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FME 0001 H Checklist for consultant / designers
FME 0002 H Asset registration form
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E.1 HYDRAULIC SERVICES – SCHEDULE OF CHANGES – REV 5.4

As a guide only, attention is drawn to changes that have been made in the following clauses since the last revision:

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**E.1. HYDRAULIC SERVICES**

**E.1.1. CHECKLIST FOR HYDRAULIC CONSULTANT / DESIGNER**

The checklist shall be completed by the design engineer to verify that the UNSW’s specific and general requirements as set out in the UNSW DESIGN & CONSTRUCTION REQUIREMENTS manual have been incorporated into the design and documentation. By providing a signature or initial in the box, the designer declares that he/she has read and incorporated its intent into the hydraulic contract works. By this the designer will be deemed to have understood and complied with this part of the manual. Note: The whole of the manual shall be read and complied with.

Refer to Diagram FME 0001/H Checklist for Hydraulic Consultant / Designer at the end of Section E.1.

**E.1.1.1. General**

This document sets out additional design and construction technical requirements to those contained in the mandatory Plumbing Code of Australia - National Construction Code Volume 3 (NCC Vol. 3). The NCC is the national framework that sets out the technical requirements for the design, construction and maintenance of plumbing and drainage installations in Australia’s states and territories. That document is produced and maintained by the Australian Building Codes Board (ABCB) on behalf of the Australian Government and each State and Territory government. Gas Installation Codes published by the Australian Gas Association and other relevant Australian Standards as applicable or as referenced by the Building Code of Australia (BCA) shall be deemed as minimum standard and in particular circumstances FM Engineering may have a standard over and above these.

In addition to the mandatory requirements of the above documents, these technical requirements shall be adopted in the execution of all UNSW projects, unless specifically altered in writing by the UNSW Engineering Services Manager.

Where 'similar to' or 'equal to' is used in association with trade names, alternative products may be offered on the basis that they perform either as well as or better than those specified and their adoption must be approved in writing by the UNSW Engineering Services Manager before inclusion and provided that the manufacturer provides equivalent warranty.

The Hydraulic Consultant is required to refer to and examine the UNSW Design and Construction Requirements document for guidance on special UNSW requirements, which may be in addition to the regulatory New South Wales Codes of Practice for Water Supply and Sydney Water requirements.
UNSW Design and Construction Requirements document shall not be referred to or appended to any project documents (Except project briefs and design and construction contracts), but project-specific clauses shall be written into the project specification to ensure construction is carried out to meet those Requirements.

Three reviews of designs are required at concept stage, 30%, and 90% and complete. At 90% stage, the designer must supply a check-list as evidence that all items and requirements briefed by the UNSW Project Management have been met and that each one shall separately be signed off as incorporated into the design, unless otherwise instructed in writing. Upon completion of Tender, you are also required to issue UNSW with a Letter of Compliance with statutory Codes.

UNSW have produced Drawing Standards and Design Requirements, which shall be followed by the Consultant.

To assist interpretation of some aspects of this document, sketches have been prepared and are located at the back of Section E.1.

E.1.1.2. Work Health and Safety 2011
The interpretation of the word “Plant” as used in Work Health and Safety Act 2011 (hereafter WH&S) determined that all building services are classified as “plant”. Therefore designers of services, internal and external to buildings, must meet their responsibilities under this Act and Regulation.

Attention is drawn to Chapter 4 for controllers of premises to identify risks and Chapter 5 for designers to identify hazards and assess risks of the final design. UNSW require all designers to carry out such identification and risk assessment with a statement of how associated WH&S issues are shall be addressed. This information shall be provided to UNSW prior to documents being “Issued for Construction”.

DELIVERABLE DOCUMENT

Provide WH&S Statement listing all construction, operation and maintenance activities or tasks likely to present risk to persons’ wellbeing and measures provided in design to ameliorate these risks.

E.1.2. DESIGN REQUIREMENTS
Prior to documentation of refurbishment works, and in conjunction with UNSW Project Manager, survey all proposed user groups for each building to determine requirement for services.
E.1.2.1. Contract Drawings

Each hydraulic services drawing shall have the following note displayed in a prominent location:

‘Only licensed persons, or those under the direct supervision of a licensed person, shall install works covered by the Plumbing Code of Australia (National Construction Code, Volume 3), and relevant Gas Installation Codes. Works required under these Codes are not detailed, as the licensee is expected to have full knowledge of these Codes. These drawings show the piping layout in the positions required by UNSW and the fittings shown may be additional to Code requirements, but shall not prevent the work from being carried out in accordance with these Codes. Certificates of Compliance shall be furnished to UNSW for all works within 7 days of Authority inspection’

An abbreviated ‘UNSW Project Specific Requirements’ list shall be provided on the legend sheet, or where practicable on the relevant service drawing to which they pertain. The consultant shall identify in point form the major departures from ‘industry standard plumbing materials and workmanship’ brought about by the special requirements of the University or identified as problem areas of quality control.

For each hydraulic service, present on the first sheet of the series a statement on the Basis of Design of that service. It shall provide all information required to size and/or maintain all components of the building infrastructure.

All major projects are to include individual services schematic drawings including valves, meters, pumps, tanks and major plant and include provisions for inspection, expansion, maintenance, testing and cleaning access. This drawing shall be the first in the set and shall identify how the system works, basis of design and all substantial information required to assess the adequacy of the design intent. It shall be maintained up to date using Revision Numbering throughout the checking and review process.

E.1.2.2. Authorities

For all plumbing and drainage works and trade waste services, an application shall be lodged with the water Authority (such as Sydney Water) as required by regulation 4 of the Plumbing and Drainage Regulation 2012. Upon completion, the plumber carrying out the work shall submit to the Project Manager the signed original Owner’s Copy of the Certificate of Compliance.

For natural gas installations, all works upon completion shall be inspected by the supply authority in accordance to the requirements of Gas Supply (Safety and Network Management) Regulation 2008 and those installations incorporating Type B appliances shall be approved and have AGA certification.
E.1.2.3. Operating and Maintenance Manual

Refer also to ‘Appendix 4 – Document Requirements - Operating and Maintenance Manuals’

Documents are to reflect the need for the hydraulic consultant to prepare Work as Executed Drawings and the Operating and Maintenance Manual. Included in the manual shall be the following documents as a minimum:

- fire pump AS 2941 Conformance Test Certificate
- pump test curve where applicable,
- pressure test certificates with actual pressures achieved;
- Certificate of Compliance with Sydney Water requirements; and
- All certificates signed by the plumber performing the work.

E.1.2.4. Asset Registration List

In conjunction with the preparation of the Operating and Maintenance Manual, the Consultant shall list all plant and equipment either removed or installed as new on an attached schedule and provide the completed list in the Manual.

Such items could include:

- thermostatic mixing valve,
- gas shut off valve,
- water filter,
- pumpset,
- trade waste pit,
- safety shower,
- safety eye wash,
- hot water unit,
- automatic toilet flushing device,
- landing valve,
- hosereel,
- water cooler,
The list shall be identical in all respects with the Excel spreadsheet. *Refer to Diagram FME 0002/H Asset Registration Form at the end of this Section E.1.*

**E.1.3. WATER SUPPLY FOR CONSTRUCTION**

During site establishment, arrange with UNSW Engineering Operations for access to the site bore water system. Construct a temporary or other bore water service to the site. Use bore water for such purposes as: washing down, street cleaning, trench compaction, pipeline cleaning and testing, etc. A reverse thread (recycled water) hose adaptor will be required to connect to existing bore water hose taps.

**E.1.3.1. Pipe Levels & Control Valves**

Tank supplies outlet and pump suction piping shall be at low level and of sufficient diameter to insure that pump suction conditions do not fall below atmospheric pressure. All other Pipe work shall be located as high as possible unless otherwise. The piping shall be configured and/or graded to ensure no air pockets are formed. Control and isolating valves located facilitate access and allow operation without the use of portable steps. The maximum height of valves above floor shall be 1500mm.

**E.1.3.2. Core Holes**

Core holes shall be cast in situ. Liner shall be removed prior to pipework installation. Incorrect positioning requires new core holes shall be approved by the structural engineer. Chopping out to extend core holes shall not be permitted.

**E.1.3.3. Chases**

Chases shall be saw cut in approved locations only.
E.1.3.4. Insulation
Kemlag is not acceptable for insulation other than for pipework chased into masonry.

Insulation shall be installed only after pipe testing. Provide polyethylene foam incorporating aluminium wrap with built in overlap similar to 'Thermotec 4-Zero'. Provide approved proprietary wood blocks in two halves and 25mm wide of equal diameter to the insulation at all fixing points. Valves, flanges and unions are not shall be insulated. In no case will insulation be less 13 mm thickness.

In noise-sensitive areas all piping shall be insulated with ‘Thermotec Acoustic 4-Zero’ to archive the noise level mandated under Vibration and Noise.

Pipes in wall chases shall be Insulate with 3mm thick foamed PVC and fix with brass/copper clips shall only be used. 3 mm thick foamed PVC is not permitted for other locations.

E.1.3.5. Brick Cavities
Piping shall not be installed in brick cavities.

E.1.3.6. Vibration and Noise
Pipe work shall be constructed and installed to prevent vibration and noise. Make approved alterations to correct any faulty condition.

In particular, where pipework is installed in noise-sensitive areas such as lecture theatres, libraries, study areas and public halls and rooms, provide sound insulation to all pipelines, with special attention given to gravity waste and stormwater lines.

Measures with be implemented to limit the noise generated by hydraulic services into these occupied spaces. These measures as implemented should limit the noise level so that it does not increase by more than 1dB for typical use above the back ground noise level.

E.1.4. SOIL AND WATER MANAGEMENT
Soil and water management shall adhere shall best practice at all times across all campuses. Kensington Campus is a catchment area for aquifer recharge, as most rainwater and stormwater is captured and recycled for site and building non-potable water requirements via the University’s bore field.

Identify suitable locations for bulk materials, delivered building materials, waste bins and delivery vehicle off-loading locations, contaminated wastewater must not discharge into the stormwater system. Where the site the site is located within the
Village Green detention catchment, provide signage around the site indicating this site drains to an environmentally sensitive structure.

Standard sandbagging cannot be maintained in place in such a space-restricted site. Please detail continuous sandbagging to protect our stormwater system downstream from being filled with building and demolition waste.

Note that all consolidation, dust suppression and washing down shall be carried out using borewater from the site reticulation. Provide temporary taps, pipes etc as required.

Civil / hydraulic / landscape Consultants are therefore required to prepare a detailed site-specific Soil and Water Management Plan with Specification for each project, complying with the detailed requirements of Randwick City Council which are available on: http://www.randwick.nsw.gov.au/default.php?id=41. There are 16 information sheets all dealing with soil and water management. The Plan shall include those information sheets applicable to the specific project and shall treat Campus roadways as though they are Council public roads for the purpose of managing soil and water.

Prevention of stormwater pollution due to oil and chemical spills shall be included in the Soil & Water Management Plan. Gross chemical pollutants entering the aquifer must be prevented at all costs.

E.1.4.1. Excavation

This specification is for the excavation and reinstatement of trenches within the grounds of the University of New South Wales and shall be considered as part of the contract for design and services installation. It shall be read in conjunction with the project specification and the general conditions of contract. If there are any discrepancies between the technical clauses regarding trenching in the project specification and this specification, the more stringent specification shall take precedence.

This specification relates to narrow services trenches only and is not intended shall be used for major structures such as large drainage culverts/pipes or for backfilling of large underground facilities such as basements or service tunnels.

This specification covers five separate categories of surfacing:

- Flexible pavements with asphalt surfacing
- Concrete paving
- Paving blocks
- Gardens

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• Lawns and sports fields.

**E.1.4.2. Existing Services**

The contractor will be provided with plans of all services that are known to the UNSW Asset Management in and adjacent to the proposed excavation. The contractor shall be responsible for:

- Surveying the route of the excavation to locate all services shown on the plans;
- Identifying the location of any unmarked services using an approved cable/pipe locator;
- Hand excavating to uncover known services prior to commencing mechanical excavation;
- Supporting the services across trenches during excavation as necessary; and
- Excavation and backfilling the trench in the manner set out in the ensuing section.

If the contractor proposes to use dyes to locate the route of sewerage or stormwater, they shall consist of approved vegetable base types only. The use of hydrocarbon based dyes will not be permitted under any circumstances.

Mechanical excavation for underground services shall not commence without approval of the Grounds and Landscape Manager. This approval will only be given when the Grounds and Landscape Manager is satisfied that all services have been properly located and identified.

If during the excavation of trenches, unknown services are encountered, work shall cease and the Campus Infrastructure Services shall be immediately notified. Work shall not recommence until the service has been correctly identified and precautions taken to ensure that no damage occurs.

Under no circumstances shall services be cut or disconnected without prior approval of the Campus & Infrastructure Services.

In the event of damage to existing services or trees while excavating, the Contractor shall contact the following staff:

- FM Engineering Survey: 938 58513
- Hydraulic Services and Gas: 938 56599
- Electrical Services: 938 54988
• Telecommunications: 938 51132
• Emergency/Out of Hours: 938 56781
• Grounds and Landscaping 938 54993

The contractor will be responsible for the repair of any services that were identified before excavation commenced or could reasonably have been located during the preliminary exploration.

E.1.4.3. Inspections

Inspections of the trench excavations shall be undertaken by the Grounds and Landscape Manager at the following stages of the project:

• Before excavation commences to discuss the location of services and to undertake a dilapidation survey of surrounding environment
• Upon completion of the excavation to check depths
• Before backfilling commences to verify that the services are laid to the levels required
• On final reinstatement.

It is the Contractor’s responsibility to notify the FM Engineering Survey 48 hours in advance of the above stages to ensure that the appropriate inspections are performed.

E.1.4.4. Trench excavation

If excavations in pathways, gardens, lawn areas encounter tree roots in excess of 50 mm diameter, work shall cease until approval is obtained from the Grounds and Landscape Manager to sever the roots.

Where in pavement, saw cut bitumen and concrete prior to excavating. Under no circumstances will approval be given if it is possible to easily lay the pipe, etc., beneath or around the roots.

Trenches for underground services shall be excavated in a straight line using a mechanical excavator or similar approved means. The trench width shall be 300 mm wider than the service shall be laid and shall be excavated to the depths shown.

Wider trenches may be approved by the Grounds and Landscape Manager but only where the space is necessary for personnel to enter the trench to connect services. Where over excavation occurs, backfill with selected excavated or imported material to required levels in 150mm layers compacted to 95% modified dry density. Remove all spoil from the UNSW site as the work proceeds using skips or trucks as the work requires. Provide...
timbering and shoring as required to protect workers and adjacent structures and remove prior to completion where possible.

Under no circumstances shall trenches be less than 150 mm wide as this will prevent adequate compaction of the backfilling.

Where the depth of trenches is to exceed 1.2 m and personnel need to enter the trench, adequate measures shall be taken by the contractor to provide support for the trench. This may require shoring or battering the excavation at a suitable angle depending upon the type of material through which the trench is excavated. The contractor shall comply with all WorkCover requirements for trench support.

All soft, yielding or other unsuitable material shall be removed and replaced with compacted clean, low plasticity soils or stabilised sand. Unsuitable material shall be removed from the site at full cost of the contractor.

E.1.4.5. Backfilling

Services shall be laid on fine grained sand which shall be extended to at least 100 mm above the top of the service. Thereafter the backfilling of the service should take place as shown.

Hydraulic services shall be laid in accordance with AS3500 2003 Plumbing and Drainage.

Where required, all services except sewer and subsoil, shall be backfilled and overlaid to 75mm above pipe socket with approved granular fill. Complete backfilling with approved excavated material. Charge or pressurise all hydraulic services during backfilling operations. Compact side support and backfilling in 225mm thick layers using mechanical compaction equipment. Maintain moisture content to achieve optimum compaction.

Note:

Provide 48 hours’ notice prior to backfilling to the UNSW survey draftsperson via the Project Officer to view record and document all new and exposed underground services.

E.1.4.6. Compaction

Surplus excavated material remaining after the backfilling of the trench shall be disposed in an approved manner to areas nominated by the Grounds and Landscape Manager. The disposal of surplus material shall be at the full cost of the contractor.

All services except sewer and subsoil shall be bedded on 50mm thick compacted sand. Sewer & subsoil bedding to suit site conditions. All backfilling shall be compacted by mechanical vibration using vibrating plate
compactors (whacker packers) or similar equipment to the approval of the Grounds and Landscape Manager. Backfilling shall take place in layers not exceeding 150 mm loose thickness and be compacted to the densities shown.

Compaction densities of at least 100% standard maximum dry density are required for areas under roadways and concrete paving.

The contractor shall compact the trench backfilling until it is compacted to the appropriate standard. Reworking of inadequately compacted material shall be at the contractor's expense.

Compaction by flooding is not permitted under any circumstances.

Compaction of backfilling shall be carried out without damaging of the services. The laying of services and backfilling and compaction will not be permitted in trenches containing pond water or mud either from rainfall, surface runoff or groundwater flow.

**E.1.4.7. Restoration of Ancillary Structures**

Where excavations pass beneath kerb and guttering, vehicular crossings, etc., proper support shall be provided for these structures until backfilling is completed. If compaction to the required standard is not possible, backfilling in trenches passing beneath ancillary road structures shall consist of lean mix concrete (minimum 10 MPa) or similar approved material.

Restore all surfaces to their original condition, using materials matching materials as found.

Bitumen, concrete and brick paved surfaces shall be restored by a UNSW approved contractor experienced in the relevant pavement restoration. This work shall be included in the contract documents.

**E.1.5. ROADWAYS**

**E.1.5.1. General**

Backfilling to the subgrade level in trenches across roadways shall be carried out using sand stabilised with 6% cement by weight unless otherwise directed. In all cases, compaction shall be to 100% of the standard maximum dry density as determined in tests AS 1289.5.1.1-2003: Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using standard compactive effort.

Prior to backfilling and compaction of vehicular trafficable trenches, trench stops/bulkheads consisting of polyethylene or hessian bags filled with clay or
other approved material and sealed in an approved manner, shall be placed across the full width of the excavated trench directly beneath the kerb to contain the compacted materials. The trench/bulkheads shall extend from the top of the service backfilling surround material to the underside of kerb level

**E.1.5.2. Pavement Materials**

The pavement shall be reinstated to the minimum depths shown in Table 1. The materials shall be used shall comprise good quality, durable, fine crushed rock and bituminous concrete (asphalt). The fine crushed rock shall conform to Road and Traffic Authority Specification No. 3051 specifically for the supply of "Unbound and Modified Base and Sub base Materials for Surfaced Road Pavements". The fine crushed rock shall be DGB20 (20 mm nominally sized densely graded base) and shall be compacted to 95% modified maximum dry density (Ref AS1289 E3.1).

**E.1.5.3. Table 1 - Minimum Pavement Thicknesses (mm)**

Flexible Pavements:

<table>
<thead>
<tr>
<th>Pavement Type</th>
<th>Wearing Surface Thickness (mm)</th>
<th>Base Thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy Traffic</td>
<td>30</td>
<td>300</td>
</tr>
<tr>
<td>Light Traffic</td>
<td>30</td>
<td>200</td>
</tr>
<tr>
<td>Car Parks</td>
<td>30</td>
<td>150</td>
</tr>
</tbody>
</table>

Concrete Pavements: (Fig 2)

<table>
<thead>
<tr>
<th>Pavement Type</th>
<th>Wearing Surface Thickness (mm)</th>
<th>Base Thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadways</td>
<td>150</td>
<td>150</td>
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<tr>
<td>Footpaths</td>
<td>75</td>
<td>75</td>
</tr>
</tbody>
</table>

Paving Blocks: (Fig 3)

<table>
<thead>
<tr>
<th>Pavement Type</th>
<th>Wearing Surface Thickness (mm)</th>
<th>Base Thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy Traffic</td>
<td>80</td>
<td>50</td>
</tr>
<tr>
<td>Light Traffic</td>
<td>80</td>
<td>50</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

N/R = Not required
Where the total volume of material shall be used in the backfilling of road trenches is to exceed 10 cubic metres, the contractor shall provide tests
certificates verifying that the material conforms to the relevant sections of the RTA Specification.

E.1.5.4. Paving Blocks
Where service trenches are shall be laid beneath existing paving block pavements, the pavers shall be carefully removed by the contractor prior to excavation. Any pavers broken during their removal shall be replaced at the contractor’s expenses. Backfilling of trenches beneath paving block pavers shall be carried out using sand stabilised with 6% cement by weight compacted to a density of at least 95% of the standard maximum dry density. The general backfilling shall finish at least 150 mm below the underside of the sand bedding to allow for fine crushed rock base material shall be placed and compacted.

The paving block base shall be constructed in a manner similar to that carried out the fine crushed rock beneath roadways. Paving blocks are shall be re-laid on sand bedding as recommended by the manufacturer so that the line and level are consistent with the surrounding pavers. A maximum tolerance in level between the undisturbed pavers and the re-laid pavers shall be 3 mm.

E.1.5.5. Backfilling under Pavements and Floors
The following procedures shall be adopted in all instances:

Backfill with approved granular material in 225mm thick layers and compact using vibrating mechanical compaction equipment to 95% maximum modified dry density or to match surrounding ground.

Specified compaction must be verified by compaction tests performed by a NATA registered testing agent and at the contractor’s expense.

Should compaction fail any test, backfill shall be removed down to within 225mm of the top of the surface and compaction and backfilling recommenced with tests taken at frequent intervals. The number and frequency of tests shall be determined in conjunction with Engineering Services and shall be dependent on size of excavation, quality of existing pavement and future pavement upgrading works.

E.1.5.6. Concrete Paving
Wherever economical or where specifically directed by UNSW Project Manager, bore under roads and pathways for hydraulic services. Where this is not possible then the existing concrete paving shall be sawn cut along the line of the proposed trench to the full depth of paving and the concrete material disposed of offsite when excavated. The excavation shall then be carried out in the approved manner and backfilling performed as for roadways. The concrete paving shall be provided with a base layer consisting of 75 mm or 150 mm thickness of fine crushed rock if the concrete is for
pedestrian or vehicular usage respectively. The fine crushed rock shall be compacted to the same standard as paving materials for roadways. Concrete shall be used in the restoration of concrete paving shall have the following 28 compressive strengths:

- Roadways 25 MPa
- Footpath 15 MPa

The thickness of concrete paving shall be similar to that removed during the excavation but shall not be less than 75 mm for footpaths, or 150 mm for roadways.

In most instances, there will be no requirement for strength testing of the concrete, however, the Campus Infrastructure Services reserves the right to carry out tests if there is any doubt on the quality of the materials being used. If concrete testing is required it shall be carried out at the expense of the contractor by a laboratory registered with the National Association of Testing Authorities for these tests.

The joints between the existing concrete and the restored concrete paving shall be filled with an approved jointing material to prevent ingress of water. The jointing material should preferably be a bitumen impregnated fibre board or similar, placed while the concrete is plastic. Alternatively, the joint may be grooved and filled with a silicon based joint sealant.

**E.1.5.7. Lawns and Sports Fields**

At least 7 days prior to commencement of works, arrange with the UNSW Grounds Curator (Telephone: 9385 4993) for all affected plants shall be removed for storage, shall be transplanted back to their original position upon completion of the works. Damage to planting not removed by UNSW shall be rectified by the Contractor to UNSW direction and approval at contractor’s cost. All costs of works incurred by UNSW shall be attributed to the project cost.

Backfill trenches with selected excavated material up to within 300mm of finished surface. Complete backfilling with sandy loam either gained from the excavation or imported as required. Compact at optimum moisture content with mechanical vibrating foot up to within 150mm of surface, heap the last 150mm and roll turf to be level with surrounding turf.

Lawns and sports fields shall be restored with turf cut from the trench prior to excavation and set aside from the original surface, or with turf of the same species imported from a source approved by the Grounds and Landscape Manager. Turf cut from the trench surface shall be stored in the shade and kept moist and shall be re-laid within 24 hours of excavation.
All new areas to be vegetated are shall be as specified and approved in writing by the Grounds and Landscape Manager. UNSW Asset Management Services, reserves the right to reject any re-laid turf surface.

**E.1.5.8. Gardens**
Where trenches are to pass through garden areas, the contractor shall seek direction from the Grounds and Landscape Manager, whether plants disturbed by the excavation are shall be transplanted or replaced and reinstated at the completion of the work. Excavation and backfilling shall then be undertaken as instructed by the Grounds and Landscape Manager.

**E.1.5.9. Compaction Testing**
Compaction testing of the backfilling shall be carried out on every third lift at a rate of one test per 50 lineal metres of trench. A minimum of one test shall be carried out for all backfilling of trenches beneath pavements, roadways, paving blocks and concrete paving areas.

Testing of the backfilling shall be undertaken in accordance with Australian Standard AS 1289 - "Methods of Testing of Soil for Engineering Purposes".

Compaction testing is shall be undertaken by a NATA registered laboratory and the results forwarded directly to the Grounds and Landscape Manager for approval. All layers will be tested to the full depth of the layer. An insitu density test by sand placement or other NATA approved means will be required. The cost of all testing shall be borne by the contractor and shall be included the contract sum.

**E.1.5.10. Barriers and Lights**
Barriers and lights are shall be erected on each side of open trenches to ensure the safety of pedestrians and to prevent traffic entering construction areas. If necessary picket and wire fences shall be erected by the contractor to ensure that unauthorised entry into the trenches does not occur.

**E.1.5.11. Pedestrian Safety**
It is the contractor’s responsibility to ensure the safety of pedestrians using the area in which trenching is being undertaken. All necessary barriers and fences shall be erected to guide pedestrians around the work area. These barriers and fences shall not be removed until the surface has been restored to the satisfaction of the Campus Infrastructure Services.

Trenches which have shall be assessed by pedestrians shall be covered with 8 mm thick standard floor plate.

**E.1.5.12. Provision for Traffic**
Where services are shall be laid across roadways or other areas used by vehicular traffic, provision shall be made for traffic by providing either suitably
signed detours or constructing the trench half road width. If required, trenches less than 1.5 m wide may be covered by 12 mm thick standard floor plate to provide continued access for vehicular traffic.

E.1.5.13. Clean-Up

Equipment wheels shall be washed of excess soils prior to leaving the construction site. Following completion of the excavation, backfilling and restoration, the contractor shall clean the adjacent areas to the satisfaction of the Grounds and Landscape Manager. Clay soils shall be removed from roadways, paving blocks or concrete areas using a high pressure water blaster to clean the surface. Wet mortar spills on adjacent pavements, grass or other surfaces shall be cleaned before drying.

E.1.5.14. Maintenance

All restored surfaces shall be maintained in a condition to which they were restored until the expiry of the contract maintenance period.

E.1.5.15. Subcontractors

Notwithstanding that the contractor may subcontract the backfilling and restoration of service trenches, it will be the contractor's responsibility to obtain all permits and approvals prior to excavation commences. The contractor shall supervise the work to ensure that it is carried out in accordance with the specification.

E.1.5.16. Erosion Sediment Control

Virtually all construction activities which require the disturbance of soil surfaces and the existing vegetation predispose the construction site to erosion. The contractor shall take all necessary measures to reduce the erosion hazard and to control sediments in run-off water so that they do not enter the stormwater drainage system. The contractor shall also carry out progressive revegetation of the site where possible to reduce the area disturbed by construction activities.

E.1.5.17. As-Built Plans

Large Projects (length of trenching more than 50M)

The University will provide plans to the Contractor showing the nearest control points adjacent to the proposed excavation.

The Contractor is to submit as-built plans, indicating the location, route and depths of cables by referring back to the Control Points, in electronic format as per CAD specifications.

Minor Projects (length of trenching less than 50M)
The Contractor is to submit as-built plans showing the location, route and depths of cables by referring to the nearest ground features (e.g.: building corners, kerbs, retaining walls). Plans are shall be drawn to a scale, not exceeding 1:200 and annotated.

E.1.5.18. Testing
All services shall be tested in the presence and to the approval of the Superintendent.

Pressure Systems: As for cold water supply (Refer: Pipework & Materials)

Gravity Pipelines: As for sanitary drainage

Underground services shall be tested before backfilling, but after the installation of thrust support blocks.

Internal pipe work shall be tested before finishing trades commence, before ceilings are installed and insulation of pipe work. On site the contractor shall maintain records of all tests.

E.1.5.19. Damage to Services
Contractor shall replace at his own expense any service damaged during construction.

E.1.5.20. Materials and Workmanship
New materials and first class Tradesmen and workmanship shall be used in all instances.

E.1.6. PIPEWORK AND MATERIALS

E.1.6.1. General
Pipe work shall comply with Plumbing Code of Australia (NCC Volume 3) and relevant part of AS. 3500, except that pipework flanges shall be rated higher for fire sprinkler and hydrant installations.

E.1.6.2. Underground Piping
Provide service identification tape in appropriate colour and incorporating detector wire or equal placed 200mm above the pipeline.

E.1.6.3. Buried Warning Tape
Underground warning tape shall be buried 300mm below the surface of the trench, directly over the centre-line of the entire pipe route.

Tape shall be colour coded, nominally 150mm wide heavy gauge polyethylene film or other approved material. Wording to identify the nature of the buried
pipe shall be repeated at 1m maximum intervals, in accordance with Australian Standard AS 2648.1. Inscriptions shall be as per the following examples (or similar acceptable text).

a. Lilac (Purple) Tape

CAUTION BORE WATER PIPE

b. Red Tape

CAUTION FIRE SERVICES PIPE

c. Blue Tape

CAUTION WATER PIPE

d. Yellow Tape

DANGER NATURAL GAS PIPE

E.1.6.4. Wire Trace

In conjunction with the buried warning tape, a 2.5mm insulated earth wire trace line shall be installed on all non-metallic underground piping systems. It shall be laid directly over the centreline of the pipe for the entire pipe route and secured with tape at one (1) metre intervals, to ensure the trace wire remains in place while the trench is backfilled.

On pipelines greater than 500 metres, the trace wire shall terminate at the below/above ground pipe interface enabling a stronger signal shall be obtained.

Where necessary, splices shall be soldered or crimp joints.

E.1.6.5. Pipe work Design Velocities:

In-ground water service 1.0 to 2.1 m/sec

Building services pressure pipe < 2.2m/sec

Water pump rising mains 1.0 to 2.7m/sec

Gravity flow pipes from upper storage (top 2 floors) 0.1 to 0.4m/sec

Gravity sewer pipes – self-cleansing for average daily flows

Sewer rising mains - > 1.0m/sec

E.1.6.6. Copper Pipe

For all pipe sizes use Type B pipe. Jointing shall be either 5% silver soldered joints, rolled groove Victaulic bolted joints or flanges as required or Viega Propress system where polymeric piping systems have been approved.
Brazed tees formed by mechanical forming tools is only permitted for metal pipe on pipe sizes greater than 25mm and installed and only where installed above ground. Joints shall be 20mm long (minimum). Provide samples to Superintendent prior to installation to demonstrate minimum quality of joint shall be used.

Where laid below ground, provide polyethylene sleeving taped to all pipe work.

E.1.6.7. Copper Pipe Fittings
Proprietary fittings only shall be used for pipes less than 25mm.

E.1.6.8. Black Steel Pipe
Black Steel pipes shall not be used.

E.1.6.9. Light Gauge Galvanised Pipe
Shall not be used.

E.1.6.10. Dissimilar metals
Connections between dissimilar metals (bimetallic corrosion) shall be avoided. For specific guidance on good practice refer to the National Physical Laboratory Guides to Good Practice in Corrosion Control Bimetallic Corrosion - www.npl.co.uk.

E.1.6.11. Rolled Groove Joint
Install rolled groove joints on exposed internal pipe work only and similar to 'Northguard' or 'Victaulic' joints.

E.1.6.12. Pipe Access for Cleaning and Maintenance
Cleaning eyes (inspection openings) for pipeline maintenance and inspection shall be provided at every section of pipe for all gravity pipelines.

Locate inspection openings every 30m, at the base of every vertical dropper, (including downpipe droppers) and at each fixture outlet and at each junction and change in direction.

Provide clear-outs to permit internal cleaning and clearing of blockages to the whole of the reticulation system. Extend risers up to the finished floor or surface, terminating under a heavy-duty inspection box. Inspection boxes shall be screw fixed, brass where located internally and cast iron externally.

For specific requirements refer Appendix A Section C, Sanitary Plumbing and Drainage Systems of the Plumbing Code of Australia.

Engrave brass clear-out covers with the following letters: S – sewer, S/W – stormwater, T/W – trade waste.
E.1.6.13. Dismantling

Unions and dismantling joints shall be provided at all plant connections and valves up to NB 65 mm to facilitate installation and dismantling. Provide isolation valves adjacent to union to allow removal of plant without shutting down service.

E.1.6.14. Exposed Threads

Where pipe work is exposed to Public view, keep external threads to minimum required to make the joint.

E.1.6.15. Mitred Joints

Not permitted unless noted otherwise.

E.1.6.16. Exposed Pipe work

In toilets, kitchens and other public rooms, pipe work shall be chrome plated and fitted with wall plates.

E.1.6.17. Flexible Braided Connections

Braided connections (Plumb-easy or similar) shall not be used in laboratories unless integral to a fixture, hot water unit installations, service ducts or plant rooms. They may be used in ablution areas where 100mm floor wastes are provided and, if they fail, no real damage is caused. Where they are used, they shall be of the correct type to prevent straining, kinking or twisting or stresses on the connections. They shall be the correct length to match the installation requirements.

Braided vibration dampers on fire pumps shall be capable of working pressures of 2,200kPa.

E.1.6.18. Equipment and Valve Labelling

All equipment shall be labelled and all valves numbered. These shall be incorporated in the operation and maintenance manuals and drawings. Labels shall be manufactured from aluminium sheet and engraved on one side with valve number. On the back of the label, identify the plant isolated by the valve.

Obtain valve numbering from the Superintendent.

E.1.6.19. Valve Numbering and Schedule

Where numbering does not exist for a building, the following system shall be adopted.

Valves shall be identified by numbering in consecutive order as follows:

As an example, a main potable water service valve installed on Level 2 of Biological Sciences Building shall be numbered: D26 – 2 – PW – 1, where
Service Abbreviations

<table>
<thead>
<tr>
<th>Service Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DW</td>
<td>Cold Drinking Water</td>
</tr>
<tr>
<td>HW</td>
<td>Hot Drinking Water</td>
</tr>
<tr>
<td>WW</td>
<td>Warm Water</td>
</tr>
<tr>
<td>BW</td>
<td>Bore Water</td>
</tr>
<tr>
<td>LCW</td>
<td>Laboratory Cold Water</td>
</tr>
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<td>LHW</td>
<td>Laboratory Hot Water</td>
</tr>
<tr>
<td>CCW</td>
<td>Circulated Cooling Water</td>
</tr>
<tr>
<td>CW</td>
<td>Chilled Water</td>
</tr>
<tr>
<td>TW</td>
<td>Trade Waste</td>
</tr>
<tr>
<td>SP</td>
<td>Sanitary Plumbing</td>
</tr>
<tr>
<td>RO</td>
<td>Reverse Osmosis Purified Water</td>
</tr>
<tr>
<td>NG</td>
<td>Natural gas</td>
</tr>
<tr>
<td>CA</td>
<td>Compressed Air</td>
</tr>
<tr>
<td>N</td>
<td>Nitrogen</td>
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<td>A</td>
<td>Argon</td>
</tr>
<tr>
<td>HE</td>
<td>Helium</td>
</tr>
<tr>
<td>V</td>
<td>Vacuum</td>
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</table>

Schedule

<table>
<thead>
<tr>
<th>Valve ID</th>
<th>Service</th>
<th>Type &amp; Size of Valve</th>
<th>Location</th>
<th>Area or equipment affected upon</th>
</tr>
</thead>
</table>

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valve operation

<table>
<thead>
<tr>
<th></th>
<th>Potable Water</th>
<th>50mm ball</th>
<th>In service riser next to Rm 221</th>
<th>Level 2, west side from Rm 245</th>
</tr>
</thead>
<tbody>
<tr>
<td>D26-2-PW-1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Buried valves must be fitted with surround and cover and engraved according to UNSW standard convention and in accordance with Drawing FME 0017 H (Latest revision).

**E.1.6.20. Painting and Identification**

Where directed, pipework which is not chromed but is exposed to view inside rooms, shall be painted. Identify all pipes in accordance to Australian Standard 1345-1995 – “Identification of the Contents of Pipes, Conduits & Ducts” and requirements of AS 3500 and Plumbing Code of Australia. Colour coding shall be in accordance with AS 1318-1985 – “Industry Safety Colour Code”. Affix pipeline labels showing name of service and direction of flow. Gas services shall also have the pressure shown. Markers similar to ‘3M Safetyman’.

Refer also: Section E.2 - MECHANICAL SERVICES – Method of Identification.

**E.1.6.21. Pipe Capping**

Pipe work shall be capped off as work proceeds to prevent ingress of dirt, concrete etc. Use proprietary caps/plugs. Crimping or flattening of pipework is not acceptable.

**E.1.6.22. Fire Stop Collars**

Ref: AS 4072 – 2005 and AS 1530 – 1994. Fire Stop collars shall be provided on all PVC pipe penetrations through fire rated floors and walls. Shall be externally-mounted as a retrofit and equal to “Promat” products to provide fire rating to suit location by expanding under 100 deg C heat to collapse the pipe.

The hydraulic documents shall provide details on the Construction Issue contract drawings advising the plumber fixer as to which side, fire side(s), of the structure to fix the fire collar(s) and relevant F/R/L rating. Default fire rating shall be 4 hours.

**E.1.6.23. Pipe Supports**

Ref: AS. 3500. Use Stauff pipe supports in exposed public areas. Provide 1.2mm thick extruded PVC insulation between supports and all piping. (Note that the purpose of the insulation is to stop slipping, allow clamps shall be
tightened, provide sound insulation, and where necessary to separate different metals). Tape or coated brackets are not acceptable, except that Abey Acoustic Clips may be used for pipe sizes up to and including 25mm to support pipes running laterally.

Steel supports shall be galvanised after fabrication and similar to 'Unistrut' or 'Flexistrut’ or similar approved, complete with proprietary fittings and pipe clamps. Pipes over 25mm shall be fully supported with Unistrut angle brackets to ensure that pipe cannot drop even if clip becomes loose with vibration. Where pipes are located in vertical ducts, they shall be fully supported at floor level using ‘Unistrut heavy duty P1000 channel’ or equal bracing to prevent vertical and lateral movement when filled with water. Pipes shall also be supported with ‘Unistrut heavy duty channel’ or similar horizontal bracket and appurtenances between floors at 2m (max) spacing.

All brackets shall be fixed with structural grade fixings to the building works without distributing any loads to other pipes. Do not use one pipe to support another.

All fixings shall be similar to 'Hilti'. Horizontal wall mounted pipes shall be fully supported by cantilevered bracket. End-fill brackets with proprietary plastic caps. Use only one brand throughout the project. For RC slabs and beams, locate fixings as recommended by the structural engineer. Riser clamps (floor mounted anchor brackets) “Flexistrut” or similar shall be used on all pipe risers of 80 mm diameter and above.

Refer also: Section E.2 – Supporting of Pipes.

E.1.6.24. Fixing Through Steel Wall Framing
Where pipework is inserted through holes in steel wall framing, provide proprietary rubber grommets to isolate pipe from steel to prevent vibration noise and corrosion.

E.1.6.25. Redundant Services Disconnection and Removal
Disconnect and remove all redundant services. Disconnection shall occur at the last live tee and the redundant branch line capped within 150mm of the main line with proprietary cap or plug. Do not remove main building infrastructure pipework unless agreed in writing by Manager FM Engineering.

E.1.6.26. Electrical Hazard Zones
The Consultant shall be responsible for bringing to the Project Manager’s notice the existence of electrical fixtures that could be affected by the installation of hydraulic works.

The documents shall require plumbers ensure they are not installing hydraulic works in electrical hazard zones. The following shall be included in the tender
and contract documents. ‘Should an electrical fixture be present which puts it within a restricted zone by the actions of the plumber, then it shall be the Contractor’s responsibility and cost to have this fixture either relocated away from the zone or shall be replaced by a fixture appropriate to the zone.’

The following standards are representative of those applicable to UNSW but it shall be the Consultant’s responsibility to ascertain all applicable standards and clauses.

AS/NZ 3000 – Wiring Rules

Clause 7.1 Locations containing baths, showers or other fixed water containers

Clause 7.2 Swimming pools, paddling pools and spa pools or tubs

Clause 7.3 Locations containing sauna heaters

Clause 7.4 Refrigeration rooms

Clause 7.5 Locations where general hosing down operations are required

Clause 7.6 Fountain and water features

Clause 7.7 Extra-low voltage electrical installations

Clause 7.9 Hazardous areas

AS/NZ 2430 - Classification of hazardous areas

AS/NZ 2430.3.1 – Examples of area classification – General

AS/NZ 2430.3.3 – Examples of area classification – Flammable liquids

AS/NZ 2430.3.4 – Examples of area classification – Flammable gases

AS/NZ 2430.3.6 – Examples of area classification – Laboratories including fume cupboards and flammable medical agents

AS/NZ 2430.3.9 – Examples of area classification – Miscellaneous

E.1.6.27. Covers, grates and frames

All grated pit covers shall be bicycle and wheelchair proof. This requires the slots shall be no wider than 10mm and no longer than 250mm. Pit gratings shall be equal to ICON ductile iron Bicycle Safe Class B or D as required by AS 3996 -2006. Provide heavy-duty hinged GMS gratings and frames on all grated surface water entry pits.
Trench gratings shall be ACO type S100 or S200 Heelguard as required with maximum opening size of 8mm x 35mm.

Refer also: Section D - EXTERNAL WORKS – Hard Landscaping

E.1.6.28. Garden beds
Concrete covers and frames.

Refer also: Section D - EXTERNAL WORKS – Hard Landscaping

E.1.6.29. External bitumen or concrete paved areas:
Cast iron gas-tight covers and frames equal to Mascot Engineering Gastight Manhole Covers, concrete filled, with reinforced concrete frame surround. Provide 10mm thick expansion joint between surround and adjacent paving.

Pits requiring regular maintenance (for example grease inceptors), but not in trafficable areas, should be fitted with heavy duty aluminium checker plate lid and surrounds, incorporating flush mounded lifting handle and locking device.

*****Refer also: Section D - EXTERNAL WORKS – Covers and Gratings***

E.1.6.30. Tile, block or brick paved areas
Cast iron gas-tight covers and frame equal to Mascot Engineering Gastight Manhole Covers, with 3mm thick 316 grade stainless steel riser strips bolted to frame and covers. Riser height to suit paving thickness. Fix pavers with appropriate bonding and bedding compounds.

Where covers are likely shall be too heavy to meet OH&S requirements, colour-stencilled or coloured concrete infill may need shall be adopted rather than inserting pavers into covers.

Key openings shall suit Gatic SR150 lifters. Provide two sets of universal type lifting keys, lengthened to suit final cover thickness. Provide and fit covers to all keyholes. 'Gatic SR150'

All covers, grates and frames for the entire project shall be from one manufacturer.

Where isolating valves are housed beneath the cover, provide inserted inspection covers to suit.

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<tr>
<th>Areas</th>
<th>Cover Weights</th>
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<td>Pits requiring regular access</td>
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access areas

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<th>Pits requiring regular access in Grassed areas</th>
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<td>Pits not requiring regular access in Roads and vehicle access</td>
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**E.1.6.31. Vent Terminations**

Terminate sewer and trade waste vents shall be AS/NZS 3500.2.2:1996 Clause 6.7.4 and Sydney Water trade waste requirements. Generally vents shall be terminated at least 6m and preferably 8m laterally from air conditioning intakes and at least 3m from wall openings. Where required, vents should be diverted away from air conditioning units and cooling towers by increasing the vent size and providing guy wire supports. Under such circumstances, it is likely that stainless steel pipework would be required to meet aesthetic approval.

**E.1.6.32. Pressure Gauges**

100mm dia Bourdon tube type shall be used, securely mounted and provided with shut-off tap & union. Where pressure gauges are mounted on pump lines, provide glycerine filled gauges for protection against extreme pressures. Full scale reading shall be 150% of expected maximum pressure. The graduations shall be in KILOPASCALS.

**E.1.6.33. Water Tanks**

Materials for water tanks installed in or on buildings shall be, copper, cast iron, stainless steel or polyethylene. Standard galvanised mild steel shall not be used. However purpose-built sectional tanks may be approved, subject to full engineering details on jointing of sections, corrosion protection, tank support, pipe penetrations, roof etc being approved by UNSW.

Only polyethylene tanks shall be used for holding non-potable water due to the potential corrosive nature of bore water. These tanks shall be fitted with a dual supply, the primary from bore water and backup drinking water. Refer to sketch.

All water storage tanks shall have overflow alarms fitted and connected to the campus wide BMS system.

Refer to Diagram FME 0003/H Non-Potable Tank Standard Details at the end of Section E.1.
E.1.7. **DRINKING (POTABLE) WATER**

E.1.7.1. *Basis of Design*

On the first drawing in the set, provide details on which the design was based. Such information shall include: How flow rate and system pressures were determined, flow rate and pressure determination for pumps, design pressure head at top floor fittings, actual head and flow curve for pump as designed showing duty points, criteria for sizing water storage.

E.1.7.2. *Pipe Materials*

The following pipe materials shall be used for potable water in accordance with products that have been endorsed as compliant with Australian Standard AS/NZS 4020:2005 Testing of Products for Use in Contact with Drinking Water. Additional requirements are as follows:

1. Type B copper with silver-soldered joints shall be used internal and external to buildings, both above and below ground or Viega Propress system, where approved. Where pipework is concrete encased below ground, wrap the pipe in 3mm thick Denso Tape to prevent concrete contacting the pipe.

2. Where underground pipework is larger than 80mm diameter, use blue stripe PN16 medium or high density Polyethylene with electrofusion welded joints. (Refer below to Water Mains).

No other materials shall be used unless with written authority from Manager FM Engineering for specific project technical reasons. Do not assume this authorisation shall be forthcoming. In particular “Rehau” composite pipe shall not be used.

E.1.7.3. *Water Meter*

Water meter(s) shall be provided to measure all water consumption at each building.

Meter type: Elster Metering Pty Ltd with pulse attachment for connection to UNSW remote monitoring system. Mandatory Requirement, Davies Shepherd.

Sub-meters shall be installed on all water consuming plant and equipment which is likely to use more than 20% of the total building Average Day Demand. Such users may include: cooling towers, laboratory non-potable water, toilet flushing tanks and pure water treatment plants. Note that it is likely these consumers will be supplied by bore or rainwater where available.

E.1.7.4. *Water Filter*

For large / multi-storey buildings, provide 200 micron automatic backwash filter with manual valved bypass immediately before the main building meter.
E.1.7.5. Water Mains

Site water mains are combined fire and domestic and are metered at the site boundary. Pipeline material shall be medium or high density polyethylene PN 16 with electrofusion joints. Minimum pipeline size shall be 110mm outside diameter, sized for fire flows concurrent with distributed site domestic / industrial flow rates. Sizes of any extension or diversion of existing mains system shall be engineered by FM Engineering. Provide all expected design flow rates for new conditions to FM Engineering.

Where electrofusion jointed mains join onto existing pipelines or where spigot and socket fittings are used, mass concrete thrust blocks shall be placed against bends, tees, ends etc. as required. A guide to thrust block sizing is provided.

Refer to Diagram FME 0004/H Thrust Blocks for Water Supply at the end of Section E.1

Connect long straight sections polyethylene pipe to existing long sections of straight cast iron with ductile iron cement lined flange-spigot and gibault joint. Where this is located within vehicle traffic areas in soil or sand substrata, support the flange connection with concrete bedding.

Connect to existing main with a tapping band and service valve for isolating service. Tapping bands shall comply with AS/NSZ 4793 types F and R to suit flexible and rigid pipelines. Where tapping is into ‘live’ mains, perform all tapping’s under pressure and as directed by UNSW FM Engineering Hydraulic Works Supervisor. Make arrangements with FM Engineering at least 7 days prior to the required shut-down to ensure service interruption is convenient to the University’s operations. Note that double tappings and breeching pieces are not shall be used instead of a larger tapping or tee.

E.1.7.6. Valves - Service Isolation

A main isolating valve shall be provided to each building in a readily accessible location as approved by “SUPERINTENDENT”. Isolate each building service line from the external water main and each branch line from the service lines.

For pipe sizes up to 65mm use 'Johns J360' or equal ball valves with screwed BSP and union connection.

For pipe sizes over 65mm use flanged epoxy-coated cast iron resilient seated valves similar to Tyco or equal with Table E flanges. Make provision for dismantling pipework and valve replacement.

All valves are to close in a CLOCKWISE direction.

For new developments provide a fire sprinkler and a fire hydrant branch line adjacent to the domestic tee. Provide a cluster of five main isolation valves.
(one on each service and one on the ring main adjacent to the three connections to ensure isolation of either section of the ring can be affected while maintaining supply to the building.

Label each above ground valve with a circular plate of traffolyte material engraved with their respective function and mounted in an approved manner on top of valve spindles with a brass ring.

Refer to Diagram FME 0017/H Valve Installation Standard Detail

(Refer also to AS2419.1 – 2005 Fig. 8.5.9)

Valve box surround colour shall be Service Specific as follows:

Potable water and fire  - Grey
Borewater    - Lilac
Natural Gas    - Yellow

Engrave the following details on all PVC surrounds:

a) Direction of operation using arrows and wording “OPEN & CLOSED”

b) In addition to a), for quarter turn valves, include the wording “QUARTER TURN OPERATION”

c) Also include engraving of Grid Ref number.

Note: All engraving shall be performed with a proprietary engraving tool using neat upper casing lettering.

**E.1.7.7. Valves in Service Risers and Ducts**

Where branches are cut into service risers or services in corridors, valves shall be located on the new pipe parallel to the main service and not on the right-angle take-off. This is required to minimise intrusion into working space.

**E.1.7.8. Valves – Laboratory or Room Isolation**

Where a number of fixtures are served with hot or cold water from outside the area, such as teaching laboratory, toilet areas, plant rooms, etc., provide isolating valves on the wall adjacent to the main entry door and inside a stainless steel wall box mounted no higher than 1500mm above the floor.

Refer to Diagram FME 0005/H - Laboratory Service Valve Compartment at the end of this Section E.1.

**E.1.7.9. Valves - Fitting Isolation**

Isolating valve on supply to each cistern, sink and basin on hot and cold water supplies shall be provided to permit individual fitting servicing. Valves shall be
chromed and located on service as it penetrates wall under fixture. They shall be installed in conjunction with in-line water savers where these are required.

Provide all valves with unions or flanges to permit replacement without cutting pipework. Loose-jumper type valves are not permitted.

**E.1.7.10. Valves – Non-Return**

Reduced Pressure Zone device (RPZD): shall be Tyco RPZD. Mandatory Requirement: Tyco Model RP03

Double check: shall be Tyco double check valves. Pumps shall be designed for the associated pressure losses.

Mandatory Requirement: Tyco Model DC03

Dual Check Valve: shall be equal to Watts Series 7

**E.1.7.11. Hose taps**

External drinking water hose taps shall only be installed where required for water supply to relocatable drink preparation units such as coffee carts, barbeques, and hot dog stands etc. In these cases only hose tap risers shall be 20mm copper pipe, fixed to masonry with copper brackets and masonry anchors or, if free-standing, to a 75x50 hardwood or treated pine post buried 500mm into 300 x 300 compacted gravel road base. Tap connection shall be 650mm above finished ground level. Provide isolating ball valve on riser. Hose tap shall be Lock-shield type fitted with a permanently installed dual check valve and “Drinking Water” sign.

**E.1.7.12. Pump-pressurized Water Systems**

(Refer to next Clause for make-up pumps to elevated storage tanks)

**General**

Provide stainless steel, vertical spindle, multistage ‘Lowara’ or equal pump. Include suction and discharge pressure gauges. Provide at least three complete pump units on stainless steel base. Isolate pump suction and discharge from fixed pipework with flexible high-pressure connectors. Motors shall be energy rated ‘high efficiency’. Provide a valved by-pass with check (non-return) valve around the pump-sets to allow mains pressure supply without pumping.

**System Design**

Design demand shall take into account at least the following: likely operation of various pieces of equipment at the same time, likely simultaneous operation of personal ablutions from accommodation units (Note that UNSW FM Engineering shall provide guidance in this instance), any additional simultaneous emergency water supply back-up to non-potable uses (in the case of borewater supply failure) and simultaneous operation of 1 or 2
emergency safety showers (laboratories). System pipe work design shall be based on the requirements of AS 3500. However maximum pumping installation demand shall be determined by the hydraulic designer based on the likely realistic requirements of the building operation and purpose. This shall be agreed in writing by UNSW FM Engineering.

Each pump duty flow rate shall be 50% of the likely maximum design demand, resulting in a total capacity of 150% of the design demand. Where pumping from water mains, design shall be based on the minimum pressure available shown in the Fire Flow Enquiry response. Design pressure at the highest point in the system shall be 300kPa (allowing 100kPa pressure loss for mechanical backflow devices), unless plant or equipment requires a specific higher pressure. Pumps shall be selected such that the calculated Duty Point (Set Point) lies at about 85% of the pump capability. Select pump duties or number of pumps to ensure the pumping installation operates across the total spectrum of demand flow rates, from a single fixture up to the design maximum simultaneous demand, assuming all pumps are operational. (DO NOT OVERSIZE PUMPS as it reduces their working life & can impart waterhammer to the pipe work). On the drawing, provide details on which the design was based. Such information shall include: How flow rate and system pressures were determined, flow rate and pressure determination for pumps, design pressure head at top floor fittings, actual head and flow curve for pump as designed showing duty points.

Controls
Control each pump by discharge pressure using a dedicated pressure transducer for each pump with variable speed integrated controllers. Controllers shall be ‘Hydrovar Master Controllers’ only, mounted on the top of the pump motor. This arrangement shall provide total redundancy regardless of any component failure.

Pump Suction & Manifolds
Pump suction manifolds shall be sized to provide the total system design flow rate at a velocity of not greater than 1m/sec. Pump discharge manifolds shall be sized for a velocity of not greater than 2m/sec. Check (non-return) valves shall be placed on the individual pump discharge. Where pump suction manifolds are larger than the pump inlet, all pipe size reduction fittings shall be eccentric (fitted with a constant top-of-pipe level) to prevent air locks. Pump suction pipelines feeding from a storage tank shall either be constantly graded from the tank to the pump suction, or provided with a single low point between the tank and the pump as conditions require (to ensure entrapped air can escape to the storage). Provide all pump installations with space to install an additional pump should one be required in the future. Connect every pump failure alarm to campus wide BMS system. Provide hours run meter to each pump. Provide multiple smaller pumps rather than a...
single large one. Controls to include “no-flow/low pressure” automatic cut-out and reset. Provide a signal terminal out from the pump fail signal to connect to the BMS.

**Power & Electrical Controls**
Fit with non-overloading, 415v, 2,900 rpm electric motor where applicable. For small units provide plug-in 240v units with timer. Set timer to run pump between the hours of 7.00am and 8.00pm (or as applicable to the occupants)

Refer to Section E.3.2 - Electrical Services.

**E.1.7.13. Make-up Pumps to Elevated Storage Tanks**
(Refer to previous Clause ‘Pump-pressurized water systems’ for pump, pipework and control requirements in addition to the following:)

**General**
Provide at least two complete pump units on stainless steel base. Control shall be by a dedicated pressure transducer to each pump. This is to ensure any future tanks in other parts of the building can be filled without having to modify or extend control wiring or redesign controls. This will necessitate the water tank inlet float valves to close tightly when the tank is at “Pump Stop Level”. Inlet float valves shall be specified with a differential water level between OPEN and CLOSED to ensure the valves open fully as the tank water level drops. Do not oversize inlet valves, otherwise the regulation tank overflow and air gap will need to be enlarged. Provide a valved by-pass with check (non-return) valve around the pump-sets to allow the tank to fill without pumping.

**System Design**
Design demand shall take into account at least the following: likely peak hourly demand from all sources (Note that UNSW FM Engineering shall provide guidance in this instance), any additional emergency water supply back-up to non-potable uses (in the case of borewater supply failure) and operation of 1 or 2 emergency safety showers for up to 30minutes (laboratories). Pump duty flow rate shall be selected at 75% design demand. Design running pressure at the inlet to the receiving tank shall be 150kPa. Where a backflow prevention device is required to be installed, (or where a building automatic backwash water filter is required to be installed), it shall be installed on the discharge side of the pumping installation where the water supply running pressure at the pump is less than 200kPa. Provide a valved by-pass with check (non-return) valve around the pump-sets, regardless of available water pressures, to allow the tank to fill without pumping.
E.1.7.14. Fitting Flow Rates

Flow rates shall meet the following mandatory WELS star ratings:

- Basins: 5 star (4L/min) generally, 4 star (6L/min) when supplied by flow-through gas boiler such as Rinnai Infinity without return loop. (Note: Basins in public ablutions shall be fitted with a single cold water time flow tap)

- Ablutions showers: 2 to 3 star (9-10L/min)

- Dishwasher: 3 star or higher

- Clothes washer: 3 star or higher

E.1.7.15. Drinking (Potable) Water Backflow Prevention

a) Backflow Prevention

Generally in addition to a registered break tank, other devices required include at least a dual check valve at or near the fitting outlet. For PC2 laboratories, a double check valve shall be installed in the Service Valve Compartment prior to the service entering the containment area.

Backflow Prevention Policy

UNSW has a Policy on "Back-flow Prevention of Potable Water Supplies". To comply with the Policy, the following must be met:

The back-flow provisions of AS 3500.2 shall be rigidly adhered to, except where the supply Authority over-rules these requirements. This Policy has been established to provide rigid rules for the provision of back-flow prevention devices at each of UNSW campuses to overcome the various individual interpretations of the requirements of AS 3500. The Kensington campus has significant contamination potential and this site has specifically been targeted.

Whilst clarification of this Policy can be obtained from the Superintendent, it is unlikely that any deviation from this Policy will be accepted.

Potential causes of pollution from within UNSW are many, due to the various biological, chemical, industrial and irrigation uses of potable and non-potable water on the campuses.

b) Containment at Site Boundary

Containment at the site boundary to protect the municipal water supply shall be handled solely by UNSW, Engineering Services.
Contractors or Engineering Consultants are not to address this work unless specifically instructed and briefed to do so in writing by UNSW Engineering Services.

c) Levels of Protection

Within the UNSW, three levels of protection shall be provided as appropriate to the proposed work:

Building containment will be required to protect UNSW general site reticulation. Devices shall be installed to suit the greatest hazard within the building, unless otherwise varied by UNSW FM Engineering.

Zone protection within the building, areas or parts thereof - to contain contamination within a specific and separable part of the site. Within this zone and downstream of the device, water must not be supplied for any potable uses.

Individual protection of each outlet - to prevent back-siphonage of contaminated substances into the water delivery system.

Zoning areas of potential contamination should not generally be done if a single device can be used at the water use point. Zoning large areas or whole floors of buildings can cause major issues with respect to defining water potability. Where Zoning is warranted, UNSW Engineering Services must approve it in writing.

In all situations, air gaps and registered air gaps are the preferred option. Mechanical devices shall only be used where it is not economically feasible to provide an air gap.

Where any activities in the building or on the site could cause potential back-flow of contaminated water to the University’s water reticulation, containment is required.

Refer: Section F - SPECIFIC AREA REQUIREMENTS

d) Bore Water in Buildings

Where bore water is supplied to a building and connected to the potable water supply as a second source, the potable water shall be fitted with a reduced pressure zone device at its connection with the bore water. An additional RPZD shall also be fitted at the incoming supply meter to comply with AS 3500 backflow protection where non-potable water supplies are provided.

Mandatory Requirement: Tyco RP03 Complete with strainers and isolators. Provide drain from atmospheric zone to building drainage.
The bore water installation shall be fitted with a double check valve device.

Mandatory Requirement: Tyco DC03 Complete with strainers and isolators

**e) Connections for Fire Services**

Where fire hosereels, hydrants or sprinklers are pressurised by a fixed pump after the potable water connection, a Tyco backflow prevention device shall be fitted.

At Kensington Campus, install a testable double check valve assembly with butterfly valves between the potable supply and prior to the feed hydrants. At other campuses where the fire supply is unmetered, provide a double detector check valve.

**f) Kensington Campus Specific Requirements**

The following are specific requirements for the Kensington Campus:

Bore Water System: The bore water system is a non-potable water supply. However it shall be deemed shall be a protected water supply. Air gaps and double check valves shall be used for significant risks of contamination.

Note that bore water shall be connected to all new user points where significant quantities of non-potable water are expected to be used. This includes such uses as cooling water, laboratory non-potable, washing, flushing and irrigation.

Irrigation is supplied from the bore water system. Backflow prevention devices are not required for irrigation.

Mechanical Equipment and Cooling Towers - Connect the bore water supply via an air gap.

Where connecting mechanical equipment and cooling towers to potable water provide an air-gap. Where this is not economically feasible, considering the long term maintenance commitment to mechanical devices, a testable mechanical device could be used.

It is vital to provide an emergency back-up supply from the potable water system at each plant location using either an air gap at the plant, or by connecting the two supplies together through an RPZD assembly on the potable supply and a DCVA assembly on the borewater. The potable water is maintained NORMALLY CLOSED.

**g) Types of Devices**

Backflow prevention devices shall be Tyco.
Refer to Diagram FME 0006/H – Site Backflow Device Schematic at the end of this Section E.1

E.1.8. NON POTABLE WATER SYSTEMS

E.1.8.1. General
Non-potable water (NPW) applies to a dedicated water system supplying directly to potential sources of contamination such as: scrub up sinks, laboratory sinks, x-ray processing, etc. and is separated from drinking water by appropriate backflow prevention devices including break tanks.

E.1.8.2. Basis of Design
On the first drawing in the set, provide details on which the design was based. Such information shall include: How flow rate and system pressures were determined, flow rate and pressure determination for pumps, design pressure head at top floor fittings, actual head and flow curve for pump as designed showing duty points, criteria for sizing water storage.

E.1.8.3. Pipework
Pipework shall be either:

Type B copper with silver soldered joints and painted or sleeved before installation (Do not use copper pipe for raw borewater), or Lilac stripe HDPE pipe, or Aquatherm polypropylene PN16 Pressure Rating or higher to suit specific test pressure.

Cross-linked polyethylene pipework will not be accepted.

E.1.8.4. Colour Coating of Pipework
Prior to installation of copper pipework, coat pipes with enamel paint coloured purple to distinguish it from potable pipework. Scrape back paint at joints to allow soldering.

E.1.8.5. Break Tank
Materials shall be selected to suit the water stored. e.g. do not use copper for de-ionised water or bore water.

E.1.8.6. Non-Potable Signage
Provide a sign “Caution not for Drinking” similar to ‘Safetyman’ over each non-potable outlet fixture.
E.1.9. HOT WATER

E.1.9.1. Ecological Sustainable Design (ESD)
Provide a circulated centralised system only where sufficient outlets would achieve an energy-efficient system. Where a centralised gas hot water is proposed provide evidence of the energy efficiency of the system by estimating the “Common factor” of the hot water reticulation using Jemena JDG-0038 Design Guide Spreadsheet Template. In commerce buildings likely to require hot water only for tea sinks, accessible toilet basins and cleaners’ sinks, provide small capacity stand-alone instantaneous electric units.

Where a new hot water system is shall be provided, it shall be supplied from gas-boosted solar units. Solar units shall be so designed to ensure maximum capture and retention of solar gain. This is most likely achieved by pre-heating make-up cold water prior to final natural gas heating. Pre-heating shall be automatically controlled to ensure heat is not lost to solar units during times of negative solar gain. Heat sink units shall be Rotex Sanicube.

E.1.9.2. Basis of Design
On the first drawing in the set, provide details on which the design was based. Such information shall include: How flow rate and system pressures were determined, flow rate and pressure determination for pumps, design pressure head at top floor fittings, actual head and flow curve for pump as designed showing duty points, temperature control, statement on Legionella control.

E.1.9.3. Piping
All piping shall be copper. Refer also to – HYDRAULIC SERVICES -Pipework & Materials.

E.1.9.4. Insulation
Only pipework chased into masonry shall be pre-lagged with Kemlag

All other hot water piping concealed in ducts and ceiling spaces shall be insulated with Thermotec 4-Zero fire retardant polyethylene foam having a density of 50kg/m³.

Where condensation on the outside of cold water pipes is liable to occur, insulate pipework as above. Refer also HYDRAULIC SERVICES -Pipework & Materials for insulation.

The extent and design thickness of insulation is shall be nominated on all hotwater reticulation drawings and a BCA Part J certification for same provided to FM Engineering.

E.1.9.5. Hot Water System
Wherever practicable provide gas fired units. These may be of the Rinnai Infinity or Bosch’s instantaneous type. Systems shall be designed to ensure
potable water use is minimised by installing short dead legs or a circulated system.

Where undersink hot water units are required, consideration shall be given to the use of 240volt push through (non-storage) units (such as Stiebel Eltron) to avoid installation of safe trays and drainage.

Tea rooms shall be provided with hot and cold water at the sink. Under no circumstances will boiling water be used as a substitute for hot water at the sink.

Boiling Water Units shall be sized to suit duty and be similar to ZIP Hydro Tap under-sink Boiling / Chilled water unit or Zip four in one or all in one, where approved.

Provide signage indicating 'Caution – boiling water outlet' adjacent to outlet.

**E.1.9.6. Circulating Pump**

Provide 'Grundfos' or equal stainless steel variable speed 240V in-line pump. Where economically justified, provide variable speed units where variable hot water flows are expected. Provide time clocks and thermostats to automatically operate the pump. Set thermostat to start pump at 65 deg.C and stop at 75 deg. C. Set timer so that pump only operates during the regular hours of building use.

Systems circulating water at less than 60 deg. C shall not be installed. (Circulated warm water systems are not permitted on the UNSW Campuses)

In all new installations and refurbishments, only timed flow taps will be installed in public ablutions areas (Does not include Student Housing). Access toilets shall be fitted with a suitable “Access” lever-type mixer tap.

Where taps in public toilets and public washrooms are replaced, they will be replaced only with timed flow taps.

No warm water will be supplied to public toilet areas except for Access toilets to save water and energy.

Timed flow taps will have a flow rate of not greater than 5 litres per minute and must be adjustable to enable operation for between 5 and 15 seconds. Installed default time flow is shall be set at 7 seconds.

Push button taps should be specified for areas that are likely to suffer vandalism.

For Access toilets, where a common or circulated warm water supply is required for other purposes within 10 metres of the toilet area, it shall be used as the supply for that area. In all other areas, unless otherwise specified.
by the University’s Energy Manager, a low-delivery electric instantaneous water heater unit (Stiebel Eltron or approved equal) shall be installed with a thermostatic mixing valve. The delivery temperature of this system shall be adjustable to operate between 35 and 50 degrees C. with the default delivery temperature being 40 degrees C.

**E.1.9.7. Thermostatic Mixing Valves**

Provide temperature-controlled water to all domestic hot water systems to reduce pipe delivery temperature, except for kitchen and cleaners’ sinks and laundry fittings. Points of use devices are not acceptable. Shall be approved by NSW Department of Health for use in health care buildings and installed to Hosplan standards.

Provide Enware 'Aquablend 1500' thermostatic mixing valves complete with all associated valves. Binder / Pease points shall be provided for testing the warm water outlet, sized to suit the duty requirements. Test certificates shall be provided to Superintendent. Locate mixing valves between 1500 and 1800mm above floor level, either in lockable hinged stainless steel wall boxes or built-in and framed wall cupboards within the room to facilitate servicing. Keys shall be to UNSW standard.

Tempering Valves shall not be used.

**E.1.10. BORE WATER**

**E.1.10.1. Basis of Bore Water Design**

Shall be used for all non-potable uses (except for marine studies). Where available, use pH adjusted borewater (Treated Bore Water) for laboratory uses. Both borewater and treated borewater is acceptable for cooling tower make-up, although water treatment within the tower may need to be adjusted if straight borewater is used. This must be advised to the chemical treatment contractor at the time of commissioning. Use of borewater shall be notified to the Mechanical Engineer for inclusion in the cooling tower project specification.

Bore water demand flow rates need shall be managed to ensure bores are not sucked dry at times of campus peak instantaneous demands. The best way to manage this is on a building by building basis by designing the system with an averaging tank (and pump where required). Where the project provides for rainwater harvesting, the make-up to the storage tank shall be by borewater. The borewater supply meter to the building should be 20mm to restrict the tank make-up flow rate and the tank inflow rate should be restricted to 1L/sec by use of a standard "Universal" float valve. Where the non-potable requirements of the building cannot be met by a 20mm meter, a larger meter
must be approved in writing by Manager FM Engineering. FM Engineering shall be requested to provide guidance with respect to availability of borewater and treated borewater supply rates and pressures prior to any detailed design being carried out.

Irrigation flow rates shall be designed on the basis of planting need. Typically lawn area shall be provided with 27mm per week precipitation and garden areas 23mm per week, scheduled to operate within the allotted night-time period which will be provided by FM Engineering once the irrigated areas are known. Maximum station flow rate shall be 1.5L/sec with only one station operating at any one time. Stations will be designed to operate for 1 or more 20 minute periods to achieve the required precipitation rate.

(For UNSW pump requirements, refer to Section: Drinking (Potable) Water – ‘Pump-pressurized water systems’ and ‘Make-up Pumps to Elevated Storage Tanks’)

E.1.10.2. Pipe Material

Copper pipework shall not be used due to the low pH and possible long term corrosive effects of the bore water. However existing toilet flushing systems being altered to bore water flushing shall remain as copper.

In-ground piping over 80mm nominal diameter shall be purple PVC Class 16 and pipework 80mm and less shall be purple PVC Class 18.

Refer to PIPEWORK & MATERIALS for Pipe Installation.

Where new pipework is shall be installed within buildings, pipelines shall be either:

Grade 316 x 1.6mm thick stainless steel seamless tube in accordance with DIN 1988, with crimped joints as supplied by Blucher Australia. Joints shall be Mapress press fittings with NBR Nitrile rubber seals, or lilac coloured HDPE or Aquatherm Polypropylene PN16 or above to suit test pressures. (Note: Cross-linked polyethylene will not be approved).

E.1.10.3. Pipe Installation below Ground

Non-potable water service shall be laid 300mm clear of parallel potable water service – this includes irrigation pipework.

All non-potable buried pipes shall be lilac.

Identification tape (lilac) at least 75mm wide stating NON POTABLE or RECLAIMED WATER shall be laid along and in contact with the pipe and fixed at 3m intervals - including irrigation pipework.
E.1.10.4. Connections
Main connections to each building, irrigation system or facility shall be at the site ring main. Each connection shall include an isolating valve and a pulse-type water meter as directed by SUPERINTENDENT.

E.1.10.5. Backflow Prevention
The bore water system is a non-potable water supply and as such does not require additional devices to be fitted, with the exception of the following:

Direct supply to laboratory outlets via a Tyco DC03 Double Check Valve.

Direct connection to potable supply for dual supplies via Tyco DC03 Double Check Valve. (Note: Potable supply shall be protected using a Tyco RP03 RPZD)

Direct feed to chemicals (Not permitted)

It should be protected from contamination wherever possible.

E.1.10.6. Isolation Valves
Refer to: HYDRAULIC SERVICES - Potable Water, Service Isolation Valves and Fitting Isolation Valves.

E.1.10.7. Water Meter
Provide a single 20mm main building meter and a single 32mm irrigation meter. Both meters shall be Elster PSM meters provided with a pulse output cable connected to the high pulse rate side of the meter ready for connection to the UNSW site EMACS metering system. Where the non-potable requirements of the building cannot be met by a 20mm meter, a larger meter must be approved in writing by Manager FM Engineering.

Sub-meters shall be installed on all water consuming plant and equipment which is likely to use more than 20% of the total building Average Day Demand. Such users may include: cooling towers, laboratory non-potable water, irrigation, toilet flushing tanks and pure water treatment plants.

Refer also to: HYDRAULIC SERVICES - Potable Water, Water Meter

E.11. IRRIGATION WATER SERVICE

E.11.1. Irrigation Water Generally
For all works of irrigation downstream of the water service

Refer to: LANDSCAPING – Irrigation.

Requirements below relate to provision of water to the irrigation system.

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E.1.11.2. Water Supply
All irrigation shall be supplied from the site bore water non-potable system. In exceptional circumstances, connection to potable water may be permitted where approved in writing by Manager Engineering Services. Provide ball-type service valve at the connection and install water meter as directed by SUPERINTENDENT.

E.1.11.3. Pipework
Supply from Borewater main to Control Valve: For pipework up to 80mm, use black Polyethylene Class PN12 or greater with lilac stripe or Lilac Class 16 PVC.

Where potable water is supplied, use Copper Type B.

Backflow prevention devices are required as follows:

Where supply is from bore water and fertilizer injection is installed, a testable Tyco Double Check Valve Assembly shall be installed. Where supply is from potable water supply, a testable Tyco Reduced Pressure Zone Device Assembly shall be installed.

E.1.11.4. Isolation valves
Provide isolation ball valves on each branch at tee and upstream of each solenoid valve. Valves shall be premium range Philmac (Black base with blue handle and unions)

E.1.11.5. Valve Boxes
Valve boxes shall be buried with lid approx. 10-20mm below turf level (for lawn areas) and 10-20mm above soil level (for garden areas). Use large boxes to house isolating ball and solenoid valve installations. Where necessary, use two boxes for ease of access.

E.1.11.6. Wiring
Underground wiring shall be multi-core multi-strand type, taped to the underside of the irrigation pipe where possible. Aboveground wiring shall be installed inside electrical conduit. Contractor to size control wiring to minimise voltage drop hence ensuring that solenoid valves operate satisfactorily.

E.1.11.7. Borewater Hose taps
Hose taps under surface boxes shall be special upturned, ball valve tap and Lock-shield key. Irrigation boxes shall have purple lid to identify it as bore water. Support box on 80 thick concrete pad. Provide Unistrut support with clamp under pipe just behind special valve and fix Unistrut to concrete slab to prevent tap from being pulled out of box Bore water hose taps shall be 20mm lilac-coloured lockshield with reverse thread outlet.
Hose tap risers shall be 25mm copper pipe, fixed to 75x50 hardwood or treated pine post buried 500mm into 300 x 300 compacted gravel road base. Tap connection shall be 650mm above finished ground level.

Provide sign 140 X 170 approx. on aluminium backing, brass screw-fixed to post or rivet to lid, with the standard pictogram and the following wording:

DO NOT

DRINK

Refer to Diagram FME 0007/H Borewater Tap Standard Detail at the end of this Section E.1

E.1.12. SANITARY DRAINAGE

E.1.12.1. Basis of Design
On the first drawing in the set, provide details on which the design was based. Such information shall include: Fixture units on each stack, total discharge flow rate, flow rate and pressure determination for sewage pumps, actual head and flow curve for pump as designed showing duty points, criteria for sizing pump station storage.

E.1.12.2. Pipe Material
Vertical stacks – cast iron, except that PVC may be used up to 6 storeys with noise insulation installed where required for noise abatement in areas such as libraries, quiet rooms, lecture theatres, etc.

Horizontal drainage – PVC

E.1.12.3. Expansion Joints
Shall be shown on the schematic line diagram and provided as follows:

- On vertical stacks, between each floor
- On each branch line exceeding 2.3m in length.
- On each branch line with fixed points more than 1.2m apart.
- On straight runs at 3.0m apart.
E.1.12.4. Access and Clearouts

Provide clearouts in locations as required and also where the words ‘consideration should be given’ apply in AS3500. In toilet drainage, provide a removable metallic access plate in the floor adjacent to the most-upstream WC on the branch. In multistorey buildings, extend the most upstream clearout through the upper floor slab and provide metallic screw down inspection plate in the floor above. At required clearouts at the stack junction, provide an access panel in the ceiling immediately below the clearout and provide clearances all round the clearout as specified in AS3500. Provide access panels in building works for clearouts at the base of each stack and ensure the clearout is accessible for roding and removal of debris from the stack.

E.1.12.5. Floor Wastes

Provide commercial grade 100mm chrome plated brass bayonet grate to suit plastic waste fittings manufactured in accordance with Australian Standard AS 2887. Make watertight around waste with epoxy concrete.

In commercial kitchens and food preparation areas, provide approved dry basket arrester or bucket trap with internal strainer under basket cage. All such traps shall be approved by Sydney Water Trade waste and have current product approval listing.

E.1.12.6. Traps

Provide traps to fixtures not provided with integral traps. All traps except WC’s shall be white in colour, ‘universal’ in construction and have 75mm water seal. Provide screwed adaptors where traps join waste piping and / or drains and provide chrome plated cover plates where traps and waste piping joins floor and wall.

Where air conditioning condensate is the only method of charging a trap, provide a ‘waterless’ trap equal to “Hep,O Plumbing Hygienic Self Sealing Waste Valves”

E.1.12.7. Tundishes

Drain air conditioning condensation and other intermittent drainage into tundishes which drain through a Hepworth waterless trap. Wherever possible the tundish shall be mounted within a wall and shall meet all the design features of the Stainless Metal Craft Model TU RE 2 Recessed Tundish with Perspex viewing window. Locate the tundish low down for viewing and to facilitate servicing should it be required. Ensure the inlet pipe is cut with a taper to ensure all drips discharge towards the rear of the unit and prevent splashing discharging from the air gap below the window.

Refer to Diagram FME 0008/H Recessed Tundish at the end of this Section E.1

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E.1.13. FIXTURES, FAUCETS AND TAPS

E.1.13.1. General
All shall be first quality and of one manufacturer. Written warranties on workmanship and materials of at least 1 year required for each unit. All units shall be subject to inspection by the Superintendent. All shall be vandal-proof.

Flow rates for domestic and laboratory sinks and basins not to exceed 6 L/min for hot water and 6 L/min for cold water. (Cleaners' sinks excluded)

Flow rates for showers not to exceed 8 L/min for hot water and 8 L/min for cold water with the combined flow not exceeding 9 L/min. Shower roses shall be AAA rated.

E.1.13.2. Drinking Fountain
Free standing Zip or equal refrigerated drinking fountain.

E.1.13.3. Toilet Pans, Cisterns and Flush Valves
New multi-storey buildings shall be provided with either a gravity flusherette tank system using flush valves or ‘Water Wafer’ cisterns or equal approved, or bore water mains-supplied ‘Water Wafer’ cisterns.

Do not convert existing flusherette systems to cisterns without written approval from UNSW Facilities Management.

Where treated bore water is available, it shall be used for toilet flushing with manual drinking water standby supply. Stand-alone installations that do not have access to a flusherette system; provide cisterns, supplied with either treated bore water or drinking water.

WC suites shall be commercial grade with 5 year Warrantee.

Cisterns shall be Caroma ‘Invisi’ dual flush/single flush or equal, fitted to discharge pipe with 'Keeseal' type concealed flush pipe connection. Include internal overflow. Cistern installation shall be detailed to ensure stop tap will not interfere with servicing any component. Where a rear access duct is not available for maintenance, provide ‘Invisi II’ large access panel for in-wall installations.

Base to have 100mm outlet. Set onto floor with 2:1 cement mortar with maximum exposed bed thickness of 10mm. Pan connector shall be copper with rubber seal.

Seat shall be closed front type, suitable for top fixing.

Disabled suites: Caroma ‘Leda’ vitreous china 6 litre full flush washdown type with proprietary disabled person pushbutton option. Seat shall be single flap
with institutional hinge. Pans shall be specially manufactured and stamped for use by disabled persons and installed 800mm (min) distance from the front of the pan to finished wall surface and seat height to comply with the Code.

**E.1.13.4. Basins**

Install with front edge 825mm above finished floor. Vitreous china wall basin with heavy duty concealed bracket as supplied with basin and generally without overflow.

For general ablutions provide one only cold water Enware or approved equal Time Flow press button pillar tap factory set to 7 seconds.

For disabled persons' use in access toilets:

a) Use lever action with maximum mixed flow rate of 6L/min.

b) Install with front edge height above finished floor to comply with the Code. Basin to have CP brass plug and washer and supply with warm water using a thermostatic mixing valve.

c) Maximum temperature 43.5 deg C.

**E.1.13.5. Urinals**

Stainless Steel trough urinals are only permitted in buildings where treated bore water is available. Flushing devise for trough urinals shall be Pubco manually operated. Wall hung urinals are shall be low-flow flushing type, with manually operated flushing from bore water or treated bore water supply only.

Horizontal discharge pipework shall incorporate maximum fall (2% minimum). Oversize pipework where space permits (65mm minimum size for 2 urinals). 90 degree changes of direction shall be affected with 2 x 45 degree bends only.

Direct connection for flushing is not permitted. Flush valves must be feed from a flush tank or cistern approved by FM Engineering.

**E.1.13.6. Cleaner's Sink**

Shall be either white vitreous china similar to Fowler or stainless steel 304 similar to Clark with 600mm upstand.

**E.1.13.7. Showers**

Provide separate floor waste and recess taps to each shower recess. Shower rose shall be WELS 3-Star Rated (as specified in Fitting Flow Rates) finished in CP brass or as specified, set 1750mm above finished floor.
E.1.13.8. Sinks
Shall be stainless steel grade 304 with satin finish and fitted with stainless steel plugs and washers. Similar to Clark.

E.1.13.9. Hose Taps
Refer to Potable Water and Bore Water for detailed requirements
All hose taps shall be key-operated.
Hand keys over to the Superintendent before practical completion.

E.1.13.10. Laboratories
Refer also: Section F - SPECIFIC AREA REQUIREMENTS

E.1.13.11. Laboratory Codes
All designs shall comply with the requirements of:
AS/NSZ 2243 – Safety in Laboratories
AS/NZS 2982 – Laboratory Design and Construction
Office of the Gene Technology Regulator –
  Guidelines for Certification of PC2 Facilities
  Physical Containment 2 Requirements
Should there be a requirement for Physical Containment 3 or 4, then these shall be applicable.

E.1.13.12. Testing for Cross-Connections
All specifications shall include a requirement as follows:

Upon completion of any works of water supply within buildings housing laboratories, testing of the potable supply for illegal connections to laboratories via other water supplies or laboratory equipment shall be undertaken by the plumbing contractor performing the works. Any risk of contamination shall be immediately brought to the attention of the UNSW Project Manager. Where the contractor has an obligation to rectify the problem, rectification shall commence immediately the risk is apparent.

E.1.13.13. Main Service Isolating Valves
Each major laboratory and each Physical Containment (PC2 and above) laboratory must include main shut off valves for all services outside and adjacent to the entrance doorway in a Laboratory Service Valve Compartment. This includes laboratory hot and cold water, natural gas and other reticulated gases.
Refer to Diagram FME 0005/H Laboratory Service Valve Compartment at the end of this Section E.1.

At all laboratory sinks and other non-potable water outlets, including laboratory hot and cold water outlets, reverse osmosis and cooling water outlets, supply and fix permanent labels with the words ‘NOT FOR DRINKING’ with the appropriate pictogram.

E.1.13.15. Backflow Prevention
Potable water supply to a building containing wet laboratories shall be fitted with a Reduced Pressure Zone Device at the point of entry to the building. (Level 2)

E.14. GENERAL TEACHING LABORATORIES

E.1.14.1. Non-Potable Supplies
Generally laboratory buildings shall be provided with non-potable laboratory water from a Registered Break Tank service, preferably located on the building upper floors. Pump boosting may be required. (Level 3)

In addition to the break tank, to prevent backflow between laboratories and building levels, install a Tyco DC03 testable double check valve at the supply point to each laboratory. Filters are not shall be fitted at this installation.

Apply the identical procedure to Reverse Osmosis supplies. (Level 4)

E.1.14.2. Drinking (Potable) Supply
Supply potable water only to wash basins, safety showers and fixed eye wash units without mechanical backflow device protection. Ensure that there are no facilities provided whereby illegal connections can be made to the hand basin, and the safety shower / eye wash units are required to be tested weekly under the Laboratory Code. (Level 4)

Hand-held eye wash guns fitted to flexible hoses are to be fitted with Dual Check Valves by the manufacturer. This shall be checked by the Consultant at design stage. Hand held eyewash/body wash equipment shall only be provided to support self-contained equipment but shall not replace them (AS4775-2007).

Due to the potential for cross connection, a Tyco DC03 will also be provided at the service supply point outside the lab.

E.1.14.3. Safety Shower Drainage - General
Potential damage resulting from the use of all safety showers shall be considered in the design process. Should a safety shower be used in an
emergency, it will result in a discharge of at least 3,500L of water at a flow rate of 76L/min in the event that one person is affected. Where such a discharge will escape from the laboratory, measures shall be designed (as agreed with UNSW Facilities and the User) into the hydraulic works to prevent escape of this water from the laboratory. Such measures could include: Project-specific designed temporary bunding across the doorways along with provision of at least one floor waste; casting grated drains into the slab around the shower; Providing project-specific designed portable containment barrier in each laboratory within easy reach of the laboratory manager.

E.1.14.4. Physical Containment Laboratories (PC2)
PC2 laboratories are defined in the Laboratory Code AS/NSZ 2982.1 Appendix B as having a ‘moderate’ severity to human health. On this premise, the risk has been taken as ‘medium’ with respect to AS/NSZ 3500.1.2 Tables E1 and E2.

E.1.14.5. Non-Potable Supplies
As per General Teaching Laboratories with the following additional measures:

To prevent cross-contamination backflow between laboratories, install a testable Double Check Valve Assembly at the point of service entry and outside the Containment Area. Only one penetration into the PC2 space shall be made for each type of service.

Provide dual check valves under each sink on hot and cold lab water equal to ‘Watts Series 7 dual check valve’.

E.1.14.6. Drainage
Where the user advises that there is a risk to human or the environment by escape of contaminants via the sewer / trade waste system, all wastewater shall be either pre-treated prior to discharge to render it safe, or contained in sealed, covered and bunded drums for disposal as arranged by UNSW Risk Management Unit.

E.1.15. PHYSICAL CONTAINMENT LABORATORIES
All Physical Containment laboratories shall be designed in accordance with the Laboratory Code AS/NSZ 2982 and the Office of Gene Technology Regulator (OGTR) as applicable to the specific laboratory.

It is essential that a Statement of Basis of Design is provided on the hydraulic design drawing relevant to each type of laboratory. This statement shall include details of purpose and reason behind the requirement for actual physical containment.
PC3 & 4 laboratories are defined in the Laboratory Code AS/NSZ 2982.1 Appendix B as having a ‘serious and life threatening’ severity to human health. On this premise, the risk has been taken as ‘high’ with respect to AS/NSZ 3500.1.2 Tables E1 and E2. Such laboratories details shall be shown on separate drawings with title similar to: “PC3 Laboratory Details”

The Statement of Basis of Design shall include the actual reason the laboratory has been classified a PC 3 or PC4, including reference to specific documents of approval by the relevant Authorities receiving the waste, such as: Sydney Water Trade Waste, local Government Council; intractable waste receiving depot; etc. Where special waste treatment or waste management systems are included, these shall be detailed with all management details written as notes to provide building maintenance staff with sufficient detail to provide safe work conditions for such staff.

Each service shall be provided via a Registered Break Tank and pump set for each individual laboratory. Hot water shall be generated within the Containment Area where required. The Consultant shall contact UNSW Engineering Operations Manager to formulate satisfactory design.

Refer to Diagram FME 006/H Site Backflow Prevention Schematic at the end of this Section E.1.

**E.1.15.1. Hand Wash Basin**

Where laboratories require installation of a hand wash basin adjacent to the exit, this basin shall be supplied with potable warm water and hands-free operation. To achieve this, provide hot and cold water supplies to Aquablend 1500 TMV with an Enware Knee Operated Hands Fee Basin Kit over a compatible vitreous china basin. As an alternative to the knee operation, provide Enware (only) sensor operation where directed by Project Manager.

**E.1.15.2. Safety Shower / Eye / Face Wash**


Model 'EC240'. with stainless steel finish. Provide 25 - 32mm POTABLE cold water supply to suit available water supply capacity; with all isolation valves key-locked open (Key to UNSW requirements). Drain the eye / face wash only to the most convenient building waste drainage system to facilitate weekly testing.

Mandatory Requirement 'EC240' Waste drain shall be provided through a Hep-V waterless trap.
E.1.15.3. Eye Wash

Provide Enware eye wash unit Model 'EE180' with drainage. Provide 20mm (minimum) POTABLE cold water supply to suit unit requirements. Eye wash shall be drained to the most convenient building waste drainage system.

Mandatory Requirement 'EE180'

Should Client requirements dictate installation of an Eye / Face Wash, then Model 'EF360' shall be substituted. Hand held eyewash/body wash equipment shall only be provided to support self-contained equipment but shall not replace them (AS4775-2007)

Due to the potential for cross connection, a Tyco DC03 will also be provided at the service supply point outside the lab.

E.1.15.4. Eye Wash / Body Spray

In addition to the above eye wash and only where directed to do so by the Client, provide Enware bench mounted eye wash / body spray unit Model 'EL450' with chrome finish. Provide 20mm (minimum) POTABLE cold water supply to suit unit requirements. Unit shall be located adjacent to a basin where available. It should be noted that it may be difficult to comply with the exclusion zones for electrical fittings.

E.1.15.5. Laboratory Sink Tapware

Faucets and taps for all fixtures and appliances shall be Enware commercial laboratory tapware including Mini Stop service valves. Finish as specified in project documents. Allow for submitting indicator button and colouring code schedule for approval prior to procurement. Cold water tap indicator shall be marked “NPCW” and hot water marked “NPHW”

Mandatory Requirement 'Enware'

E.1.15.6. Laboratory Gases

Install gas cylinders with proprietary locking devices such as those supplied by Matheson

Secure small diameter gas lines with STAUFF pipe clamps

Provide flash-back arresters on all combustible gas outlets

E.1.15.7. Floor Wastes

Where new floor wastes are required these shall be installed in existing buildings and where potential for prohibited substances (chemical spills) is very low, floors shall be re-graded to drain to the wastes. All floorwaste drains are shall be charged with a fixture as per AS 3500. Unless this can be achieved, consideration should be given to deleting the floor wastes.

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Refer: HYDRAULIC SERVICES - Trade Waste

E.1.15.8. Laboratory Equipment Cooling Systems
Provide a flow and return cooling system to meet the cooling demands of the equipment likely shall be installed. Liaise closely with the user representative for the project to ensure they provide all hydraulic information necessary to design the system. Provide supply and return connections to all wet fume cupboards, furnaces, electron microscopes, and laboratory benches likely to require chemical reaction cooling or condensing of gases. Tundishes shall only be provided for return water where it is not pressurized and therefore will not flow through a tube connection to a return tap. The top of the tundish shall be raised above the bench to prevent it being used as a sink to deposit waste water and chemicals.

The system shall be pumped from a gravity collection tank at building basement level and the return upsized and vented to ensure gravity flow thus reducing return pressures to atmospheric. This allows for an infinite range of head loss characteristics across equipment and prevents backpressure in the equipment discharge reducing or stopping cooling water flow rates. The pump duty flow pipeline shall be sized for the maximum likely combined cooling flow rates and required equipment inlet pressures. Where equipment is sensitive to high inlet pressures, provide a pressure reducing valve in the equipment supply pipe. At each branch line feeding groups of like equipment, provide a balancing valve with binder points to allow final system balancing during commissioning. Such groups of equipment shall be limited to flow rates no greater than 0.5L/sec. to prevent starvation of cooling water supply.

Method of cooling is dependent upon temperatures required. For general cooling of glassware, furnaces and distilling apparatus cooling towers and immersion coils are satisfactory, producing cooling water of about 25 to 35 degrees depending on weather conditions. For cooling of sensitive equipment such as laser beam generators, electron microscopes, neutron magnetic resonance generators etc, mechanically cooled water from chillers is required to achieve the 18 degrees (max) temperature requirement. This is most reliably achieved by a dedicated chiller, co-located in the basement with the receiving tank and pump.

Refer to Diagram E.1.10 Laboratory Equipment Cooling System at the end of this Section E.1

E.1.16. LABORATORY CENTRALISED REVERSE OSMOSIS SYSTEMS
Where buildings are specifically designed to house wet laboratories, a centralised pure water system shall be designed and installed as follows:

Raw water supply: shall be obtained from the site borewater system if the building is located on the Kensington Campus. Where available treated bore water shall be
used, otherwise use raw bore water. Provide backflow prevention as required, borewater sub-meter, sand/carbon filtration, UV disinfection and cartridge micro-filtration prior to the RO process.

**Water efficiency:** Overall water efficiency of the treatment process shall be at least 80%, obtained by the use of a series of reverse osmosis (RO) processes to concentrate the reject impurities.

**Plant production rate:** RO plant shall be sized to produce one day’s Average Day Demand supply of pure water in 8 hours. Average Day Demand shall be determined from the users. Where this is not possible, assess requirements based on like installations within UNSW and with the assistance of the users.

**Product Specifications:** RO water product shall be a Type 2 (analytical grade) to ISO3696 (Water for Analytical Laboratory Use), requiring de-ionising using ion exchange prior to product storage.

**Point of Use Treatment:** Where Type 1 (Ultrapure grade) is required for specific users, this shall be provided as a “point of use” treatment. These units shall be strictly limited in numbers due to the cost of maintaining such equipment. It is suggested that one unit per building level would be sufficient, with all operation and maintenance requirements provided by the user to ensure quality water to the users’ satisfaction.

**Product storage:** Pure water produced by the RO plant shall be stored in a single translucent polypropylene tank with capacity for a minimum of 8 hours’ use.

**Circulation:** To maintain quality product, the main distribution system shall be a “flow and return” system with UV disinfection controlled by the duty and standby circulation pumps. Pumps shall be sized to circulate total storage every 4 hours. Duty and standby functions shall alternate each 24 hours.

**Branch lines:** Off-takes from the ring (flow & return) main shall be made at one only point for each laboratory, with a supply emergency isolation valve located within the laboratory service valve compartment.

*Refer to Diagram FME 0009 H Laboratory RO System Arrangement at the end of this Section E.1.*

**E.1.17. BUILDING AUTOMATION & CONTROL SYSTEM AND ALARMS (BACS)**

All equipment fault and level alarms shall be relayed back to security. This would normally be done via the Cardex system.

The Hydraulics Services Contractor shall allow for the following BACS associated items where applicable:

1. Fire Hydrant pump – run and fault alarms;

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2. Fire sprinkler pump – run and fault alarms;
3. Sump pump – run and fault alarms;
4. Water meter analogue output with graphed flow rate in litres per second, recording daily usage in kilolitres, and collection of historical data;
5. Water pump – run and fault alarms;
6. Bore water meter analogue output with graphed flow rate in litres per second, recording daily usage in kilolitres, and collection of historical data;
7. Bore water pump – run and fault alarms;
8. Fire services tank – high and low water level alarms;
9. Natural gas meter analogue output with graphed flow rate in litres per second, recording daily usage in kilolitres, and collection of historical data;
10. Natural gas system 3 valve closed status;

E.1.18. STUDENT HOUSING SPECIAL REQUIREMENTS

E.1.18.1. Bore Water Use
Bore water shall be used for all irrigation, toilet flushing and external hose taps. All bore water shall be metered with separate sub-meters for internal building use and irrigation. Water meter sizes shall be as follows to limit peak demand flow rates.

Building uses: 20mm connected to campus wide BMS
Irrigation: 32mm connected to campus wide BMS

E.1.18.2. Toilet Flushing
Flushing shall be by either dual flush cisterns or dual flush flush-valves similar to Pubco. Cisterns shall be fed from roof-mounted flush tanks or direct from borewater main. Flush valves shall be fed only from roof-mounted flush tanks. Flush tanks shall hold at least 50% of Average Day Demand for toilet flushing, with filling rate of 0.5L/sec (max).

E.1.18.3. Hand Basins and Showers
Provide all domestic ablutions with hand basins supplied with warm and cold water regulated by tapware with WELS rating of 5. Minimum requirement for hot water temperature control shall be Enware Aquablend 1500. Under no circumstances will tempering valves be permitted. Maximum run for warm water pipelines shall be 10m to prevent excessive water loss. Showers shall be WELS rating of 3 (10L/min).

Design and Construction Requirements Rev - 5.4 (Dec 2012)
E.1.18.4. Soil Waste

Cleaning eyes (inspection openings) for pipeline maintenance and inspection shall be provided at every section of pipe for all gravity pipelines.

Locate inspection openings every 30m, at the base of every vertical dropper, (including downpipe droppers) and at each fixture outlet and at each junction and change in direction.

Provide clear-outs to permit internal cleaning and clearing of blockages to the whole of the reticulation system. Extend risers up to the finished floor or surface, terminating under a heavy-duty inspection box. Inspection boxes shall be screw fixed, brass where located internally and cast iron externally.

For specific requirements refer Appendix A Section C, Sanitary Plumbing and Drainage Systems of the Plumbing Code of Australia.

Direct rodding access shall be provided to one or more water closet pans by providing a 100 mm chrome plated inspection shaft brought up to floor level directly next to the WC pan.

E.1.19. FIRE HYDRANTS AND HOSE REELS

E.1.19.1. Basis of Design
Indicate on drawings basis of design of system, including: Design Code, flow rates, head loss in pipelines, residual pressure of mains at design flows, pump duties if applicable, height of highest hydrant above ground, available flow rates in main

E.1.19.2. Pipework
Pipework shall be galvanised mild steel (Heavy wall thickness of > 5.39mm for 100mm dia. pipe) where above ground inside and outside buildings In-ground pipework shall be either ductile iron or Type B copper. Flanges shall be a minimum Table E pressure rated for pipework over 80mm diameter.

All pipelines shall be capable of withstanding working pressures of up to:

- 1700kPa for non-boosted pipelines
- 2200kPa for boosted pipelines

External dedicated fire mains pipework shall be kept as short as possible and preferably no longer than 50m to ensure fire mains are not used for domestic purposes or cross-connected to the campus combined fire / domestic town system.
E.1.19.3. Existing Hosereels
Where hosereels are shall be retained by UNSW, the Contractor shall be responsible for their removal and return to the UNSW store in undamaged condition. Where hosereels are shall be reused, the Contractor shall maintain their condition as at the time of contract. The Contractor shall repair or replace hosereels damaged during his contract.

E.1.19.4. Hosereel Isolation Valve
For the purposes of supplying hosereels, the UNSW Kensington Campus water supply is a fully metered supply (Building meters shall be disregarded for the purposes of hosereels isolation). Therefore hosereel supplies may be taken off the hydrant service. Isolation valves must be ball valves, clearly marked in accordance with the Standards and UNSW requirements. They must be located in a prominent and readily accessible position.

In other locations, hosereel supplies shall be supplied by a separate service within the building fed from the discharge side of the water meter immediately after the meter and before the domestic supply stop valve. Provide locked ball isolating valve on hosereel supply.

E.1.19.5. Hosereels
Provide all hosereels with 36m hoses. Provide instruction panel, setting out operation instructions, fixed permanently to front of each fire hosereel.

E.1.19.6. Fire Hosereel Pump
Provide pressure system discharging 1.26L/sec with residual pressure at the hosereel of 250kPa, construction similar to Prime Pumps 'FHR4/60' centrifugal pump with close coupled TEFC, non-overloading, 415v, 2,900 rpm electric motor. Include suction and discharge pressure gauges. Provide pressure tank similar to Davey 'Supercell 8' with 8L nominal capacity, butyl liner, modified non-return valve for slow filling and air valve. Provide complete unit on GMS base.

E.1.19.7. Hydrant Systems Design
Systems shall be complete with connection to water main; booster valve and booster pump installation.

All external fire hydrants provided to new buildings fitted with a Fire Brigade Booster Valve shall comply with AS 2419 requirement of 700kPa running pressure and shall be boosted from the building fixed fire pump.

Fire hydrant protection to buildings adjacent to new developments shall be maintained in some form. Either existing hydrants will be retained or replaced in a location to suit the building being protected, or boosted.
hydrants in the new development shall be extended to an external hydrant to suit the adjacent remaining building.

**E.1.19.8. Hydrants**

External hydrants: (Pillar Hydrants) Double brass 63mm landing valves on 100mm GMS. Pipe and fittings shall have internal and external galvanizing coating of minimum of 300 g/m². Above ground hydrant piping shall be constructed of Steel pipe in accordance with AS 1074 and shall be—

(a) medium pipe in sizes up to and including DN 80;

(b) medium pipe in sizes above DN 80;

Note: Heavy wall thickness of > 5.3mm for 100mm dia. Pipe or copper standpipe and brass cap. GMS shall not be buried. Turn down landing valve at 30°. Provide isolating valve on branch line to permit landing valve servicing. Wrap pipe with Denso tape to isolate from concrete and install concrete anchor block at tee and bend and provide 100 thick x 450 square concrete pad around standpipe. Top surface shall be level with finished ground level.

Internal hydrants: Right angled type single brass 63mm landing valve with integral Storz coupling and cap. Provide a hydrant at roof level in an accessible and convenient location for periodic flow testing of the hydrant system (Up to 20L/sec flow rates).

**E.1.19.9. Hydrant Booster Valve**

Arrange hydrant booster valve shall be in parallel and not in series with the fixed hydrant booster pump to prevent boost pressures being experienced by the pump and associated flexible connections. This will also prevent the pump being destroyed during boosting.

GMS pipework shall not be used prior to the supply hydrant standpipe. Each booster shall have Tyco double check valve fitted before the feed hydrant standpipe and a single swing check valve and gate valve between the feed hydrant standpipe and booster inlets. Fabricate the assembly in GMS pipework with flanged or Victaulic joints. Provide 100mm glycerine-filled pressure gauge, drain tap, Storz couplings and caps. Drain tap shall be capped ball valve to prevent accidental depressurization.

Provide and mount a block plan separately to the booster to the exact details of the UNSW standard Hydrant Block Plan. Refer to Facilities Management Signage Officer for advice.

*Refer to Diagram FME 0037 H Fire Hydrant Booster Requirements at the end of this Section E.1*
E.1.19.10. Hydrant Pumps

In all new buildings, locate the hydrant pump so that it is arranged in parallel with, and not pressurized by, the hydrant booster valve. Refer to AS 2419 Fig. 7.5.

The manufacturer shall confirm in writing the pumpset serial number, that the tests have been conducted and that each pumpset is in accordance with this Standard.

NOTE: Confirmation in writing means that test results and other information required by the Standard are recorded on a certificate.

The manufacturer shall supply a pump characteristic curve calculated from the data obtained during the test.

The manufacturer shall also supply a schedule of all readings taken during the test including those readings taken on the compression-ignition engine.

NOTE: See Appendix H of AS 2941 for examples of typical performance test data sheets (sheet extract attached). All performance tests shall be conducted on a test rig complying with the requirements of AS 2417 Grade 2 tests of test rig instrumentation shall be regularly calibrated by an accredited laboratory.

NOTE: To assure the quality of all pump and driver assemblies, manufacture should be carried out in compliance with the requirements of a recognized Australian quality assurance program

Refer to Diagram FME 0037 H. Fire Hydrant Booster Requirements at the end of this Section E.1

Provide complete unit on GMS frame inertia block, including main pump, jacking pump, pressure vessel, diesel motor, fuel tank, controls, circulation pipework and valves, and all other required appurtenances. Isolate pump suction and discharge from fixed pipework with high-pressure flexible connectors. Fixed hydrant pump shall be arranged in parallel with the fire brigade boosted supply. Where tall the pump has to be arranged in series with the fire hydrant booster valve in existing buildings, connectors shall sustain a test pressure of 2,200kPa.

Main Pump: 20.0L/sec @ 27m (typical duty - shall be assessed for each project) delivered head at the most disadvantaged hydrant. Similar in construction to Prime Pumps ‘F-80x65-16-PW2’ with diesel drive selected to suit location.

Fire hydrant ‘run’ signal shall be connected to the Fire Monitoring System to ensure the hydrant pump is turned off in the event of a false actuation.
E.1.20. FIRE SPRINKLERS
Systems shall comply with AS 2118-1999, components shall comply with AS 4118 and pumpsets to AS 2941. They shall be complete with booster pump installation where required, connection to water main and fire brigade booster valve. Make allowance for draining test water to stormwater system. Jacking Pump shall be Electric automatic. Provide block plan in accordance with AS 2419 and UNSW Standard.

E.1.20.1. Basis of Design
Indicate on drawings basis of design of system, including: Design Code, flow rates, head loss in pipelines, residual pressure of mains at design flows, pump duties if applicable, height of highest sprinkler above ground, available flow rates in water supply main.

E.1.20.2. Water Main Connection
Water supply shall be from the site combined fire / domestic water mains located adjacent to the building. Refer to E.1.5.5 Water mains part of this document.

E.1.20.3. Mandatory Roof Sprinkler Tanks for Building over 25 m in “Effective Height”
UNSW has a mandatory requirement for a dual (redundant) water supply for all high-rise buildings on the Kensington Campus in accordance with BCA Specification E1.5. The typical configuration will incorporate a roof top tank with infill, to supply water by gravity to the sprinkler system with full bypass around to fire pumps and a low level mains feed supply to the building from the campus site fire main reticulation. UNSW require separate hydrant and sprinkler service reticulations for all Sprinkler Hazard Categories. Note: AS 2118.6 Combined Hydrant and Sprinkler System are no longer permitted to be installed on the campus due to the lack of redundancy presented by these systems.

E.1.20.4. Sprinkler Booster Valve
Modified proprietary type similar to Northguard and fitted with pressure gauge, drain tap, Storz couplings and caps. Drain tap shall be capped ball valve to prevent accidental depressurization. Provide TYCO DC 03 Double Check Valves instead of the single check valve usually provided. Refer to Drawing: FME 0037 H – Hydrant Booster.

E.1.20.5. Sprinkler Hazard Classifications
Generally hazard classifications shall be specified in accordance with AS2118.1, however, for all new sprinkler system installations and
refurbishments, the minimum level of protection for University buildings shall be specified as Ordinary Hazard Group 1, as defined in AS2118.1-1999.

The following specific areas within University buildings shall have the minimum hazard classifications of:

- Ordinary Hazard Group 1 – enclosed offices, physical laboratories, lecture rooms, and lecture theatrettes
- Ordinary Hazard Group 2 – open plan offices, chemical laboratories, lecture theatres
- Ordinary Hazard Group 3 – libraries and museums

Where the quantity of combustible storage is excessive in terms of volume and height and the combustibility of those fuels is high and where the rate of heat release of fuels is high such as bulk storage of flammable and combustible liquids additional precautions shall be taken in compliance with the requirements of AS 1940. However, some flammable and combustible liquids have other physical and chemical properties that may require additional precautions and specialist advice should be sought for the fire protection in those cases.

**E.1.21. STORMWATER DRAINAGE**

**E.1.21.1. Council Conditions of Development Approval**

**Kensington Campus**

Kensington Campus has a campus wide Stormwater Strategy agreement with Randwick City Council which details engineering design methodology. Stormwater shall be designed to parameters shown on the Stormwater Catchment Management Plan and Stormwater Diversion Structures Plan available from the University’s Facilities Management Information Services group. These drawings identify overland flow paths, drainage structures forming boundaries of overland paths, detention basins, method of calculating detention volumes and run-off from sub-catchment areas etc. Overland flow paths shall not be disrupted or violated by construction or removal of kerbs, or removal of kerb inlet pits. Where diversion occurs due to development, full hydraulic computer modelling using the DRAINS model shall be carried out and submitted to Randwick Council for their approval. Existing detention basins and percolation chambers shall be retained. Where alterations due to development are proposed, identical footprint areas for percolation, identical volumes for detention and weir crest levels shall be maintained. Piped drainage capacities shall not be increased in areas draining
to catchments outside the Village Green Detention Basin due to potential flooding in Anzac Parade and surrounding streets.

The Village Green Detention Basin has been designed to accept flows from its existing catchment area. There is no additional detention storage available to accept additional catchment. Randwick Council will not permit stormwater shall be diverted from other catchments to the Village Green Detention Basin.

Dedicated rainwater tanks shall not be installed. It should be noted that borewater is extracted from the Botany Sands Aquifer which is recharged with campus stormwater run-off via the aquifer recharge percolation chamber at the Village Green. This forms the major part of the University’s water management strategy.

The Development Application should show that the proposed development drainage satisfies the requirements as set down in the Stormwater Strategy which is part of the Campus 2020 Master Plan, the basis of all project DA assessments by Council.

Refer to Appendix 6 - UNSW Kensington Campus Stormwater Strategy

Refer to Diagrams FME 0012 Stormwater Catchment Management Plan and FME 0013 Stormwater Diversion Structures Plan at the end of this Section E.1

Randwick Campus

Randwick Campus has building-specific detention Any alterations to building works or stormwater drainage will require special treatment, as Randwick Council have placed the highest of constraints on stormwater detention and discharge rates for this site.

Detention basins are identified on the UNSW Randwick Stormwater Master Plan drawing.

E.1.21.2. Basis of Design

Show Basis of Design on the drawings, including: Design storm, design flow rates and pipe capacities, storm intensity, time of concentration and calculations of volumes for detention basins and percolation pits. Such basins and pits shall be formally designed and documented with the project.

E.1.21.3. Pipework

In-ground - Reinforced concrete (RC), fibre reinforced cement (FRC) or polyvinyl chloride (PVC). RC and FRC shall be spigot and socket jointed. PVC shall be solvent welded.

Where appropriate, siphonic drainage systems may be used.

Minimum pipe size for downpipe drainage 100mm.
Where buried PVC pipework is greater than 2.5m below finished surface, side support and overlay shall be inspected and approved by the Superintendent before backfilling.

**E.1.21.4. Downpipes**

Buildings up to 2 storeys: 1.2mm thick copper for internal. Zincalume or PVC for external.

Buildings over 2 storeys: cast iron or uPVC to AS/NZS 1260 – DWV Pipes SN8 (150 up) and SN10 (100 only) concrete encasement of downpipes is discouraged.

Terminate cast iron pipes with watertight socket or mechanical joint at roof gutter spigots. Provide inspection openings (screwed access gate where possible) at the bottom of all downpipes and enter in-ground pipe with 2 x 45 deg. bends or long radius bends.

**E.1.21.5. Roof Drainage**

Sumps: Proprietary nickel-bronze hinged grate and sump similar to Gatic TJ12. Capacity: Allow hydraulic capacity in gutters, rain heads and downpipes for hydrant flow testing up to 20L/sec where building is equipped with internal fire hydrants.

**E.1.21.6. Kerb Outlets**

Where possible, direct all roofwater and stormwater flows to the underground piped system.

Where necessary, provide preformed aluminium or galvanised mild steel kerb outlets. Encase steel sections in 50 thick (min) 3:1 sand / cement mortar.

**E.1.21.7. Pits**

Precast reinforced concrete with 150mm deep silt trap and knockouts for pipe entries. Internal sizes to match cover and surround dimensions, make good pipe connections with watertight 100mm (min) thick epoxy concrete collar. Adjust wall heights to final levels and make connection with cover surround watertight using epoxy concrete or grout.

**E.1.21.8. Pits – Redundant**

If inlet gully pits are redundant in the new landscape design, the following treatment of pits needs shall be carried out:

Pits on line without other pipes entering can be converted into inaccessible chambers by removing the top of the pits and constructing or installing a sealed prefabricated reinforced concrete slab. The chamber can then be buried.
Where more than one pipe enters the pit, or a severe change of direction occurs on a single entry pit, it needs shall be accessible and hence fitted with a removable Gatic cover.

Where it is unlikely that entry will be required due to pipeline configuration and sizes, the removable cover could be buried if in grassed area. However these instances would only be with consent of Engineering Services Hydraulics staff.

**E.1.21.9. Gratings**

Refer HYDRAULIC SERVICES - Pipe work and Materials

**E.1.21.10. Drainage Pumps**

Submersible pumps and close coupled submersible motors similar to Flygt, with stainless steel or epoxy coated cast iron casings and bronze impellers with in-built suction strainers and stainless steel shaft. Motors shall be 415v. Install with galvanized mild steel lifting chains to enable pump shall be lifted 1.5m clear of pit for maintenance. Non-return valves shall be spring loaded resilient seated (Not Duo Check or similar butterfly pattern).

Control panel shall be wall mounted, steel galvanized after fabrication, powder coated enamel finished orange colour. Provide key-lockable door master keyed to building requirements.

Mount the following equipment on the cabinet door:

Lights to indicate:

i) Power on

ii) Pump running

iii) Pump failure

iv) High level alarm

v) Pump duty selector

vi) Controls inside cabinet:

vii) Main power supply circuit breaker

viii) Circuit breaker for each pump

ix) on/off/auto switch for each pump

x) Audible alarm

xi) Alarm mute
Operation:

xii) Provide one duty and one standby pump with alternating start

xiii) Only one pump to operate at any one time.

xiv) Discharge flow rate > 3.0L/sec

xv) Standby pump to start if duty pump fails to discharge or maintain flow.

xvi) Automatic activation of alarms

xvii) Float switches shall be mercury type similar to 'Flygt'

E.1.22. TRADE WASTE

E.1.22.1. Basis of Design
Show on the drawings the basis of design of trade waste pre-treatment pits and chemicals known shall be discharged at the time of design. The purpose of pre-treatment shall be identified.

E.1.22.2. Pipework
In ground pipework shall be as for sanitary drainage, except that rubber rings shall be acid resistant when connecting to existing drainage.

All other pipework shall be polyethylene (Vulcathene or approved equal).

E.1.22.3. Silt Arrester
Install silt arrester to trap sand, silt and clays.

Supply and install 60L effective capacity 3 compartment PVC silt arrester with fixed baffle and weir and fitted PVC cover. Plumb with PVC Class DWV pipe and fittings. Drain sink directly to high level inlet without trap, but install trap in discharge.

Where mounted on floor, provide galvanised mild steel frame with castors to assist with removal of arrester for cleaning purposes.

E.1.22.4. Plaster Arrester
Install plaster arresters only where gypsum is shall be trapped. Do not use for sand, silt or clays.

Supply 40L Grade 304 stainless steel plaster arrester with removable SS baffles and bolted down SS cover equal to Clark Model 76652. Provide SS frame 50mm x 50mm on casters to assist with removal of arrester for cleaning purposes.
E.1.22.5. Basket Arrester
Provide a fine stainless steel basket arrester to the inlet of all trade waste pits serving laboratories to catch broken glassware, syringes and other foreign objects likely to enter the wastewater. The arrester shall be fitted into its own pit with top access for basket removal. Basket shall be manufactured as follows:

Supply and install on the inlet side of the pit, a stainless steel basket as manufactured by Mascot Engineering to catch all debris larger than 3mm diameter entering the pit via the inlet pipe. It is shall be easily removed from above the pit for cleaning without the screenings entering the pit accidentally. The weight of the empty basket is shall be no more than 5Kg. The unit is shall be complete with stainless steel cradle and basket with extended lifting handle. The cradle shall be fixed to the pit wall by 2 x 6mm stainless steel masonry anchors so that the lip of the basket is immediately under the inlet pipe. Extend handle up to within 20mm of underside of pit cover frame. Approx. size of basket: 460long x 200wide x 100deep front lip x 210deep back.

Refer to Diagrams FME 0014 H Trade Waste Basket Arrester at the end of this Section E.1

E.1.22.6. Silver Recovery Unit
As per user requirements and UNSW approval.

E.1.22.7. Grease Arrester
Provide 1000L minimum precast concrete arrester similar to C.I.&D. with heavy duty concrete lid with Gatic covers and frames. Coat all internal surfaces with acid and alkaline resistant epoxy. Brace internally during backfilling operations.

Provide ground vent and educt vent to Sydney Water Corporation requirements. Take care to extend the educt vent up to a height to release gases away from habitable areas and prevent offensive odours entering buildings.

E.1.22.8. pH Correction
Automatic using pH probes and chemical dosing. Maintain pH between 6.5 and 7.5.

E.1.22.9. Trade Waste Storage
Materials shall be compatible with stored liquid. Where reinforced concrete tanks are used, line or coat internal surfaces with acid and alkali resistant epoxy. Provide basket arrester before each trade waste pit.
E.1.23. NATURAL GAS

E.1.23.1. Basis of Design
On the drawing, provide details on which the design was based. Such information shall include: Gas demand calculation, pressure loss in pipework, pressure at building.

E.1.23.2. Authority Inspection
All natural gas installations shall be inspected and certified by the gas supply authority (e.g. Jemena) prior to being put into service.

E.1.23.3. Pipework
To suit test pressures of 500kPa.

Buried outside buildings: Nylon, polyethylene or copper. Denso or polyethylene sleeve copper pipes.

Buried inside buildings: Not permitted.

Above ground: Copper tube Types A and B to suit natural gas.

E.1.23.4. Laboratory Gas Outlets
Provide each bench top gas outlet with flash-back arresters.

E.1.23.5. Isolation
ROOMS
Where uncontrolled gas outlets such as Bunsen burners or kitchen appliances are installed, provide a press button emergency gas shut off system with key controlled start-up switch similar to Gas Guard by System Control Engineering Model GG1. The emergency press button shall be near to the main entrance and provided with appropriate signage.

Install the solenoid valve assembly as close as possible to the main manual shut-off valve prior to any take offs.

Provide main manual shut-off valve outside the room in a box common to the other services as described in Section - Laboratories

BUILDINGS
Manual Point of entry to each building: Provide wall-mounted manual shut-off valve at the point of entry to each building. The valve is shall be accessible and external to each building. A durable and permanent sign is shall be provided in a prominent position adjacent to the valve. The sign with black
lettering 25mm high on yellow background is to include the following wording: “GAS VALVE”.

Boilers: Emergency valves for all steam and hot water boilers shall be provided. Locate in an accessible position remote to the boiler and clearly identify by the appropriate sign.

Laboratories & kitchens: Provide “Gas Guard” or “Kromschroeder LSV” safety system with ball isolating valve at assembly inlet and outlet (as supplied by System Control Engineering). Provide black lettering on yellow sign with instructions for emergency shut-off and resetting.

Automatic

Where a building is provided with a fire detection or suppression system, and is supplied with gas, provide a “System 3” automatic gas shut-off valve assembly (as supplied by System Control Engineering Pty Ltd) with ball isolating valve at assembly inlet. System 3 shall activate upon fire sprinkler flow detection. (Note that water flow is shall be used rather than alarm activation to prevent false fire alarms shutting down the gas). Locate in an unobstructed location at the main person entry.

All valves shall be not greater than 1500mm above floor level. Where the valve is mounted inside a cabinet, the cabinet shall not be lockable.

Connect a signal from the System 3 to UNSW Security Cardax alarm system to ensure that resetting of the valve occurs promptly.

Provide the following black on yellow signs:

At building fire indicator panel sign to have the words “GAS SHUTS OFF (insert location such as kitchen or to building) ON FIRE TRIP OR POWER FAILURE - AUTOMATIC SHUT OFF VALVE LOCATED IN (ROOM LOCATION) - TO RESET, FOLLOW INSTRUCTIONS ABOVE SYSTEM 3 VALVE”.

Above System 3 valve, affix to the wall operating and resetting instructions for System 3.

On the door(s) leading to the System 3, sign to have the words “GAS VALVE INSIDE”.

Mandatory Requirement, ‘System 3’

**E.1.23.6. Markers**

Provide surface markers at each change of direction or pipeline end. Markers shall be directional arrows engraved on a brass plate, mounted on a concrete block or in concrete pavement and installed flush with the finished surface.
E.1.23.7. Testing
Test all works to AG601 Appendix E. Seal the gas system after removing all items of plant or equipment liable to damage at the test pressure. Remedy defects found and retest as required.

E.1.23.8. Control & Isolating Valves
Valves shall be quarter turn ball type (AGA approved). Valves up to 50mm shall be screwed; 65mm and larger shall be flanged.

Below ground valves shall be similar to 'Richards Spherical Ball Valves' and installed under a cast iron surface box.

E.1.23.9. Gas Regulators
Low and medium pressure regulators shall be diaphragm type similar to 'Jeavons' as supplied by Systems Control Engineering. On major supply systems, provide two full capacity regulator installations in parallel so that supply to the building will be maintained during servicing. No by-passes to the regulators are permitted. Where supply is to continuous flow water heaters or Bunsen burners, provide additional step down regulator to 1.75kPa.

Provide 'Binder' type test point on the inlet and outlet.

Mandatory Requirement, 'Binder'

E.1.23.10. Venting
Care should be taken to control gas vented from OPSO valves at regulators. Gas odours are a source of nuisance and if there is any indication that gas will be released in an inhabited area it should be vented via pipeline to above the roof line and away from air inlet vents and building openings.

E.1.23.11. Gas Meters
Provide pulse type gas meter to each building. Meter to provide pulse for connection to and be compatible with UNSW central monitoring system. Sub-meters shall be installed on all major gas consuming plant and equipment which is likely to use more than 20% of the total building Average Day Demand, and where inefficiencies and losses are potentially significant.

Diaphragm meters shall be used for all purposes across campuses due to their accuracy, minimal maintenance and turndown ratios up to 600:1. Size meters for the minimum probable demand rather than maximum possible to ensure small losses are identified. Where medium pressure supply (100kPa) is shall be metered, such meters shall be sized by the meter supplier, as special
meters area available for this purpose and the meter will be correctly sized for that pressure.

Meters shall be fitted with Remote Volume Pulser (RVP) and output wiring ready for connection to the site EMACS metering system.

Provide the assembly with upstream filter and regulator to stabilise inlet pressure and downstream regulator with discharge pressure to suit equipment connected.

Turbine meters shall not be used due to their small turndown ratio and Rotary meters shall not be used due to their on-going maintenance requirements. House meter within weatherproof enclosure where installed outside buildings.

As a guide, meter sizes and their ranges are:

Model 750 – up to 300Mj/hr (8m3/hr)
AL 425 – up to 1,000Mj/hr (25m3/hr)
AL 800 – up to 1,600Mj/hr (45m3/hr)
AL 1000 – up to 2,200Mj/hr (60m3/hr)
AL 1400 – up to 3,000Mj/hr (80m3/hr)
AL 2300 – up to 5,000Mj/hr (130m3/hr)
AL 5000 – up to 11,000Mj/hr (290m3/hr)

(The above capacities assume gas pressure is reduced to 10kPa prior to the meter and based on a pressure loss through the meter of 0.5kPa)

Refer also to Diagrams FME 0015 H Meter Sizing & Selection at the end of this Section E.1

E.1.23.12. Water Heaters

Continuous flow Rinnai hot water heaters shall be installed where there is a requirement for an external gas hot water unit. Where bulk hot water is required, an assessment shall be made on need for hot water storage. Binder-type test points shall be provided to allow safe testing of inlet and outlet temperatures and gas pressures. Provide labelling and insulation of pipework to conform to other parts of this document. For multiple system installations electronic controllers should be used to provide the “lead – lag & alternating start” principle.

For larger project, refer to Engineering Operations and discuss.
E.1.23.13. Tailpipes

Where located in ground, provide 450mm square x 450 deep tailpipe pit similar in construction to stormwater pits.

Where condensation or dust is likely to occur in pipework, particularly at the base of risers in buildings, provide a drain or cleaning point consisting of two ball valves with a short vertical length of pipe, equal in size to main pipe, between the valves. This allows the gas supply shall be isolated and the liquid drained by the lower drain valve.

E.1.24. MAIN SERVICES TUNNEL

E.1.24.1. General

The main services tunnel runs generally east-west from Valentine Annex to Science Rd. It is a restricted access space, which has specific requirements for placement and types of services and methods of installation. The following conditions must be met by any works or service connections to the tunnel.

E.1.24.2. Access

Special conditions apply for entry and work permits, which shall be determined from UNSW Engineering Operations Manager. Give notice when applying for access into Services Tunnel.

E.1.24.3. Pipe Locations

Refer to the cross sections for details of installation and cross-over locations. No pipes shall penetrate the tunnel roof. All wall penetrations shall be mechanically sealed with bolted weep flanges where below the water table. All other penetrations shall be watertight.

Where conduits are connected to the tunnel, they shall be graded away from the tunnel wall to a self-draining scour point to prevent entry of seepage via the conduits.

Refer to Diagram FME 0016 H Tunnel Cross Section at the end of this Section E.1

E.1.24.4. Additional Services

No additional services or extension of existing services shall be introduced without explicit permission of UNSW Engineering Operations Manager and an accompanying risk assessment.

Existing nitrogen pipeline dedicated to the Photovoltaic Laboratory shall not be interfered with for any reason. Other nitrogen and oxygen pipelines shall be continuous welded without any valves within the tunnel.
Natural gas joints shall be brazed wherever possible. Screwed joints shall be kept to a minimum. No regulators or venting shall be installed within the tunnel. No joints are shall be within 300mm of oxygen pipeline on vertical risers and no longitudinal natural gas services shall be located within 300mm of the oxygen pipeline.

E.1.24.5. Electrical Hazard Zones
All drainage sumps up to floor level are Class 1 Zone 2 (AS3000) rated, requiring explosion rated cabling and sump pump motors up to and including the local pump isolation switch.

Steel shielding is installed on tunnel roof and wall near grid H14. This must remain intact to protect electromagnet interference with adjacent electron microscope.

E.1.24.6. Structural Issues
Where services tunnel walls are sprayed concrete, pipelines or fittings are shall be fixed to those walls by bracing from the roof and the floor. Bracing shall not be fixed to the walls. All framing and bracing members are shall be kept clear of the wall and floor surfaces using synthetic spacers.

Where galvanised steel vertical supports are located within side drains, they shall be raised with 25mm high stainless steel spacers. All floor fixings shall be stainless steel.

E.1.24.7. Drainage
Additional drainage pumps installed in tunnel extensions shall be connected to the central drainage pump control cubicle in the Webster entrance for power supply, pump control and alarm monitoring. Pumps shall be identical to existing Nossiter submersible Model NP750T with 0.75kW and 415volt motor. Discharge shall be at least 50mm pressure pipe with non-return valve both at the pump and at the discharge pit located outside the tunnel to prevent drainage of stormwater back into the tunnel. Direct flow towards outlet of receiving pit.
E.1.25. SECTION E.1 SUPPORTING DIAGRAMS

FME 0001 H Checklist for consultant / designers
FME 0002 H Asset registration form
FME 0003 H Non-potable tank detail
FME 0004 H Thrust blocks
FME 0005 H Laboratory service valve compartment
FME 0006 H Site backflow
FME 0007 H Borewater tap
FME 0008 H Recessed tundish
FME 0009 H Laboratory equipment cooling
FME 0010 H Laboratory reverse osmosis system
FME 0012 H Stormwater management plan
FME 0013 H Stormwater diversion structures
FME 0014 H Basket arrester
FME 0015 H Gas meter sizing and selection
FME 0016 H Services tunnel cross section
FME 0017 H Buried valve
FME 0018 H Block plan
FME 0033 F Kensington fire truck access plan
FME 0037 H Fire brigade booster arrangement
FME 0038 H Valve Selection Table
This check list shall be completed by the actual designer to verify to UNSW that the specific and general requirements of the UNSW DESIGN & CONSTRUCTION REQUIREMENTS manual have been incorporated into the design and documentation.

<table>
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<th>Drawing Number</th>
<th>Diagram Description</th>
<th>Initials</th>
<th>Initials</th>
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<td>Checklist for consultant / designers</td>
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<td>Stormwater drainage</td>
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<td>E.1.22</td>
<td>Trade waste</td>
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<td>Natural gas</td>
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<td>E.1.24</td>
<td>Main services tunnel</td>
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Designer: ........................................Date: ...........................................

UNSW FM Engineering Rep: ...........................................

Prepared: R. Andrews  Date: 10/12/2012
<table>
<thead>
<tr>
<th>Asset Description</th>
<th>Asset Status</th>
<th>Handover Date</th>
<th>Building No</th>
<th>Room No</th>
<th>Asset Location</th>
<th>Make</th>
<th>Model</th>
<th>Power Board No</th>
<th>Remarks</th>
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</table>

Note: Assets to be registered include all fixtures, fittings and equipment likely to require servicing or likely to be required to operate for servicing other equipment where equipment is remote from that fitting.
NON-POTABLE WATER TANK DETAIL

PUMP BUDDY DIFFERENTIAL INLET FLOAT VALVE

ACCESS TO BOTH FLOAT VALVES

25MM (MIN) SERVO TANK FILLING VALVE FLOAT VALVE

HIGH WATER LEVEL ALARM 25MM BELOW OVERFLOW (CONNECT TO BMS)

WATER METER (CONNECTED TO EMACS BY UNSW)

LOW WATER LEVEL ALARM 150MM ABOVE TOP OF OUTLET (CONNECT TO BMS)

TOP WATER LEVEL

OVERFLOW

DRINKING WATER VALVE OPEN

OUTLET

BOREWATER METER (CONNECTED TO EMACS BY UNSW)

DRINKING WATER BACKUP SUPPLY

POLYETHYLENE NON-POTABLE WATER TANK SIZED AS SPECIFIED. FACTORY CAST IN PIPE CONNECTIONS FOR: INLETS, OVERFLOW, SCOUR, OUTLET & BMS CONNECTION

MULTIPLE VARIABLE SPEED DRIVE PUMP(S) & INTEGRAL CONTROLS AS REQUIRED & AS DESIGNED CONTROL PUMP BY DISCHARGE PRESSURE TRANSUCER WHEN INLET VALVE OPENS (SIMILAR FOR BOREWATER)

PROVIDE WAFFLE PAD OR SIMILAR MATTING BETWEEN TANK AND SUPPORT STRUCTURE
CAST CONCRETE AGAINST UNDISTURBED GROUND

WATER MAIN

UNDISTURBED SIDE OF TRENCH

FORM UP & EMBED FITTING IN GRADE 15 (MIN) CONCRETE

DO NOT EMBED JOINTS

WATER MAIN

SECTION

PLAN

<table>
<thead>
<tr>
<th>Pipe Dia</th>
<th>90 Bend</th>
<th>45 Bend</th>
<th>Tee &amp; Dead End</th>
</tr>
</thead>
<tbody>
<tr>
<td>100mm</td>
<td>650w x 600h</td>
<td>450w x 300h</td>
<td>600w x 450h</td>
</tr>
<tr>
<td>150mm</td>
<td>900w x 650h</td>
<td>700w x 600h</td>
<td>750w x 750h</td>
</tr>
<tr>
<td>200mm</td>
<td>1200w x 1200h</td>
<td>1200w x 600h</td>
<td>1000w x 950h</td>
</tr>
<tr>
<td>300mm</td>
<td>2100w x 1400h</td>
<td>1500w x 1100h</td>
<td>1700w x 1200h</td>
</tr>
</tbody>
</table>

DIMENSIONS SUITABLE FOR 95kPA (min) SOIL BEARING.
NOT SUITABLE FOR BENDS WITH CONVEX VERTICAL COMPONENT.

NOTE:
Thrust block details are a guide to sizes required when used on rubber ring type jointed pipes and cast against undisturbed side of trench. Trench depth shall be at least 600mm cover to top of pipe. Where thrust is absorbed by electrofusion welded joints in polyethylene pipe, thrust blocks may be smaller or eliminated depending on proximity of rubber ring joints in fittings or existing connecting pipelines.
SITE BACKFLOW DEVICE LOCATION SCHEMATIC

1 — Level of protection

2 — RPZD BUILDING CONTAINMENT

3 — RPZD ZONE PROTECTION TO PLANT ROOM EQUIPMENT

4 — Fixture air gap

5 — Dual Check at all sinks, equipment, ice machines, etc.

6 — OGTR registered LABORATORY PC2

For PC3 & 4 labs refer to Regulations

SITE BACKFLOW DEVICE

DRINKING WATER

PLANT ROOM

HIGH RISK

NON-DRINKING WATER

ADMIN SPACE

POTABLE WATER USE ONLY

Level 4

Level 3

Level 2

Level 1

SITE BOUNDARY

Sydney Water supply main

THE UNIVERSITY OF NEW SOUTH WALES

FACILITIES MANAGEMENT

Project Location

UNSW STANDARD

Drawing No:

FME 0006 / H

Revision

1
PLASTER BOARD WALL CLADDING

SECURE EACH SIDE TO WALL FRAMING

32Ø DISCHARGE PIPE

CLEAR PERSPEX WINDOW

FIXING LUG

PLAN

20-25Ø DRAIN PIPE CONNECTED TO TOP OF TUNDISH

CHAMFER DRAIN PIPE AT 45° WITH LONGER SIDE TOWARDS BACK OF TUNDISH TO STOP LEAKAGE AT AIR GAP

STAINLESS STEEL RECESSED IN-WALL TUNDISH

HEpVo WATERLESS TRAP UNDER FLOOR

SECTION

STAINLESS STEEL RECESSED IN-WALL TUNDISH SHALL BE MODEL TU-RE-2 AS SUPPLIED BY STAINLESS METAL CRAFT
(Phone: 3735 5666)
INLET PIPE INVERT JUST ABOVE RIM OF BASKET AND FRAME

BASKET ASSEMBLED IN FRAME & HELD AGAINST WALL FOR DEMONSTRATION PURPOSES. NOTE THAT INLET PIPE SHOULD ONLY JUST CLEAR TOP OF FRAME.
# Meter Selection

## Table 1: Factors Affecting Meter Selection

The following table details the factors affecting meter selection.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Diaphragm Meters</th>
<th>Rotary Meters</th>
<th>Turbine Meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Rangeability</td>
<td>At least 600:1 at +/- 1.5%</td>
<td>At least 20:1 to 90:1</td>
<td>50:1 extending with increase in density.</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Not required</td>
<td>Bi-annual or annual inspection of oil level. Refer to manufacturers recommendations.</td>
<td>Annual inspection (spin test) of turbine blades. Refer to manufacturers recommendations.</td>
</tr>
<tr>
<td>Continuity of Supply</td>
<td>Meter failure can interrupt gas supply.</td>
<td></td>
<td>Meter failure has virtually no effect but meter will not register.</td>
</tr>
<tr>
<td>Gas Borne Solids</td>
<td>Normally unaffected.</td>
<td>Meter failure will interrupt the gas supply. Filter required.</td>
<td>Blades may be damaged and freedom of rotation may be affected. Filter required.</td>
</tr>
<tr>
<td>Flow Variations</td>
<td>Generally unaffected</td>
<td>Owing to inertia of impellers sudden and large changes in flow can lead to momentary high or low downstream pressures.</td>
<td>Owing to inertia of turbine rapid cyclic flow changes will cause over-registration. Effect will depend on frequency and magnitude of flow changes.</td>
</tr>
<tr>
<td>Presence of Liquids</td>
<td>Corrosion possible. Freezing can stop meter and cause permanent damage. Materials of construction may be affected.</td>
<td>Corrosion possible. Oil may be displaced from gears. Freezing possible. Materials of construction may be affected.</td>
<td>Corrosion possible. Freezing possible. Lubricant dilution and rotor imbalance are possible. Materials of construction may be affected.</td>
</tr>
<tr>
<td>Gas Density</td>
<td>Unaffected in design range within Manufactures specifications.</td>
<td>Insignificant.</td>
<td>Minimum flow is lowered with increased density.</td>
</tr>
<tr>
<td>Pressure Variations</td>
<td>Excessive differential pressure variations will cause damage.</td>
<td>Rapid change of differential pressure may cause damage.</td>
<td>Rapid pressure changes may cause damage. Particular problems when meters are installed at high pressure.</td>
</tr>
<tr>
<td>Accommodating Future Demand</td>
<td>Increase in maximum flow needs larger meter or additional streams or higher pressures. Initial over-sizing may affect low flow measurement accuracy.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Pressure</td>
<td>Typically less than 10 kPa. Special version up to 700 kPa available.</td>
<td>Available up to ANSI 150 (20 Bar).</td>
<td>Available up to ANSI 600.</td>
</tr>
<tr>
<td>Pipe Work Requirements</td>
<td>Large physical volume for give rating. No special pipe work considerations. Bypass may be required.</td>
<td>No special pipe work considerations. Filter may required. Bypass may be required.</td>
<td>Straight pipe length at inlet of meter required upstream of the meter (or flow straighteners utilised). Flow restrictors may be installed to prevent turbine over-spending. Filter may be required. Bypass may be required.</td>
</tr>
</tbody>
</table>
PLACE SURROUND LEVEL TO PAVEMENT

ENGRAVE VALVE NUMBER
AS PER UNSW D&C
SECTION E.1.4.17

225Ø PVC SHROUD TO
PREVENT INGRESS OF
SOIL. REST ON CAST
IRON FOOT

PROVIDE COMRESSIBLE
COLD MIX BITUMEN SEAL
BETWEEN FOOT & VALVE
TO PREVENT LOAD
TRANSFER TO VALVE BODY

CLOCKWISE CLOSING
IDENTIFIED BY RED VALVE SPINDLE
TOP) RESILIENT-SEATED SLUICE VALVE
WITH FLANGED, SPIGOT OR SOCKET
ENDS TO SUIT INSTALLATION

PROVIDE EXTENSION SPINDLE
FIXED TO VALVE STEM AS
REQUIRED TO ACHIEVE
CLEARANCE RANGE SHOWN

TYCO CAST IRON VALVE BOX
IN ROUND NON-SLIP
RECYCLED POLYETHYLENE
SURROUND, COLOUR TO SUIT
SERVICE AS FOLLOWS:
POTABLE WATER - GREY
BOREWATER - LILAC
NATURAL GAS - YELLOW

COMPACT BEDDING &
SIDE SUPPORT TO 98%
TO PREVENT PIPE
FAILURE AT VALVE

NOTE:
CONFIRM DIRECTION
OF OPERATION
BEFORE ENGRAVING

NOTE:
FOR QUARTER TURN BALL
VALVES INCORPORATE THE
ADDITIONAL WORDING

BURIED VALVE DETAIL

BURIED QUARTER TURN
VALVE BOX DETAIL

BURIED GATE
VALVE BOX DETAIL

OPEN
CLOSE

1/4 TURN

S.V

ENGRAVING INSTRUCTION
MIN. LETTER HEIGHT = 10mm
UPPERCASE FONT = ARIAL
MIN. LINE WIDTH = 2mm
ARROWS 20 x 13mm

POLYETHYLENE SURROUND

POLYETHYLENE SURROUND

S.V

1/4 TURN

28/01/11
28/08/2012

UNSW STANDARD

WATER & GAS 1/4 TURN & GATE VALVES

BURRIED VALVES

ASSET MANAGEMENT