Umow Lai

St George Hospital – Emergency Department – Option 11

Design Development Report – Mechanical Services

NSW GOVERNMENT
HEALTH INFRASTRUCTURE
NSW HEALTH

Report No S.SGH-0101/R005
Date June 2012

engineering sustainable environments

REPORT AUTHORISATION

PROJECT: **ST GEORGE HOSPITAL – EMERGENCY DEPARTMENT – OPTION 11**
DESIGN DEVELOPMENT REPORT – MECHANICAL SERVICES

REPORT NO: **S.SGH-0101/R005**

Date	Rev	Comment	Prepared by	Checked by	Authorised by
08/06/12	1	Preliminary Issue	LLW		
20/06/12	2	Design Development Issue	LLW	MS	

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EXECUTIVE SUMMARY

Umow Lai are engaged in the design of the Mechanical Services and Medical Gases for the new Emergency Department of St George Hospital. This report outlines the Design Development works completed.

The report identifies the strategy for the mechanical services for the new building.

This report summarises the Design Development of the Mechanical Services for the St George, Emergency Department (ED) Option 11.

In summary the mechanical services work for the new Emergency Department building includes-

- Chilled water is to be interconnected to the existing Chilled water system.
- Heating hot water will be interconnected with the supply to the Ward block on the new platform created as part of the early works boiler package.
- Medical gases will be interlinked with the existing systems with the exception of the suction system where new plant will be established as the existing is not suitable for extension.
- Air handling system will generally be VAV systems with central air handling units, zoned typically on a department basis.
- Existing Pneumatic Tube (Lamson tube) distribution system will be extended and modified to serve the new building

The cost estimate for the Mechanical services for the Emergency Department building is currently $ 2,998,500.00 excluding GST. The cost of the Early works (Boiler package and Services Centre) is additional.

CONTENTS

1 INTRODUCTION

1.1 PURPOSE

The purpose of this report is to outline the design of the mechanical services and medical gases for the new ED of St George Hospital and to demonstrate that a thorough analysis of design and engineering services has occurred and to ensure that the intent of the Functional Brief and project objectives are being met.

1.2 GENERAL

The Building Engineering Services covered by this report includes:

- Mechanical ventilation systems;
- Air conditioning systems;
- Mechanical Services Switchboards and Building Management Controls Systems (BMCS);
- Pneumatic tube system; and
- Medical Gases.

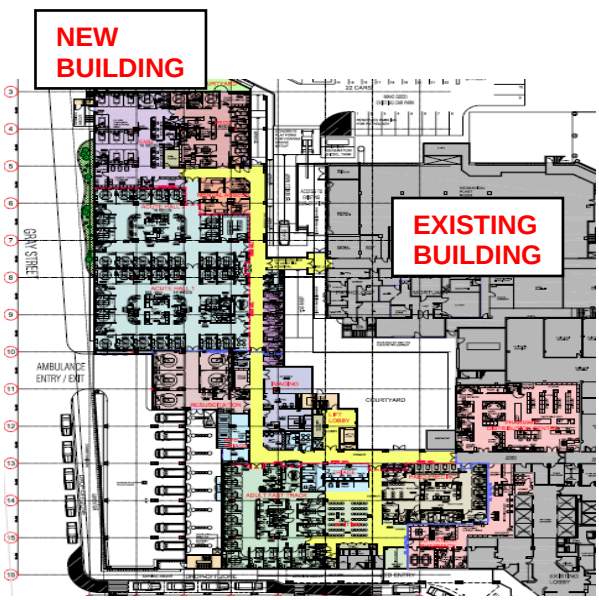
1.3 PROJECT DESCRIPTION

The project involves the construction of a new Emergency Department (ED) adjacent to the main hospital entrance.

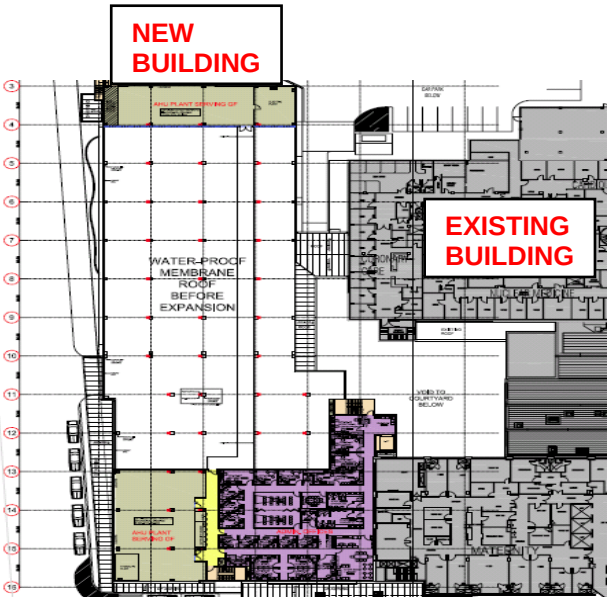
This project involves the demolition of the existing Engineering Building on Gray Street which necessitates the relocation of the existing Oxygen VIE, medical gas bottle store, the existing BCMS control panels as well as the decentralisation of the Steam boiler system. The new building also extends towards the existing fire station and requires the demolition of the waste holding area. The existing receiving areas, including cleaners, linen and pharmacy are being relocated to allow interconnection of the new ED with the existing main entry to the Hospital.

The decentralisation of the existing Steam systems is known as Early Works 1 and is currently in construction.

The Early works package, known as the Service Centre, which provides accommodation for the Medical gases, Engineering Department, Linen and Cleaners store is entering construction.



Ground Level Architectural Plan



Level 1 Architectural Plan

1.4 CLASSIFICATION/TYPE OF CONSTRUCTION

The general classification of the building is Class 9a occupancy for the ED and Class 5 for the associated office space in accordance with Part A3 Classification of Building and Structure of the BCA.

Rise in storeys: Proposed new building 2 Storey with the allowance of extending to a total of 8 storeys.

1.5 ARCHITECTURAL DRAWINGS

The thermal modelling in this report is based on the following Architectural drawings prepared by Health Projects International:

Table 1 *Reference Drawing Summary*

DWG No.	Issue	Title	Author	Date
SGHED-Ga	1	Ground Floor Plan – Zone A	Health Projects Int.	04.05.12
SGHED-Gb	1	Ground Floor Plan – Zone B	Health Projects Int.	04.05.12
SGHED-Gc	1	Ground Floor Plan – Zone C	Health Projects Int.	04.05.12
SGHED-A-P-1(11.6c)b	1	Master Plan – Level 1 Option 11.6c	Health Projects Int.	12.01.12
SGHED-A-P-1(11.6c)c	1	Master Plan – Level 1 Option 11.6c	Health Projects Int.	12.01.12
A-R-E-1	1	Elevations – West and South	Health Projects Int.	30.03.12
A-R-E-2	1	Elevations – East and North	Health Projects Int.	30.03.12

The Design Development drawings are based on the following

DWG No.	Issue	Title	Author	Date
Revit Model	NA	St George	Health Projects Int.	08.06.12

1.6 ROOM DATA SHEETS

This report and drawings are based on Interim DD Issue Room Data Sheets, revision1 dated 11 May 2012.

1.7 LEGISLATIVE DESIGN REQUIREMENTS

The Mechanical Services will be designed to comply with the latest requirements of the following authorities and codes:

- The Building Code of Australia 2011;
- Department of Planning NSW;
- New South Wales, Engineering Services and Sustainable Development Guidelines, Technical Series TS11, December 2007, Version 2.0;
- Health (Legionella) Regulations;
- Building (Legionella Risk Management) Regulations; and
- Occupational Health and Safety Regulations.

The following Australian Standards (where relevant and not necessarily limited to this list) will also be complied with:

- AS 1228 Pressure equipment – Boilers;
- AS/NZS 5601 Gas installations Set;
- AS 1324.1 Air filters for use in general ventilation and air-conditioning- Application, performance and construction;
- AS 1668.1 The use of ventilation and airconditioning in buildings - Fire and smoke control;
- AS 1668.2 The use of ventilation and airconditioning in buildings - Ventilation design for indoor air contaminant control;
- AS 1668.2 Supplement 1 - The use of ventilation and airconditioning in buildings - Ventilation design for indoor air contaminant control;
- AS 1668.3 The use of ventilation and airconditioning in buildings - Smoke control systems for large single compartments or smoke reservoirs;
- AS/NZS 1677.2 Refrigerating systems - Safety requirements for fixed applications;
- AS/NZS 2107 Acoustics - Recommended design sound levels and reverberation times for building interiors;
- AS 1807.1-26 Cleanrooms, workstations, safety cabinets and pharmaceutical isolators - Methods of test;
- AS 2243.3 Safety in laboratories - Microbiological safety and containment;
- AS 2243.6 Safety in laboratories – Plant and equipment aspects;
- AS 2243.8 Safety in laboratories - Fume cupboards;
- AS 2593 Boilers - Safety management and supervision systems;
- AS 2639 Laminar flow cytotoxic drug safety cabinets - Installation and use;
- AS2896-2011 Medical gas systems - Installation and testing of non-flammable medical gas pipeline systems ;

- AS/NZS 2982 Laboratory design and construction;
- AS/NZS 3000 Electrical Installations;
- AS/NZS 3666.1-3 Air-handling and water systems of buildings - Microbial control;
- AS 3892 Pressure equipment-Installation;
- AS 4254 Ductwork for air-handling systems in buildings;
- AS 4343 Pressure equipment - Hazard levels;
- AS 4260 High efficiency particulate air (HEPA) filters - Classification, construction and performance;
- AS 4426 Thermal insulation of pipework, ductwork and equipment-Selection, installation and finish.

1.8 LIMITATIONS OF THE REPORT

1.8.1 Limitations of the Investigation

The investigation required for the preparation of this report did not include:

- An exhaustive examination of all aspects of the existing installation, analysis of design calculations, specifications and as-installed records;
- Possible defects contained in inaccessible sections of the existing installation;
- Physical verification of plant and system capacities and operation;
- Assessment of presence of asbestos or other hazardous building materials; and
- Measurement of air and water flow rates and temperatures, electrical loadings, switchboard temperatures etc. unless otherwise noted herein.

As noted above, our review encompassed a perusal of existing documentation and we have relied on the information obtained from the listed documents. However, we accept no liability for the accuracy or otherwise of this information.

It should be noted that the current record of the installed services is not complete or up to date.

1.8.2 Opinion of Probable Costs

The opinion of Probable costs of the building services and associated works based on very preliminary design concepts and as such could vary within ± 15% of the actual tender price.

The opinion of Probable costs included in the report are based on labour and materials at today's rates but do not include the following:-

- Builder's Work in Conjunction With;
- Goods and Services Tax;
- Work at overtime rates;
- Escalation ;
- Project Management or Consulting Engineers Professional fees; and
- Contingency.

2 DESIGN PARAMETERS

2.1 DESIGN CONDITIONS

Indoor Design Conditions are to be as noted in clause 6.7.15 of the NSW Health TS11 guidelines:

Table 2 *Indoor design conditions*

Indoor Design Conditions		
Operating Rooms, ICU, ED		
Summer	23.0 ± 1°C db Adjustable	30-55% Note – no humidity control system is provided.
Winter	21.0 ± 1°C db	
All Other Areas		
Summer	24.0 ± 1°C db	60% maximum
Winter	20.0 ± 1°C db	

Outdoor design conditions are as per AIRAH ACS Design Air DA9A for Sydney

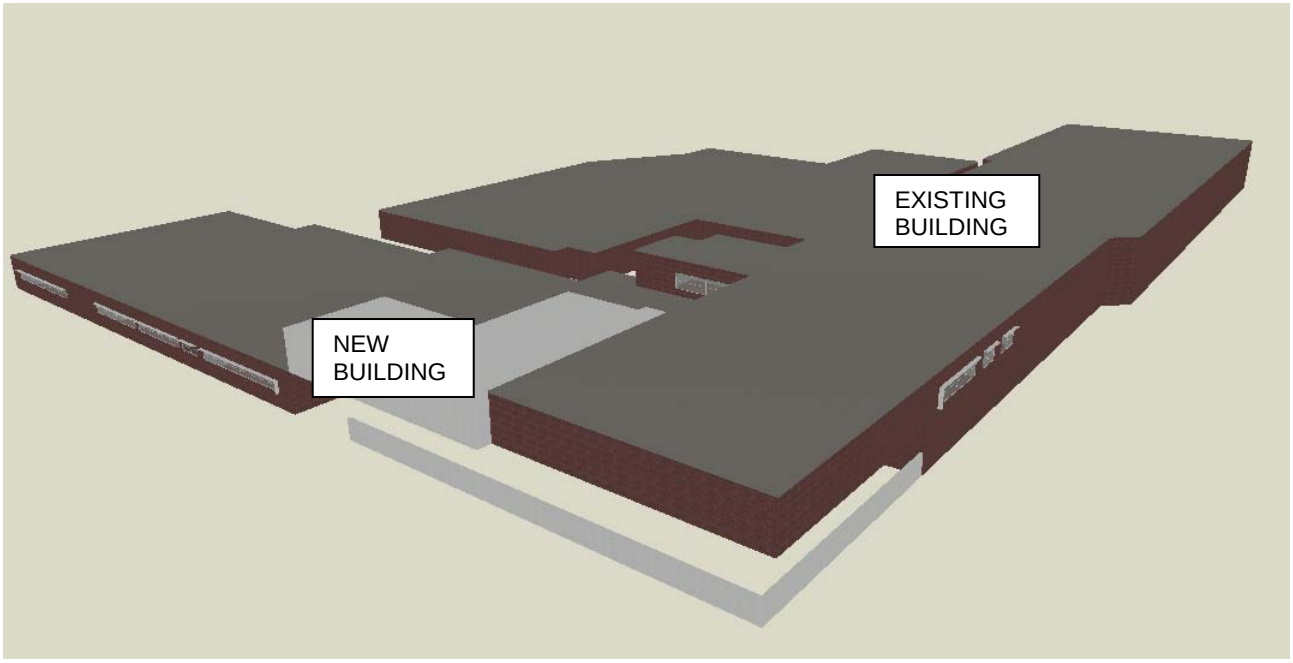
Table 3 *Outdoor design conditions*

Outdoor Design Conditions		
Summer	31.1°C db	19.8°C wb
Winter	7.2° C db	80% RH
Critical Care Areas		
Summer	33°C db	23.5°C wb
Winter	6.0° C db	80% RH

2.2 LOAD CALCULATION

2.2.1 Modelling Software

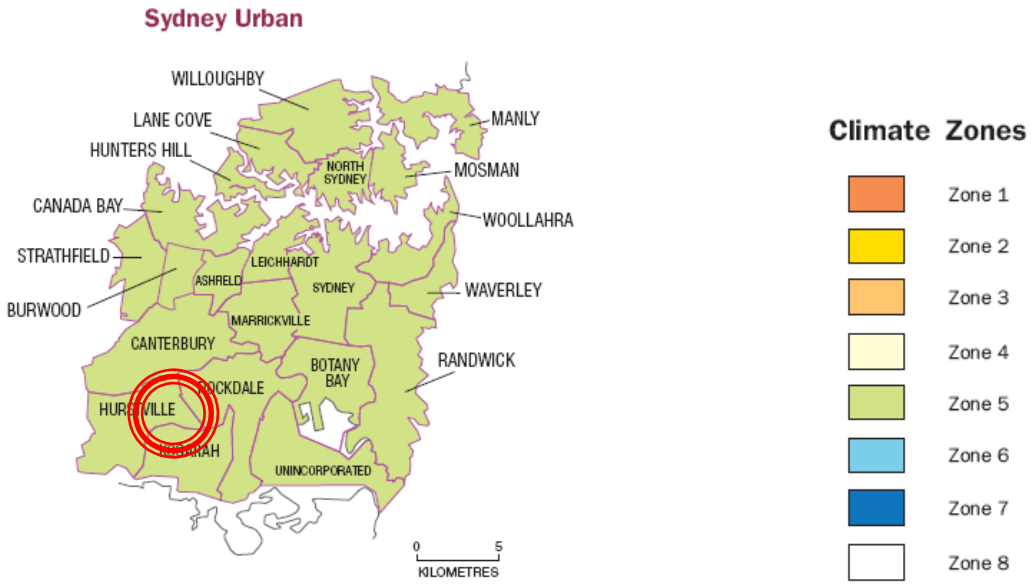
Design Builder software has been used to model the proposed new ED building at St George Hospital and hence determine the heat loads and size the air conditioning systems. Design Builder is a is a project delivery system used in the construction industry which is certified under E+ Test and ASHRAE Guidelines.



DESIGN BUILDER MODEL

2.2.2 Building Fabric

The thermal performance criteria of the proposed building is dictated by the requirements of the NCC Part J. These requirements are in turn based on the location of the building, which in this case is Climate Zone 5.



Based on this Climate Zone, the following table outlines the thermal performance criteria used in the building model, which are in line with the Deemed-to-Satisfy provisions.

Table 4 *Building Fabric Compliance*

BCA Section	*Building Fabric Type*	*DTS Building Fabric Total R-value*
Section J1.3	Roof and ceiling	3.2
Section J1.4	Roof lights	N/A
Section J1.5	External Walls	2.8
	Internal Walls*	1.8
Section J1.6	Suspended Floors	2.0

Glazing System

Single clear glazing has been used in the building model with the following specifications:

Description: Clear Single Glazing With Internal Blind
Total U-Value: 5.84 (W/m^2K)
SHGC: 0.84
Comments: Internal Blinds assumed not in use

3 SYSTEMS

3.1 AIR HANDLING UNITS

Item	Proposed Systems
Supply Air	For future proofing floor by floor plant is preferred, however, given the limited space requirement the plantroom for ground floor is being documented on Level 1. Two plant areas have been established due to the length of the building. The level 1 office area will be served by an Air Handling unit in the Level 1 south plant space with VAVs to provide zoning. The areas with high outside air requirements will be served by a second Air Handling unit. Miscellaneous ventilation fans will also be located on the roof. The air distribution system will be designed to maintain supply air velocities below 0.25 m/s in the occupied zone measured 1 to 1.5 metres above the floor.
Air Conditioning System Type – Entire Area	TS11 categorises the entire Emergency Department as a Category 1 Area (Clause 6.6.20). Filtration G4/F8 Economy cycle will be provided where practical – currently planned for all units on the Ground floor and the main unit in Level 1.
Air Conditioning System Type – Resuscitation *(general air handling plant configuration)*	Defined as a Critical Care Area. Proposal is for an air handling unit dedicated to this area. The isolation room will have a dedicated fan coil unit and interlocked exhaust system.
Air Conditioning System Type – Entry, Waiting, Triage *(general air handling plant configuration)*	TS11 stipulates that air shall not be recirculated from these areas. This area will be served by an Air Handling unit. The Entry, Waiting and Triage area will be fully exhausted, to comply with the TS11 requirement not to recirculate air from these areas. This unit will serve VAV boxes to provide zoning.
Air Conditioning System Type – Fast Track and Main track *(general air handling plant configuration)*	These areas will be served by central air handling units with zoning provided by VAV boxes. This unit will serve VAV boxes to provide zoning. Isolation rooms will have dedicated fan coil units and interlocked exhausts.
Air Conditioning System Type – Procedure *(general air handling plant configuration)*	These rooms will be served from the air handling unit serving the area. Supply air rate will be designed to 10AC/hr Localised exhaust will be provided at each bed.
Air Conditioning System Type – Imaging *(general air handling plant configuration)*	The Imaging area will have dedicated air handling plant sized for the specific equipment in each room
Air Conditioning System Type – EMU *(general air handling plant configuration)*	This area will be served by a dedicated air handling unit with VAV boxes for zone control

Item	Proposed Systems
Air Conditioning System Type – PECC *(general air handling plant configuration)*	This area will be served by a dedicated air handling unit with VAV boxes for zone control. Fittings in this area will be suitable for Psychiatric patients
Air Conditioning System Type – Office area ground *(general air handling plant configuration)*	This area will be served by a dedicated air handling unit with VAV boxes for zone control
Air Conditioning System Type – Pharmacy *(general air handling plant configuration)*	This area will be served by a dedicated air handling unit with VAV boxes for zone control
Air Conditioning System Type – Existing areas including entry lobby *(general air handling plant configuration)*	The existing ductwork and diffusers in this area will be reused. A new air handling unit will be provided on the linen block roof to serve this area, to allow the demolition of the existing ductwork which runs through the refurbished areas.
Smoke Management	The requirements for Smoke Management are understood to be as follows– ▪ A Shut down of air handling systems greater than 1,000 L/s where not used for zone smoke control and not serving critical treatment areas; and ▪ A provision for a future automatic air pressurisation system for fire isolated exits in accordance with AS/NZS 1668.1 for when the building is over 25m high. We note that the building is to be sprinkler protected as it is interconnected with the existing building.

Current Plant Listing is as follows, –

Plant No.	AHU-ED-G-1	AHU-ED-G-2	AHU-ED-G-3	AHU-ED-G-4	AHU-ED-G-5	AHU-ED-G-6
Location of Plant	Level 1 Plantroom-North	Level 1 Plantroom-North	Level 1 Plantroom-North	Level 1 Plantroom - North	Level 1 Plantroom-North	Level 1 Plantroom - North
Air Handling System Type	Air Handling Unit with VAV boxes	Air Handling Unit with VAV boxes	Air Handling Unit with VAV boxes	Air Handling Unit with VAV boxes	Air Handling Unit with VAV boxes	Air Handling Unit with VAV boxes
Cooling Source	CHW	CHW	CHW	CHW	CHW	CHW
Heating Source	HHW	HHW	HHW	HHW	HHW	HHW
Areas served	EMU	PECC	Adult Hall 2	Mental Assess	Adult Hall 1	Resuscitation
Guideline Category	1	1	1	1	1	1
Hours of Operation	24/7	24/7	24/7	24/7	24/7	24/7
Supply Air L/s	1870	1290	2850	1770	2850	2420
Floor Area m^2	312	225	433.5	309	450	212
Supply Air L/s/m^2	6	6.3	5.2	5.75	6.4	11.4
Economy cycle	Provided	Provided	Provided	Provided	Provided	Provided
Type of Smoke Control	Shut down	Shut down	Shut down	Shut down	Shut down	Shut down

Plant No.	AHU-ED-G-7	AHU-ED-G-8	AHU-ED-G-9	AHU-ED-G-10	AHU-ED-G-11
Location of Plant	Level 1 Plantroom	Level 1 Plantroom	Level 1 Plantroom	Level 1 Plantroom	Level 1 Plantroom
Air Handling System Type	Air Handling Unit with VAV boxes	Air Handling Unit with VAV boxes	Air Handling Unit with VAV boxes	Air Handling Unit with VAV boxes	Air Handling Unit with VAV boxes
Cooling Source	CHW	CHW	CHW	CHW	CHW
Heating Source	HHW	HHW	HHW	HHW	HHW
Areas served	Imaging	Ambulance Entry	Adult Fast Track	Triage	Paediatric
Guideline Category	1	1	1	1	1
Hours of Operation	24/7	24/7	24/7	24/7	24/7
Supply Air L/s	1260	620	2750	2420	1400
Floor Area m2	224	43.5	414	430	248.1
Supply Air L/s/m2	5.6	14.3	6.6	5.6	5.6
Economy cycle	Provided	Provided	Provided	Provided	Provided
Type of Smoke Control	Shut down	Shut down	Shut down	Shut down	Shut down

Plant No.	AHU-ED-G-13	AHU-ED-G-14	FCU-ED-F-1	FCU-ED-F-2
Location of Plant	Roof of existing	Roof of existing	Office area plant room	Office area plant room
Air Handling System Type	Air Handling Unit with VAV boxes	Air Handling Unit using existing distribution ductwork	Air Handling Unit with VAV boxes	Fan coil unit
Cooling Source	CHW	CHW	CHW	CHW
Heating Source	HHW	HHW	HHW	HHW
Areas served	Pharmacy	Existing areas	General office areas	Meeting rooms
Guideline Category	1	1	1	1
Hours of Operation	24/7	24/7	24/7	24/7
Supply Air L/s	1650	1230	3550	900
Floor Area m2	322.2	570	631.9	137.6
Supply Air L/s/m2	5.1	4	5.6	6.6
Economy cycle	Provided	Provided	Provided	No
Type of Smoke Control	Shut down	Shut down	Shut down	Shut down

Plant No.	FCU-ED-G-1	FCU-ED-G-2	FCU-ED-G-3	FCU-ED-G-4
Location of Plant	Ceiling space of Gnd Floor	Ceiling space of Gnd Floor	Ceiling space of Gnd Floor	Ceiling space of Gnd Floor
Air Handling System Type	Fan Coil unit	Fan Coil unit	Fan Coil unit	Fan Coil unit
Cooling Source	CHW	CHW	CHW	CHW
Heating Source	HHW	HHW	HHW	HHW
Areas served	Resus isolation	Trauma Isolation	Comms room 1	Comms room 2
Guideline Category	1	1	1	1
Hours of Operation	24/7	24/7	24/7	24/7
Supply Air L/s	330	300	TBA	TBA
Floor Area m2	26.9	24.2		
Supply Air L/s/m2	12.3	12.4		
Economy cycle	No	No	No	No
Type of Smoke Control	Shut down	Shut down	Shut down	Shut down

3.2 CENTRAL PLANT ITEMS

The following table outlines the mechanical services systems proposed for the new building.

Item	*Current Investigation / strategy*
Cooling Plant Configuration	The existing central chiller system is located at ground level of the CSB block. The existing chillers are water cooled and there are 4 chillers, 1 by 2300, 1 by 1200 and 2 by 1000kW. Based on measured chilled water supply in January there is approximately 650kW of spare capacity within the system. Due to the enclosure of the courtyard, emergency take off valves are being provided at the Peri-operative plantroom for use during a chiller failure. Estimated Cooling Load for the ED is 360kW Estimated Cooling Load for the vertical expansion of up to 8 Levels allowance is 2400 kW (This has been provided in the Chilled water pipe sizing only).
Heating Hot Water Plant.	There is currently no central heating hot water system. As part of the Steam boiler works, new Heating Hot water generators are to be on a roof platform adjacent to the chillers on the roof of the Linen block. It is proposed that the new heating hot water plant for the ED is co-located with this plant to allow for redundancy/backup in these areas. Due to the enclosure of the courtyard, emergency take off valves are being provided at the Peri-operative plantroom for use during a heating hot water generator failure. Estimate Heating Load for the ED is 250 kW Estimated Heating Load for the vertical expansion of up to 8 Levels allowance is 1600 kW (This has been provided in the Heating Hot water pipe sizing only).
Building Management Controls Systems (BMCS)	The existing Hospital Campus is served by two control systems, one by Environmental Automation (EA) and one by Siemens. Both are proprietary in nature. The current philosophy has been to extend the EA system. For this project it is proposed to tender for a BACnet compliant open control system that can be accessed over the Hospital IT infrastructure (This is acceptable to the network supervisors). With optional prices to connect to the existing Siemens and EA systems. This will occur as part of the early works – service centre package. Note that panels and front ends for both existing systems will be relocated as part of the early works. The Building Management Control System (BMCS) will monitor and control the mechanical services and medical gases. The BMCS will provide time control functions for general lighting. The BMCS will monitor and provide trend logging for all energy usage to Air conditioning, lifts and house lighting and power. The system will provide on/off fault monitoring of hydraulic pumps and lifts. A high/low level interface for critical fire and security alarms will be provided (up to 30 points provided). The BMCS will provide after hours Air conditioning control by key switches where appropriate.

Item	*Current Investigation / strategy*
Pneumatic tube system	The existing system is a 110mm tube system from Lamson systems. The system will be extended to connect the new ED with the existing pathology services.

3.3 VENTILATION SYSTEMS

Item	*Current Investigation / strategy*
Ventilation	All natural and mechanical ventilation systems required by the relevant authorities will be provided. The systems to be provided may include those listed below, however the list of systems is not necessarily limited to these areas: ▪ Toilet amenities ▪ Dirty Utilities ▪ Isolation rooms ▪ Cleaners Store ▪ Photocopy Room Exhaust ▪ Plant rooms ▪ Substations ▪ Switchroom
Ambulance Bay	The design of this system will comply with the AS1668.2 requirements for small carparks with an allowance of 500L/s per vehicle
Tunnel Ventilation	The existing services tunnel beneath the ED building, has an exhaust system which rises through the boiler house area. This system will be modified to suit the new building configuration. Dual exhaust fans will be provided as per the existing system.

Currently sized ventilation systems

Description	Area Served	Sizing based on	Provisional Air Quantity
TEF 1	South	To AS 1668.2	700
TEF 2	Centre	To AS 1668.2	710
TEF 3	North	To AS 1668.2	870
Dirty Utility 1	South	To AS 1668.2	200
Dirty Utility 2	Centre	To AS 1668.2	150
Dirty utility 3	North	To AS 1668.2	310
Procedure room 1	Procedure room 1	Low level exhaust at bed head	260
Procedure room 2	Procedure room 2	Low level exhaust at bed head	320
Entry exhaust	Entry exhaust	Exhaust of all supply air	2420
Ambulance entry	Entry exhaust	Exhaust of all supply air	620

Description	Area Served	Sizing based on	Provisional Air Quantity
Isolation 1	Adult Hall (trauma)	Isolation room minimum of the greater of 12AC/hr or 145L/s	330
Isolation 2	Resuscitation	Isolation room minimum of the greater of 12AC/hr or 145L/s	365
Waste	Disposal area	To AS 1668.2	60
CPEF 1	Ambulance Bay	To AS 1668.2	4000
GEF	Tunnel Ventilation	Replacement of existing. Dual fans required	400

4 MEDICAL GASES

4.1 SYSTEM DESCRIPTION

Item	*Current Investigation / strategy*
Oxygen VIE	The relocation of the Oxygen VIE has been documented as part of the Early Works – Service Centre package. For the ED project, existing pipework in the tunnel system will be extended to serve the ED requirements.
Medical Air	The existing Medical Air system will be extended to serve the Emergency Department. Pipework will be extended from the existing plant area.
Suction	The existing suction system is a Venturi vacuum system. This system is not appropriate for extension and a new Suction system will be provided for the ED., located so that it can be extended to the rest of the hospital. The proposed location for the system is in the Northern Plantroom on Level 1 of the new ED building.
Bottled Medical Gases (Hydrogen, Nitrogen, Carbon Dioxide, Nitrous, Medical Air)	The relocation of the Bottle store is occurring as part of the Early Works – Service Centre package. For the ED project, existing pipework in the tunnel system will be extended to serve the ED requirements.
Workshop Gases (LPG, Acetylene)	The relocation of these cylinders is occurring as part of the Early Works – Service Centre package. There are no other works to these gases associated with the ED project.

5 PNEUMATIC TUBE SYSTEM

5.1 SYSTEM DESCRIPTION

Item	*Current Investigation / strategy*
Pneumatic Tube	There is an existing 110mm Pneumatic Tube system within the facility installed and maintained by Lamson Tubes. An additional number of stations as shown on the drawings are to be installed to serve the new Emergency Department. The existing system has capacity to serve the additional stations.

6 TS11 REQUIREMENTS

6.1 INFECTION CONTROL

6.1.1 General

Isolation control principals will be adopted throughout the facility with air moved from clean to dirty areas. Areas which are likely to have a high infection control risk such as the waiting area and triage will be fully exhausted and maintained at negative pressure to the surrounding spaces.

6.1.2 Isolation Rooms

The Emergency Department will be provided with a number of isolation rooms. These will be provided with separate air handling and ventilation systems to promote infection control. These rooms will be provided with 100% outside air where multiple fan coil units are connected to a common outside air system non return dampers will be provided in the ductwork so that air transfer between the rooms is prevented.

There are 2 Class N Isolation rooms currently documented.

There are a number of isolatable rooms documented. These are not Class N rooms and are supplied from the central air handling units and have been provided with 1 VAV per 2 rooms.

6.2 BUSINESS CONTINUITY

As the Emergency Department now interconnects substantially with the existing buildings there is a risk of issues with Business Continuity during the construction of the Building from the interconnection of mechanical services.

To limit the risk we have undertaken the following –

- Provide new air handling plant to areas affected by the works
- New Emergency fill point for the Oxygen VIE provided as part of the Services Centre Package..
- Access to the chiller plantroom roller door will be compromised; however, maintenance can be undertaken through the alternative door access at the other end of the plantroom.
- Minor shutdown of the chilled water system may be required to interlink the new building with the existing infrastructure.

6.3 VERTICAL EXPANSION CAPACITY

It is intended to size the pipework reticulation system so that they have capacity to be extended to an additional 6 levels of intensive clinical areas. The exhaust systems will have roof mounted fans with vertical discharges which can be lifted and replaced as the building extends upwards. The chilled water and heating hot water plant will be located outside the building footprint.

6.4 EXCEPTIONS FROM GUIDELINES

There are currently no exceptions from the Guidelines noted.

7 CAPITAL COST ESTIMATE

7.1 MECHANICAL SERVICES

	DD estimate	SD estimate	Comments
M1.0 - Equipment			
M1.1 Chillers	$	$	Existing chillers to be utilised
M1.2 Boilers	$ 100,000.00	$	New boilers now part of ED package
M1.3 Cooling Towers	$	$	Existing to be utilised
M1.4 Heat Exchanges			None proposed
M1.5 Pumps	$ 22,000.00	$ 22,000.00	
M1.6 Factory made air handling units	$ 140,000.00	$ 260,000.00	
M1.7 Evaporative coolers			None proposed
M1.8 Process (computer) Air Conditioning Unit			None proposed
M1.9 Packaged DX Air Conditioning Units			None proposed
M1.10 Room Fan Coil Units	$ -	$ 25,000.00	Ducted fan coil units now included in item M1.6
M1.11 Radiators & Fan Convectors			None proposed
M1.12 Centrifugal Fans	$	$ 10,000.00	Types of fans to be finalised.
M1.13 Axial Flow Fans	$	$ 16,500.00	
M1.14 Roof Mounted Fans	$ 110,000.00	$ 25,000.00	
M1.15 Electric Duct Mounted Heaters			None proposed
M1.16 Sounds Attenuators	$ 50,000.00	$ 50,000.00	
M1.17 Humidifiers			None proposed
M1.18 VAV Boxes	$ 50,000.00	$ 130,000.00	
M1.19 Air Filters	$ 35,000.00	$ 2,500.00	
M1.20 Kitchen Hoods			None proposed
M1.21 Other items not included above.	$	$	
M2.0 - Ductwork			
M2.1 Ductwork	$ 400,000.00	$ 400,000.00	

	DD estimate	SD estimate	Comments
M2.2 Air Diffusers & Grilles	$ 220,000.00	$ 100,000.00	
M2.3 Fire Dampers	$ 6,500.00	$ 4,000.00	
M2.4 Sheet Medal Enclosures for Built-up Air Handling Units excluding Equipment.			None required – AHUs of packaged type
M3.0 - Pipework and valves			
M3.1 Pipework and Valves	$ 425,000.00	$ 275,000.00	
M3.2 Cooling and Water Coils			Included in AHUs and FCUs
M3.3 Water Treatment.	$ 5,000.00	$ 5,000.00	
Sub Total			
M4.0 - Insulation	$ 250,000.00	$ 270,000.00	
M5.0 - Electrical and controls			
M5.1 Electrical Work	$ 100,000.00	$ 175,000.00	
M5.2 Automatic Controls.	$ 200,000.00	$ 175,000.00	
M6.0 - Building management systems	$	$ 80,000.00	Controls component now in M5.2
M7.0 - Testing, commissioning, as installed drawings, manuals, maintenance and defects liability	$ 150,000.00	$ 170,000.00	
M8.0 - Special equipment			
M8.1 Medical Gas Pendants			Included in FFE
M8.2 Fume Cupboards			None specified
M8.3 Laminar Flow Benches			None specified
M8.4 Cytotoxic Cabinets			None specified
M8.5 Steam Generators			None specified
M8.6 Cool Rooms	25,000.00		None specified
M8.7 Mortuary Table			None specified
M8.8 Mortuary Cabinets (refrigerated)			None specified
M8.9 Ice Making Machines			None specified
M8.10 Audiometric Booth			None specified
M8.11 Laundry Equipment			None specified
M8.12 Dental Equipment			None specified

	DD estimate	SD estimate	Comments
M8.13 Dental Wet Vacuum system			None specified
M8.14 Refrigerated Drinking Fountains			None specified
M8.15 Paint Spray Booth			None specified
M8.16 Fume Cupboards			None specified
M8.17 Biological Safety Cabinets			None specified
M8.18 Cytotoxic Cabinets			None specified
M8.19 Laminar Flow Benches			None specified
M8.20 CSSD Equipment			None specified
M8.21 Other items not included above.	$ 50,000.00	$ 50,000.00	Pneumatic tubing system allowance
M9.0 - Medical gases			
M9.1 Medical Vacuum	$ 240,000.00	$ 180,000.00	Includes for new vacuum plant
M9.2 Medical Oxygen	$ 175,000.00	$ 94,000.00	
M9.3 Medical Air	$ 120,000.00	$ 61,000.00	
M9.4 Other Medical Gasses (Itemise).	$ 72,000.00	$ 90,000.00	Nitrous oxide, Valve isolation boxes and alarm panels
Sub Total	$	$	
TOTAL (elements M1.0 to M9.0)	$ 2,945,500.00	$ 2,670,000.00	

Notes:

- Early Works costs are additional to the above estimates.
- GST is not included.
- Refer to limitations noted in section 1.7.2.

7.2 VALUE ADDING STRATEGIES

7.2.1 Central Plant

The use of central plant allows the provision of redundancy for each area, without the addition of multiple items of plant. This reduces the capital expenditure in terms of space and structural costs as well as in the mechanical services budgets.

7.3 LIFE CYCLE ASSESSMENT

7.3.1 Introduction

The following is a Design Development stage life cycle assessment of the major mechanical plant proposed. We have based this on our design documentation and industry based experience of these systems on other projects.

We have based our life cycle assessment on a 25 year expected refurbishment cycle.

7.3.2 Chilled water system

7.3.2.1 Capital

Existing central plant is to be used. Capital cost is for secondary chilled water pumps, duty and standby proposed.

7.3.2.2 Replacement

It is expected that chiller and cooling tower replacements may be required within the 25 year cycle at about the 10 – 25 year mark as the existing plant is about 10 years old. However, it should be noted that there is a significant amount of plant operating well beyond this life span. The pumps should operate for the 25 year life.

7.3.2.3 Maintenance

Ongoing water treatment of the secondary loop system, checking of pumps and similar. Water treatment of the primary and condenser water loops is also required; this is part of current maintenance costs. Maintenance costs are expected to increase at the 20 year mark as the pumps reach their economic life.

7.3.2.4 Energy

Use of Primary/Secondary pumping with VSDs on the secondary pumps as well as economy cycles on air handling units is expected to minimise the energy useage of the chilled water system.

7.3.3 Heating hot water system

7.3.3.1 Capital

Capital cost listed above.

7.3.3.2 Replacement

Both the generators and pumps are expected to last the 25 year life cycle point.

7.3.3.3 Maintenance

Ongoing water treatment of the secondary loop system, checking of pumps and similar. Water treatment of the primary water loops is also required.

Monthly inspections are required with more detailed quarterly and annual inspections.

7.3.3.4 Energy

Use of Primary/Secondary pumping with VSDs on the secondary pumps is expected to minimise the energy consumption of the chilled water system.

7.3.4 Air Handling Units, VAV boxes and Fan Coil units

7.3.4.1 Capital

Capital costs are included above.

7.3.4.2 Replacement

Air Handling Units, Fan Coil units and associated VAV boxes are expected to last the 25 year life cycle.

7.3.4.3 Maintenance

Maintenance costs are regular monthly inspections on the operation; more detailed inspections are undertaken at 6 and 12 monthly intervals. Filters will be inspected monthly with replacement rates dependant on outside air conditions and the level of dust/contaminants within the hospital.

7.3.4.4 Energy

Economy cycle is being provided to all Air Handling Units. Use of VAV systems will minimise air quantities to areas with minimal requirements. Fan Coil Units in the patient areas are used to provide pressure regimes and will therefore be constant volume.

7.3.5 Exhaust Fans

7.3.5.1 Capital

Capital costs are included above.

7.3.5.2 Replacement

Exhaust fans are expected to last the 25 year life cycle.

7.3.5.3 Maintenance

Maintenance costs are regular monthly inspections on the operation; more detailed inspections are undertaken at 6 and 12 monthly intervals. HEPA filters on the exhaust systems to the isolation rooms will need monthly inspections; replacement is expected to occur annually but will depend on the room usage.

7.3.5.4 Energy

Exhaust systems are expected to operate constantly as the areas served are 24 hour operation.

7.3.6 Fire and Smoke Dampers

7.3.6.1 Capital

Cost of the dampers is included above.

7.3.6.2 Replacement

Dampers are expected to last the 25 year life cycle.

7.3.6.3 Maintenance

The dampers will require annual inspections to the Australian Standards.

7.3.6.4 Energy

To be included in the Air Handling Units, Fan Coil Units and Exhaust systems energy above.

7.3.7 BCMS

7.3.7.1 Capital

Cost of the BCMS is included in 5.2 and 6.0 above.

7.3.7.2 Replacement

The BCMS is expected to last the 25 year life cycle.

7.3.7.3 Maintenance

Monthly maintenance is also required for the BCMS.

7.3.7.4 Energy

Not applicable.

7.3.8 Medical gases

7.3.8.1 Capital

Capital cost is included above.

7.3.8.2 Replacement

The medical gas systems are expected to last the 25 year life cycle.

7.3.8.3 Maintenance

Maintenance is required to check the alarm systems and to the Vacuum pump.

7.3.8.4 Energy

Energy usage will depend on the amount of usage of the vacuum system.

8 SUSTAINABILITY INITATIVES

The following is a summary of sustainable initiatives which are proposed to be utilised and which impact on the Mechanical Services. These will be confirmed at a later stage of the project when/if an ESD consultant has been engaged.

8.1 AIR CONDITIONING SYSTEM

It has been decided that the project shall employ a Variable-Air-Volume (VAV) air conditioning system; a system that has been used extensively around the world. As the name implies, the volume of air supply is varied to meet the temperature requirements of individual rooms and zones. VAV systems use variable speed drives (VSD's) on the supply air fan so that when the air conditioning requirement is low, the fans can slow down, thus saving fan energy.

A dedicated ceiling-mounted VAV box is provided for each room or area, and varies the quantity of supply air in the duct. The VAV box is connected to the Building Management System (BMS) and can therefore be controlled independently. This means that the set point in each group of rooms can be adjusted to meet patient request or to reduce energy when rooms are not in use.

The most frequent complaint about air conditioning in hospitals is cold air drafts blowing on patients in bed. Using conventional 4-way blow diffusers with VAV will not mitigate such complaints. It is therefore recommended that ceiling-mounted 'swirl diffusers' be used (refer Figure 1). These diffusers serve to reduce the amount of air blown directly on the patients by distributing the supplied air more evenly.

Figure 1 *Swirl ceiling-mounted diffusers*

The main benefits of VAV air conditioning systems include:

- Good control and thermal comfort;
- Central plant and recirculation of air throughout the building;
- Minimal distributed chilled water throughout the building;
- Minimal maintenance requirements in patient areas; and
- Extensive precedent use and contractor experience.

8.2 MIXED MODE VENTILATION

Mixed mode ventilation is not appropriate in these areas.

8.3 ADVANCED CONTROLS AND AUTOMATION

Well designed and implemented controls are fundamental to achieving sustainable systems. While some of the controls strategies listed may seem obvious, it is alarming how often they are not included in projects. Due to their high importance in achieving a successful, sustainable project, they have been summarised in this section.

8.3.1 Building Management System

Building Management Controls Systems (BMCS) provide intelligent control to electrical and mechanical systems. The BMCS varies the output of energy systems in accordance with actual indoor and outdoor conditions, which saves energy, reduces greenhouse gas emissions, prolongs equipment life and reduces maintenance. Therefore, despite the high upfront costs, the financial payback period of a BMCS system is usually very short.

8.3.2 Economy Cycle

Economy cycle can be implemented for the air handling systems where outside ambient conditions are favourable and less than the internal conditions. In this case the cooling system turns off and the air handling system runs on full outside air and full relief air exhaust. This is a method of providing free cooling.

8.3.3 Variable Speed Drives

The cooling loads in the building in summer and during seasons with mild weather are significantly lower than the designed load. Therefore it is possible to reduce the supply air quantity during these periods without compromising the comfort conditions in the spaces and the minimum ventilation requirements set by Australian standard AS1668.2.

Variable Speed Drives (VSDs) will be installed on supply and return air fans in the AHUs. The VSD will be linked to the BMCS. Weather conditions will dictate operational parameters.

VSDs on chilled water pumps that would be controlled by a pressure differential signal, hence maintaining minimum speeds required to provide sufficient water flow through the chiller.

8.3.4 Electrical Sub Metering

In successfully managing energy consumption it is important that sufficient data is available to building managers to allow them to monitor consumption and compare historical data and trends. Sub-metering allows building managers to fine-tune operational procedures to peak load lop, thereby minimising consumption and detecting any operational problems early.

This could include separate metering for:

- Chillers (should these be altered as part of the project);
- Air handling fans;
- Chilled water and heating hot water pumps; and
- Additional items which have a large energy use.

9 RISK ASSESSMENT

Below is the Risk Matrix obtained from PRC-102-Project Risk Management by NSW Health Infrastructure.

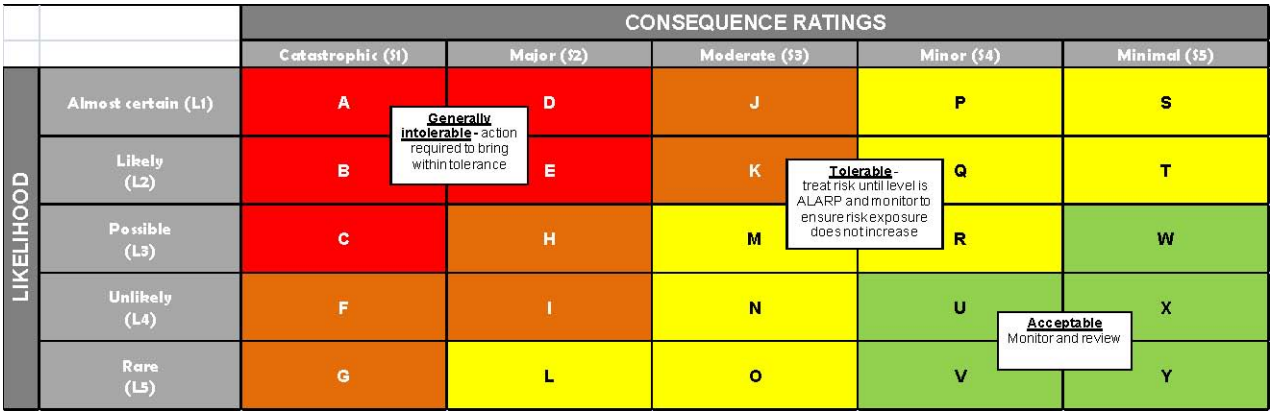


Figure 2 *HI Risk Matrix*

Present risk is the risk to HI if no further action is taken.

No current risks identified specific to the mechanical services package.