complying with AS3996.
- Coating – bitumen to AS/NZS3750.4
- Surface of cover is to be finished with a non-skid pattern raised 5 mm

4.11 MANHOLE COVERS

Refer to Engineering Standards, Part 3, Section 2.26

Manhole covers and frames shall comply with AS3996. Covers may be single or multi-part, solid or concrete infill to suit the required opening. In all cases the minimum acceptable opening is 900 x 900mm or 900mm diameter. Manhole covers for water supply purposes shall be water tight.

Manhole cover frames shall be firmly bedded in high-strength concrete and accurately position to ensure no reduction of the clear opening into the space. In all paved areas the top of the cover and frame shall be flush with the surrounding surface and lie parallel to the plane of the surrounding surface. In unpaved areas the top of the chamber cover and frame shall protrude 10mm above the surrounding area.

Unless otherwise specified the following specifications shall apply:

- Size: as shown on the drawings and schedules.
- Clear entry: all manhole covers and frames shall provide for a minimum clear entry of 900 x 900 mm or 1000 mm diameter.
- Class: areas subject to vehicular access – Class D, all other areas - Class B. Class D covers shall be non-rocking. Covers for water supply applications shall be watertight. Covers shall not be lockable unless shown otherwise on the drawings and schedules.
- Materials: Covers shall be manufactured from ductile cast iron conforming to AS1831/ISO 1083 grade 500/10 or cast iron to AS1830.
- Skid resistance: Surface of cover is to be finished with a non-skid pattern raised 5 mm minimum.
- Protective coating: bituminous coating in accordance with Clause 2.7.1 of AS3996 or with **AS/NZS3750.4** applied to all non-sealing and non-threaded surfaces of the cover and frame. Sealing and threaded surfaces shall not be coated.
- Solid covers are preferred.
- Where concrete filled covers are required to meet the specified size requirements, then structural infill procedures in accordance with Appendix G of AS3996 must be supplied with each delivery.

4.12 FIRE HYDRANTS

Refer to Engineering Standards, Part 3, Section 2.12.

The hydrants shall comply with AS3952 or BS 750/NZS 1152 and shall be of the clockwise, closing regular pattern (i.e. tall pattern), streamline screw down type 75 mm diameter and the flange drilled on the inlet shall be for an 89 m diameter flange and have slotted holes, rated PN16 or higher.

Pure PTFE gland packing (see below) or "O" ring sealing system and nylon or epoxy coated to AS/NZS 4158.

Hydrants must be supported to prevent any sideways movement on the line of the main. Hydrants shall be mounted on an approved type of hydrant tee with hydrant risers, if necessary, so that the top of the hydrant spindle is within the range of 100 mm to 250 mm of the finished surface level. The hydrant tee shall be supported by the concrete anchor block sufficient in size to take all the hydraulic thrust exerted when the hydrant is in operation. Hydrants must be placed within 5°of vertical.

Each hydrant shall be covered with an approved type hydrant box and lid, the final visible surface of which shall be painted with road marking paint in accordance with Standard Detail Drawings.

Approved Hydrants:

- Hydra valve- MicoCrevet
- Gillies screw down hydrants –Tall type
- Tyco Fig F 502 Fire Hydrant Tall type.
- AVK Series 29 Tall Hydrant

4.13 STOP TAP VALVES (DN15 FOR WATER METER ISOLATION)

Refer to Engineering Standards, Part 3, Section 2.16.

DN15 ball valves shall be full bore, ¼-turn dezincification resistant (DZR) brass ball valves, manufactured to AS 4796. All water meter valves shall have BSP female-female threaded ends with lever handles.

Approved valves:

- Isis Heavy Pattern WaterMarked DZR Brass ball valve
- ZetcoWaterMarked DZR Brass ball valve.

Where a lockable water meter valve is specified on the drawings, the locking mechanism will slide over the stem nut to prevent removal or tampering with the stem. The lock mechanism will allow the insertion of a padlock of diameter matching SWA's padlock system for service disconnections.

The following lockable water meter valve is approved by SWA:

- DN15 (1/2") Isis WaterMarked DZR brass ball valve fitted with an integral locking lever providing both lock open and lock closed facilities.

4.14 GATE VALVES (LESS THAN DN80)

Refer to Engineering Standards, Part 3, Section 2.9.

All gate valves less than DN80 shall be clockwise closing, handwheel operated with female/male BSP screwed end joints. Gate valves shall be approved to BS 5154 or AS 1628 or DIN 3352 part 4.

Typical approved models:

- AVK 50 mm 03-063-6000 service connection valve (2" BSP/63PE socket for 50mm pipeline connections)
- AVK 50 mm 03-063-3000 service connection valve (63PE socket for 50mm pipeline connections both ends)
- Hawle 50mm 4050 (63PE fusion tail both ends)

4.15 GATE VALVES (DN80 AND LARGER)

Refer to Engineering Standards, Part 3, Section 2.8

Gate valves shall be resilient seated - manufactured to AS/NZS 2638.2, clockwise closing. External and internal protective coating to AS/NZS 4158. Rated at PN16.

All sluice valves shall be provided with boxes, surrounds, with paint markings and indicator posts in accordance with the Drawings.

Approved models:

- Hawle E2 series
- AVK Series 55 & 57 valves (Licence SAI #2420 & 2573)
- Gillies SF Series
- Tyco Figure 500 Series (Licence # PRD/R61/0412/2)
- Crevet Ltd Norcast(Licence # 1327)

For installation in PE pipelines Hawle 4060E2 and 4500E2AS Series (Licence # SMKP20123) valves with electrofusion PE tails shall be used for all valves unless flanged or socket end models are specified in the Drawings.

Flanges to be raised face and drilled to AS/NZS 4087 PN16 figures B5 (or AS2129, Table D).

Sluice valves arranged for keyway operation shall be supplied with the necessary cast iron surface boxes and extension spindles as specified on the schedules.

4.16 AIR RELEASE VALVES

Refer to Engineering Standards, Part 3, Section 2.10.

Air release valves shall be the float type with a ductile iron body and bolted cover or approved ABS copolymer, bottom inlet and float and valve operating mechanism of non-corroding materials. Air valve materials shall be compatible with potable water and shall be fitted with an isolating valve. Sealing faces should be suitable rubber.

Air release valves shall be double acting valves of the size indicated in the following schedule. They shall automatically exhaust bulk air during filling of the pipeline and automatically allow air to re-enter the pipeline when the internal pressure approaches a negative value due to draining or a major pipeline break. The valves supplied shall also be capable of automatically exhausting small quantities of air from the line during operation. The valves shall be so designed to ensure that the ball or float is not drawn into the orifice by high air velocities.

Air Release Valve Sizes (mm)	
Pipeline Diameter	Air Valve Branch Connection
100 -150	25
200 -250	50

Isolation valves for air release valve installations may be Bonomi Topic ball valves or similar approved by the Engineer.

Approved air release valves:

- ARI S-010 25 mm, BSPT threaded.

Air valves larger than DN50 shall be flanged: Flanges to be raised face and drilled to AS/NZS 4087 PN16 figures B5 (or AS2129, Table D) and shall be as specified in the Project Specification.

4.17 NON RETURN VALVES

Refer to Engineering Standards, Part 3, Sections 2.8 and 2.9.

Non-return vales shall comply with AS 4794-Non Return Valves for Water Purposes – Swing Check and Tilting Disk

Unless otherwise specified swing check valves shall be adopted. Valves bodies shall be manufactured from ductile iron, rated at PN16 and designed to avoid shock on the valve and the pipe work immediately downstream. Flanged end connections shall be raised face and drilled to or AS/NZS 4087 PN16 figures B5 (or AS 2129 Table D).External and internal protective coating to AS/NZS 4158.

All non-return valves shall be suitable for installation in either horizontal or vertical pipework.

Approved models of swing check non-return valves:

- AVK model 41/8X.

4.18 PRESSURE REDUCING VALVES (PRV'S)

Refer to Engineering Standards, Part 3, Section 2.13.

Pressure Reducing Valve bodies shall be standard sized, manufactured from highest quality meehanite cast iron or ductile iron, flanged to match the pipe-work and supplied complete with full face flat rubber joint rings and 316 stainless steel bolts.

Internal and external operational parts shall be manufactured from 316 stainless steel.

The body and sealing shall be streamlined to avoid shock on the valve, wear and cavitation at all of the operating conditions of the valve and the pipe work immediately downstream.

Internal seals should be manufactured from suitable rubber in order to be drop-tight as far as possible and to ensure maximum performance reliability with minimal maintenance as recommended by the manufacturer.

Pressure reducing valves shall be designed with a maximum working pressure of 16 bar and shall be provided with quality pressure gauges with a range appropriate to the operating conditions.

Approved models:

- Cla-val model 690

PRV's shall be installed in conjunction with a suitable, standard size inline strainer upstream.

4.19 REMOVAL OF REDUNDANT VALVES

Where an existing valve or hydrant is made redundant by the Works the Contractor shall undertake the following:

- Remove the box and concrete surround to waste.
- Place appropriate compacted hard fill within the valve riser.
- Reinstate the ground surface in accordance with the Contract Document.
- Indicator posts may either be re-used provided they are in reasonable condition or removed to waste.
- Return redundant valve to the SWA Store at Vaitele.

4.20 MARKER POSTS

Marker posts for valves and line indication shall be of an approved type in painted, concrete filled pre-galvanised steel tube. Valve indicator posts shall be coloured blue and shall bear the inscribed letter "SV". Line indicator posts shall be coloured white.

4.21 GALVANISING

Where items are required to be galvanised they shall first have all weld spatter, mill scale and other adherents removed after fabrication then they shall be pickled, washed and hot dip galvanised in accordance with the relevant AS/NZS standards. The deposition rate shall be a minimum of 460 g/m^2. All parts shall be neutralised after galvanising in order to minimise discolouration.

Where galvanised items have been cut or damaged on site, the damage to the galvanising or to the cut edges shall be immediately made and by means of an approved zinc-rich cold galvanising paint.

Repairs to damaged items shall only be carried out with the approval of the Supervisor.

4.22 SERVICE CONNECTIONS

Except for any large connection that may be required, a standard service connection shall consist of the following:

a) EITHER a LG2 gunmetal DR type, fully enclosed tapping band, OR – a Polyethylene type, fully enclosed with stainless steel bolt tapping band (*Refer to Engineering Standards, Part 3, Section 2.19)*

b) a 15 mm female/female ¼ turn ball valve in accordance with the Drawings using approved fittings and materials (*Refer to Engineering Standards, Part 3, Section 2.16)*

c) the required length of 20 OD PE PN16 service pipe from the main valve to the meter to a maximum of 6 m length.

Approved models:

- Milnes Tapping Bands
- Talbot (Winchester) Self Tapping Ferrule
- IPLEX Kwik Tap
- OBE – Tap Self Tapping bands

Note:

Securer type (with round knurled head), S'LON type Ferrules, and Ali-Bronze Tapping Bands shall not be accepted.

Galvanised bolts must not be used in conjunction with gunmetal tapping bands, stainless steel bolts shall be used. Electrofusion welded tapping bands are not permitted.

4.23 RESERVOIR FLOAT CONTROL VALVES

Refer to Engineering Standards, Part 3, Section 2.15.

Ball float valves are required for closing the water reservoirs inlets. Valves bodies shall be manufactured from materials suitable for the purpose. The lever shall be manufactured from non-corroding cast iron, mild steel or stainless steel and the float shall be manufactured from tinned copper or a suitable plastic. The body and sealing shall be streamlined to avoid shock on the valve, wear and cavitation at all of the operating conditions of the valve and the pipe work immediately downstream.

Valves for new steel storage tanks, DN100/DN150 inlet shall comply with the following:

Cla-Val W-series DN100/150 flanged 90 degree angle valve with CF1-C1 float, copper/bronze tube & fittings (model 8124-01), flanges drilled to AS 2129 Table D or AS/NZS 4087 PN16, figure B5 or B6.

Unless otherwise approved, the following specifications shall also apply:

- Threaded end connections shall comply with AS 1722.2.
- Flanged end connections shall be raised face and drilled to AS 2129 Table D or AS/NZS 4087 PN16, figure B5 or B6.

4.24 METERS

4.24.1 Bulk Meters

Refer to Engineering Standards, Part 3, Section 2.17.

Bulk water meters shall be standard size ductile iron inline helical rotary magnetic drive (Woltman) type water meters, cubic meter measuring, epoxy blue. The meters shall be suitable for horizontal or inclined pipelines without loss of accuracy.

Water Meters shall be manufactured to AS 3565.1 Meters for cold potable water, Part 1: Volumetric and Turbine Meters. Where the meter is required to measure a wide range of

Flows, meters shall be manufactured to AS 3565.2 Meters for cold potable water Part 2: Combination Meters.

Unless otherwise approved, the following specifications shall also apply:

- Threaded end connections shall comply with AS 1722.2.
- Flanged end connections shall be raised face and drilled to AS 2129 Table D or AS/NZS 4087 PN16, figure B5 or B6.

Restriction of the water flow through the meter must be kept to a minimum with low head loss characteristics, and no change in the direction of flow.

For maintenance purposes the complete measuring mechanism shall be quickly replaceable with a pre-calibrated measuring mechanism. One spare pre-calibrated complete measuring mechanism shall be supplied for each size of meter.

The Register shall be sealed and waterproof with a minimum 7 figure straight reading counter calibrated for cubic metres reading to an accuracy of ± 2%.

The Register shall include a dial or sweep hand reading to 0.1 m^3, and a protective lid.

The body shall be of highest quality cast iron, flanged to match the pipe-work. Supply complete with full face flat rubber joint rings and bolts. Maximum working pressure shall be 16 bars.

Approved models:

- Bermad WPH-K Class B or C
- SensusMeijet Class B or C
- Meinecke WP
- ActarisFlostar M Class C

Bulk meters shall be installed in conjunction with a suitable, standard size inline strainer upstream.

4.24.2 Domestic Water Meters

Refer to Engineering Standards, Part 3, Section 2.18.

Approved models:

- Zenner MTK-AM ZR Class C inline water meter
- Elster Kent PSM-T Class C inline water meter
- Sensus 620 Class C inline water meter
- Actaris TD8 Class C inline water meter
- Maddalena DS TRP Class C inline water meter

Other makes as tested & approved could include Meinecke, Sappel.

4.25 STRAINERS

Refer to Engineering Standards, Part 3, Section 2.11.

Bulk water meters and PRV's shall be installed in conjunction with a suitable, standard size inline strainer upstream.

It is preferable to allow a length of straight pipe equal to five times (5x) the internal pipeline diameter of the pipeline between the meter and strainer to improve the accuracy of the downstream meter.

Strainers shall have:

- A working 16 bar pressure and 1 bar maximum head loss.
- A sieve element made from 316 stainless steel.
- A body manufactured from ductile iron or cast iron. External coating shall be a polymeric coating in accordance with AS/NZS 4158.
- Flanged end connections with raised face and drilled to AS 2129 Table D or AS/NZS 4087 PN16, figure B5 or B6.
- A body to be clearly marked with flow direction, size, serial number, manufacturer's identity and pressure rating.

Restriction of the water flow through the strainer must be kept to a minimum with low head loss characteristics.

For maintenance purposes the complete strainer insert component shall be accessible to allow easy removable for regular cleaning.

Approved models:

- Kent (Elster) H4010
- Sensus WP-F

4.26 ANCHOR BLOCKS

Cast in situ concrete anchor blocks shall be provided at all points where an unbalanced thrust occurs on mains exceeding 50 mm diameter. This shall include all bends, tees, valves, reducers, hydrants and at any other position as may be required.

Anchor blocks shall be poured against natural (undisturbed) ground and the inner face of the block shall not be of a lesser thickness than the diameter of the fittings and shall be so constructed as not to impair access to the bolts on the fittings or access to adjacent joints or fittings. Any additional excavation required to accommodate anchor blocks shall be carried out after the fitting is in position and the thrust face shall be trimmed back to remove all loose or weathered material immediately prior to concreting.

Concrete shall have minimum compression strength of 17.5MPa at 28 days. Anchor blocks shall be allowed to develop adequate strength before any internal pressure is applied to the pipeline.

Precast concrete blocks shall be used for DN50 mm pipelines.

A protective membrane to protect against abrasive damage to the pipeline shall be provided between the pipe (irrespective of the pipe material) and the concrete anchor blocks.

Where all pipes connecting to a fitting are continuous PE pipes and approved end-restraint or electrofusion welded fittings then an anchor block will not be required, except in special circumstances.

Where a mechanical jointing is used to connect the PE pipe to a pipe or fitting of then an anchor block shall be constructed at that fitting. Precast anchor blocks shall be used to support all sluice valves and hydrants.

All anchor blocks shall be left exposed for inspection by the Engineer before backfilling.

Where pipes are laid on a grade steeper than 1 in 3 they shall be securely anchored by means of high grade concrete blocks to prevent movement down the slope.

4.27 CONNECTIONS

Where PVC or iron pipes pass through the concrete wall of manholes, tanks, structures or chambers a watertight joint shall be made by coating the pipe with solvent cement for the full engagement length and dusting the wet solvent cement with dry sand. When this surface has set, it will key more readily to concrete or mortar. The engagement portion of the pipe shall be free of all scratches and damage to ensure a good watertight seal.

5. PIPELINE HANDLING, INSTALLATION, TESTING AND COMMISSIONING

Refer to Engineering Standards, Part 4, Section 7

Notwithstanding the requirements of this section, all pipelines shall comply with the relevant standards for installation, from handling through to commissioning.
These standards include but are not limited to;

- AS/NZS 2566.2 - Buried flexible pipelines – Installation
- AS/NZS 2032 - Installation of PVC pipe systems
- AS/NZS 2033 - Installation of polyethylene pipe systems

5.1 TRANSPORTATION AND HANDLING OF PIPES

All handling (including transportation and lifting) of pipes shall be undertaken in such a manner as to prevent damage to linings and coatings, and deformation or breakage of any kind and to ensure the safety of workers and the public.

All pipes shall be stored on racks and supported to prevent deformation as per the manufacturer’s specifications and shall be kept clear of pedestrian traffic at all times.

Unless due precautions are taken, pipes shall always be moved in slings or bolsters and not rolled.

All pipes and associated fittings necessary for the construction of the pipeline become the contractor's responsibility after removal from the points of supply.

If a pipe or fitting is damaged after leaving the point of supply, it will be rejected until the defective part has been removed or repaired at the Contractor's expense and to the satisfaction of the Engineer.

5.2 PIPE ALIGNMENT

5.2.1 Allowable slow bending

Before any trench excavation or banking for pipes is undertaken, the levels of the original surface shall be surveyed with an approved method or instrument and agreed between the Engineer and the Contractor, recorded on drawings or in writing but shall in no way relieve the Contractor of responsibility for on-going accuracy. In the event of work being undertaken without such prior agreement, the Contractor shall accept the levels and figures determined by the Engineer.

For supply pipelines, particularly intake pipelines, the work shall be carried out in strict accordance with the positions, levels and alignments shown on the plans or directed by the Engineer and shall not be varied without the prior consent of the Engineer. The Contractor shall use an approved method or instrument for maintaining line and grade.

Where possible, pipes shall be laid in straight runs or laid in slow bends in accordance with the manufacturers specifications.

PVC joint deflection should not exceed 3° (degrees) from the straight or bent in a radius no less than 200 times the pipe diameter.

PE pipelines should be kept as central as possible within the trench to enable correct side-fill compaction.

The bending of PE is permissible and the properties of fusion jointed systems enable changes of direction without recourse to the provision of special bends or anchor blocks. PE pipe shall not be cold bent to a radius smaller than 20 times the outside diameter.

The Contractor shall increase the width of trench excavation to enable each joint to be correctly made in the straight condition and after jointing to be deflected to the required degree of curve.

5.2.2 Tight bends

All required bends exceeding joint deflection or pipeline bending allowances must be made with appropriate socket spigot or electrofusion fittings – with preference for long radius bends where practical – and anchored in accordance with the Drawings. This requirement includes bends in both the horizontal plane and the vertical plane (such as sags and crests).

Hot bending of PE or PVC pipe shall not be accepted under any circumstances.

5.3 PIPE INSTALLATION

All excavation work shall be carried out safely and in accordance with, government laws and Health and Safety regulations.

All pipe laying shall be carried out by competent personnel whom the Engineer considers suitable.

Any protective coatings applied to the pipes that are damaged, must be repaired to the Engineer's satisfaction before laying.

Where socketed pipes are laid, joint and sling position holes shall be formed in the bedding material to ensure that each pipe is uniformly supported throughout the length of its barrel and to

enable the joint to be made, and to allow the free withdrawal of the sling without risk of damage to pipe external coatings.

No protective cap, disc or other seal on the end of a pipe or fitting shall be removed until the pipe or fitting that it protects is ready to be jointed. Suitable measures shall be taken to prevent soil or other material from entering pipes, and to anchor each pipe to prevent flotation or other movement before the Works are complete.

Flanged joints shall be correctly aligned before any bolts are tightened. Jointing compounds shall not be used when making flanged joints. Bolt threads shall be treated with graphite paste and the nuts tightened evenly in diametrically opposite pairs.

Pipes shall be cut by a method which provides a clean square profile, without splitting or fracturing the pipe wall, and which causes minimal damage to any protective coating. Where necessary, the cut ends of pipes shall be formed to the tapers and chamfers suitable for the type of joint to be used and any protective coatings shall be made good, and the ends sealed.

Where ductile pipes are to be cut to form non-standard lengths, the Contractor shall comply with the manufacturer's recommendations in respect of ovality correction and tolerances to the cut spigot end.

Pipes built into the structures shall be installed to a tolerance of ±3 mm in a vertical or horizontal direction. In addition, to ensure that the flange boltholes are in correct alignment, the tolerance on angular position shall be ±1 degree.

5.3.1 Open Trench Pipe Laying

All trenches should be cut no wider than that detailed the Drawings. Additional excavation is necessary at each joint to provide sufficient room for the joint to be properly made and to ensure that the pipe rests on the barrel and not on the socket. The preparation of the trench bottom to give an even bed for the barrel of the pipe and the proper alignment of the pipe is of great importance.

Trenches shall be excavated in straight lines, or in even curves between bends and fittings, and the trench bottom shall be trimmed to an even level and grade, free from soft spot, rocks and other debris before pipe laying is commenced.

A 100 mm layer of approved free running, non-cohesive, granular material (including sifted excavated spoil) shall be laid along the trench bottom prior to laying the pipes. Depressions shall then be made to accommodate the pipe joints.

If the Contractor takes out any material to a greater depth than shown on the drawings or specification without the instruction of the Engineer, the extra depth shall be filled with AP20 mm hardfill in uniform layers not exceeding 150 mm in thickness. Each layer shall be thoroughly compacted before the next layer is placed and compaction shall be achieved by mechanical compaction equipment appropriate to the size and location of the trench.

No additional payment will be made for additional backfill due to over-excavation, either depth or width.

In the event that trenching is permitted through paved footpath, driveways or carriageways, the Contractor shall saw-cut along both edges of the trench in continuous straight lines parallel to the pipeline. All excavations within these areas shall be to the minimum dimensions as per the drawings and standard details.

At no stage shall a trench entirely close off a public roadway or remain open at the end of a day's work.

5.3.2 Marking Tape

Refer to Engineering Standards, Part 3, Section 2.22

The contractor shall provide and lay approved 100mm wide "detectable" warning tape within above the bedding layer for all buried pipe installations, 50mm diameter or greater. Approved tape shall be blue with metallic stainless steel or copper alloy wire, stipulating "CAUTION- WATER MAIN BURIED BELOW" (or similar). No metallic tape is required for ductile iron or steel mains.

5.3.3 Overland Pipe laying

All overland pipes scheduled in the Contract shall be black PE and laid in straight lines, in even curves to avoid damage from foot and vehicle traffic, plantation fires, ploughing and vegetation trimming. The ground surface shall be cleared by hand to an even level and grade, free rocks, sharp edges and other debris before pipe laying is commenced.

All overland pipes shall be laid with suitably spaced hillside/overland pipe restraints as specified in the Drawings. The spacing shall be as directed by the Engineer, but shall be no less than 20m intervals.

Where changes in direction greater than the maximum allowable bend of the pipe material or the maximum allowable deflection of the pipe joints are required, a factory fabricated bend with a suitably designed thrust block must be installed to the satisfaction of the Engineer.

5.4 TESTING

Testing shall be undertaken to prove the structural soundness of all construction including structures, pipelines, and valves, thrust blocks and to prove the water-tightness pipelines and structures including but not limited to intakes, storage tanks and break pressure tanks.

5.4.1 Pressure Testing

Before pipeline joints are covered, each section of the main, together with all fittings (including all in site concrete thrust blocks) shall be pressure tested. The test shall be carried out and all necessary apparatus supplied by the Contractor.

Water for the testing shall be provided from an approved potable water supply at the cost of the Contractor. All testing pumps and equipment shall be checked by the Engineer prior to any testing. When the pipeline has been charged with water, the Contractor shall ensure that air has been completely removed, that valves are in working order and that the stuffing boxes of valves are watertight. Particular attention shall be paid to sealed off branches.

PVC and Steel pipelines shall be filled with water and all air discharged. Concrete lined pipes shall be soaked for at least 12 hours before testing. A pressure of 12Bar (but no more than the working pressure) shall be maintained for a period of not less than 4 hours and measured at the lowest point of the section under test.

PE pipelines shall be filled with water and all air discharged. A pressure of 10Bar (but no more than the working pressure) shall be maintained for a period of not less than 4 hours and measured at the lowest point of the section under test.

Thereafter, the pump shall be disconnected and at the expiry of a period of 24 hours the quantity of water consumed in restoring the original test pressure shall be measured. The quantity of water consumed shall not exceed 20 litres per 100 mm diameter of pipe per 1000 metres length over the period of 24 hours.

Care must be taken not to exceed the test pressure at any point on the pipeline by sitting the pressure gauge at a known level on the pipeline and by making a suitable correction.

The Works may utilise and connect to existing pipelines as outlined in the Contract. Under the direction of the Engineer, the Contractor will be required to carry out additional Pressure Testing on some of these lines and fittings.

5.4.2 Swabbing

On completion of pipelaying and hydraulic testing in any section of the Works and before disinfection, the Contractor shall pass a soft foam swab through the pipeline a sufficient number of times to achieve clear wash water. The Contractor shall provide all necessary swabs and temporary pipework, fittings and pumps for the work.

5.4.3 Disinfection

After the satisfactory testing of the water supply pipelines, they shall be thoroughly cleaned in accordance with the Specification. When instructed to do so by the Supervisor and under the Supervisor's direction, the Contractor shall then disinfect the pipeline by chlorination either in sections or as a whole. The Contractor shall provide a suitable chlorine-dosing pump (including the provision of chlorine) which shall be capable of accurately injecting the required concentration of chlorine solution at a steady rate into the pipeline. The Contractor shall introduce at least 20 mg/L. of chlorine or such greater quantity of chlorine as will produce a residual of at least 1 mg/L of free chlorine at any point along the pipeline or section of the pipeline being sterilized two hours after the whole of the pipeline or section of the pipeline has been filled with water. The Engineer or his representative will test the residual of free chlorine.

If after 24 hours, the residual chlorine is 1 mg/L or greater, then disinfection shall be deemed to be complete and the chlorinated water shall be drained and flushed away to a suitable outlet where no harm will result from the flow or its chlorine content.

On completion of disinfection, the Contractor shall close off access to the pipeline and no further work will be permitted affecting the interior of the pipelines. Should any unauthorized access occur and if the Supervisor rules that contamination may have resulted, the Contractor shall carry out at his own expense re-disinfection measures required by the Supervisor.

5.4.4 Pipeline Commissioning

In cases where sections of an existing pipeline are replaced, the existing pipeline shall remain in place and operational until such time as the new pipeline has been successfully tested and approved by the Engineer.

Both the new and existing pipelines shall remain operational until the last service connection in the affected area has been transferred to the new pipeline, or a temporary supply in place to the satisfaction of the Engineer.

Only at this time, in conjunction with the Employer’s representatives, can the existing pipeline be abandoned and disconnected or capped in accordance with the standards set out in the Drawings.

Temporary fittings such as tees and additional sluice valves may be incorporated during the pressure testing and commissioning phase and then replaced by an approved, permanent connecting joint but the connection excavation must remain open until the Engineer has approved the connections.

Under the direction of the Engineer, the Contractor may be required to carry out additional Pressure Testing in accordance with the Contract on such connections. Such additional pressure testing shall be expected as a part of the necessary temporary works to ensure the supply is maintained to the community at all times and the Contractor shall meet all associated costs for all additional pressure testing.

5.5 BACKFILLING OF TRENCHES

Backfilling of pipe trenches shall be carried out immediately the pipes have been tested and shall be carried out in general accordance with Section 5 of AS/NZS 1477 using granular bedding material as outlined above.

A 100 mm layer of approved free running, non-cohesive, granular surround material shall be laid above the top of the pipe before placing selected backfill.

The selected backfill material may comprise granular or other material arising from excavation works, if approved by the Engineer and shall be free of organic materials, lumps larger than 150 mm and stones larger than 40 mm. It shall be carefully introduced, placed and compacted.

If any excavated material is deemed unsuitable for use as backfill by the Engineer, the Contractor shall import suitable material as a replacement. The Contractor shall provide the Engineer with samples of the proposed imported backfill material for approval no later than seven days before the commencement of backfilling operations.

Each layer of backfill shall be a maximum thickness of 200 mm and shall be spread and compacted before the next layer is placed. Where hand compaction is required the layers shall be a maximum of 200 mm uncompacted layers.

Backfill material shall not be substantially wetter or drier than the surrounding soil as some backfill soils may expand or shrink as they attain the same moisture content as the surrounding soil. Any backfill material markedly different in character from the surrounding soil should not be used except with the approval of the Engineer.

All open cut trenches within the road carriageway shall be backfilled and reinstated with premix before the contractor leaves the site after a day's construction. No exemption to this level of temporary reinstatement shall be permitted by the Engineer.

5.5.1 Backfilling of Trenches under Roads

Pipe trenches in public sealed roads shall be filled above the pipe bedding with approved material as specified by the LTA specifications for the specific area of works and in accordance with approved construction methods. The material shall be transported and spread by methods that shall not cause the segregation of the coarse and fine particles.

The Contractor shall confirm with the LTA prior to commencing any backfilling under roads, the approved materials, construction methodology and comply with all testing required by the LTA in accordance with their specifications.

Areas of segregated coarse or fine material shall be removed and replaced with well-graded material in accordance with LTA specifications for compacted material for the location of the work to the full depth of the layer.

The trench backfill shall be finished to give a hard, tight, dense, stone mosaic surface free of segregated material, cakes of excessive fines, roller marks and other surface irregularities.

5.5.2 Removal and Control of Water

The contractor shall take control of all water reaching the site of the work from any source, so as to prevent damage to the trench, pipe or structures. The Contractor shall be responsible for any damage to persons or public or private property due to interruption or diversion of such waters as a result of his operations and shall make good any such damage at his own expense. This shall include any silt borne water that is seen to block or obstruct street cesspits. The Contractor shall be responsible to have these cleaned out if deemed necessary by the Engineer at his own expense.

5.5.3 Disposal of Excess Spoil

Excavated material except that required and approved for backfilling shall be loaded directly onto trucks and carted to an approved tip site. Unless a tip site is nominated in the Specific Conditions of Contract, the contractor shall arrange his own tip sites and is responsible for any associated costs. He shall also advise the Engineer of their location before commencing excavation. If abandoned asbestos cement pipes are being removed, this shall be done in a safe manner and disposed of at an approved site.

If disposal is not to a nominated tip site, the contractor shall be responsible for the maintenance of the tip sites used, including the spreading of tipped material, formation and maintenance of access roads, and installations of any necessary signs if required.

5.6 HARD ROCK

Rock shall be defined as hard or strongly cemented beds or masses which cannot be ripped at a production rate to exceed 12 m^3/hour by a 12 tonne hydraulic excavator or 15 m^3/hour by a 20 tonne hydraulic excavator with a fully experienced operator and equipped with a 600 mm bucket (max) with suitable rock teeth. Rock shall also be defined as material which cannot be ripped or cross ripped by a bulldozer in good condition of approximately 32 tonne mass when fitted with a single tine ripper of appropriate design, and having a flywheel power of approximately 212 kW (285 HP).

Boulders of volume less than 0.125 m^3 shall not be classified as hard rock; nor shall materials removed from paved or concreted surfaces.

When hard material is encountered for which the Contractor wishes to claim as rock, it shall be notified at once to the Engineer who will give a decision in writing. In cases of doubtful classification, the decision of the supervising Engineer shall be final.

After the Engineer has inspected the rock, the Contractor shall arrange for the rock surface to be surveyed before excavation proceeds. Any material excavated prior to inspection and levelling will not be considered for classification as rock.

Measurement of rock shall be based on solid volumes and on the difference in levels of the surface of the rock and the excavation lines and levels shown on the Drawings.

Payment shall be on solid measure to the trench width as shown in the Drawings and no payment shall be made for over break. The Contractor shall meet all associated costs for any surplus trench width excavations.

5.7 SURFACE REINSTATEMENT

Surface reinstatement shall be at least equal to the original condition or that required by the new works and the Contractor shall allow in his rates and prices to meet this requirement whether scheduled separately or not.

5.7.1 Grassed Surfaces

All grassed areas and private property affected and disturbed by the works shall be topsoiled. Topsoil shall be free of all sticks, stones, clay or any deleterious material and shall be spread to a compacted depth of 50 mm.

The Contractor shall restore the finished surface of the excavated trenches by replacing and lightly compacting the excavated topsoil to form a slightly mounded finish.

In cut and fill areas the surface finish specified in the earthworks section shall apply.

5.7.2 Non-metalled Plantation Tracks (Unsealed / Unpaved Access Roads)

Where trenches and associated excavations are clearly through non-metalled plantation, vehicle tracks or driveways, backfilling shall be with compacted hardfilling without topsoil. Any subsequent subsidence shall be rectified with the addition of extra basecourse at the Contractor's expense.

5.7.3 Metalled Roads (Tar-sealed / Paved Roads)

Reinstatement of Metalled Roads shall generally comply with the Land and Transport Authority (LTA) Standards. Where LTA Standards are not available, reinstatement shall meet the minimum requirement as follows.

Where trenches and associated excavations are through metalled carriageways or plantation tracks backfilling shall be with compacted hardfilling. Where directed by the Engineer, the top 200 mm of backfill shall be GAP 40 basecourse metal as defined in NZS 4404 and shall be thoroughly compacted.

Any subsequent subsidence shall be rectified with the addition of extra basecourse at the Contractor's expense.

5.7.4 Time for Completion of Reinstatement

The Contractor shall complete the reinstatement of any section within the period specified below:

Paved surfaces - within seven days of backfilling the trench, but always before a public holiday period.

Unpaved surfaces – within 14 days of backfilling the trench.

If the Contractor has not completed the reinstatement of any section within the specified period, the Engineer shall have the power to have such reinstatement work done without further notice and the cost of such work shall be deducted for payments due to the Contractor. The Engineer however, may extend this period to allow for periods of prolonged wet weather, or other reasons.

5.8 CARRIAGEWAY CUTTING AND REINSTATEMENT – PUBLIC SEALED ROADS AND PUBLIC FOOTPATHS

All public sealed road carriageway surfaces and paved public footpath surfaces damaged or removed during the works shall be reinstated as shown on the Drawings and as specified below. All surface reinstatement shall be completed before Completion will be granted.

All cutting and reinstatement of public sealed roads and public footpaths shall be undertaken in full accordance with the standards and specifications of the Land Transport Authority. Prior to commencing of any cutting of pipe trenches in public road reserves, the Contractor shall confirm with the LTA the required materials, construction methodology required and shall comply with all testing required by the undertaken in accordance with LTA specifications.

Where there is a conflict between the road specifications in the Project Specification and the LTA road works specifications, the LTA specifications shall take precedence.

Road cutting shall be carried out with a road cutter or similar tool to the minimum width required for excavation and installation of the pipeline in a manner to reduce damage to surrounding roadways as specified by the LTA. All machinery used shall be fitted with pneumatic tired wheels to reduce damage to roads.

Backfilling of trenches under roads shall comply with the requirements of Clause 5.5.1.

The surfacing and sealing of the trench shall be undertaken as directed by the LTA to match the existing surfacing of the road.

The minimum extent of reinstatement shall be 300 mm from the extent of the trench as shown on the Drawings. All edges shall be saw cut to produce a straight edge.

Where the edge of the trench is within one metre of a construction joint, a crack or the edge of the existing pavement, then this additional area shall be replaced as part of the trench reinstatement.

Footpaths and driveways, either cut by a pipe trench or otherwise damaged as an unavoidable result of the Works shall be reinstated or wholly replaced as directed by the Engineer. All work shall be carried out in accordance with the relevant LTA specifications and standards or, in absence of these, in accordance with the recommendations from LTA engineers.

The cost of reinstatement shall be paid as an extra over to the rate for the installation of the pipeline.

6. PUMP STATIONS AND RISING MAINS

6.1 MATERIALS

Material specifications shall be those defined in Section 4 of this specification.

6.1.1 Flanges, Bolts and Gaskets

Flanges shall have dimensions and drilling to AS 2129 Table D except where specifically noted otherwise.

All bolts and gaskets are to be suitable for long-term use with potable water.

All gaskets shall be made of EPDM (ethylene propylene diene monomer).

Where PE pipe is to be connected to ductile iron or stainless pipe or fittings or any other material, the connection shall be made using the correct PE stub flange, stainless steel backing ring and stainless steel dressing set. Bolts shall be tightened to the correct torque.

All pipe threads are to be BSP unless noted otherwise.

All backing rings on plastic pipe shall be stainless steel and shall be fastened using stainless steel dressing sets.

6.1.2 Stainless Steel

All stainless steel shall be 316 grade. Stainless steel nuts and bolts shall be factory coated with Molybond coating or approved alternative.

6.1.3 Non-Return Valves

These shall be a 300 series stainless steel spring-loaded valve with a synthetic rubber seal, installed between two flanges as detailed on the drawings and shall be suitable for use with potable water.

6.1.4 Cylindrical Filters

All cylindrical filters consist of "wedge wire" screens prefabricated from acid dipped (top surface polished) AISI 304 grade stainless steel to meet the performance requirements of the Drawings, in accordance with the manufacturers specifications.

All cylindrical filters shall be made of 60 M (1.52mm headwidth x 2.54mm depth) wedge wire on SR250 support ribs (6mm deep x 3mm wide) at 25 mm centres with a flanged end for pipe connections on one end, and bevel welded ring and flat bottom cap on the other end.

The cylindrical filter shall be continually wound around a set of support rods, which are either shaped or round.

Each size of wedge wire cylindrical screen assembly shall be as follows: refer to Project Specification, Section 2 –Particular Specification.

The open area for cylindrical wedge type filters shall be between 24.4% and 39.7% for 1 mm aperture opening. The Minimum Collapse Pressure of all wedge wire filters is to be 2813 kPa. The slot shall be 1.0 mm ± 0.1 mm.

Approved manufacturers:

- Deeco Services Ltd (NZ)
- Wedge Tech Australia Pty Ltd

6.2 INSTALLATION OF PUMPS AND PIPEWORK

Pumps (including integrated pump control units) as noted on the drawings will be supplied by the Employer.

All materials detailed on the drawings are to be supplied and installed by the Contractor.

The mounting pedestal shall be accurately located and securely fixed. The pumps shall be installed strictly in accordance with the manufacturer's recommendations.

6.2.1 Pipe Connections to Inlet Wet Wells

Where the pipework passes through the wall of the wet well chamber, a watertight joint between pipe and chamber shall be made by using a PE puddle flange, secured correctly with mortar.

6.2.2 Steelwork

All steelwork, brackets and pipe specials shall be subjected to the anti-corrosion requirements of Clause 17 of this technical specification.

6.2.3 Installation of Pipework

All pipes shall be carefully placed and supported at the proper lines, levels and grades as detailed on the drawings. Gibault and flanged joints shall be made by tightening bolts gradually in diametrically opposite pairs.

6.2.4 Testing and Inspection

The Contractor at his own expense shall supply all testing equipment, materials and labour. The Contractor shall include in his prices for everything necessary to carry out a pressure test on the pumps, pipework and rising mains. The cost of testing shall be included in the general rates for pipelaying and pump installation. The Contractor shall test all pipework in the presence of the Engineer.

6.2.5 The Works After Successful Testing

Notwithstanding successful testing of the works, further leaks or damage that may occur throughout the remainder of the Contract and Defects Liability Period shall be repaired by the Contractor.

6.2.6 Basis of Payment

Where no provision has been made in the Bills of Quantity to the contrary, the price quoted by the Contractor for any pipe laid in position will be held to cover everything necessary for this, including in particular, excavation in all materials met and backfilling, including hand work as necessary, timbering or shoring and dewatering if necessary, laying, jointing, bedding, testing and reinstatement.

7. CIVIL WORKS

7.1 SITES

Refer to the network layout drawings for individual site specific structures included in the Works.

Allowance should be made for any civil earthworks. Each site is to be level and free of loose rock and vegetation to the satisfaction of the Engineer prior to works beginning.

Each structure site is to be prepared with adequate base material as required before any concrete work can be done. Approval by the Engineer of base material and compaction is required before concreting.

7.2 BACKFILLING FOR STRUCTURES, ACCESS ROADS AND TANK CONSTRUCTION

7.2.1 Materials

Structural backfill shall consist of clean, well-graded hardfill that complies with the grading shown on the Drawings or Specifications, wherever specified. The Contractor shall obtain approval from the Engineer as to the acceptability of the material proposed. Ordinary backfill shall consist of selected site excavated material, which is free from organic matter, and free from stones or broken rock larger than 150 mm across.

Backfill shall be carried out promptly behind pipe laying and except with the approval of the Engineer, all trench bracing shall be removed as backfilling progresses.

7.2.2 Structural Backfill

Backfill under all footings and slabs with structural backfill as shown on the Drawings. The backfill used shall comply with the grading shown on the Drawings and be compacted in layers not exceeding 150 mm in loose thickness. Compact by means of a vibrating roller or plate compactor to a minimum CBR of 12 as tested by Dynamic Cone Penetrometer.

Should any filling material become contaminated (with excavated material or the like) or should any placed filling be disturbed, such material shall be dug out, replaced and compacted to the Engineer's direction at no extra cost.

7.2.3 Ordinary Backfill

Backfill exterior faces of footings, walls, supports and structures with ordinary backfill. This material is to be placed in layers not exceeding 200 mm thick and compacted by means of a vibrating roller or plate compactor.

7.3 SITE ACCESS TRACKS

Notwithstanding the access requirements of the Works, the Contractor shall, where scheduled in the Bills of Quantity, provide an access road to a particular structure site, including clearing of vegetation along an existing plantation track or foot trail. All such scheduled site access roads are to be considered temporary and for construction purposes but left in place following completion of construction. Access roads shall be machine or hand excavated, graded dirt surface to facilitate drainage and shall be clear of trees, large stumps or rocks.

7.4 PIPELINE ACCESS TRACKS

Where scheduled in the Bills of Quantity, the Contractor shall provide an access track and associated excavation, and topsoil stripping and backfilling in accordance with the Drawings.

Sub-grade to be inspected and approved by the Engineer prior to application of basecourse.

The basecourse shall be compacted hardcore complying with LTA specifications to a thickness of 200mm.

The surface (top 100mm) shall be graded granular material complying with LTA specifications and shall be thoroughly compacted.

7.5 CHAIN LINK MESH FENCING AND GATES

Refer to Engineering Standards, Part 3, Section 2.30

Chain link fences and gates (including posts, rails, chain link mesh and wires) shall comply with AS1725 with the following minimum requirements:

- Chain link fences and gates shall generally comply with the requirements of Standard Drawing W-026 except where varied by the contract specifications.
- All materials shall be heavy duty galvanised (W10Z). Alternatively, all materials may be black polyvinyl (PVC) coated, if specified by the contract.
- Standard duty galvanised materials are not acceptable as they do not comply with AS1725.
- Security fences shall be a minimum of 2100 mm high plus a minimum 3-strand barbwire extension, 450 mm high.
- Chain link mesh shall comply with the following:
    - Standard diamond pitch 50mm.
    - Wire 2.5mm.
    - Selvedge Knuckle-Knuckle (KK).
- Support cabling: 3.15mm diameter.
- Tie wire: 1.57mm diameter (for tying mesh to support cables).
- Netting clips 19mm x 2.20mm (alternative to tie wire).
- Lacing wire: 2.00mm diameter (for tying mesh to posts and rails).
- Barbed wire: 1.57mm high tensile, long-life (Onesteel Zalcote or similar).

The fencing contractor shall prepare a detailed fencing plan showing the location of all bracing panels, gate layouts and sizes and all other non-standard details, together with a schedule of major material and sizes, for submission to the Engineer for approval prior to ordering materials.

8. CONCRETE STORAGE TANK REPAIR

8.1 TANK WATERPROOFING

8.1.1 General

Following removal of the internal ladder, all surfaces shall be prepared and the waterproofing membrane applied strictly in accordance with the current technical data sheet. A pre-qualified contractor, well trained in the application of the specific, documented, waterproofing system, shall carry out all work. All materials used in conjunction with the new waterproofing system, shall be approved by the product supplier.

8.1.2 Surface Preparation

All surfaces to which the new waterproofing system is to be applied, shall be clean, sound and free from contaminants, such as concrete curing compounds, paints, form release agents and all other coatings.

Concrete surfaces should be prepared by water blasting (and wire brushing where necessary) in order to remove laitance and open up the concrete pore structure.

Concrete surfaces should be free from major imperfections. All major imperfections must be repaired with a suitable, cementitious, reprofiling mortar such as VandexUni Mortar 1-Z, which is suitable for reprofiling depths of 6 mm to 12 mm. Larger repairs are to be carried out using a suitable cementitious repair mortar.

The internal ladder can only be reinstalled following full curing of the waterproofing membrane to manufacturer specification.

8.2 **WATERPROOFING MEMBRANE SYSTEM**

Where designated on the drawings, concrete surfaces shall be waterproofed with a cementitious render, flexible waterproofing membrane. The waterproofing material is to consist of a sulphate resistant cement powder, graded quartz sands and inorganic additives, mixed with a liquid polymer. The membrane must form an impermeable layer on the substrate surface and not rely on crystal growth within the substrate in order to be effective. It must be flexible, compatible with the host concrete and masonry, non-toxic, and can be applied by trowel, or as a slurry by brush or spray application.

The waterproofing product shall have the following properties:

Australian Standard AS4020:	Potable water compatibility maximum pass achieved
Form:	Cementitious powder
Colour:	Cement grey
Crack movement:	0.3 mm dynamic crack movement
Elongation at break:	13% (20°C)
Water head capacity:	15 metres (positive and negative pressure)
Initial set:	2-4 hours
Full cure time:	5 days @ 20°C, 50% RH
Application temperature:	5°C to 30°C

VandexCemelast meets the performance criteria and is an approved product for this application.

8.3 STEEL PAINTING AND CORROSION PROTECTION

The Contractor shall be responsible for the painting and corrosion protection treatment of both the internal and external ladders. This shall include the restoration of any damaged paintwork on the existing equipment.

Unless otherwise stated, all metal surfaces are to be wire brushed (or equivalent) to remove all traces of rust, scale, grease, etc; prime coated with one coat of primer and finished with two coats of enamel, all paint products being suitable for potable water use.

No lead-based or other toxic paints are to be used.

All painting shall be completed and completely cured before re-installation.

The Contractor shall ensure that precautions against electrolytic action between metals are taken.

9. STORAGE TANK CONSTRUCTION

This section of work comprises the site preparation, supply, fabrication, delivery and construction of all site components, tanks, pipework, and the necessary valves to complete, test and commission the required storage tanks. The Contractor shall also adhere to the requirements of the other relevant sections of this specification, including, but not limited to, Section10 (Concrete Work) and, Section 17 (Steelwork & Metalwork).

9.1 SITE WORKS

Notwithstanding the requirements of this Contract, the Contractor shall liaise with the tank manufacturer during all phases of the Works (planning and construction) in order to define the responsibility and requirements of the manufacturer. The Contractor shall ensure that all such agreements and work will not compromise the manufacturer's warranty for the supply and construction of storage tanks.

Such agreements may include, but not be limited to:

- the supply and transportation of materials
- excavation of the tank site
- the 'cut in' into the existing pipeline terminating at the inlet and outlet valves outside the tank site
- the fitting or pre-inspection of critical elements such as site foundations, concrete ring beams, pipework and pipeline connections

The Contractor shall be responsible for any sub-contractor agreements and shall indemnify the Employer against any delays or failure to complete the Works to the manufacturer's specification arising from such sub-contractor agreements.

9.1.1 Site Preparation

The tanks must be installed on a cleared site, prepared as per the Drawings with a suitable poured level concrete ring beam where specified.

Allowance should be made for the necessary civil earth works. The site is to be level and free of rock, vegetation or water.

It is necessary to construct a level area 3 to 4 m larger than the diameter of the ring beam to enable the movement of the equipment around the tank. The sand inside the ring beam should be to a depth of 150 mm to 200 mm and compacted. The top layer of sand should be free of stones and sticks or other sharp objects.

Height variations in the ring beam can have an adverse effect on both the installation and ultimate performance of the water tank so it is critical these specifications are adhered to.

Once construction has been completed, an aggregate such as blue metal, crushed rock or stones shall be placed around the ring beam and cover the entire fenced area to prevent erosion and minimise vegetation growth.

9.1.2 Site Works

Allowance should be made for the necessary Storage Tank Works includes the following:

a) Site clearing, foundations, concrete ring beam construction, pipework laying.

b) Transportation and site assembly of a new Storage Tank complete with floor, walls, waterproof membrane, roof, ladder, access hatch, security fencing, pipework, roof vent and fittings as specified in the Drawings and manufacturers requirements.

c) Testing and Commissioning of the entire site.

9.1.3 Fittings

All pipes and fittings shall comply with this specification and shall be tested for leakages and faults before commissioning any inlet lines to the structures. Fitting shall be installed as per Drawings.

9.1.4 Scour Drain

Tanks are to be supplied with an under floor scour drain which allows for the total contents of tank to be drained as per the Drawings. The scour drain shall be supplied with a valve and valve protector box.

9.2 PRE-FABRICATED STEEL STORAGE TANKS

9.2.1 Tank Selection

Prefabricated, site assembled steel water storage tanks are to be polyethylene lined, bolted steel tank construction, and to the design criteria and construction methods specified. Deviations from the specified design and construction details are not permitted.

9.2.2 Drawings And Specifications

Construction shall be governed by the drawings and specifications showing general dimensions and construction details. After approval by the Engineer, of detailed construction drawings prepared by the Manufacturer, there shall be no deviation from theses drawings and specifications except upon written order or approval from the Engineer.

9.2.3 Qualifications Of Tank Manufacturer

The Tank Manufacturer shall be a specialist in the design, fabrication, and construction of bolted steel water storage tanks with polyethylene liners. The manufacturer shall be quality certified, have an ISO 9001 registration or equivalent.

9.2.4 Design Criteria

- Job Site Location – refer to the Project Specification and the Drawings
- Product to be Stored – Drinking Water - Minimum Freeboard 0.20 m
- Specific Gravity - Drinking water - 1
- pH of Product – Drinking water range 6 to 8.
- Temperature of Product – Water in tank not to exceed max 40°C
- Minimum Capacity – Varies depending on tank site 50 to 200 m^3 +/- 3 %.
- Design life – 50 years
- Seismic and Cyclonic Zone
  - Earthquake Zone 2 – AS1170.4
  - Cyclonic Region D – AS1170.2
- Dimensions of tank as per manufacture, and site specific.

- Compliance with all relevant Australia/New Zealand standards in Section 5.10, including any required supporting documents.
- Structural Certificate required for all tank designs.

9.3 MATERIALS

9.3.1 Tank Structure

The materials, design, fabrication, and construction of all bolted steel polyethylene lined tank shall, at a minimum, conform to all of the design and construction standards listed in Section 9.3.15.The tank shall be Self-Supporting – and meet all Seismic and Cyclonic Design criteria. (Rated Earthquake Zone 2 AS1170.4).

9.3.2 Steel

Steel sheets, plates and trusses shall conform to or shall be at least equal to all standards listed in this technical specification.

Steel Sheets for tank walls to be BlueScope G300 Zincalume Steel, Colorbond Ultra or approved similar.

Profile of steel sheets to be 8-80 V-Lock Wall Profile, to AS4600 Standard, with a minimum thickness being specific to tank size.

Steel sheets used for dome roof to be BlueScope high tensile G550 Zincalume Steel, Colorbond Ultra or approved similar.

Minimum thickness for roof steel to be 0.42mmbmt.

Protective coating for all sheet steel to be Zincalume steel AZ 150 heavy duty coating or Colorbond Ultra, colour to be specified and approved prior to manufacture.

9.3.3 Roof

Roof trusses to be fully self-supporting, independently certified dome roof trusses and to be hot dipped galvanized. The roof shall be designed to Cyclonic design standards and certified so. The roof shall consist of roof sheeting material, as per above, spanning hot dipped galvanized truss section.

The length of the roof sheets used shall be such that a minimum number of end laps for the entire roof are used. Where required the end laps shall not be less than 300mm and the centre of the overlap shall be at a truss centreline. Side laps shall not be less than one corrugation. No roof supporting steelwork shall intrude into the water storage below the maximum overflow level.

9.3.4 Bolts

All joints in sheet steel to be bolted with M10-M16 galvanized, flanged head, high tensile steel bolts, size and length to be design specific. The Bolts shall be property class 8.8 as per AS/NZS 4291.1.

All nuts and washers to be galvanized and made from high tensile steel and property class 8 as per AS/NZS 4291.2. Poly-capped bolt heads shall be used for additional corrosion protection. All hardware to conform to standards listed elsewhere in this technical specification. The surface of all bolts shall be smooth and free from quenching cracks and harmful defects such as flaws and burrs that may affect the performance of the bolt. A

compliance test certificate in English shall be supplied with every batch of bolts. This shall have the results of tests for the mechanical properties of the steel used in the manufacture. It shall also clearly show the measured dimensions of the bolt and reference codes used for the inspection. The sample size shall be as per AS/NZS 1252.

9.3.5 Multiple Row Punching

All sheets in the shell of the tank that requires multiple vertical row punching (double or triple) must be in single stroke to insure proper alignment.

9.3.6 Appurtenances

The contractor shall furnish and install the appurtenances as shown on the Drawings and as specified below.

Unless otherwise noted, standard appurtenances shall be as follows:

Inlet and Outlet Connections

Inlet, outlet, and overflow connections shall conform to the locations specified on the plan sheets. Cast iron accessories shall be used.

Vent

Multiple mushroom-screened heavy-duty roof ventilators shall be furnished above maximum water level of sufficient size to accommodate normal inlet and outlet flow. The overflow pipe shall not be considered to be a tank vent. The vent shall be so designed and constructed as to prevent the entrance of birds or animals.

Outside and Inside Tank Ladders and Access Hatch

An outside hot dipped galvanized type ladder and accessories shall be furnished at the location designated on Manufacturers details. The ladder inside the tank shall be a fibre glass ladder or equivalent. Safety ladder cage with access hatch and guard railing shall be installed. Hot dipped galvanized handrail and toe board around the deck perimeter shall be installed as specified by the manufacturer. All tanks shall have an access hatch located on the roof access deck. Hatch is to be lockable and hot dip galvanized.

9.3.7 Liquid Level Indicator

A liquid level indicator with stainless steel float and target board shall be installed to the tank manufacture’s specifications.

9.3.8 Internal Nozzle with Overflow Weir Cone

The internal nozzle with overflow weir shall conform to the size and location specified on the manufactures plan sheets. Anti-vortex flanged accessories shall be provided if connection to pumping equipment is required.

Unless stated otherwise, the nozzles shall be P.E. complying with all New Zealand and Australian Standards. All nozzles shall extend clear of the tank to enable unhindered connection to other pipe work, the fittings and shall terminate in a flanged Table D or E or ANSI or BSP fitting as nominated.

A scour drain shall be installed in the centre in the tank to allow for the total contents of tank to be drained. The floor of the tank shall slope to the centre of with a minimum slope of 3%.

9.3.9 Coating

All metal plates, supports, members, and miscellaneous parts, except bolts, certain accessories, and appurtenances, shall be factory coated in accordance with the provisions of these specifications. Field coating, except for touch-up will not be permitted. For specific coating specification refer to attached MCS G300/G300S Steel Specification.

Interior

Thermally cured epoxy Trico-Bond EP or equal or Electrostatic applications of FDA and NSF approved thermoset epoxy, 5.0 mil average dry film thickness.

Exterior

Amine Epoxy primer with baked acrylic finish coat or equal (First coat is to be a powder application of modified epoxy Trico-Bond EP, 2.5 mils average dry film thickness. Second coat of acrylic polyurethane, 1.5 mil average dry film thickness).

Other options can be proposed (Exterior Coating – Z-Bond EP optional exterior coating. One coat Zinc rich primer, 2.0 – 2.5 mils average dry film thickness, One coat electrostatic application of FDA and NSF accepted thermoset epoxy, Trico-Bond EP as top coat 5.0 mils average dry film thickness, One coat urethane top coat, 1.5 mils average dry film thickness, Coating system to have 8.5 mils average total dry film thickness).

9.3.10 Lining

Heavy Duty Food Grade Reinforced Polyethylene Liner. The liner shall be of the reinforced liner type consisting of a heavy-duty homogeneous impervious membrane with an internal woven mat or scrim. The liner shall be to Australian Standard AS/NZS 4020 - "Testing of Products for Use in Contact With Drinking Water". Minimum thickness to be 0.5 to 0.6 mm. Minimumtensile strength – 2600 N Warp and Weft 2400 N (AS 2001.2.3).Minimum tongue tear - 550 N Warp and 450 N Weft (BS 3424.5).Minimum flex cracking of 400.000 cycles (AS 141.6) and minimum coating adhesion 90 N / 50 mm.

9.3.11 Tank Foundation

Base setting stave placement and concrete shall be done in accordance with the tank manufacturer's recommendations. The tank manufacturers shall certify the placement of the setting stave. The tank foundation shall be designed according to the manufacturer to safely sustain the loads from the tank.

The foundations shall be level with differential not exceeding +/- 0.3 cm in any 75 cm circumference under the shell. The levelness on the circumference shall not vary more than +/-0.6 cm from an established plane.

The tanks shall include a Tank Bolt Down Brackets set including chemical anchors & studs for fastening to concrete ring beam foundation.

The tank shall be provided with a Geotextile fabric Membrane placed under the liner layer. The geotextile shall be a 100% polyester non-woven material and used as a protective barrier between the soil and the liner.

The tank shall be constructed with the placement of a set of sacrificial magnesium alloy anodes buried under around the foundation. Anodes are to be connected to the tank walls with a 6mm diameter PVC insulated cable. Anodes and backfill mixture placed

around them are to be as per A.S. 2239 - Galvanic (sacrificial) Anodes for Cathodic Protection

9.3.12 Tank Construction

Field construction of factory-coated - lined bolted steel tanks shall be factory certified in accordance with the tank manufacture's recommendations. Particular care shall be exercised in handling and bolting of the tank plates, supports, and members to avoid abrasion or scratching of the coating and/or galvanizing.

The tank shall be installed onto a concrete ring beam or slab. The manufacturer shall specify the design.

9.3.13 Basic Site Requirements

It is necessary to construct a level area larger than the diameter of the ring beam (3 to 4m) to enable the movement of equipment around the tank. A 100 mm bottom layer of compacted GAP 40 and 150 mm of clean compacted sand on top shall be placed inside the ring beam. Once construction has been completed, an aggregate such as GAP 65 should be placed around the ring beam to prevent erosion.

9.3.14 Testing And Warranty

Following completion of construction and cleaning of the tank, the tank shall be tested for liquid-tightness by filling the tank to its overflow elevation. The Contractor, in accordance with the tank manufacturer's recommendations shall correct any leaks disclosed by this tank test.

The tank manufacture shall warrant the tank system against any defects in workmanship and materials for a period of one year from the date of final acceptance. In the event any defect should appear, it shall be reported in writing to the manufacturer during warranty period. In addition, a conditional 10-year limited warrantee is to be offered on the tank and all components.

9.3.15 Quality & Standards

Australian and NZ Design Standards shall be used as reference:

a) AS4100 – Steel Structures

b) AS/NZ 1170 Series for Structural Design Actions

a. AS/NZ 1170.1 - Live and dead loads

b. AS/NZ 1170.2 – Wind loads

c. AS/NZ 1170.4 – Earthquake loads

c) AS4600 – Cold Formed Steel Structures

d) AS1657 – Fixed Platforms, Walkways, Stairways and Ladders – Design, Construction and Installation.

e) AS2419.1 – Fire Hydrant (Tanks)

f) AS2118 – Fire sprinkler systems

g) AS2832.2 – Cathodic Protection

h) AS2239 – Galvanic (sacrificial) Anodes for Cathodic Protection

i) AS4020 – Products for use in Contact with Drinking Water

j) AS4680 – Hot Dipped Galvanized Coatings on Ferrous Articles

k) AS 1110.2 - ISO Metric Hexagon Bolts and Screws – Product Grade C Part 2: Screws.

l) AS 1214 - Hot-dip Galvanized Coatings on Threaded Fasteners (ISO metric Coarse Thread Series).

m) AS/NZS - 1252 High-Strength Steel Bolts with Associated Nuts and Washers for Structural Engineering.

n) AS/NZS - 4291.1 - Mechanical Properties of Fasteners Made of Carbon Steel and Allow Steel Part 1: Bolts, Screws and Studs

o) AS/NZS 2491.2 Mechanical Properties of Fasteners Made of Carbon Steel and Allow Steel Part 2: Nuts with Specified Proof Load Values – Coarse Thread

p) ISO 4161 – Hexagon Nuts with Flange – Coarse Thread

q) ISO 15071 Hexagon Bolts with Flange – Small Series – Product Grade A.

10. CONCRETE WORK

10.1 GENERAL

This section of the specification covers the supply of concrete to be provided for structural purposes in this contract.

10.2 REFERENCE DOCUMENTS

Work shall comply with the relevant requirements of the following standard specifications together with the further provisions herein:

NZS 3104 Specification for Concrete Production

NZS 3108 Specification for Concrete Production Ordinary Grade.

NZS 3111 Methods of test for water and aggregate for concrete

NZS 3112 Methods of Test for Concrete - Parts 1, 2, 3 & 4

NZS 3121 Specification for water and aggregate for concrete

NZS 3122 Specification for Portland and blended cements (General and special purpose)

10.3 CONCRETE SUPPLY

All concrete other than base or site screed concrete shall be either special or high grade concrete produced in a plant having a performance record consistent with the grade of concrete specified and complying with the requirements of NZS 3104 as amended herein and, with the relevant provisions of NZS 3109.

Clause 2.9.4 of NZS 3104 shall not apply. All ready mixed concrete shall be supplied in agitator trucks complying with NZS 3104.

Each batch delivered shall be accompanied by a delivery docket certifying the cement type, maximum aggregate size, specified strength, slump, date, time mixing completed, and time water added at the plant. At the completion of the contract a schedule of delivery docket numbers for all concrete supplied shall be forwarded to the Engineer.

In addition to the provisions of NZS 3104 Clause 2.9.3 and NZS 3109 Clause 7.3.1 amendment No.1, the following shall apply:

No water shall be added to the concrete after it has left the mixing plant without:

a) the permission of the Engineer;

b) A set of test cylinders being taken from the mix in question, tested in accordance with NZS 3112, Part 2, all at no cost to the contract.

Where approval has been given to the contractor to place concrete by pumping the mix supplied shall be one designed for that purpose. Details of the mix design shall be submitted to the Engineer for approval.

Base or site screed concrete may be ordinary grade concrete and may be batched in accordance with NZS 3104**.** All concrete shall be normal weight concrete.

10.4 CONCRETE STRENGTH

Unless shown otherwise on the drawings, all concrete shall have the following minimum 28-day compressive cylinder strength:

Concrete Type	Strength
Structural Concrete	30 MPa
Ordinary Concrete	17.5 MPa
Masonry Infill	25MPa
Blinding or Site Screed	10 MPa

10.5 MATERIALS

In addition to or in substitution for the provisions of the relevant NZ Standards, the following requirements shall apply:

10.5.1 Cement

Cement shall be ordinary Portland Cement complying with NZS 3122.

The contractor shall advise the Engineer in writing which brands of cement he intends to use for the various types of construction in the works. Generally only one brand of cement shall be used throughout the Works to maintain uniformity of colour and to establish undivided responsibility for cement quality. No change in the brand of cement used shall be permitted without the prior written approval of the Engineer.

10.5.2 Aggregates

If the aggregates used have a potential to react expansively with cement alkalis, the alkali content of the cement expressed as equivalent Na_2O shall be less than 0.6%.

No change in the source of supply of aggregate or water shall be permitted without prior approval of the Engineer. The Engineer may order sampling and testing of aggregate and/or water to be carried out by an independent testing laboratory in the event of unsatisfactory performance, at no additional cost to the contract.

10.5.3 Admixtures

Delete Clause 6.5 of NZS 3109 and substitute the following provisions:

The contractor shall supply details and rates of application of the admixtures that he proposes to use. No admixture shall be used without the prior written approval of the Engineer.

10.5.4 Chloride

Delete Clause 6.6 of NZS 3109 and substitute the following:

The use of calcium chloride in any concrete shall not be permitted.

10.5.5 Change of Mix

Notification shall be given to and approval obtained from the Engineer before any change is made to an approved mix design during the contract.

10.5.6 Measurement

The provisions of Clause 2.6.1 of NZS 3104 shall be varied to provide that the measurement of cement by bags will be permitted, but only for ordinary grade concrete.

10.6 CONCRETE TESTING

Concrete acceptance test shall be carried out in accordance with NZS 3109 and NZS 3112 with the following additional or amending provisions.

The contractor shall supply all materials, labour and equipment required to prepare test samples of concrete delivered to the site.

Compression testing shall be carried out at the cost of the contractor by an independent laboratory approved by the Engineer.

Slump tests shall be taken for each delivery of concrete and the results recorded by the contractor.

A set of specimens for compression tests shall consist of four specimens from each sample of concrete, one of which is to be tested at seven days and the remainder at 28 days after casting. Where the results of seven day tests indicate in the opinion of the Engineer that the concrete strength may be deficient the Engineer may direct the contractor not to place any further concrete until the cause of the low results has been ascertained and the contractor has taken such steps as may be necessary to ensure that future production of concrete will comply with the specification.

Field tests. Test blocks made to determine stripping times or the influence of the weather on strength shall be treated as required in NZS 3112, Part 2, Clause 3.5.3 except where accelerated

curing is employed in which case they shall be subjected to the same curing cycle as the structure which they represent.

10.7 REJECTION OF CONCRETE

10.7.1 Slump Tests

Concrete having a slump value outside the tolerance limits specified in Clause 9.3 of NZS 3109 will be liable for rejection at the discretion of the Engineer.

10.7.2 Compression Tests

Where compression test results do not comply with the specified strength requirements the concrete concerned may be rejected at the discretion of the Engineer, in accordance with Clauses 9.5.6.2 and 9.5.7 of NZS 3109.

If the contractor disputes the test results he may elect to arrange confirmatory tests on cores of hardened concrete in accordance with Clause 9.5.7 of NZS 3109. In this case he shall notify the Engineer of his intention in writing within one week of the rejection order and before removing any concrete. A testing authority approved by the Engineer shall do the tests. If the test proves the concrete to be satisfactory, the Engineer may approve reasonable costs incurred in making the confirmatory tests as an extra to the contract.

10.8 SITE MIXED CONCRETE

1.1.1 Preliminary

The following clauses are additional to the requirements of the “Concrete Work” part of the specification in cases where the Contractor elects to mix his concrete on site.

1.1.2 Aggregate

Before commencing work the Contractor shall submit samples of proposed aggregates to the Engineer for his approval. The source of supply of aggregates shall not be changed unless approved by the Engineer. Ample and completely separate stockpiles of coarse and fine aggregate shall be kept on the site at all times under conditions approved by the Engineer.

1.1.3 Storing Of Cement

The Contractor shall ascertain the Engineer’s requirements before erecting store sheds. Cement shall be so stored and handled at all times as to be protected against deterioration or contamination from any source whatsoever, and so as to be capable of being inspected at all times. Any cement that does not conform to NZS 1844 or is in a condition that the Engineer does not approve shall be removed from the site of the works.

1.1.4 Records

The Contractor shall keep complete records of cement deliveries and individual consignments shall be kept separate in the store. The Engineer shall have access to these records.

1.1.5 Concrete

The concrete shall comply in all respects with the requirements of NZS 1900 Ch. 9.3 A for High Grade Concrete. The Engineer will require to be satisfied that the Contractor is able to fulfil those requirements consistently on the site. The content and crushing strength shall not be below the amounts given in the following:

Minimum crushing strength of standard cylinders at 28 days standard cured,25 MPa

Minimum cement content per cubic metre of mixed concrete – 304 kg

Maximum permitted water cement ratio = 0.6 (by weight)

1.1.6 Trial Mix

It is the Contractor's responsibility to establish by preliminary testing, the proportions of aggregates cement and water, which produce the concrete most suitable for each particular portion of the works with respect to workability, homogeneity, strength and density. Any information which the Engineer may have on the performance of aggregates and suitable mix proportions will be made available to the Contractor upon request, but the provisions of this information no way absolves the Contractor from his responsibility to produce a concrete complying with all requirements of this Specification. At least 12 test blocks shall be made of the final trial mix. At least one half of these blocks shall attain strengths 50% or more in excess of the required minimum crushing strength when tested at 28 days.

The Contractor shall obtain the approval of the Engineer for the proposed mix design before any concrete is placed, after producing evidence of 28 days strength test results. Such concrete testing shall be at the Contractor's expense.

1.1.7 Cement Content

The cement content shall not be reduced below that in the table above. Should the contractor fail to achieve the required strength, slump and workability at the specified minimum cement content, he shall increase the cement content at his own expense in order to satisfy all the requirements.

1.1.8 Concrete Mixing

Unless otherwise approved by the Engineer, the mixing of concrete shall be done in a power driven batch mixer complying with NZS 1052 or other approved type that will ensure the thorough mixing of all materials. The volume of the mixed material per batch shall not exceed the manufacturer's rated capacity of the mixer. The entire batch shall be discharged before re-charging. The mixing time shall be measured from the time when all the materials are in the mixer drum. The minimum time of mixing shall be one and a half minutes for mixers of 0.8 m^3 or less capacity, and a mixer of a larger capacity shall have the time of mixing increased by 20 seconds for each additional 0.5 m^3 or fraction thereof. The drum shall rotate at a peripheral speed of approximately 60 m per minute at a point on the widest section of the drum, or at a speed of 12 rpm whichever is the slower.

11. REINFORCEMENT

11.1 GENERAL

This section of the specification covers the supply, fabrication, and placing of all reinforcement required in the contract.

11.2 REFERENCE DOCUMENTS

Work shall comply with the relevant requirements of the following standard specifications, together with the further provisions herein:

NZS 3109 Concrete construction

AS/NZS 4671 Steel reinforcing materials

AS/NZS 1554.3 Structural steel welding - Welding of reinforcing steel

AS/NZS ISO 3834.1 Quality requirements for fusion welding of metallic materials - Criteria for the selection of the appropriate level of quality requirements

11.3 MATERIALS

All mild steel round and deformed bar (denoted R and D respectively on the drawings) shall be Grade 300E complying with AS/NZS 4671. All reinforcing bars shall be "micro-alloyed" (MA). The use of "quenched and tempered" (QT) reinforcing bars is only permitted for use with the prior written approval of the Engineer. All high yield steel (denoted HR and H on the drawings) shall be Grade 500E deformed bar complying with AS/NZS 4671. Typical nomenclature for reinforcement as used on the drawings is shown on the appended "Standard Concrete Reinforcement Details" sheet.

Where not specifically described otherwise on the drawings bar reinforcement shall be Grade 300E mild steel and shall be deformed for all sizes larger than 6 mm diameter. All reinforcing mesh shall comply with AS/NZS 4671. All spacer bars and hangers shall be mild steel. All cover spacers shall be either:

a) concrete blocks of an approved size and shape made with 10 mm maximum size aggregate. In exposed work blocks shall match the surrounding concrete in colour and texture; or,

b) mortar blocks of an approved size made with cement/sand ratio of 1:2; or,

c) plastic chairs of an approved type.

The use of Grade Class L and S reinforcement bars is not permitted.

The use of Grade Class N reinforcement bars is not permitted without prior written approval of the Engineer.

All wire used for tying reinforcement shall be soft black iron wire between 1.20 mm and 2 mm diameter.

Depending on what is available locally, steel reinforcement material with slightly different properties to above may be used upon approval from the Manager, Technical Division.

11.4 CERTIFICATION AND MARKING

All reinforcing bar or mesh shall be delivered to either the site of the works or the fabrication yard in unbroken bundles clearly labelled for identification and accompanied by maker's certificates in accordance with Section 9 of AS/NZS 4671.

Contractors are to provide procurement certificates detailing the source origin (i.e. NZ made or overseas procured), the method of manufacture (micro-alloy vs. quench and tempered), the grade of steel (300E or 500E), and confirmation of the applicable bar markings for that source.

In addition to the requirements of the above NZ Standard Specifications, the bundles shall only be broken after identification and approval by the Engineer or his authorized representative with the appropriate certification.

The contractor shall prepare bar bending schedules and all fabricated bar reinforcing shall be tagged for identification before delivery to site. Each delivery of fabricated reinforcing bar shall be accompanied by schedules identifying the location of the bars in the structure.

11.5 STORAGE AND PROTECTION

All steel shall be stored immediately on delivery to the site in approved weatherproof racks so that it is clear of the ground and vegetation and protected at all times from damage or surface deterioration.

11.6 CLEANING OF STEEL

The surface of the steel reinforcement shall comply with the requirements of NZS 3109 Clause 3.3 at the time of concreting. The contractor shall obtain the approval of the Engineer for any cleaning methods proposed to achieve this condition.

Undue delay between cleaning and concreting may result in an additional cleaning operation by the contractor being ordered by the Engineer.

Special care shall be taken to ensure that reinforcing is not coated with dried concrete or cement paste at the time of placing the surrounding concrete.

11.7 FABRICATION

All reinforcement shall be cold formed to the shapes and dimensions shown on the drawings. Bends and hooks shall comply with NZS 3109 Section 3 Table 1.

Stirrups and ties shall be bent to the diameter of the main reinforcing bars. Deformed bars shall be bent around rollers rather than fixed pins.

No reinforcement shall be used with unspecified kinks or bends.

Reinforcement shall be straightened before bending when so directed by the Engineer without additional payment.

No reinforcement shall be either bent or straightened in a manner that will damage the material.

One reverse bend of bars is permitted providing this reverse bending is carried out in accordance with NZS 3109, i.e. Grade 300E can be reverse bent once providing the bend diameter is the same as the original bend and Grade 500E can be reverse bent only when heated to cherry red for bending.

11.8 LAPS AND SPLICES

All reinforcement shall be supplied in the full lengths indicated on the drawings.

Laps at locations other than those either specified or shown on the drawings will not be permitted unless approved in writing by the Engineer.

Where lap lengths are not shown on the drawings they shall conform with NZS 3109 Clause 3.6 and Table 2. Bar offsets and offset places splices shall be formed by cranking the bars at a slope of 1 in 12.

11.9 WELDING SPLICES

The Engineer shall not permit the welding of reinforcing bars unless noted on the drawings or otherwise specified or approved in writing.

Where approved, welded splices shall conform with NZS 3109 Clause 3.6.3 and where the weld is not considered "pre-qualified", as defined in Appendix F of AS/NZS 1554.3, a written welding procedure (Procedure Qualification Records – PQR as provided in AS/NZS 1554.3 Appendix D) must be provided by the contractor for approval by the Engineer prior to the physical works being undertaken.

11.10 PLACING AND FASTENING

All reinforcing shall be accurately placed and fixed in the positions shown on the drawings and secured against displacement during the placing and compaction of the concrete.

Distances from the forms shall be maintained using stays, ties, hangers, precast blocks, plastic chairs as specified in Clause 3, or by other approved devices.

Steel chairs or hangers shall be provided to support all top reinforcing bars not supported by either reinforcing stirrups or ties.

The reinforcement shall be secured at intersections and to supports with tie wires. Ties and supports shall be located at sufficiently close intervals to maintain the rods in their correct positions.

11.11 INSPECTION AND REJECTION

After placement the reinforcement shall be inspected and approved by the Engineer or his representative before any concrete is placed. At least 24 hours notice shall be provided for inspection and approval. The removal of all formwork preventing proper inspection shall be allowed for.

Concrete placed before inspection and approval shall be liable to rejection and removal.

11.12 MATTERS FOR RESOLUTION FROM AS/NZS 1554.3 APPENDIX E

The following clarifies the "Matters for Resolution" listed in AS/NZS 1554.3 Appendix E:

Matter for Resolution		Clause	Contract Requirement
(a)	Limitations of welding processes	1.1	The use of a welding process not listed shall require the Qualification of welding procedures by testing.
	Approval for welding to proceed	1.6.1	Welding other than that shown on the drawings or other appropriate documents shall require the approval of the

	Matter for Resolution	Clause	Contract Requirement
			Engineer.
(b)	Welding within bend portions of reinforcing bars	1.6.2	Welding in bend portions are not permitted without the prior approval of the Engineer. Approval may require the qualification of welding procedures by a test piece that simulates as close as possible to the actual joint.
(c)	Joining reinforcing steel to structures	1.8	Welding procedures shall be qualified to the appropriate Part of AS/NZS1554.
(d)	Approval of parent material	2.1	Welding procedures shall be qualified to the appropriate Part of AS/NZS1554.
(e)	Approval of welding consumables	2.3.1	Welding consumables not covered by the consumable standards mentionedin2.3.1 (a) or (b) shall be qualified in accordance with Clause4.5.2.
(f)			
(g)	Use of non-symmetric connecters in Seismic resistant applications	3.1.2	Welding, including tack welds, other than that shown on the Drawings or other appropriate documents shall require the Approval of the Engineer.
(h)	Nominal tensile strength of welds	3.1.8	Welding consumables that provide weld metal with the nominal tensile strength requirements shown on the drawings or other documents shall be used, and comply with 4.5 of AS/NZS1554.3.
(i)	For anchorage splices, approval of base material, weld size and strength	3.2.3&Table 4.5(B)	The base material and size for anchor plates shall require the approval of the Engineer. Weld size and strength shall be as shown on the drawings or other documents.
(j)	Qualification and use of location of tack welds	3.3	All tack welding shall meet the requirements of Clauses3.3.2 and 3.3.3 of AS/NZS1554.3.
(k)	Qualification of welding procedure	4.1,4.2,5.8,6.7 &7.2	Before welding commences all welding procedures shall be qualified in accordance with the Standard.
(l)	Qualification of welding supervisor	4.10.1	The fabricator shall provide evidence acceptable to the Engineer that welding is to be carried out under suitable supervision.
(m)	Qualification of welding personal	4.10.2	The fabricator shall provide evidence acceptable to the Engineer that welders are suitably qualified before welding commences.
(n)	Correction of defective welds	4.11.8&9.5	The Engineer shall be advised of the intent to repair weld prior to the correction of defective welds.
(o)	Manual flash butt welding	5.7.1	Manual flash butt welding shall require the approval of the Engineer.
(p)	Type and extent of inspection	9.2&10.3	For Category SP welds, all joints should be subject to 100% visual scanning, 50% of the welds should be subject to visual examination, 10% subject to Magnetic Particle Inspection or liquid penetration testing, and 10% subject to radiographic examination of Ultrasonic testing. Evidence of the above-mentioned examinations must be provided to the Engineer on completion of the work. Welding inspectors and NDE technicians shall hold appropriate CBIP (Certification Board for Inspection Personnel) qualifications.
(q)	Availability of records for peruse by inspector	10.1	Section 10 of AS/NZS1554.3 shall apply.
(r)	Cleanliness of welds prior to inspection	10.3.2	Slag removed, wire brushed, no dirt, scale or rust.

11.13 SPECIAL FABRICATION REQUIREMENTS FOR GRADE 300E AND 500E REINFORCING TO AS/NZS 4671

(Reproduced from Pacific Steel recommendations as modified by Building Industry Authority Advisory Note No.9 dated 18 July 2003)

11.13.1 How To Minimise Possibility of Fracture While Bending Seismic Bars

Cold bending can be carried out on SEISMIC Grade 300E and SEISMIC Grade 500E bars as long as excessively tight bends are avoided. Pacific Steel recommendations are:

a) Free cold bending (e.g. with the bar fixed in concrete) or bending with a former can be applied as long as you stay within the limits recommended in the design standards.

b) For the first bend, minimum diameter of Bend (Pin diameter) should be as given in the table for each size of the bar.

c) When bar is required to be reverse bent during construction, either:

- plain reinforcing bar should be used; or
- a hot reverse bending process should be applied to deformed bars.

d) If cold reverse bending of deformed bars is to be used, then larger bend radii (larger than recommended in the following table, e.g. 120 mm or greater on 16 mm bars) should be applied.

MINIMUM RECOMMENDED BEND (PIN) DIAMETER AS NZS 3101:1995 TABLE 7.1 & 7.2

Rebar Type	Bar Diameter (d)								
	6	**10**	**12**	**16**	**20**	**25**	**28**	**32**	**40**
Plain Bars	30	50	60	80	100	150	170	200	240
Deformed Bars	30	50	60	80	100	150	170	200	240
Plain Bars (Stirrups & Ties)	20	20	30	4	40	80	-	-	-
Deformed Bars (Stirrups & Ties)	30	40	50	70	80	150	-	-	-

11.13.2 Hot Bending Procedure (for reverse bending)

When deformed reinforcing bars are required to be reverse bent, hot bending procedure should be employed. The strength of Pacific Steel Seismic reinforcing bars is not affected by short heat cycles up to about 800°C (cherry red heat). The following procedure is recommended for hot bending Seismic Grade 300E reinforcing:

a) If bars are to be reverse bent or straightened, inspect all previous bends for any pre-cracking. Pre- cracked bars should be replaced.

b) Preheat bars in the bend area and approximately 50 mm either side of the bend area to about 800°C (cherry red).

c) Perform the reverse bend or straightening at this temperature.

d) If bars have been allowed to cool markedly during the bending operation, reheat to above 600°C.

e) Allow bars to cool in still air and protect from cooling wind.

Note that the above hot bend reverse bending procedure is not permitted for use with seismic Grade 500E deformed bar.

11.13.3 Site Welding

Site welding, including tack welding, should not be carried out on Seismic Grade 500E reinforcing under any circumstances.

12. FALSEWORK, FORMWORK AND SURFACE FINISHES

12.1 GENERAL

This section of the specification covers the supply and construction of all falsework and formwork and the requirements for all surface finishes in this contract.

12.2 RELATED DOCUMENTS

Work shall comply with the relevant requirements of the following standard specifications together with the further provisions herein:

NZS 3109 Concrete construction

NZS 3114 Specification for concrete surface finishes

12.3 CONTRACTOR'S OBLIGATIONS

The contractor shall design and construct all falsework and formwork to provide adequate rigidity and strength to support safely all loads occurring during construction without appreciable settlement or deflection and to produce concrete sections consistent with the specified cambers, tolerances, and finishes.

12.4 ENGINEER'S APPROVAL

If required the contractor shall submit to the Engineer detailed plans and design calculations of the falsework and formwork for approval.

These plans shall indicate the amount to be allowed for settlement and deflection under the construction loads. Approval shall in no way relieve the contractor of his responsibility with respect to the Construction Act or for satisfactory performance.

Until the Engineer's written approval is obtained, no work shall proceed on the construction of falsework or formwork.

12.5 DESIGN CRITERIA

In the design of falsework and formwork due consideration shall be given to the following:

a) the wet weight of concrete

b) the weight of formwork

c) loads incidental to construction operations including the effect of impact and vibration loads during the placing and compaction of concrete

d) wind or other lateral loads

e) distortion due to pressure loads from wet concrete

f) additional loads resulting from placement of concrete by pumping

In multistorey work the falsework design shall take account of the fact that the all-up weight of wet concrete, formwork and construction loads will usually exceed the design live load for the floor below.

The deflection of any single supporting beam shall not exceed 1/900 of its span and for any cantilever beam the deflection shall not exceed 1/300 of its free length.

12.6 FALSEWORK CONSTRUCTION

Falsework shall be founded on firm secure footings.

Provision shall be made by means of wedges or jacks, for adjusting the height of the formwork. This is to allow for settlement and to provide camber as well as to permit gradual lowering of the formwork during striking.

Adequate bracing shall be provided both transversely and longitudinally.

12.7 FORMWORK CONSTRUCTION

Forms shall be built in a substantial and workmanlike manner and shall be entirely free from warps, misalignment, or bulges.

Forms shall be built and maintained so as to produce mortar tight joints and smooth even faces.

Except in cases of curved or special surfaces where form lining may be specified, forms for all fair-faced concrete surfaces shall be surfaced with steel, resin bonded plywood especially manufactured for concrete work or other materials which will produce the surface finish specified in Clause 9, Surface Finishes.

Soffit formwork shall be constructed with a camber of uniform curvature, of 1/360 of the span unless otherwise specified.

The methods of construction shall be such that vertical surfaces can be stripped without disturbing the boxing or supports to beam, slab, or arch soffits, which are required to be left in place for a longer period.

Unless otherwise specified or approved, forms for high sections such as walls and columns shall be provided with washout ports or traps of adequate size and spacing at the bottom of all concrete lifts to allow thorough cleaning of the surface of the concrete from all rubbish, wood shavings,

loose aggregate, etc. before commencing the next lift. The formwork shall be inspected immediately before any concreting is commenced to ensure that all such material has been removed.

Forms of high sections may have one side left open, which shall be closed progressively as concreting advances, but at no stage to a height exceeding 2.0 m above the layer of concrete being placed.

Alternatively, pouring traps may be provided at intervals of 1.5 horizontal and 2.0 m vertically.

Forms shall be filleted or chamfered at all sharp corners, and shall be given a slight level at all projections to ensure easy removal without damage to the concrete.

Bolts, and other metal fittings used in formwork construction shall be constructed so as to permit their easy removal to a depth of at least 50 mm from the face without injury to the concrete and so that upon their removal the cavities left are of the smallest possible area.

Forms may be re-used, subject to the approval of the Engineer, and provided they still satisfy the requirements of this specification.

Surfaces of re-used forms that are to come in contact with concrete shall be thoroughly cleaned before construction.

The inside surface of all forms shall be given a coat of an approved release agent which shall not stain or adhere to the concrete, or shall be saturated with water immediately before placing the concrete. If oil or similar material is used, it shall be applied prior to placing the reinforcing steel, so as to avoid fouling of the surface of the steel. Waste oil shall not be used as mould oil.

In addition to the provisions of this clause formwork shall comply with the requirements of Clause 12.9, Surface Finishes.

Formwork for concrete spans shall be adjusted prior to concreting with sufficient allowances in height to:

a) Offset the estimated settlement and deflection of formwork under load from concreting as shown on the approved falsework plans.

b) Allow for the specified camber shown on the drawings to offset the long-term dead weight deflection of the spans.

During placing of concrete all temporary struts or blocks shall be removed from the inside of forms as the concrete reaches that level.

If, during placing, undue settlement, bulging, or other defects become apparent in the formwork, the contractor shall cease placing and shall take all necessary steps to the satisfaction of the Engineer to remedy such defects.

12.8 PENETRATIONS

The contractor shall refer to all associated architectural, mechanical, electrical, and standard detail drawings, specifications and manufacturer's literature for dimensions and details of rebates, chases and cast-in items not specifically on the structural drawings, but which are required to be included for satisfactory completion of the work.

All embedded items shall be accurately located, plumbed as required and supported against displacement.

12.9 SURFACE FINISHES

The classification and standard of acceptance for all specified finishes shall conform to the requirements of NZS 3114 as modified and extended by the following clauses. The surface finishes shall be as listed on the drawings. Where not shown on the drawings surface finishes shall be as listed in NZS 3114 Table 1 for formed surfaces and Table 2 for unformed surfaces.

12.9.1 Sample Reference Panels

The contractor shall provide sample panels of specified finishes as and when required in the contractor documents. Panels shall be prepared in accordance with Clause 104.4 of NZS 3114 and any special requirements in this specification or shown on the drawings.

12.9.2 Formed Finishes

All surfaces cast against formwork (e.g. walls, columns, beams, bridge abutments, piers and vertical or near vertical surfaces) shall be produced with the finishes specified herein or shown on the drawings.

All such finishes shall comply with the standard classified finishes "F1 to F6" as specified in NZS 3114 and any additional special finishes "FNZ" specified herein or shown on the drawings.

Where special exposed aggregate textured or profile surfaces are required they shall be formed in accordance with Section 2 of NZS 3114 and classified as "FNE" or "UNE" as appropriate.

Mould oils used shall not stain or adhere to the concrete surface or impair the adhesion of any specified coating. Waste oil shall not be used for this purpose.

Where a formed surface is to be the base for plaster coats or tiled surfaces a rough surfaced lining material may be used and mould oil dressings shall be kept to a minimum. Surfaces showing residual mould oil deposits likely in the opinion of the Engineer to affect the adhesion of a subsequent coating shall be thoroughly scrubbed with detergent to remove all traces of the residual material.

All joints in forms shall be constructed so as to prevent grout leakage. All joints in forms for F5 and F6 shall be constructed without visible misalignment and sealed against water loss using suitable sealing strips or compounds.

All tie holes for finishes F4 and F6 shall be filled with sand cement mortar as specified for finishes F1 and F3 in Section 10 of NZS 3114. The cement shall be the same brand as used in the parent concrete. The filled tie holes shall match the colour of the parent concrete for finishes F3 and F6.

If the colour match is not satisfactory in the opinion of the Engineer, he may direct that the whole surface be bagged as described in Clause 20.4.1, to achieve a uniform colour.

Wire form ties, where used shall be cut back into the concrete at least 25 mm and the resulting recess pointed or filled as for the bolt holes.

12.9.3 Unformed Finishes

All surfaces, generally horizontal or near horizontal formed without the use of formwork such as on-ground slabs, pavements, suspended slabs, topping screeds and bridge decks, shall be produced with the finishes specified herein or shown on the drawings.

All such finishes shall comply with the standard classified finishes U1 to U11 as specified in NZS 3114 and any additional special finishes "UNX" specified in this specification or shown on the drawings.

Where approval is obtained from the Engineer to use Wet Screeding (Point Screeding) and using screeds less than 3.0 m in length the specified control tolerances for gradual deviations listed in Table 3 of NZD 3114 may be reduced at the direction of the Engineer.

The reduced tolerances shall be the specified tolerances multiplied by the ratio of the screed length to 3.0 m. The surface shall be checked using a straight edge having a similar length to that of the screed.

Unless specified or approved otherwise all screeding shall be carried out by using appropriate screeds operated over side forms accurately set out to the correct profile with due allowances for specified cambers.

Side forms may be either fixed or temporary and constructed of either wood or metal.

Floating shall only be commenced after the moisture film has disappeared and initial stiffening of the concrete surface has taken place.

Mechanical steel trowelling for a U3 finish may be performed using machines of either the rotating trowel type or the compacting type combining a rotating disc and hammers. The latter type is preferred.

Where textured finishes U5 or U6 are specified the surface shall be allowed to set sufficiently after floating to retain the broom or type marks. The type of broom or tyne employed shall be approved by the Engineer.

Where a U6 finish is specified the brooming or tyning shall be such as to remove all laitance and to provide an adequate key for bonding of the topping.

12.10 REMOVAL OF FALSEWORK AND FORMWORK

No formwork shall be struck without the approval of the Engineer, and methods of removal likely to cause overstress in the concrete shall not be used.

The times of removal of formwork from the various parts of the structure will preferably be controlled by tests on the concrete which will be carried out by the Engineer.

As a guide to the contractor to enable him to arrange his program of work the minimum times in days, with due allowance for mean temperature, as given in NZS 3109 Clause 5.4 Table 5 may be used for the removal of formwork.

Where construction loads are required to be distributed to lower floors or if adequate strength has not been attained or where the control of early age creep deflections demand, then beams, slabs and cantilevers shall be propped beyond the minimum stripping times.

Formwork shall be struck in such a manner as to permit the concrete to take the stress due to its own weight gradually and uniformly, without shock.

The sequence of striking shall be as shown on the Placing Diagram, or, if not shown, shall be as approved by the Engineer. For continuous slab, girder or arch spans the falsework shall not be removed from any one span until the above periods have elapsed after the placing of the last concrete in immediately adjacent spans.

13. CONCRETE CONSTRUCTION

13.1 GENERAL

This section of the specification covers the handling and placing of structural concrete in this contract.

13.2 RELATED DOCUMENTS

Work shall comply with the relevant requirements of the following standard specifications together with the further provisions herein:

NZS 3109 Concrete construction

NZS 3114 Specification for concrete surface finishes

13.3 HANDLING AND PLACING

The methods of handling concrete and the sequence to be adopted in placing shall be notified in writing by the contractor and subject to the approval of the Engineer, and shall thereafter not be varied without further approval.

Notwithstanding any previous acceptance of methods proposed, the Engineer may order their use to be varied or discontinued should it be found that unsatisfactory concrete is being produced.

13.4 CHUTES

Metal lined chutes may be used but where steep slopes are required the chutes shall be either equipped with baffle boards or be assembled in short lengths which reverse the direction of movement.

Equipment made from metal containing Aluminium shall not be used to transport concrete.

13.5 PUMPING

Concrete may be placed by pumping provided that a concrete mix, designed and approved for pumping is used and that approved (as in 3.21 of this document) equipment is employed.

13.6 NOTICE TO ENGINEER

The contractor shall advise the Engineer when he intends to commence placing concrete. No concrete shall be placed until the Engineer is satisfied that the requirements of this specification and the drawings relating to formwork, reinforcement and construction joints have been complied with entirely. No concrete shall be placed in the absence of the Engineer without his prior approval.

13.7 TIME LIMITS

The Engineer may reject concrete not placed and vibrated in forms after 90 minutes have elapsed from the stated time that water was added at the plant.

Concrete not placed in its final position in the forms within 30 minutes after discharge from the mixer or agitator truck, or before initial set has occurred shall not be used. For concrete mixes containing accelerating admixtures the time of 30 minutes shall be reduced to 15 minutes.

13.8 PLACING

Concrete shall be placed and compacted so as to avoid segregation of materials, displacement of reinforcing, separation between layers of adjacent parts, zones of poor compaction or area of weak concrete such as may be evidenced by honey combing in the finished work.

The maximum permitted free fall drop of concrete is 2 m and the lateral flow shall be restricted to 1 m unless otherwise approved by the Engineer.

13.9 CONCRETE COMPACTION

All compaction of concrete shall be carried out in accordance with Clause 7.6 of NZS 3109 as further modified by the following provisions.

All concrete shall be thoroughly compacted during and immediately after depositing, by means of approved power driven immersion vibrators of a size suitable for the section being poured.

Special permission shall be obtained from the Engineer for the use of form vibrators in sections inaccessible to the immersion type of vibrator.

Vibrators shall be used in such a manner as to prevent displacement of reinforcing, damage to formwork, and the transfer of vibration to concrete that has taken only its initial set.

13.10 CONSTRUCTION JOINTS

13.10.1 General

All construction joints shall be formed in accordance with Clause 5.6 of NZS 3109 as further modified or added to by the following clauses. Generally all joints shall be Type B.

Construction joints shall be located only at the specified positions either shown on the drawings or specified herein unless otherwise approved by the Engineer.

Where construction joint locations are not indicated, the contractor shall submit his proposals to and obtain approval from the Engineer before proceeding with the construction of the section in question.

In construction joint proposals the size and layout of areas to be poured shall be generally in accordance with Clause 10.2 so that shrinkage cracking is avoided.

Joints in adjacent structural elements shall be made to line up such that compatible shrinkage movements occur.

Beams shall be poured monolithically with slabs. Upstands shall be poured monolithically with slabs, or beams.

13.10.2 Location of Joints

Unless otherwise approved or specified elsewhere construction joints shall generally be located in the following positions:

a) For in-situ beams and suspended slabs joints shall be formed near midspan at a maximum spacing of 15 metres.

b) For columns and walls joints shall be formed immediately below and above beams and slabs

c) For suspended slabs and toppings the maximum area poured in one operation shall not exceed 120 square metres, with a maximum dimension of 15 m. This area shall be reduced to 80 square metres where specified tolerances demand fixed screeds.

d) For slabs on the ground the above maximum may be increased by 50% where the increase is not incompatible with construction joint locations in foundation beams.

13.10.3 Slabs

For all slabs provision shall be made for shrinkage control joints within the pour to be formed by either sawcutting or another approved method. Sawcuts, if used, shall be carried out not more than 48 hours after the concrete is poured. The cuts shall be to a depth of one third of the slab thickness and true to line for the full length of each cut.

The maximum spacing between sawn control joints or control joints and construction joints shall be 6 m for suspended slabs and 5 m for slabs on the ground.

For toppings similar provisions for shrinkage control joints shall be made but the maximum spacing and areas, shall be reduced to comply where appropriate with manufacturer's specifications and to prevent shrinkage cracking.

13.10.4 Priming Joints

In addition to the requirements of Clause 5.6.2 of NZS 3109 the hardened concrete shall be primed with a neat cement grout immediately prior to the placing of fresh concrete against the prepared surface.

13.11 CURING AND PROTECTION

Curing and protection shall comply with the requirements of Clause 7.8 of NZS 3109. With reference to paragraph 7.8.2 only options (a), (b), (c) shall be permitted unless otherwise approved by the Engineer.

When concreting in hot weather, the work shall, where practicable, be protected from the direct rays of the sun and from drying winds. Concreting shall not be commenced when heavy rain is falling or threatening and if rain commences during a pour, the contractor shall protect the work as directed to prevent damage to the concrete or to any newly finished surfaces until the concrete has set to such a stage as to withstand leaching of the cement.

To permit screeding and also finishing operations to be completed in the dry, shelter shall be provided over any section of slab that is being poured.

In the event of deterioration in weather, the Engineer shall be the sole judge of whether concreting may continue or not.

13.12 REPAIR OF CONCRETE

The repair of all minor surface defects and structural defects of concrete shall be carried out in accordance with Sections 7.7.5, 7.7.6, 7.7.7, and 7.7.8 of NZS 3109 except as further provided herein.

No repairs to either class of defect shall be carried out without the approval of the Engineer.

All repaired concrete shall have the same strength, durability, colour, and surface finish as the parent concrete unless otherwise approved by the Engineer.

13.12.1 Formed Surfaces

Abrupt changes in excess of the specified limit shall be either ground off to a minimum standard of 1 in 20 height to length, or in accordance with Clause 105.6.4 of NZS 3114 and the resulting surface finished to match the colour and texture of the surrounding concrete.

Gradual deviations shall be corrected using methods approved by the Engineer and the resulting surface finished to match the surrounding concrete.

The repair of all surface defects shall be carried out to the standards specified either in NZS 3114 or elsewhere in this specification, appropriate to the class of finish required. Except where specified otherwise in this specification repairs to surface defects for finishes F3 and F6 shall be carried out as follows:

a) Immediately after the removal of formwork the defective surface shall be stoned to remove all small projections and fins and thoroughly wetted, then allowed to approach a surface dry condition.

b) A sand cement grout shall be applied to the surface by means of either wood or cork floats or, clean burlap or sponge rubber pads as appropriate. The grout shall be thoroughly rubbed into all air holes and other defective areas using a circular motion.

c) After the grout has stiffened sufficiently any surplus shall be removed with an appropriate float or pad.

d) When visibly dry (after about two hours) the surface shall receive a further rubbing down with a burlap or sponge rubber pad.

e) Finally the surface shall be stoned when the concrete has sufficiently hardened, normally not less than 28 days after pouring.

f) The grout used shall consist of one part cement to 1½-2 parts fine sand by volume and shall be mixed to the consistency of thick paint.

g) The sand used shall be from the same source as the fine aggregates used in the parent concrete and shall all pass a 600 mm sieve and not more than 10% should pass a 150 mm sieve.

13.12.2 Unformed Surfaces

Abrupt changes in excess of the specified limit shall be corrected as for formed surfaces (refer Clause 12.1), but with reference to the notes related to Table 3 of NZS 3114.

Gradual deviations in excess of the specified limits shall be corrected as for formed surfaces (refer Clause 12.1).

14. REINFORCED BLOCK MASONRY

14.1 GENERAL

The section of the specification covers the supply of materials and the construction of all reinforced block masonry in this contract.

14.2 RELATED DOCUMENTS

Work shall comply with the relevant requirements of the following standard specifications together with the further provisions herein.

AS/NZS 4455.1 Masonry units, pavers, flags and segmental retaining wall units - Masonry units

AS/NZS 4455.3 Masonry units, pavers, flags and segmental retaining wall units - Segmental retaining wall units

NZS 4210 Masonry construction: Materials and workmanship

NZS 4230 Design of reinforced concrete masonry structures

14.3 GRADES

Masonry shall be Grade B as shown on the drawings and as defined in NZS 4230.

14.4 MASONRY UNITS

An approved manufacturer shall manufacture all masonry units in accordance with AS/NZS 4455.1 & AS/NZS 4455.3. All units shall be of uniform colour and texture and free of cracks, chips or other defects.

For all cells grouted construction open-end bond beam Type 2016 blocks shall be used.

For reinforced cells only grouted construction, standard Type 2001 blocks shall be used together with Type 2014 bond beam blocks and type 2005 open-end blocks where necessary to accommodate the reinforcing.

14.5 MORTAR

The mortar shall consist of four parts of clean sand to half part of hydrated lime mixed and allowed to slake for not less than 24 hours before use. Immediately before use one part of Portland Cement shall be added to give a mix of proportions 1:0.5:4 for cement, lime, and sand respectively, measured by volume.

Alternatively, an approved plasticiser may be used in place of the lime, mixed in accordance with the manufacturer's instructions. Examples are Febmix Plus by FEB NZ, MaxMix® by Sika, or approved equivalent.

If a batch of mortar which has been prepared for use has stiffened due to lapse of time, workability may be restored by the addition of water and thorough remixing. Re-tempering water shall be

added to a basin formed by the mortar and the mortar carefully worked into it. Re-tempering by dashing water over the mortar shall not be permitted.

Any mortar not used within one and a half hours after the addition of cement shall be discarded.

14.6 GROUT AND GROUTING

14.6.1 Material

Grout shall be fine grout complying with Section 2.3 of NZS 4210. If the grout is to be pumped it shall be suitable for that purpose.

Coarse grout with a maximum aggregate size of 13mm may be used only if approval is obtained from the Engineer.

14.6.2 Method of Grout Placement

Grouting shall preferably be done by the high lift grouting method with the use of an expansive admixture, such as Cavex by Sika, described under Clause 2.12 of NZS 4210.

The admixtures shall be added to the mix on site in accordance with the manufacturer's written instructions immediately before commencement of the filling operation.

For Grade C masonry, rodding of the grout will be an acceptable means of achieving the consolidation required under Clause 2.12 of NZS 4210. It is essential that the grout has a spread value within the range 450 mm to 530 mm specified in Clause 2.3.2.1 (c) of NZS 4210. For Grade A and B masonry, consolidation shall be by vibration.

On completion of grouting a weighted board shall be placed on top of the wall or alternative approved means taken to prevent spill over of the expanding grout.

Alternatively, if approved by the Engineer, the grouting may be performed without using an expansive admixture by either of the following two methods:

a) The high lift grouting method including consolidation and reconsolidation as described in Clause 2.13 of NZS 4210.

b) The low lift grouting method described in Section 2.14 of NZS 4210.

For any of the above methods, grouting shall not commence until the mortar has attained sufficient strength, but in any case not sooner than 12 hours after completion of mortaring.

14.7 REINFORCEMENT

In addition to the requirements of Clause 2.1.4 NZS 4210 the following provisions shall be complied with. All reinforcing shall be supplied and placed in accordance with the detailed drawings, including standard detail drawing SD20.

Vertical bars shall return not less 250 mm into the top bond beam and into lintel beams over openings. Horizontal bars shall be continuous around corners. At the end of a wall or opening horizontal bars shall be either hooked around the vertical bars or turned down 250 mm into the end vertical cell.

All reinforcing bars larger than 6 mm diameter shall be deformed mild steel (Grade 300) unless shown otherwise on the drawings.

14.8 BLOCKLAYING

In addition to the requirements of Section 2.7 of NZS 4210 the following clauses shall be complied with.

14.8.1 Tanking

Masonry surfaces to which tanking membranes are to be applied shall have mortar joints flush with the surface.

14.8.2 Registered Masons

All concrete masonry work shall be carried out by masons approved by the Engineer. The Engineer may require a mason to demonstrate he can achieve the required standard of workmanship by the construction of a test panel.

The approved mason shall check the set-out of masonry and reinforcement, check on quality of materials and workmanship, continuously supervise grouting and ensure the adequacy of propping and stays to masonry. The approved mason shall report in writing to the Engineer at least every week on the standards of materials and workmanship.

14.8.3 First Course Blocks

The first course shall be constructed of open-end bond-beam blocks laid upside down to facilitate cleaning out of the bottom of the wall prior to grouting, bottom course shall be fully grouted.

14.8.4 Clean-Out Openings

Where the high lift grouting method is to be used temporary clean-out openings shall be provided at every vertical bar at the bottom of each lift.

Where the low lift grouting method is to be used temporary clean-out openings shall be provided where necessary at the bottom of each lift to ensure satisfactory cleaning out and inspection.

For both high and low lift grouting methods, the clean-out openings shall be cut neatly with a circular masonry saw.

The opening shall have a minimum height of 100 mm above the footing by 100 mm width, where they will be concealed by a skirting or other trim. Where they will be exposed in the finished work they shall be cut to 100 mm in width by the full height of the block and closed off with plaster material. It is noted however that this will compromise the aesthetic standards.

14.8.5 Items to be Cast In

All anchors, bolts and other items shown on the drawings to be case in shall be secured in place before grouting commences.

14.8.6 Control Joints

Vertical control joints shall be constructed in the positions shown on the drawings. Where not shown they shall be placed not more than 4.8 m apart in positions approved by the Engineer. The spacing of the joints should be uniform where possible.

The control joints shall be constructed in accordance with the details shown on the drawings. The joint face of the control blocks shall be painted with a primer compatible

with the sealant material, before laying. The vertical joint mortar shall be raked out to a depth of 18mm on each face. A polyurethane sealant such as Sikaflex® MS by Sika or equivalent shall then be run in each joint in accordance with the manufacturer's instructions. The joint shall be neatly pointed with mortar on completion.

14.8.7 Cleaning of Blockwork

Any mortar or grout dropping to visible surfaces shall be cleaned off as soon as they occur so as to give a clean blockwork finish.

14.8.8 Cutting of Blockwork

When cutting of block units is necessary, cuts shall be made neatly and true with a circular masonry saw.

14.9 BRACING DURING CONSTRUCTION

Temporary bracing shall be provided to all concrete masonry work where necessary to resist all loads until they are structurally complete.

14.10 TEMPERATURE EXTREMES

The precautions listed in Sections 2.18 and 2.19 of NSZ 4210 shall be complied with when construction occurs in extremes of temperature.

14.11 TESTING

14.11.1 Compressive Strength of Mortar and Grout

Compressive tests on samples of mortar and grout shall be carried out in accordance with Appendix 2.1 of NZS 4210. Curing, capping and testing shall be carried out by an SWA approved laboratory.

14.11.2 Masonry-To-Mortar Bond Tests

These shall be carried out in accordance with Appendix 2.B of NZS 4210. Testing shall be carried out by an SWA approved laboratory.

14.11.3 Tests to Confirm Design Compressive Strength

In areas of Grade A masonry so noted on the drawings, tests shall be carried out in accordance with Appendix B or C of NZS 4230 to confirm the compressive strength assume in design. Tests shall be carried out by an SWA approved laboratory.

15. PRE-CAST CONCRETE CONSTRUCTION

15.1 GENERAL

This section of the specification covers the manufacture, transport, and construction of pre-cast concrete units together with ancillary in-situ works.

15.2 RELATED DOCUMENTS

Work shall comply with the relevant requirements of the following standard specifications together with the further provisions herein.

NZS 3101.1&2 Concrete structures standard - Concrete Structures Standard

NZS 3109 Concrete construction

NZS 3114 Specification for concrete surface finishes

AS/NZS 1170 Set Structural Design Actions Set

AS/NZS 1554.1 Structural steel welding - Welding of steel structures

AS/NZS 1554.3 Structural steel welding - Welding of reinforcing steel

PCI Journal, Jan/Feb 1985, pp 26-112

15.3 PENETRATIONS

Pre-form all penetrations over 100 mm square in locations as shown on the drawings. Immediately prior to manufacture, the contractor shall obtain from the Engineer confirmation of all penetrations required.

15.4 CONSTRUCTION

Unless shown otherwise, all units shall be constructed monolithically, and no construction joints shall be formed within the unit without the Engineer's approval.

Units shall be individually marked for their respective locations on the job, consistent with the manufacturer's shop drawings.

15.5 STRUCTURAL CONCRETE AND REINFORCEMENT

All concrete and non-prestressed reinforcement use shall comply with the relevant provisions of other parts of this specification.

Concrete admixtures shall not be used without the specific approval of the Engineer.

Units shall be properly cured until the required release strength (as determined by field test cylinders) has been reached. Curing shall be either by continuous moist curing, or low-pressure steam, or other accelerated curing processes approved by the Engineer.

Low pressure steam curing shall be limited as follows:

a) The temperature of the enclosure shall not exceed 50°C within five hours of casting.

b) Maximum temperature of the enclosure shall not exceed 80°C or as approved by the Engineer.

Concrete used in the units shall be high grade and specified strength not less than 30 MPa, or higher if shown on the drawings.

Pre-stressing reinforcement shall comply with NZS 3109.

15.6 TOLERANCES

Permissible manufacturing deviations shall be in accordance with NZS 3109:1997 Table 5.1.

15.7 SURFACE FINISH

The surfaces of units to receive in-situ concrete or grout shall have stiff broomed (U3) finish of good keying quality. Edge and soffit forms shall be F4 finish or as otherwise shown on the drawings. No bagging or patching of boney concrete shall be permitted without prior inspection and approval by the Engineer. Finishes to in-fill sections in materials other than reinforced concrete shall have high tolerance finishes appropriate to the material being used.

The inside vertical surfaces of shell beams and horizontal joints of wall panels shall be roughened to an amplitude of 5 mm.

15.8 INSPECTIONS

The contractor shall obtain from the manufacturer, and notify the Engineer in writing of his program for casting of the units at least two weeks in advance of casting, so that periodic inspections may be made during progress of the work.

Key inspection times requiring notification are during manufacture, after manufacture (prior to dispatch to site), and after construction but prior to grouting etc. It shall remain the contractor's responsibility to obtain from the manufacturer pre-cast units complying in all respects with the drawings, specifications, and "as-built" details of the supporting structure.

15.9 TRANSPORTATION AND CONSTRUCTION OF UNITS

15.9.1 General

Pre-cast units shall be placed true to line, level, and plumb within at least the tolerances given in NZS 3109 for in-situ concrete. The contract documents may call for stricter tolerances. Permissible manufacturing deviations shall be in accordance with the PCI Committee report.

Units shall be protected from damage or overstress during handling, transportation, and storage on the site.

Cutting or modification of the units in any form shall not be permitted unless within the limits of this specification and as authorised by the Engineer.

15.9.2 Floor Units

Seating for floor units shall be true to line and level, to provide even and uniform bearing for the units. The minimum length of such seating (including allowance for tolerances) shall be shown on the drawings, with minimum of 75 mm on concrete masonry and 50 mm on reinforced concrete.

Units shall be bedded on seatings using a 6 mm thick bed of plastic mortar, placed immediately prior to construction of units. Where required, this bedding may be supplemented by steel shims at locations of high bearing to limit extrusion of the mortar. Such shims shall not exceed 35 mm square, and be slightly thinner than the adjacent mortar layer.

Differential camber between adjacent erected units shall not exceed 6 mm. Where necessary, this provision may be met by on site selection and positioning to ensure that units showing large and small cambers are not in adjoining locations.

The levels of support seatings shown on the drawings make no allowance for camber.

The contractor shall allow for the average design camber in the pre-cast units by adjustment of the seating levels to achieve the correct finish levels and in-situ topping thicknesses shown on the drawings. For the purposes of setting the seating levels the average precamber shall be assumed to be 0.003 x pre- cast unit span, unless more detailed information is provided by the manufacturer.

15.9.3 Beams

Pre-cast beam units shall be placed true to line and level. If the unit seats on a wall or column, the minimum seating shall be 50 mm on concrete or 75 mm on masonry. The units shall be effectively braced to prevent displacement during concreting, grouting, or welding, and remain braced for at least seven days after adjacent in-situ concrete has been poured.

15.9.4 Columns

Pre-cast columns shall be braced and held in position for at least 14 days after adjacent in-situ concrete has been poured.

15.9.5 Foundations

Pre-cast foundations shall be bedded on a 50 mm layer of in-situ wet concrete. The wet concrete shall initially be placed with a convex upper surface so that it will first contact the pre-cast unit in the centre of the unit. The wet concrete shall be sufficiently proud so that the pre-cast unit will extrude the wet concrete under its own weight. The wet concrete and unit shall be placed so that concrete extrudes from all sides of the unit and no cavities are formed under the unit.

15.10 CEMENT GROUTING

Where cement grouting is required, a proprietary premixed low viscosity, high wetting, non-shrink grout shall be used and applied strictly in accordance with the supplier's recommendations. The grout shall have a strength of 10 MPa greater than that of the concrete elements to be joined.

Reinforcing bars to be grouted shall be clean and free from all oil, paint and mill scale. Holes to receive grouted bar shall be drilled with a percussion drill (not diamond drilled), washed clean, and scrubbed out with a wire bottle brush. Pre-formed holes shall be formed with a corrugated metal former. Oil-free air shall be used to clean out the holes immediately prior to grouting.

The preferred method of grouting vertical bars without proprietary splice sleeves is to measure out the calculated volume of grout and place in the hole, then place the bar to be grouted. Bar spacers shall be used to locate bars centrally in the hole.

For horizontal bars, the holes shall be formed with inlet and outlet ports. The components shall be located in their final locations and the grout space sealed. Grout shall be injected under pressure through one port and continued until neat air-free grout exudes from the second port. The ports shall then be closed off.

Grouting between concrete surfaces shall be carried out in either of the ways described above depending whether the grout space has a greater vertical or horizontal dimension respectively. Grout volume shall be calculated and compared with that actually used in order to ensure complete filling of the grout space. The perimeter of the grout space shall be effectively sealed to prevent grout loss.

Grout shall be left to set without shock and vibration for at least three days or until it has reached a strength of 20 MPa.

15.11 WELDING

Welding of embedded plates and the like shall be in accordance with AS/NZS 1554.1:2000.

Welding of reinforcing bars shall be in accordance with AS/NZS 1554.3:2008. For Grade 500 bars, low hydrogen electrodes shall be used with moderate energy input.

15.12 PROPRIETARY SPLICES

Proprietary reinforcing bar splicing systems (e.g. NMB splices, swaged couplers) shall be installed strictly in accordance with the manufacturer's written instructions.

16. WATERPROOFING SPECIFICATION

16.1 GENERAL

This section of the specification covers the supply of materials and the application of all water and moisture proofing measures required under this contract.

16.2 VAPOUR BARRIERS

A vapour barrier membrane is required under all concrete ground floor slabs above ground water level, and wherever else shown on the drawings.

The vapour barrier membrane shall be either:

a) "SikaProofBentonite" laid and applied strictly in accordance with the manufacturer's written technical instructions; or

b) "Moistop 737" or polyethylene (polythene) sheet 0.25 mm thick. Joints between sheets shall be either heat-sealed for a minimum width of 50 mm or lapped a minimum of 150 mm and sealed with a pressure-sensitive plastic tape not less than 50 mm wide provided that such tape need not be used with self-sealing polyethylene sheet.

All penetrations shall be sealed and the free edge of sheets shall be sealed against the foundation beams.

The vapour barrier shall be protected against damage and any damage occurring shall be repaired to the satisfaction of the Engineer at the contractor's expense prior to the placing of any concrete.

16.3 TANKING MEMBRANES

A tanking membrane is required under all concrete slabs and beams below ground water level and wherever else shown on the drawings. The supply and application of this membrane shall comply with the following requirements.

16.3.1 Materials

The tanking membrane shall, unless otherwise approved, be either:

a) "Bituthene 3000 Elastomeric Sheet - Tanking and Waterproofing Membrane" by Nuplex; or

b) "SikaProofBentonite" by Sika.

The type of membrane proposed, if different from that shown on the drawings, shall be submitted with the tender. The tanking membrane shall be manufactured by an approved manufacturer, and shall meet or exceed the properties of the materials in (a) and (b) above.

Primers, mastics, and pastes shall be fully compatible with the membrane and be approved by the membrane manufacturer for that use.

All materials shall be protected from rain and physical damage and from temperatures exceeding 30°C for extended periods. Cartons stored outdoors shall be on raised pallets and covered completely to ensure weather tightness.

The tanking membrane may not be compatible with some form release agents, polysulphide sealants, etc. The contractor shall check to ensure incompatibility problems do not arise.

16.3.2 Applicators

The contractor applying the tanking membrane shall be currently approved by the membrane manufacturer. Any exceptions must be referred to the manufacturer for approval before any work is commenced.

The name of the applicator and a copy of the manufacturer's letter of approval shall be submitted to the Engineer before work commences on site.

16.3.3 Application

The tanking membrane is being used to ensure a completely watertight structure; hence the membrane shall be applied in such a manner that this shall be achieved.

The application procedures for the tanking membrane inclusive of surface preparation, membrane installation, inspection, repair, and backfill shall be in strict accordance with the membrane manufacturer's recommended practice and the best trade practice.

The manufacturer's advice shall be sought and followed for special or unusual details.

The contractor shall allow for the attendance of the manufacturer's representative during membrane application to ensure that correct procedures are being followed. The Engineer shall be given at least 48 hours notice of such attendance.

16.3.4 Surface Preparation

Surfaces must be free of voids, spalled areas, loose aggregate and sharp protrusions, with no coarse aggregate visible. The applicator shall inspect the surface and arrange remedial works before commencing application.

Blowholes or form tie holes over 13 mm in length and/or 6 mm deep and other holes shall be plugged with plaster finished flush with the surrounding surfaces.

Sharp protrusions, e.g. reinforcing tie wire, shall be cut back to 10 mm below the concrete surface and plugged with plaster, finished flush with the surrounding surface.

In addition to the above, masonry shall have mortar joints flush with the surface.

All horizontal surfaces shall be cleaned to remove dust, loose stones, dirt, and debris immediately prior to membrane application.

16.3.5 Protection

The contractor shall take steps, as necessary, to prevent the membrane from being damaged after application. Steel reinforcing cages shall be placed on chairs with plastic tips or rolled feet. On no account will steel cages be allowed to lie on an exposed membrane surface.

In reinforcing cages adjacent to vertically applied exposed membranes, a suitable protection board must be used to prevent damage as the steel is lowered into place.

16.3.6 Inspection and Repair

Prior to the membrane being covered in any way, the area involved must be thoroughly inspected for any physical damage. No other work must be carried out until all necessary repair work has been carried out in total accordance with the manufacturer's recommended practice.

After all repair work is completed and prior to a covering being applied, the membrane shall be inspected by the Engineer. Work shall not continue until the Engineer has confirmed, in writing, that the membrane has been inspected and is satisfactory. At the discretion of the Engineer, the contractor shall carry out further remedial works to bring the membrane to a satisfactory standard.

16.3.7 Backfill

In any situation where tanking membrane is exposed to backfill, the membrane shall be protected by an approved protection board such as 6 mm "Hardiflex".

The Engineer shall be given 24 hours notice of the contractor's intention to commence backfilling.

16.3.8 Warranty

The manufacturer and applicator of the tanking membrane shall each supply a written warranty covering a term of 10 years, warranting the continuous water and vapour proofing of the tanked structure. These warranties shall be supplied to the Principal prior to the issue of the Maintenance Certificate.

16.4 WATERPROOFING

Waterproofing treatment is required to all concrete slabs, retaining walls, and other locations where shown on the drawings, and where the application of tanking membranes is not specified, or not practicable.

The supply and application of the waterproofing treatment shall satisfy the following requirements:

16.4.1 Materials

The water proofing treatment shall be a crystalline chemical cementitious formulation prepared by an approved manufacturer and specifically developed either for use as an admixture, wet concrete or as a surface treatment.

The treatment chemicals shall be formulated to react within the calcium silicate hydrations, calcium hydroxide, mineral salts, and un-hydrated and partially hydrated

cement, and lead to the formation (and repeat formation in the presence of water) of insoluble crystals which render the concrete impermeable to ingress of water from any direction.

Supplementing or compatible formulations shall be available within the same system:

a) for incorporation within horizontal or vertical construction joints, which may in use be subject to structural movement;

b) which expend (re-expand) into the joint with the ingress of water into the joints.

16.4.2 Applicators

The contractor applying the waterproofing system (or parts thereof) shall be currently approved by the manufacturer. The name of the applicator, together with a copy of the manufacturer's letter of approval shall be submitted to the Engineer before the work commences on site.

16.4.3 Application

The waterproofing treatment is being used to ensure a completely watertight structure; hence the treatment shall be applied in such a manner that this shall be achieved.

The application procedures for the waterproofing treatment inclusive of surface preparation, installation, inspection, repair, and backfill shall be in strict accordance with the waterproofing treatment manufacturer's recommended practice and the best trade practice.

The manufacturer's advice shall be sought and followed for special or unusual details.

The contractor shall allow for the attendance of the manufacturer's representative during treatment application to ensure that correct procedures are being followed. The Engineer shall be given at least 48 hours notice of such attendance.

16.4.4 Surface Preparation

Structural defects, e.g. construction, faulty construction joints, and honey combing, to be routed out to sound concrete and repaired as per manufacturer's written recommendations.

16.4.5 Curing

Provide necessary spray, or fog curing, to surface treatment for the minimum prescribed period, as per manufacturer's written instructions.

16.5 WATERSTOPS

Unless noted otherwise on the drawings, all construction joints in fluid retaining structures or basements below ground water level shall be formed with a central waterstop consisting of either:

a) Sika "WaterStop" with the width of the waterstop, as near as possible, the same as the thickness of the concrete wall or floor; or

b) Sika "SikaSwell®-P Profiles", Type 2003 fixed using "SikaSwell® S-2 Sealant"; or

c) an approved equivalent product or material.

The waterstop shall be fully supported so that it is not disturbed during concreting or during formwork removal. All joints shall be made in accordance with the manufacturer's recommendations. Prior to use, the waterstop shall be stored in accordance with the manufacturer's recommendations. A copy of all such recommended practices shall be submitted to the Engineer prior to the start of installation on site.

16.6 JOINT SEALANTS

Unless noted otherwise on the drawings, all construction joints in fluid retaining structures or basements below ground water level shall be formed with a minimum depth of 12 mm deep and width of by 15 mm wide rebate, for a sealant placement on the wet side of the joint. Unless otherwise approved, the sealant shall be "Sikaflex® - 11FC" applied over "Sika® Primer -3N", applied strictly in accordance with the manufacturer's written instructions.

The contractor is responsible to obtain written confirmation of the manufacturer's recommendations and procedure for the particular sealant application and shall supply a copy to the Engineer.

The contractor shall submit to the Engineer names of proposed qualified applicators for approval prior to work being undertaken.

The contractor shall adhere strictly to all manufacturers' recommendations in the application of joint sealants.

16.7 ATTENDANCE AND SUPERVISION

The contractor shall allow for the attendance of the manufacturer's representative during sealant and water stop installation to ensure correct procedures are followed. The Engineer shall be given at least 48 hours notice of such an attendance and shall be present.

17. STEELWORK & METALWORK

17.1 SCOPE

This section of work comprises the supply, fabrication, surface treatment, delivery and construction of steelwork and metalwork.

The Contractor shall adhere to all requirements of the following standards except where specified otherwise herein or instructed otherwise by the Engineer.

NZS 3404:	-	Steel Structures Standard
NZS 4711	-	Qualification tests for metal - arc welders
AS/NZS 1554	-	Structural steel welding
AS/NZS1554.1	-	Welding of steel structures
AS/NZS 4680	-	“Hot Dip Galvanized (zinc) Coatings on Fabricated Ferrous Articles”.
AS 2177	-	Non-destructive testing - Radiography of welded butt joints in metal
AS 2207	-	Non-destructive testing - Ultrasonic testing of fusion welded joints in carbon and low alloy steel

17.2 SHOP DRAWINGS

The Contractor shall prepare shop detail drawings, two copies (hard and electronic) of the drawings shall be submitted to the Engineer and approval of these drawings shall be obtained prior to commencing fabrication. Approval of these drawings will not cover dimensions of layout.

The responsibility for the accuracy of the shop drawings for both structural adequacy and detail shall remain entirely with the Contractor. Should it be found at any stage that a shop drawing does not comply with the Engineer's Drawings and Specification, the Engineer may order the rectification of the drawing and, any work executed. The entire cost of such rectification shall be borne by the Contractor.

17.3 TOLERANCES

All sections, plates, flats, etc. shall be straight and within code specified tolerances. Where required steelwork shall be straightened in a manner approved by the Engineer before fabrication is commenced.

Each section of work shall be fabricated to the required degree of accuracy, suitable jigs, templates, and the like shall be used where practicable.

17.4 WELDING OPERATORS

All welding plant and equipment shall give adequate personal protection to the welding operators.

All welding operators employed on the work shall have been tested and certified within the previous three months by an approved agency for the particular type of welding they are engaged upon. Alternatively, the welding operators shall not be employed on the work until they have passed tests in accordance with the requirements of NZS 4711 and to the satisfaction of the Engineer.

The Contractor shall supply the Engineer, before any fabrication commences, with copies of the above test results for welding operators he proposes to employ on the Contract.

Throughout the whole of the construction period the Contractor shall keep an accurate record of the sections of work carried out by each welding operator.

These records must be kept available on site for inspection by the Engineer when requested.

17.5 WELDING AND ELECTRODES

17.5.1 Welding

All welding carried out in connection with this Contract shall be done by the metallic arc process using coated electrodes.

17.5.2 Butt Welds

All butt welds shall be full penetration. No pinholes or slag inclusions shall be permitted. Great care must be taken when laying vertical butt welds, and a constant check must be kept to ensure complete fusion and freedom from slab inclusions.

17.5.3 Fillet Welds

All fillet welds not specified on the Drawings shall be taken as 6 mm (nominal size) fillet, and unless the actual length of weld at each joint is stated, it shall be assumed to be the

maximum obtainable along all lines of contact of the members jointed, to form a continuous weld.

17.6 BOLTING

In general, all field connections shall be bolted as shown on the Drawings. Holes shall be drilled, or punched, not more than 2 mm greater than the nominal bolt diameter and parallel washers shall be used under all nuts, and where required where channels and joists are bolted, tapered washers shall be used.

Bolts shall be Mild Steel Grade 4.6 or High strength grade 8/8 as shown on drawings and tightened snug tight unless shown or specified otherwise.

Generally steel bolts, nuts and washers shall be hot dipped galvanised.

Stainless steel nuts and bolts shall be factory coated with Molybond coating or an alternative approved by the Engineer.

17.7 TRANSPORT

The Contractor shall transport all materials to the site taking all care and responsibility and making arrangements with the necessary Authorities. He shall insure or otherwise indemnify the Employer against loss, damage, accident or fire en route and any delays which may ensue for late completion arising from the damage.

18. ELECTRICAL

18.1 INTRODUCTION

The Electrical Contractor shall be a subcontractor to the Main Contractor and shall be subject to the same General and Special Conditions of contract applying to the Contractor.

Contractors are to make use of the Tender Period to clarify any aspects or inconsistencies of these documents that may influence the pricing or the execution of the Contract. Any such inconsistencies found subsequent to the letting of the Contract shall have the interpretation placed upon them by the Engineer. The Contractor shall abide by this interpretation.

All clauses of the complete specification shall apply to the Electrical Subcontractor and all his specialist subcontractors.

The locations of equipment, etc. are shown diagrammatically on the drawings. Their final location on site may vary by up to 5 metres from the positions shown or described, unless specifically dimensioned in the detail drawings. Contractors shall include for these minor variations in equipment positions within their Tender. Subsequent changes to the positions within the aforementioned limits prior to installation shall be carried out at no additional cost.

Final routes shall be determined by the Contractor on-site and shall be subject to the final approval of the Engineer.

18.2 INFORMATION TO BE SUPPLIED WITH THE TENDER

The tender submission shall include:

- a completed Bills of Quantity
- a list of all Subcontractors, including manufacturers and/or suppliers

The Contractor is responsible for supplying all information to Manufacturers, Suppliers and specialist Subcontractors for items, equipment, work, etc. covered within these Documents for which he requires prices for the completion of his Tender.

18.3 COMPLIANCE

Provide written confirmation at the time of tender, that all equipment offered and all aspects of the Tender fully comply with the Specification, that the components offered are suitable for their intended use.

18.4 ACCESS

This Contractor shall provide and maintain scaffolding, ladders, movable platforms, hoisting and lowering equipment. No hoist or other equipment shall rest upon or be suspended or attached to the permanent structure without prior written approval from the Contractor.

18.5 WORKS SUB-LET

Provide with the tender submission the name of each Manufacturer, Assembler, Installer, etc. proposed for the work together with full details of the work (e.g. design, manufacture, assembly, supervision, etc.) or materials the Contractor proposes to sub-let.

18.6 FEES AND PERMITS

Obtain all permits and pay all fees necessary for the proper completion of the Contract.

Comply at all times with all recommendations and requirements of the Samoa Electricity Regulations and all amendments, relevant Electrical Codes of Practice, Standards, Local Bylaws and Acts.

18.7 QUALITY OF THE INSTALLATION

Commodities and material shall be new, unless detailed otherwise, and comply with the relevant New Zealand Standard (or Australian Standard if no New Zealand exists), and be suitable in every way for the Service Conditions and their intended use.

For commodities specified to comply with a particular Standard, obtain "Certificates of Compliance" from Manufacturers when requested by the Engineer.

Selection of commodities and their fixings, etc. shall be such as to exclude the possibility of any corrosion.

Handle, store and fix commodities with care and in accordance with the Manufacturer's recommendations to ensure that they are in perfect condition when incorporated into the work.

18.8 ALTERNATIVES

These will generally only be considered where the words "Or Equal Approved" are used. They must be nominated within the Tender and be accompanied with the Tender cost adjustment for each alternative; otherwise the Contractor shall supply only the specified equipment.

Later application, unless clearly in the Employer's technical and financial best interests will not be approved. Where a later application is approved, the alternatives may only be used after the issue of written acceptance from the Engineer.

18.9 VARIATIONS IN EXTENT OF CONTRACT

The Employer reserves the right to instruct the Contractor to carry out variations to the Contract. For variations not provided for in the Price Schedule the Employer may call on the Contractor to submit a separate written quotation.

18.10 PENETRATIONS

Provide all penetrations through new and existing building structures necessary to run all cabling and equipment required under this contract. The Engineer shall approve locations and penetrations through floors for additional cable access before drilling commences. Typically, co-ordination drawings will show locations of proposed penetrations.

Do NOT drill or penetrate into pre-stressed concrete columns, beams or floor ribs or through exterior walls, foundations, etc., without approval by the Engineer. Seal all penetrations to prevent the ingress of moisture.

18.11 ISOLATION AND ENERGISATION OF EQUIPMENT

Where existing "in-service" wiring or equipment has to be modified or extended, the Contractor shall arrange a time and duration period with the Employer and the Engineer for the power supply to be disconnected.

The Contractor shall not de-energise, energise or modify any existing equipment, wiring, etc until written authorisation has been received from the Engineer.

18.12 MOTOR- SOFT STARTERS

Starters shall be set up initially to reduce starting and stopping currents to 300% FLC.

New units shall be suitable for mounting within a switchboard. Provide all manufacturer's recommended ventilation requirements within the switchboard.

Protection shall be fully compatible with and coordinated with the system as shown on the Drawings and shall comprise a common alarm output. All auxiliary contacts, interfaces, control indications and functions as shown on the drawings and required for operation of the control and telemetry system shall be supplied/and installed. This shall include all defined alarms and control functions required for controls.

Full harmonic suppression must be included to fully comply with all NZECP36 requirements and to all local Power Supply Company requirements.

The Contractor shall fully programme and commission the soft starters. The soft starters shall be set-up to provide motor protection. The starter shall provide the following minimum protection settings:

- Line fault
- Power loss
- Voltage imbalance

- Phase reversal
- Undervoltage
- Overvoltage
- Overload
- Underload
- Jam/stall
- Excessive starts per hour

18.13 INSTALLATION OF EQUIPMENT

18.13.1 General

Site assembled equipment such as MCCs, distribution boards, junction boxes, control panels, instrumentation, packaged equipment, etc. shall be correctly assembled, interconnected, levelled and aligned by the Contractor.

The Contractor shall supply and install approved mechanical protection on electrical equipment and wiring which is mounted within 1400 mm above an operating floor or platform; subject to damage during normal plant operation and maintenance.

The Contractor shall adequately seal the following whether provided by this Contractor or not to prevent ingress of moisture and maintain required fire ratings.

(a) openings made through building walls, floors, roofs, etc, for cable reticulation

(b) cable duct openings above ground floor

(c) cable trench openings into buildings

(d) spare conduit or cable entries

(e) other areas where moisture, water, process fluids, rodents, insects, etc. may accumulate.

All electrical equipment and cable runs shall be set out and planned whether shown on the drawings or not, and in co-ordination with all other services. All cable runs shall be planned to avoid unnecessary cross-overs. Cables shall be run neatly straightened and untwisted and be neatly clipped, saddled or clamped to their support system. Cables shall not be bent beyond the manufacturer's minimum bending radius.

Equipment found to require drying out shall be referred to the Engineer.

Holes shall be drilled and not burnt out using gas torches or electric arcs. Welding shall be carried out by certified welders. The location of all drill holes through pre-stressed concrete or structural steelwork shall be approved by the Engineer.

Piping, conduit and tubing shall be formed with pipe benders.

When damaged, protective coatings shall be immediately repaired to the approval of the Engineer.

Protective plugs and covers shall not be removed until connections are about to be made. All unconnected conduit ends shall be capped, plugged or otherwise sealed.

The Contractor shall ensure all lids for trays/ladder/trunking are securely fixed in place prior to Practical Completion.

The Contractor shall ensure that joints and connections made between different metals subject to galvanic action are adequately protected to the approval of the Engineer.

18.13.2 Mounting and Positioning

The Contractor shall be responsible for all mounting plates, brackets, supports and fixings etc necessary to install and connect up all commodities plant, equipment, instrumentation, etc. necessary to complete the work.

Equipment shall not be mounted on, or attached to, vibrating equipment or other sources of vibration, when practical.

All mounting hardware shall be 316 stainless steel or hot dipped galvanised.

Temporary protection shall be provided for all equipment once removed from enclosed storage facilities to prevent damage from weather, dust, welding spatter, paint drips and any other environmental conditions encountered during construction.

Painted surfaces that are damaged during installation shall be restored to their original condition.

Hangers, supports, guides, instrument cable, tray and conduit shall be furnished or fabricated and installed as required to form a complete installation.

Supports shall be placed at or as near as practicable to change of line direction. All supports, mounting bolts, nuts, bolts and gaskets etc shall be supplied by the Contractor.

Instruments, cable support systems, cable and equipment shall not obstruct walkways and accessways.

Stands, mounting plates and brackets etc shall be free from burrs and sharp edges with the holes drilled or machined. They shall be hot-dip galvanised finished.

Brackets and supports shall be constructed so that vibration from wind and adjacent machinery is negligible and be of sufficient thickness to prevent buckling.

Equipment shall be levelled in two planes and plumbed in the third. Any requirements for aligning to associated equipment shall be carried out.

All mounting and fixing screws, bolts, washers, etc. shall be stainless steel unless otherwise approved. Excess threads shall be removed.

No equipment, brackets, supports, tubing, cable ladder, tray or cabling shall be fastened to handrails or piping.

Where equipment is mounted along or in access ways, it shall be positioned so that it is protected from damage and does not represent a hazard to personnel using the accessway.

All equipment shall be adequately protected against corrosion, mechanical damage, vibration, process fluids, heat, etc.

18.14 WIRING AND CABLING

18.14.1 General

Provide all wiring and cabling as detailed on the drawings. Where cable sizes and types are not stated on the drawings, the Contractor shall design and select cabling to suit the load.

18.14.2 Wiring

Segregation of extra low voltage, and low/medium voltage wiring will be carried out to the relevant Standards, Codes, etc.

All wiring shall be continuous; joints are not acceptable.

Terminals shall be sized and arranged so that one wire only is terminated in each side of each terminal block. Bridging links shall be provided for multi-terminations.

Where neutrals are looped, both the first and last items shall be directly connected to the neutral bar.

Screened, twisted pairs shall be used for analogue wiring. Screening shall be continuous between cable terminations, covered with insulation and terminated in one point only.

Connections and wiring shall be arranged with special care to prevent overheating resulting from bunched conductors and to give a tidy appearance.

18.14.3 Cabling

Cabling shall be run concealed within conduits, trunking etc and on above-ground cable tray networks.

XLPE cables shall comply with AS 3198 or BS 5467

PVC cables shall be manufactured to NZS 6401.

All cables shall be continuous, joints shall not be permitted.

All circular cables shall enter boxes, panels, cubicles, plant and equipment etc. via approved metal cable glands.

PVC ducting, galvanised water pipe, or other approved means, shall be installed where mechanical protection is required. This and cable supports shall be free of burrs and sharp edges. Bushing and sleeving shall be provided as required to prevent cable damage.

Where single core cables are used for three phase circuits, the three cables comprising each sub-circuit shall be kept in close proximity, preferably in trefoil formation.

18.14.4 Pump Control Cables

Pump Control Cables shall be flexible tinned fine stranded copper cable, heat, oil and chemical resistant, suitable for permanent submersion to 500 metres and shall be direct buried in accordance with the design drawings.

5-Core Conductor: 2.5mm^2 annealed fine wires of tinned electrolytic copper stranded for HIGH flexibility (Class 5)

Insulation: EPR R90

Sheath:	Special Elastomer Rubber
Temperature Range:	Fixed -40 to 90°C / Flexing -20 to 90°C
Minimum Bending Radius	Fixed 4 x cable diameter / Flexing 6 x cable diameter
Relevant Standards: to AS/NZS 5000:2003	IEC 60092-353, IEC 60092-350, IEC 60332-3 CAT. A, Generally

Arrange for the Engineer to inspect the trenching and installed cabling prior to backfilling and proceed with backfilling only upon their approval to do so.

Provide all trenching necessary to reticulate cabling and lay the cable above pipelines as detailed on the drawings. The cable trenches shall be clear of all spoil, rocks, etc and covered with a further layer of fines. The trench shall then be backfilled in 150 mm layers. Each layer shall be well compacted before the next layer is installed.

Approved models:

- Firstflex ML05/2.5BK

18.15 EARTHING AND BONDING

18.15.1 General

All earthing shall be in accordance with Samoa Electricity Regulations and local Power Supply Company requirements.

All exposed metal and electrical equipment including junction boxes, panels, doors, CT secondaries, transformer screens, armouring, etc. shall be earthed.

Earth conductors shall be multi-strand copper with green/yellow insulation.

All cabinets and junction boxes shall have an approved earth bar. Earthing on screws or bolts through cabinet walls will not be accepted. All earthing conductors shall terminate on the earth bar.

All cable ladder, trays, metallic conduits, pipework and equipment shall be bonded to provide earth continuity over their entire length.

Instrument cable screens shall be insulated from earth in the field. The screen shall be earthed at one point only.

Where looped connections are made they shall be connected into a common lug and both ends of the loop shall be directly connected to earth.

18.16 PUMP CONTROLS

18.16.1 Flow Switch

Bore pump controls shall be complete with a Grundfos flow switch, suitable for operation on the control voltages detailed.

The Contractor shall determine on site the final location of the flow switch to ensure readings are free of interference by equipment or structure and to allow ease of maintenance. The flow switch shall be located in a position where it is readily accessible

for removal and inspection. All installation work shall be in accordance with the manufacturer's recommendations.

18.16.2 Float Level Switches

Where shown on the drawings pump controls shall be complete with a Grundfos float level switch for low level input to the motor control panel, suitable for operation on the control voltages detailed.

The low level relay shall be connected to operate at a point 200 mm above the highest suction inlet of the pump strainer.

The final level of the floats shall be adjustable by up to 200 mm up or down.

In general, the floats shall be located in a position where they are readily accessible for removal and inspection. All installation work shall be in accordance with the manufacturer's recommendations.

Floats shall be terminated to junction boxes where detailed to permit ready removal and replacement. All cables outside of the wet well shall be enclosed in ducts.

18.17 INSPECTIONS, TESTING AND COMMISSIONING

18.17.1 General

Prior to inspection/commissioning of the Works by the Engineer for the purposes of certifying Practical Completion, provide the Engineer with completed, signed Test/Inspection/Pre-commissioning Reports indicating that the Works are now ready for inspection and commissioning. The contents and results of these Reports must be acceptable to the Engineer, and are an essential prerequisite to the Engineer proceeding with inspection/commissioning of the work for the purposes of the issue of the Certificate of Practical Completion.

A complete final signed set of inspection and testing results shall be bound within each Operating and Service Manual.

Repair or replace as instructed by the Engineer, at no charge, any item or features not complying with these Documents.

18.17.2 Inspection

The Contractor shall verify by visual inspection and report that the installation is in accordance with the Employer’s Requirements, Drawings and relevant Codes, Standards, Bylaws etc.

The Engineer will inspect the Work during installation and on completion when notified by the Contractor. This inspection shall not relieve the Contractor of responsibilities in case of later discovery of defective materials or workmanship.

18.17.3 Testing and Pre-commissioning General

Provide all equipment and personnel necessary to carry out all tests and pre-commission to the satisfaction of the Engineer and record all results.

These procedures shall demonstrate the operation of the completed section of the installation and all component parts, the results of which shall be to the satisfaction of the Engineer.

Testing and Pre-commissioning shall generally include but shall not be limited to:

- Compliance with the Documents, Codes, Standards, etc
- Continuity
- Point to point
- Proper termination
- Insulation resistance
- Tightness of all terminations and connections
- Earthing resistance
- Polarity
- Control logic sequence tests
- Full functional tests.
- Loop tests on field instruments.

18.17.4 Commissioning

The Contractor will be responsible for full commissioning of the work. This will include final calibration and setting up of equipment. The Contractor shall provide all equipment and personnel necessary to carry out the commissioning to the satisfaction of the Engineer and record all results.

The commissioning procedures shall demonstrate the operation of the completed installation and all component parts, the results of which shall be to the satisfaction of the Engineer. The commissioning shall include the commissioning of the new and existing aerators.

Arrange for Subcontractors to be in attendance where commissioning of the installation involves their equipment.

Where components, control and protection systems, etc have been disconnected at the manufacturers works to permit transportation to site, they shall be fully re-tested to ensure their performance is identical to that obtained during the works tests.

18.17.5 Completion and Demonstration to the Employer's Staff

The Contractor shall:

- Tidy up and remove all excess materials from the site. This includes original and now redundant materials, etc.

- Demonstrate the completed commissioned installation to personnel nominated by the Principal.

- Instruct nominated members of the Employer's staff in all aspects of the operation and maintenance of the completed installation including the use of Operating and Service Manuals.

A minimum period of one full day shall be allowed for demonstration and instruction and be at times convenient to the Employer. Demonstrations shall be carried out with specialist personnel from each sub-contract in attendance. The Contractor shall give a minimum of 48 hours' notice to the Engineer and the Employer prior to carrying out the demonstration.

18.17.6 Practical Completion

The Certificate of Practical Completion does not become due until receipt of a copy signed Electrical inspection by the Employer's staff, draft Manuals and As-Built documentation complete with site testing and commissioning results.

Tidy up and remove all excess materials from the site. All cubicles and panels supplied under this Contract shall be vacuum cleaned inside and on top to remove foreign materials. Similarly, switch rooms, electrical cupboards and distribution frame cupboards shall also be vacuum cleaned.

18.17.7 Defects Liability

Carry out all inspections, checks and test procedures on the following for the duration of the Defects Liability Period, recording tests and results within the logbook to be kept on site by the Principal.

The Defects Liability Certificate does not become due until the required inspections, checks, tests and the recording of results has been carried out in accordance with the aforementioned Standards and to the satisfaction of the Engineer.

Repair any defect, which does not compromise the effectiveness of any system, excluding fair wear and tear within 7 days during the Defects Liability Period specified.

Defects, which do comprise the effectiveness of the system, shall be repaired within 24 hours. Failure to do so will result in the work being done by others at the Contractors expense. The Defects Liability Period shall for the period stated in the Conditions of Contract, calculated from the date of Practical Completion.

Payment of the retention money will be effected after the lapse of the Defects Liability Period and provided the installation has been in satisfactory working order during this period.

18.18 AS BUILT DOCUMENTATION

18.18.1 General requirements

As-Built Drawings and Operating and Service Manuals shall be provided by the Contractor for all components of the Works and shall be appropriately titled, indexed, identified, numbered and dated. Standard of drawing practice shall comply with relevant standards.

Provide two complete draft sets each of As-Built Drawings and Manuals, minor omissions and defects excepted, to the Engineer prior to Practical Completion. The draft As-Built Drawings and Manuals will be returned after review. The Contractor shall resubmit after the necessary amendments.

Provide two complete sets of final As-Built Drawings and Manuals, to be delivered to Engineer within two weeks of Practical Completion. Refer to the General and Special Conditions of Contract for retention of monies pending delivery of final As-Built Drawings and Manuals.

18.18.2 As-Built Drawings

As-Built drawings shall be marked `As-Built' and shall show the Contractor's name, address, telephone number and date of commissioning, and shall contain all relevant information to ensure they fully reflect the final As-Built arrangements. The drawings shall

not be reduced from their original size. The drawings shall be drafted by a competent draftsperson in AutoCAD 14 format to a standard acceptable to the Engineer. As-Built drawings are required to be A3 size. Drawings are to be of original quality.

As-built drawings shall include exact details of all installations, but shall not include dimensions as shown on 'shop drawings' unless for the specific purpose of indicating concealed work which is only accessible by demolitions or excavation.

The following additional specific requirements for as-built drawings are as follows:

1. Building services layouts showing switchgear locations, cable support systems, lighting, power outlets etc.
2. Schematics shall be provided for the following:
   (a) Single line diagrams showing the switchboards and distribution boards, including all mains and submains, cabling sizes and types, etc
   (b) Schematic diagrams showing the control systems within motor control centres and distribution boards

Each diagram shall conform to the standard mentioned under General Requirements.

18.18.3 Operating and Service Manuals

The manuals shall contain a general description of the whole works sufficient to describe its normal function to non-technical personnel. The manuals shall contain the following information relating to these works:

- all diagrams;
- list of suppliers, parts lists and schedules;
- schedules detailing make, model, rating and manufacturer of all fittings and accessories, i.e. contactors, drives, starters, power outlets, light fittings, switches, etc.
- Service requirements, maintenance procedures, and frequency thereof. In particular the recommended procedures of individual Manufacturers;
- measures necessary to electrically isolate any equipment;
- description of protection equipment and its mode of operation;
- description of RTU equipment and its operation;
- Manufacturer's details and recommendations including technical leaflets. Photocopies leaflets are NOT acceptable. Specific models of equipment shall be underlined in red pen and cross-referenced to the plant number.
- testing and commissioning data and results (works and site);
- recommended spare parts lists;
- fault finding procedure lists;
- list of record drawings and description, plus A3 reductions of the accepted "As-Built" drawings;
- System descriptions. This section shall be appropriately subdivided providing information on each and every system fully describing its sequence of operation.

19. BUILDING WORKS

The following clauses refer specifically to the design and construction of building works. Where appropriate the requirements of Sections 1 to 17 also apply to building works. In the event that anything in the following clauses differs from any requirement specified in Sections 1 to 17, the requirements of the following clauses shall apply.

19.1 SITE WORKS

19.1.1 Site Clearance

For new structures, clear the area to be covered by the concrete slab of vegetation and other debris. Remove topsoil from the whole of the building site to the approximate depth of 150mm.

19.1.2 Building Platforms

Prepare building platforms for the new buildings to the level shown on the drawings.

19.1.3 Excavation

Excavate for the foundations of the new concrete slab, to the depths and shapes as shown on the drawings. Care must be taken to ensure that a solid bearing is obtained in all cases, and any doubtful bearings shall be noted and pointed out to the Engineer, whose decision shall be final.

Trenches shall be of sufficient width to include formwork. Pouring against the ground is only permissible with approval from the Engineer.

Also refer to drawings for other structures that are to be removed, if any.

19.1.4 Backfilling

Backfill around the foundations and elsewhere with excavated material to bring up to the required grade.

19.2 CONCRETE WORK

19.2.1 Construction Joints

1. General

In general construction joints are detailed in the drawings and shall not be varied without the Supervisor's express consent. Vertical joints shall be formed with suitable bulkheads.

Reinforcement shall run continuously through Construction joints, unless shown otherwise in the drawings. At least three clear days shall elapse between adjacent pours of concrete.

The following are in addition to N.Z.S. 3109 Clause 5.6

2. Position of Joints:

a) Slabs- If not detailed, the Contractor shall ascertain the requirements of theEngineer before starting the work.

b) Beams - Unless expressly detailed otherwise on the drawings, or agreed by the Engineer, lengths of pours shall not exceed 9000mm.

3. Preparation of Joints (except slabs poured onto fill):

Joints shall be deeply hacked to remove all weak material and give a degree of relief at least as deep as a fractured concrete surface. Chip away edges so that these are not damaged. In the event of edges being damaged, the Engineer reserves the right to nominate the method of repair the Contractor shall adopt. Immediately before the new concrete is poured, be thoroughly wetted, after which excess water shall be removed.

19.2.2 Damp proof course

Slabs shall be poured on a waterproof 0.125mm thick black polythene membrane or similar approved by the Engineer with joints lapped 300mm and jointed with pressure sensitive tape.

19.3 CARPENTRY

19.3.1 General

The work under this section consists of all labour, materials and equipment necessary to perform carpentry works of properties in accordance with the drawings, specification and schedules herein.

All works shall be carried out in accordance with the requirements of the National Building Code for Western Samoa and NZ Timber Preservation Authority Specification H3 for building timber, and shall be branded or certified as requested by the Engineer. Manufacturers instructions shall be followed for the use or installation of particular materials or components.

19.3.2 Requirements

Prime all faces of exterior finishing timbers such as fascias and facings to joinery prior to fixing in place.

19.3.3 Materials

Timber

All timber to be imported Radiata Pine Dressing Grade 1 [imported] treated with preservative process in accordance with the requirements of the NZ Timber Preservation Specification H3.

Timber shall be free from shakes, loose knots and gumstreaks. Substandard, warped or split timber as well as timber with bruises and tool marks shall be removed from the site as directed by the Engineer.

All timber shall be thoroughly seasoned. All framing and exterior timber shall be tanalised.

Stacking of all framing timber, sarking and weatherboards shall be on skids and covered with tarpaulins. All finishing lines shall be in a shed or inside the building.

Damp Proof Course

All timbers resting on or against concrete or concrete blockwork shall be protected by a layer of 3-plymalthoid under full bearing surface.

Diagonal Bracing

Diagonal bracing shall be continuous galvanised steel strap in accordance with NZS 3604, and shall be provided in walls and roof planes where shown.

Fastenings

All nails shall be of approved manufacture, pattern length and gauge. Nails shall be used in adequate numbers to securely fix all timbers in accordance with best trade practice.

All screws shall be of approved manufacture of proper gauge and length and non-corrosive suitable for the fittings to be secured

All metal fastenings, nails, bolts, nuts, washers etc., used externally shall be galvanised after manufacture.

19.3.4 Wall Framing

All framing shall be plumb and true and to all dimensions shown. Plates shall be in long lengths, halved at intersections. Plates on concrete shall have a bituminous fabric damp proof course between timber and concrete, and shall be secured to the concrete with M12 galvanised bolts at 1200mm centres, or otherwise shown in the drawings. Wall framing shall be 150mm x 50mm or 100mm x 50 Plates, studs and nogs as shown in drawings.

19.3.5 Roof Framing

Secure all trusses as detailed. Fix all other roof framing and purlins as shown. All purlins shall be in long lengths. Provide all strapping and noggins as shown for ceiling linings.

Provide barge and fascia boards to sizes shown.

19.3.6 Completion and Make Good

Allow for making good all work disturbed by building works.

19.4 GLAZING

19.4.1 Materials

Glass shall be free from cracks, scratches, bubbles, blisters and other defects that will interfere with the appearance or service.

Glass shall be of general glazing quality, and shall comply with NZS 4223.

Thickness of all window glazing shall be of a minimum of 6mm thick.

19.4.2 Workmanship

Workmanship and methods of glazing and fixing shall comply generally with the Manufacturers recommended practice.

19.4.3 Glazing Methods

The method of glazing shall be such that building movements due to wind and thermal effects are not transferred to the glass. Comply with the manufacturer's recommendation for the relevant glasses. Before glazing, clean rebates and fixing surfaces, remove any temporary film and ensure that glass edges are undamaged.

19.4.4 Marking

Mark glass after glazing with soap or marking compound, not with advertising stickers. Remove any labels, paints or tape present on the glass during glazing.

19.4.5 Cleaning and Replacement

On completion clean and polish all glass, replace any damaged or broken glass and leave the whole of the work in good condition. Glass cleaning agent shall be of clean water to which detergents may be added in small quantities or an approved glass-cleaning agent.

19.5 ROOFING

19.5.1 General

The work required under this section consists of all labour, material and equipment necessary to complete roofing including battens, ridges, barges, flashings, cappings, gutters, downpipes, in accordance with the drawings, specification and /or schedules herein.

All work shall be in accordance with the Manufacturer's instructions to obtain a completely watertight roof and shall be in accordance with the Building Code managed by the Ministry of Works, Transport and Infrastructure (MWTI). Contractor is to strictly adhere to the sheet fastening requirements of the Building Code of Western Samoa.

19.5.2 Materials

All materials shall be free from imperfections, discolouration, deformation, etc., and shall be protected from weather while stored on site.

Roofing material shall be as specified in the drawings. The installation shall be in strict accordance with the Manufacturer's instructions. The work consists principally of new 24 gauge Color Bondroofing.

All materials and workmanship are to be the best of their respective kinds. The Contractor shall provide all jointing materials, solder, nails, screws, wedges, etc, to make the whole roof completely watertight.

19.5.3 Sarking

Allow for providing and fixing double-sided, fire retarding sisalation on wire netting on top of the timber purlins. Allow fixing to the fascia as detailed in the drawings.

19.5.4 Lapping

Roofing sheets shall be lapped 1-½ corrugations and shall be screw fixed every 2nd corrugation at the ridge and the eaves and at the end sheets. All laps shall be well primed with calcium plumbate priming.

19.5.5 Fastenings

Fix roofing in one length from ridge to eaves fasten to each purlin with four fixings per width of sheet and with six fixings at top and bottom and at the end sheets. For securing roofing to timber purlins use Type 17 self-drilling screws 55 x 6.5 with integral neoprene washers and with Snap-On caps in matching colour or as otherwise specified in the drawings. For securing flashings use screws as above or approved blind pop-rivets. Neatly join flashings at junctions and ensure that all are watertight.

19.5.6 Ridge and Barge Capping

Finish off along ridge and verge lines with purpose-made ridge capping or barge rolls.

19.5.7 Metal Separation

Prevent direct contact between incompatible metals, and between green hardwood or chemically treated timber and aluminum or coated steel, by either:

a) applying an anti-corrosion, low moisture transmission coating to contact surfaces; or

b) inserting a separation layer.

19.5.8 Gutters and Downpipes

Supply and fix all gutters and downpipes to the sizes and in the positions as shown on the drawings. Gutters shall be PVC Marley Flowline or The Engineer approved, and shall be supplied complete with all brackets clips and other accessories to complete the installation.

Fix gutters strictly in accordance with the Manufacturer's instructions to correct falls. Correct any water pooling that occurs. Leave the installation in a clean and watertight condition.

Downpipes shall be Novapipe PVC Pressure Pipe Class B conforming to NZS 7648 1987 or as otherwise specified in the drawings. Supply complete with all fittings. Prefabricate gutters to the required shape. Form stop ends, bends and returns as required to complete the installation. Provide and install 'turn downs' into the gutters for downpipe outlets. Overflow pops are not required unless otherwise specified.

19.6 PLUMBING

19.6.1 General

The work under this section consists of all labour, materials and equipment necessary to perform plumbing works of properties in accordance with the drawings, specification and schedules herein.

The whole of the plumbing is to be carried out in accordance with the rules of local by-laws, New Zealand Drainage and Plumbing Regulations 1978, relevant Standards of the Plumbing Association of Samoa and by a licensed plumber with a registered business to best trade practices.

19.6.2 Pipes and Fittings

Water pipes from main and through buildings shall be PVC to NZS 7648.

Waste pipes shall be polypropylene and vent pipes shall be PVC.

Traps shall be two-piece polypropylene.

All pipes shall be concealed where possible.

Pipe runs and locations are indicated diagrammatically on the drawings

Any exposed tubing in toilets and showers shall be chromium plated and fitted with CP flanges at walls.

Sleeves for pipe passing through a roof shall project above roof finishing and shall be watertight.

All back vents shall be PVC or as indicated on drawings. Carry the vent through roof and finish with cowls.

Brass floor traps to have CP screwed gratings spiggoted and socketed, jointed to The Engineer's approval.

All tubing buried in the ground shall be PVC.

PVC pipes shall be fitted in accordance with Code of Practice for installation of unplasticised systems.

All water pipes shall be set straight or to an even gradient, avoiding all places where air locks are likely to occur.

Easy bends shall be used throughout.

The minimum cover for in-ground service pipes shall be 300mm except for:

a) Concrete slab on ground - 75mm below slab base

b) Public thoroughfares, vehicular access ways - 450mm below finished surface level.

For water service pipes located in rock strata pipe shall be surround by 75mm of sand or fine-grained soil. No rock or sharp-edged material shall be permitted to come into contact with the pipe.

For straight runs of pipes up to 18m, one end shall be fixed and the other shall have full provision for extension.

Pipework shall not be embedded in concrete or built into any structure of any building fabric unless otherwise shown in the drawings and approved by the Engineer.

Full provision shall be made for differential expansion rates of wall and pipework.

Above Ground Pipework shall be located in inconspicuous locations. Concealment in dedicated service ducts, wall cavities, subfloor space etc shall be adopted as a first priority; surface mounted pipework shall be located to minimise mechanical damage.

Full provision for maintenance access for pipe repair and isolation shall be made for concealed services.

19.6.3 Location

In-ground service pipes shall be located in dedicated trenches. No service pipe shall be laid through any sewer drain or septic tank. Service pipes located across sewer drains shall have a minimum clearance of l00mm above the highest part of the sewer drain.

19.6.4 Standpipes

Standpipes shall be supported for their full height. Standpipes shall be clipped to masonry or concrete surfaces with M4.5 x 30mm masonry anchors at 300mm centres maximum or as shown in the drawings. Flanged elbow shall be secured with 2 No masonry anchors.

Standpipes secured to the building structure shall be located above a self-draining impervious paving service. Ponding/seepage of water adjacent to the building structure is not permitted. Standpipes shall be 450mm minimum height above ground surface level.

80mm x 50mm treated timber stake shall be used for all freestanding standpipes. Stake shall be embedded 50mm minimum into the soil. Freestanding standpipes shall be located to minimise mechanical damage

Single tap cold water supply shall be use for all basin taps in the Toilet facilities.

9.3Waste Pipes and Traps

Waste pipes shall be of sizes required for purpose, and shall fall with even gradients.

Junctions shall be swept in direction of flow and traps shall be of same sizes as waste pipes.

Vent pipes shall have a plastic vent cowl. Brass floor traps to have CP gratings spiggoted and socketed, jointed to The Engineer's approval.

19.6.5 Tapware

According to location, all sink and wash hand basin tap sets shall be identical in design and manufacture. i.e. tap sets shall not have two different type of spindles and handles and shall all bechrome plated finish.

The approved brand of tapware is: Methven

19.6.6 Pans and Cisterns

Cisterns shall be secured by corrosion resistant fasteners to anchorages in solid walls or to cistern boards fixed in or on framed walls. Expansion fixing to wall linings is not permitted.

Water Supply

A 15mm stop tap including stainless steel faceplate shall be installed adjacent to the cistern approximately 300mm above floor level.

All cisterns shall be fitted with an overflow that discharges into the cistern. External overflows are not preferred.

Closet Pans

Pans shall be secured to building sub frame and/or floor to ensure positive fixing. Pans shall be installed no more than 20mm above the finished floor level. The requirement shall only be waived for disabled person installation. All pan joints and flush pipe connections shall be checked. Faulty joins and connections shall be resealed and/or replaced.

For concrete floors the base edge of the pan shall be bedded on cement mortar and secured to the floor with plastic plug inserts.

All pans shall be fitted with an approved plastic seat and lid.

19.6.7 Testing and Finish

All new fittings shall be tested to ensure their ability to discharge waste water and the soundness of flashings etc at the time of installation.

All fixtures shall be properly anchored and bedded to ensure their proper function; attention shall be paid to flashings and sealing of all services to prevent the seepage of water into joinery and surface finishes and general structural members.

19.6.8 Materials

Taps and Valves

Taps to basin and sinks shall be MethvenUltraline or similar The Engineer approved. Faucets and taps shall be chrome plated.

Stopcocks on W.C cistern shall be “in line” stop valves

Sanitary Fittings

W.C pans shall be white McSkinings Glen Afton or similar The Engineer approved vitreous china.

Toilet seats shall be white Dux Royal or similar The Engineer approved.

W.C cisterns shall be white Dux Lo Line or similar The Engineer approved complete with flush pipe.

Wash hand basins shall be one tap holed Mercer or Burns and FerrallWB2or similar The Engineer approved, complete with brackets, waste, plug and chain.

Sinks shall be Burns and Ferrall, or similar The Engineer approved stainless steel satin finish twin bowl with waste size: 50mm.

Bathroom Hardware

All Toilets facilities shall be provided with Toilet Paper holders (chrome plated) for each proposed new toilet, and mirrors (500mm x 500mm) to be located over each washbasin as indicated in drawings.

19.6.9 Completion and Make Good

Allow for making good all work disturbed by this Contract, including removal of all debris.

19.7 JOINERY

19.7.1 General

The work under this section consists of all labour, materials and equipment necessary to perform Joinery works of properties in accordance with the drawings, specification and schedules herein. Work shall comply with modern processes and practices covered by Samoa trade certificates or The Engineer approved certificate in joinery and timber machining.

All works shall be carried out in accordance with the requirements of the Home Building Manual for Western Samoa

19.7.2 Requirements

All timber shall be treated with a preservative process in accordance with the requirements of the NZ Timber Preservation Authority Specification H3 for building timber and shall be branded or certified as requested by the Engineer.

All timber shall be Radiate Pine Dressing Grade 1 [imported].

Other materials shall be as specified separately or the best of their respective kinds.

19.7.3 Fastenings

Use nails, screws, bolts or other fastenings as specified or as appropriate for the work. Drill for screws and countersink. Do not hammer screws. Fastenings generally shall be steel but galvanised or brass where liable to corrosion. Exposed fastenings are to match associated hardware.

19.7.4 Windows

Windows shall have all frame members 140 x 40 with sills or as specified and transoms splayed for weathering outside glass line. Frames shall be properly jointed and where shown shall have “Breezeway Altair” louvre frames. Frames shall be fixed with powder-powered fasteners and wedging where required.

All louvred glass blades shall be 6mm thick clear sheet glass.

All windows shall be installed according to Manufacturer’s specification and installation details.

19.7.5 Door Frames

Doorframes shall be 140 x 40, or as shown in the drawings. Fix as for window frames and provide 40 x 12 stops glued and nailed to frames

19.7.6 Doors

External doors shall be flush external quality solid core doors faced, and internal doors shall be hollow core.

All hinged doors (open-in and open-out versions) shall be hung on 3 off 100mm stainless steel butt hinges with fixed pins. External doors to have fixed brass pins, internal doors to have loose pins.

19.7.7 Windows and Doors Hardware Accessories.

All doors and windows shall include all matching hardware accessories, including locksets and lever handles.

Supply and fit all hardware as scheduled and specified by the manufacturer. All screens or fastenings are to be of like materials.

Lock Sets

LockwoodS104 Exit Dead latch or similar The Engineer approved lock set.

Door Buffer / Door Closers

Fit all doors as specified in the drawings with a Drake and Wrigley Model 1086 SCP door buffer and Lockwood door closers or similar The Engineer approved.

Built-in-Furniture / Fittings

All dimensions shall be confirmed on site before fabrication of any joinery units.

Built according to details in the drawings. All Reception counter, Tellers' counters and all Kitchen counters and Bathrooms' sink benches and cupboards are to have selected formica finish or similarly approved for all the exposed faces or surfaces of the furniture, including counter and desk tops.

All fittings shall be sanded to a smooth even surface.

All joints shall be mortise and tenor, dovetail, tongue and groove, mitred as required and shall be well flushed with approved glue.

All timber resting on or against concrete or concrete block-work shall be protected by a layer of 3 plymalthoid under full bearing surface.

19.7.8 Cupboard Doors

Hinges: fit doors on approved cupboard door hinges

Catches: Fit approved magnetic catches to all doors

Locks: Fit Yale brass cylinder cabinet [076] cupboard lock complete with 2 keys to each individual door and to 1 door for each pair.

Bolts: Fit Drake & Wrigley Socket bolts 1438 EB. 60mm surface mounted to the internal face of one leaf where doors are paired.

Handles: Fit 75mm 'D' handles, SCP finish to each door.

19.7.9 Joinery

Fix in place all joinery including window and doors, counters, cupboard and benches as shown. All items shall be handled and placed carefully, accurately and firmly.

All joinery shall be hand finished with glass paper with arises removed. Any work showing plane or hammer marks, bruises or scratches shall be rejected.

19.7.10 Completion and Make Good

Allow for making good of all work disturbed by this Contract.

19.8 ELECTRICAL

19.8.1 General

The work under this section consists of all labour, materials and equipment necessary to perform electrical works of properties in accordance with the drawings, specification and schedules herein. All works shall be carried out in strict accordance with the requirements of the National Building Code for Western Samoa, Electric Power Corporation Regulations and requirements, and NZ Wiring Regulations and shall be carried out by licensed tradesmen only.

The Contractor shall obtain all permits and shall pay all fees required for the electrical works, and make all necessary connections, carry out all work and conduct all tests to leave the whole installation in perfect working order.

Certificates of guarantee and fitness of installation must be handed over to the Engineer by the Contractor at the completion of work.

19.8.2 Demolition

Remove all redundant conduits, ducts, cables, fittings and remove all debris from site in accordance with current regulations and guidelines.

19.8.3 Inspection and Tests

The Contractor will be responsible for the issue of all notices required by the Supply Authority concerned. All work is to be completed to the best trade standard and to manufacturer's instructions and all employees are to be skilled tradesmen, licensed with the relevant authority. The Contractor shall obtain all necessary Permits and shall pay all fees. At completion of all works the Contractor shall provide certificates and guarantees of fitness and installation.

19.8.4 Load Balancing, Power Factor, Voltage Drop

Select cables sizes so that voltage drop between main switchboard and appliances is not over 5%.Installation is multiphase, balance loads across phases to within 5% or as close as feasibly possible.

19.8.5 Materials

Confirm positions of equipment with The Engineer before installing it. Positions of equipment on drawings are indicative only. Install all necessary holes, penetrations, chases and make good, and paint to satisfaction of The Engineer.

Switch and Meterboards shall be located to comply with EPC regulations.

Circuit Breakers and Residual Current Devices (RCD) Main Switch: Include a circuit breaker to isolate the main switchboard.

RCD: Include a Residual Current Device (previously called earth leakage circuit breakers) on each final sub-circuit supplying GPO's.

Earthing: 6mm minimum size for main earth conductor. Do not break earth conductortee-off from it or solder to it. Each circuit to have separate earth conductor. Earth all exposed metal fittings, pipes, ducts or brackets within reaching distance of any electrical supply.

Earth stakes shall be as close as practicable to external wall. Extend not more than 200mm above finished ground level. Metal guard to be provided.

Wiring: All wiring shall be concealed unless otherwise specified. Surfaces to be painted to match existing.

19.8.6 Cable Installation Methods and Standards

Install cables neatly, parallel to walls, ceilings or floors. No mechanical stress on cable or its termination.

a) Size: Minimum cable size 1 sq mm for lighting and 2.5 sq mm for power. Space cables away from objects that could become hot - 75mm minimum

b) Embedded cables: if cables are embedded in plaster, concrete, mortar or other finishes, enclose them in conduits. Minimum 10mm cover over conduit. Cables to be withdrawable after installation.

c) Segregation: do not run cables supplied from different switchboards in same conduit.

d) Bending radius: not less than 6 times cable diameter. Straight runs for at least 300mm after leaving switchboard. No more than 2 layers if sheathed cables are bunched in one enclosure. Cable in vertical metal ducts: clip to duct at internal of 2 meter maximum.

e) Jointing: no jointing underground, except with approval of The Engineer and only using approved jointing techniques and materials.

f) Lugs: use only crimped type; no soldered or bolted type.

g) Mechanical or hydraulic Service ducts: if running cables in these ducts, enclose them in ducts or conduits.

h) Service ducts: if running in service ducts, either clip inside duct or enclose in PVC conduits or ducts.

19.8.7 Cable Types

a) General requirement: PVC insulated TPS cable, 0.6/1kV insulation

b) Exposure: Cables exposed to mechanical damage or vandalism; to be enclosed in galvanised steel conduit or duct (Unistrut).

c) Stranding: Multi stranded high conductivity copper. Temperature rating - 75 deg. C min working temperature.

d) Underground: Use only multi stranded PVC insulated TPS.

19.8.8 Conduit and Ducting

Assess all conduit requirements before tendering from drawings and/or site inspections.

a) PVC conduits: Heavy duty, category A, minimum 20mm diameter, to NZS. Conduit fittings high impact PVC/ for U/G installation

b) PVC ducting: Rigid plastic, extruded type, removable clip on cover. Get approval to use. Install without twisting, warping, sagging. Do not use where exposed to mechanical or vandal damage, or sunlight.

c) Metal conduit: Galvanised, minimum 20mm diameter, to NZS. Do not use below ground level.

d) Metal duct: Removable galvanised 1mm thick metal cover. Screw cover to duct with galvanised metal thread screws with captive nuts at spacing of 900mm maximum. Fix duct to masonry walls with Dynabolts at max 1200mm spacing.

19.8.9 Accessories and Equipment

Supply and install all accessories and equipment to hand over the electrical installation in correct working order.

Power outlets, switches, batten holders, ceiling roses etc. to be polycarbonate, Clipsal, HPM, or similar approved.

19.8.10 Construction Generally

a) Scope of Works - Supply and install:

- 3-Phase Power supply - New mains and submains.
- Any new power outlets in locations shown. Confirm locations.
- All equipment needed to complete the electrical installation.

b) Supply, Metering and Switchboards

- Meter Box: Supply and install waterproof metal meter box.
- Switchboard: Locate switchboard in verandahs, and recess if possible, in accordance with EPC regulations. Circuit breakers to comply with EPC regulations.

c) Wiring Methods

- Use PVC insulated and sheathed cable clip PVC/TPS cable.
- Battens: cables shall be fixed to battens when run in ceiling.
- Surface mounted cables:
  - Exterior: enclose in galvanised conduit.
  - Interior: enclose in white approved Duct.
- Junction Boxes: must remain accessible.
- Lighting outlets: earth them
- Underfloor access: where access needed, construct floor traps, and reinstate floor surface to approval.
- Carpet or Tiles: if you remove them to run cables, replace them, using qualified tradesman.
- Roof Insulation: if disturbed, replace it.

d) Light and Power

- Light fittings**:** as specified in drawings. All fluorescent light Fittings shall have dust covers.
- Switches: All new light switches Clipsal HPM or equivalent - 10 amps, rocker type. If relocating a switch, mount at 1200mm above floor level.
- Power Outlets: All new power outlets, with earthed, double outlet, 3 flat pin, polycarbonate, standard fixing holes. All power points shall be surface mounted individually switched in positions shown on drawings: 400mm above finished floor level, 200mm above bench level, unless otherwise shown on drawings.

19.8.11 Completion and Make Good

Allow for making good of all work disturbed by this Contract.

19.9 PAINTING

19.9.1 General

The work required under this section consists of all labour, material and equipment necessary to furnish and apply paint and other coverage to all surfaces (unless otherwise noted) in accordance with the drawings, specification and schedule herein.

All work generally shall be carried out in accordance with the requirements of AS/NZS 2312: The Painting of Buildings

19.9.2 Requirements

Combinations

Do not combine paints from different manufacturers in a paint system. Clear timber finish systems: Use only the combinations of putty, stain and sealer recommended by the manufacturer of the topcoats.

Delivery

Deliver paints to the site in the manufacturer's labeled containers

Tinting

Use only products that are colour tinted by the manufacturer or supplier.

Putty

Oil-based or polymeric based. Putty for timber finishes: Lacquer or water based, or 2K inert putty. Do not use oil based or glazing putty.

Spraying

The use of spray equipment is not permitted without prior written approval from the Engineer.

Adulteration of Paint.

Where paint supplied by the Manufacturers is found to be adulterated in any way whatsoever other than recommended thinning level, the Contractor must replace such defective paint with a new batch whether such defective paint is the subject of a warranty claim against the Manufacturers or not.

Drying Times.

The Contractor shall allow the following minimum drying times for paints:

- Undercoats: 24 hours prior to enameled finishing coat being applied.
- Enamel: 24 hours prior to the application of the second coat.

Number of Coats

Unless specified as one coat or two coat systems, each paint system consists of not less than three coats. Provide additional coats if necessary to:

- prepare porous or reactive substrates with prime or seal coats consistent with the Manufacturer's recommendations;
- achieve the total film thickness or texture; or
- achieve a satisfactory non-transparency

19.9.3 Painting

Protection

Remove door furniture, switch plates, light fittings and other fixtures before starting to paint, and refit in position undamaged on completion of the installation.

Substrate Preparation

All finishes shall be sanded using appropriate grade sandpaper's ensuring that all raised imperfections are removed. Sanding of all surfaces shall also occur during subsequent coats. Each coat is to be allowed to dry and be rubbed down with glass or garnet paper of a suitable grit before the next coat is applied. Use filler tinted to match the substrate if the finish is transparent. All paint is to be applied by brush or roller. Where paint is applied by brush it is to be laid off so that no brush marks show.

Priming Before Fixing

Apply one coat of wood primer (including end grain) to the back of external fascia boards, timber door and window frames, bottoms of external doors, associated trims and glazing beads before fixing in position.

Paint Application

Apply the first coat immediately after substrate preparation and before contamination of the substrate can occur. Ensure each coat of paint or clear finish is uniform in colour, gloss, thickness and texture, and free of runs, sags, blisters, or other discontinuity.

Repair of Galvanising

Where galvanised surfaces have been subsequently welded, prime the affected area with zinc rich organic binder.

Dry Stripping.

Any loose or flaking material on ceilings or walls that cannot be removed by washing off must be dry stripped.

Painted Steel Frames and Cabinets.

All rust scale is to be removed by cleaning down thoroughly with a wire brush and coarse/ medium grade emery cloth/paper.

Stopping

Wall and ceiling cracks are to be properly cut out and stopped up with neat gypsum plaster, or an appropriate cellulose filler. Loose stopping over nails to plaster sheets is to be removed and the nail punched before re-stopping. All loose plaster sheets are to be re-nailed with galvanised clouts, punched and stopped.

All nail holes and cracks in painted woodwork are to be stopped with wood putty or ready mixed wood fillers. All nail holes and cracks in stained woodwork are to be stopped with wood putty stained to match the existing colour of the woodwork or ready mixed coloured wood fillers. Wood putty or fillers used are to be of a quality proprietary brand.

All surfaces must be rubbed down between coats. Any surfaces that have a high gloss paint retention must be rubbed down with wet and dry carborundum paper before the application of any paint.

Concrete Surfaces

Concrete surfaces shall be sealed with two coat of an approved latex (water based) sealer as directed.

Metalwork.

Mild Steel:

a) Remove any rust, scale, and peeling paint with a wire brush and scraper. To the exposed metal areas apply one coat of rust remover.

b) Allow to dry (or after the lapse of a quarter hour) and wipe dry with a clean rag. If heavy rust patches still remain, repeat the treatment with a wire brush and rust remover.

c) Do not wash with water. If the metal gets wet repeat treatment and dry.

d) Apply one coat of Red Oxide-Zinc Phosphate paint. After a minimum of 24 hours apply two coats of gloss enamel, allowing twenty-four (24) hours (minimum) between each coat.

Galvanised Steel:

a) Unpainted new galvanised steel is to be treated with acid etching agent GALVPREPor similar approved material, using abrasive plastic pads such as Scotch-Brite or similar. Do not use steel wool with GALV-PREP.

b) New galvanised steel is to be pre-treated a minimum of twenty-four hours prior to the application of the first coat of paint. The surface should be a light grey in colour, and evenly wetted with the agent.

c) Wash thoroughly with water and when dry apply two coats of acrylic paint (or other material approved by the Engineer) allowing at least two hours between coats.

Mild Steel and Wrought Iron:

a) To be painted (after treatment for rust with an approved rust remover as required) with one coat of red oxide zinc phosphate primer and two coats of gloss enamel, allowing twenty-four hours (minimum) between each coat.

NOTE: The discharge of toxic fluids and other wastes, etc, into the sewerage or drainage system, is strictly prohibited.

19.9.4 Color Scheme

Internal wall surfaces:

- Paint type – latex (water based) paint with a semi gloss (satin) finish
- Colour Scheme – To be selected and approved by the Engineer.

Ceiling

- Paint type – latex (water based) paint with a flat finish to mask surface imperfections
- Colour Scheme – To be selected and approved by the Engineer.

External wall surfaces

- Paint type – latex (water based) paint with a semi gloss (satin) finish
- Colour Scheme – To be selected and approved by the Engineer.

Timber Door / Window frames and panels / Fascia

- Paint type – latex (water based) paint with a full gloss finish
- Colour Scheme – To be selected and approved by the Engineer.

Steel handrails or other surfaces

- Paint type – solvent based enamel paint with a full gloss finish
- Colour Scheme – To be selected and approved by the Engineer.

19.9.5 Paint type

All paint products shall be Taubmans or an equivalent quality product approved by the Engineer.

19.10 FLOOR COVERINGS

19.10.1 General

The work required under this contract includes the installation of new floor finishes, the preparation of the base, then the laying and sealing of non-slip ceramic tiles in accordance with the drawings, specification and schedules herein. All work generally shall be in accordance with the relevant New Zealand Standards. The application of any floor finishes shall automatically imply acceptance without reservation of the base surfaces and the Contractor will be held responsible for the work and finished result. No subsequent claim as to the suitability of the finishing materials to the base will be considered.

19.10.2 Inspection

Give sufficient notice so that inspection may be made prior to laying the flooring.

19.10.3 Samples

Submit labelled samples of resilient finishes illustrating the range of colour, pattern or texture as seen in the finished work.

19.10.4 Materials and Components

Materials

Supply and install 300mm x 300mm non-slip ceramic tiles of the Engineer selected colour for all the floors including balcony and verandah areas in accordance with Manufacturer's instructions.

Supply and install non-slip ceramic tiles for all wet areas like Kitchens and Bathrooms in accordance with Manufacturer’s instructions. Tile sizes as detailed in drawings.

Protect edges at doorways, etc., with a Raven RP 13 metal cover strip or similar approved.

Skirting

All tiles shall be extended to provide a wall skirting of 150mm height above floor level and retained with a 30mm x 10mm timber beading.

19.10.5 Completion and Make Good

Allow for making good of all work disturbed by this Contract, including the removal of all debris.

19.11 SEWAGE WORKS

19.11.1 Standards and Workmanship

Materials shall comply with the appropriate New Zealand Standard. Drainage work shall comply with the New Zealand Drainage and Plumbing Regulations 1978 and local requirements.

19.11.2 Pipes and fittings

Pipes and fittings shall be unplasticised PVC generally 100 diameter with 50 diameter connection to urinals or as specified in the drawings.

Gulley traps shall be complete with dishes and cover.

19.11.3 Drains

Drains shall be laid generally as shown on drawings in trenches excavated only to depths required to provide even and regular falls. All joints shall be properly made and inspection fittings are properly placed before concrete work is commenced.

19.11.4 Septic Tank

The new septic tanks shall be constructed as shown with pipe connections and removable covers. Ensure that covers are above the surrounding ground level.

19.11.5 Soakage Trench

The soakage trench shall be as detailed and filled with stones of minimum grade of 50 mm

19.12 MECHANICAL SERVICES

19.12.1 Ceiling Fans

Supply and install new ceiling fans as specified in the drawings, and in strict accordance with the Manufacturer's specifications and instructions.