SYDNEY FISHMARKET REDEVELOPMENT

Building Services Concept Report

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engineering sustainable environments

REPORT AUTHORISATION

PROJECT: **SYDNEY FISHMARKET REFURBISHMENT**
BUILDING SERVICES CONCEPT REPORT

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EXECUTIVE SUMMARY

Umow Lai were engaged to review options and concept designs for the Building Engineering Services for the Sydney Fish Market Redevelopment. This involved the following services;

- Mechanical Services including air conditioning, refrigeration and ventilation systems;
- Electrical Services including main switchboards, metering, distribution boards and general and emergency lighting;
- Vertical Transportation (lifts and escalators).
- Hydraulic Services including water supply, drainage, on site detention, grease traps and water to sewer.

The concept report has been developed in conjunction with Connybeare Morrison Architects, the Sydney Fish Market Engineering Department and other members of the design team during the initial project design meetings.

The provision of the Services will be coordinated and integrated and include a number of Environmentally Sustainable Development (ESD) initiatives. These initiatives will be further investigated in Schematic Design and Design Development.

The services report examines the capital and operational cost impacts and benefits of various options explored for the Sydney Fish Market redevelopment.

MECHANICAL SERVICES – Air Conditioning

The proposed location for the mechanical plant room is adjacent to the wholesalers on the ground floor north boundary. The plantroom will need to be constructed as part of Stage 2 and integrated into the overall scheme. The chilled water plant sizing is based on a load of 350kW for cooling. This would serve the BOH retail, restaurants and Tavern and provide 10% spare capacity. Further calculations will be made in detailed design phase and as the spatial uses become clearer.

Two air conditioning options which were considered are,

- Air Cooled (Option 1) and
- Water Cooled (Option 2a and 2b)

Based on the assessment carried out by Umow Lai, we recommend Option two be implemented as it provides the best long term benefit for the Sydney Fish Market in relation to plant space, water usage and energy savings. Life expectancy of both options is 25 years. The risk of Legionella is eliminated for both options as the condenser water system for Option 2 would be via a closed loop.

The water cooled option will required less maintenance work and will reduce issues associated with corrosion from salt laden air. Corroded coils reduce the efficiency of the system which over time will result in increased energy costs.

Refrigeration Plant

Two refrigeration options which were considered,

- Tenant Supply Air Cooled Refrigeration Plant (Option 1) and
- Central Ammonia Chiller Plant (Option 2)

We recommend Option 1 be implemented.

The central refrigeration plant would provide a very high initial cost which would be paid back over time based on tenant usage. The main benefit for the central refrigerant plant is that it would require significantly less power to operate when compared with tenant supplied equipment.

Options also considered which were not considered feasible;

- Tri-generation
- Bio Digestion
- River Heat Rejection

Electrical Services

The existing electrical supply and distribution within the area to be redeveloped generally must be upgraded and renewed. All major electrical loads and distribution boards will be submetered and connected to a remote metering system.

Lighting will incorporate energy-efficient fluorescent, compact fluorescent, metal halide and LED lamps. Automatic lighting control will be adopted wherever practicable.

Provision of communications to tenants will generally be similar to that provided for a retail complex. The existing IP CCTV camera system will be extended to the new development.

Hydraulic and Fire Services

Hydraulic Services will comprise:

- Sanitary plumbing, drainage and vents.
- Grease waste system including new grease arrestor, trade waste drainage and vents
- Hot, cold and tempered water systems including dual booster pump set
- Natural gas services to new hot water plant and to cafeteria
- Rainwater harvesting plant including pump/s and filtration.
- Downpipes and internal stormwater drainage

Fire Services will comprise;

- Fire Hydrant system complete with Fire Brigade booster assembly, backflow prevention valves and a booster pump. Combined booster assembly for the Existing and New Fish Market building.
- Fire Sprinkler system on Level 1 & Level 2 of the building including. Fire Brigade Booster assembly, backflow prevention valve and booster pump if required.
- An automatic fire alarm system utilising addressable smoke detectors will be installed on Level 3 and Level 4 of the building and as part of the smoke hazard management system with the fire alarm panel located inside the proposed Fire Control Centre.
- A Sound System and Intercom Systems for Emergency Purposes (SSISEP) will be provided throughout the building
- Hose reel service
- Potable fire extinguishers.

The site appears adequately serviced by the existing Sydney Water and Sewer main services. The relevant authorities will advise of any required upgrade works subject to the lodgement of a Section 73 Notice of Requirements.

Backflow prevention Devices will be provided as property containment through the installation of a Reduced Pressure Zone Device to the existing water meter located in the plant room in level 1 of the existing Sydney Fish Market Building and individual containment to the new subsidiary water meters at the proposed restaurants and wholesalers.

The cold water supply for the project will feed from the current 100mm water supply to the existing Fish Market building located underneath loading dock 1, subject to advice received in the Section 73 Notice Of Requirements. It is proposed that each tenant, restaurant and wholesale property be fitted with a water meter that is data logged back to a central data read point. Currently the water usage at the Sydney Fish Market is 230 KL/day and the expected requirement for the proposed development is an additional 270 KL/day. This will give the site a total daily water requirement of 500KL/day. In order to reduce potable cold water consumption a stormwater reuse system is proposed as described under Section 4.9 Rainwater Reuse System.

The Gas supply to the new development is proposed to be fed via the existing the existing Natural Gas supply to the site. The natural gas supply to the individual tenants will be complete with isolation valves and subsidiary meters that will be pulse emitting, Data logger system meters monitored back to the Fish Markets existing Mater Data Logger system.

We propose a Geothermal system for hot water pre-heat. For details refer to Mechanical section 3.3. Option 2. Geothermal for hot water pre-heat uses the same principle as the geothermal heat rejection detailed in Mechanical Section 3.3, however a refrigerant gas will be used for the ground loop instead of water.

The sites Rainwater Reuse System will involve two systems including clean rainwater run-off from the awning area above level 1 and a separate stormwater system which will capture the run-off from the level 3 Car park and driveway ramp. The clean rainwater will be stored in a 100,000L capacity tank located below the proposed Tavern. This Rainwater will potentially be used for W.C flushing and wash down of wholesale areas. The stormwater captured will be stored in a tank with a capacity of 400,000L located by the civil engineer. This stormwater will potentially be used for the irrigation of foreshore area, promenade, hosing down of the truck service lane, grease arrestor and loading dock wash down plus cooling of mechanical condensers.

We propose sewer drainage to gravitate from fixtures, stacks, etc. and further to the authority's 300mm sewer main located underneath the existing car park driveway in Jones Street. Two 5000L capacity Grease Arrestors will be located in close proximity to the future tavern area and two Grease Arrestors will be located in the loading dock area. A suction line is to be provided complete with 'Kam-lok' connection to allow truck maintenance.

All fixtures shall be 1st quality free of manufacturing imperfections and equal to Caroma Leda 2000 back inlet smart flush suites and Caroma Leda Vasque vanity basins.

Fire Hydrants will be provided. The Hydrant service is to be fed from the existing 100mm Fire Hydrant connection currently serving the Fish Markets existing car park/wharf area. The existing Fire Hydrant Booster Assembly will need to be upgraded and relocated to satisfy the requirements of AS2419.1-2005. The installation will be provided with a Double Detector Check Valve Assembly to achieve Backflow Prevention requirements as per AS2419.1-Fire Hydrant Installations and NSW COP. Fire Hose Reels will be provided in accordance with BCA E1.4 'Fire Hose Reels'. Fire Sprinklers will be provided on level 1 and level 2 of the building. Fire Sprinklers will be provided on level 1 and 2 of the building. The sprinkler system will be fed from the existing Fire Hydrant connection currently serving the main Fish Market building.

Limitations of this Report

Due care and skill has been exercised in the preparation of this report.

This report is intended as a guide to assist with the development application for the project and assist the design team. Specific details may vary during the design development of the project.

No responsibility or liability to any third party is accepted for any loss or damage arising out of the use of this report by any third party. Any third party wishing to act upon any material contained in this report should first contact Umow Lai for detailed advice which will take into account that party's particular requirements.

The site investigation consisted of a visual observation of the existing installations. As-installed mechanical and electrical documentation was generally not available at the time of inspection.

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1 MECHANICAL SERVICES

1.1 GENERAL

Umow Lai were engaged to review options for the air conditioning and refrigeration plants for the Sydney Fish Market Refurbishment. Options considered for

- Central Air Conditioning Plant, Air and Water Cooled; and
- Central and Tenant Supplied Refrigeration Plants;

Options were examined based on capital, operational cost and sustainability impact.

Ventilation systems serving the Sydney Fish Market have also been described in this report.

1.1.1 Staging

The Sydney fish market refurbishment will be constructed over 4 stages;

- Stage 1 – Demolition works;
- Stage 2 – Restaurants, Retail and Carpark East.(Mechanical plant room)
- Stage 3 - Restaurants, Retail and Carpark West. and
- Stage 4 – Tavern, Warehouses and Retail Outlets West of the Main Building.

1.1.2 Design Conditions (for full load performance)

All design conditions should be in accordance with AIRAH/CSIRO Weather Data for Non Critical (Comfort) Applications.

Summer

35°C dry bulb maximum
22°C wet bulb maximum

Winter

4°C dry bulb (saturated)

1.1.3 Mechanical Ventilation Design Criteria

Exhaust air will be in accordance with AS1668 Part 1 & 2 and the Building Code of Australia.

All areas shall be designed to relevant authorities codes requirements.

Toilet ducted exhaust systems are to code requirements plus 20% spare capacity to cater for future tenant toilet exhaust.

Ventilation rates will be in accordance with AS1668.2.

1.1.4 Limitations

This report is based on preliminary levels of information. Site baseline cooling and heating load profiles will change through further development of the design and provision of comprehensive design parameter data from the future tenants. As such, it is expected that final equipment selection, costing and performance outcomes may change as more detailed design is conducted and further information sought.

1.1.5 Cost Estimates

Cost estimates included in this report are an opinion of the probable cost 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. Also the estimates are subject to change due to market fluctuations.

1.2 EXISTING INFRASTRUCTURE

1.2.1 Main Building Refrigeration System

The main building houses the central refrigeration plant which is located adjacent to the facilities office on the mezzanine level. The system capacity is 700 tonnes or 2460kWr, made up of 3 lead/lag compressors which operate on R22 refrigerant, serving 36 cool rooms and ice making systems. The majority of the load is used to cool freezers (-20ºC) and cool rooms (-2 ºC). The system was design based on an ambient temperature of 35 ºC and therefore struggles on hot summer days when temperatures exceed 35 ºC.

Issues - Refrigeration R22 is a HCFC (Hydrochlorofluorocarbon) which will be phased out in 2020 as committed to under the Montreal Protocol. It is predominant in the Sydney market and was imported up until 2010. There is however no direct replacement refrigerant on the market currently.

Existing R22 Compressor in Mezzanine Plant Room

The main options to be considered are;

Option 1

System retrofit with a similar refrigerant. There are numerous complications for a plant the size serving the fish market. These include; issues with POE (polyester) oils, dryers, changed operating pressures and non compatible seals would have to be investigated.

Option 2

Replace the existing plant and install a new central tri-generation plant which would provide -20ºC glycol using the waste heat from generators. The refrigerant used in these chillers would be Ammonia which has zero ozone depleting potential and is not listed to be phased out.

Tri-generation in principle generates power by gas engines and recovers the rejected heat from the flue and the jacket water cooling system to generate chilled glycol supply through an ammonia absorption chiller. Gas reliability and availability on site and electrical connections are key site issues to be investigated

The use of Tri-generation will dramatically reduce the Greenhouse Gas Emissions of the market as grid electricity is replaced with relatively low carbon emitting natural gas. Considering the quantity of electricity that would be used for refrigeration, the use of tri-generation provides a considerable overall CO2 emissions reduction with a commercial return on investment.

Further analysis is recommended into the tri-generation option, particularly the cost and technical integration of the ammonia absorption chiller as this is an innovative element which requires consideration.

1.3 AIR CONDITIONING OPTIONS

1.3.1 General

The proposed location for the mechanical plant will be adjacent the wholesalers on the ground floor north boundary. The plantroom will need to be constructed as part of stage 2 and integrated into the overall scheme. The Plantroom size is estimated to be 130m2, based on the water cooled chiller with geothermal heat rejection option. Plant spatial requirements have been summarised at the end of each option in this report.

Reticulated chilled, heating hot water and domestic hot water piping will be run hard up against soffits or trenched underground to serve the restaurants, retail and tavern. Piping is capped at each tenant with an interlock control cable, ready for connection to fan coil units by tenant. Tenants will be allocated a limited supply of chilled and heating hot water.

1.3.2 OPTION 1 - Air Cooled Plant

The central chilled water plant would consist of an air cooled chiller with two chilled water pumps that operate on a duty/standby arrangement. The chiller shall have coatings on the condenser coils for fin protection (corrosion protection).

The chilled water plant sizing is based on a load of 350kWr for cooling. This would serve the BOH retail, restaurants and Tavern and provide 10% spare capacity. Further calculations will be made in detailed design and as the spatial use becomes clearer.

Future provisions shall also be made for further expansion in relation to future chiller space. The addition of approximately 2700m² of office space will require provision for an additional 330kWr chiller. Alternatively a single 680Kwr air cooled PowerPax chiller could be installed which would satisfy all future chilled water requirements.

Provision will be made for Ø100mm chilled water flow and return pipes from the ground floor plant to be run and capped off on the first floor for future connection to mechanical plant.

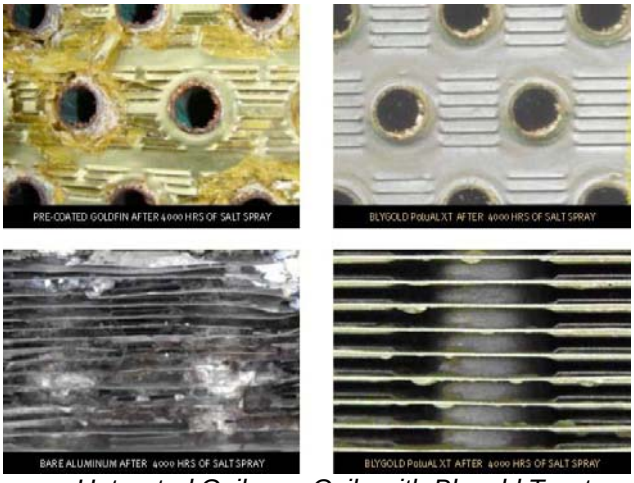
The air cooled chiller will feature “Turbo-core” compressors with magnetic oil free bearings. Chillers utilising these compressors are the most efficient and quiet on the current market.

Typical Air cooled chiller installation.

1.3.3 Blygold Treatment

As the mechanical plant is located on the water anti-corrosion treatment will be necessary to prevent corrosion of the HVAC coils throughout. A Blygold spray treatment will be provided to all coils to ensure the coils efficiencies are maintained.

Coils will need to be monitored and maintained every 6-12 months.



Untreated Coils *Coils with Blygold Treatment*

Air Conditioning Option 1 Spatial Requirements

Item	Size LxWxH (mm) Includes service Space	Comments
Air Cooled Chiller 350kWr	8500x4000x2700 (Externally Located)	Chiller location and external openings within plant to be assessed to ensure condenser air is discharged to outside via high static condenser fans.
Future Chiller 330kWr	8500x4000x2700 (Externally Located)	Chiller location and external openings within plant to be assessed to ensure condenser air is discharged to outside via high static condenser fans.
Storage Tank	Ø2250dia x 2500 high	8,000L chilled water storage buffer tank.
Pumps	1600x1250x500 (each)	Circulating Pumps
Chilled Water Piping	2x Ø100mm Risers	Reticulated throughout plantroom at high level. Paths to be indicated on the detail design drawing.
Expansion Tanks	1 off Ø1000 x 800high	Located at high level within plantroom
Chemical Dosing	1500x1500x1500	Water Treatment
VSD's	1800x400x2000	VSD's located in a panel installed against internal wall.
Controls Board	1200x400x1200	Located in a panel installed against internal wall.
MSSB	2x1800x400x2400	MSSB located against internal wall.

Chilled water piping will be run to each tenant for future connection by tenant. (Air conditioning system installed by tenant during fitout.) The chilled water piping serves, restaurant, retail and the tavern.

RISKS

- Ventilation around the air cooled chiller will be difficult with current plant layout. The chiller could be installed externally on the level above, however this will result in the loss of 1 or 2 car parking spaces.
- Air cooled system leaves itself open to corrosion of the condenser coils which effect the systems efficiencies if not treated and maintained sufficiently.

1.3.4 OPTION 2a – Chiller Plant With Geothermal Heat Rejection

The central water cooled chiller plant will consist of a water cooled chiller with two chilled water pumps that operate on a duty/standby arrangement. The chiller will require a condenser water loop for heat rejection. The two most suitable methods for running a condenser water loop are;

1) Geothermal

2) Wet/Dry Cooler.

The chilled water plant sizing is based on a load of 350kW for cooling. This would serve the BOH Retail, restaurants and Tavern and provide 10% spare capacity.

Future provisions shall also be made for further expansion in relation to future chiller space. The addition of approximately 2700m² of office space will require provision for an additional 330kWr chiller. Alternatively a single 680Kwr water cooled chiller could be installed which would satisfy all future chilled water requirements. Provision will be made for 2 x Ø100mm chilled water pipes from the ground floor plant will be run and capped off on the first floor for future connection to an Air Handling Unit (AHU).

Geothermal Heat Rejection – This would consist of drilling and inserting a ground loop 100 meters below the ground. The loops consist of HDPE 32mm PN16 pipe with fusion welded returns (See photo below right). Each loop requires approximately 1 day to install which includes drilling, grouting and welding. If the project requires, an additional drill will be used to speed up the process.

Loops would deliver 4.5-5kW of heat rejection each. To maximise the payback for the system the loops would be designed to cover 70% of the load which will be the majority of operating hours. The remaining 30% will be served by a dry cooler.

Factored into the installation cost will be performance modelling of the geothermal heat rejection with a detailed report carried out by the UNSW. (To be negotiated)

Wet/Dry Cooler – This would consist of a single wet/dry fluid cooler which would operate with the Geothermal plant during peak conditions only. The dry cooler size could also be selected to allow for the future office additions on level 1. Alternatively a space would be allocated for future installation (considered in plant spatial table).

Typical Water Cooled Chiller

Geothermal Piping

Air Conditioning Option 2a Spatial Requirements

Item	Size LxWxH (mm) Includes service Space	Comments
Chiller 350kWr	6000x3000x2700	Water Cooled
Future Chiller 330kWr	6000x3000x2700	Water Cooled
Storage Tank	Ø2250 x 2500 high	8,000L chilled water storage buffer tank.
Chilled Water Pumps x2	1600x1250x500	With VSD
Condenser Water Pumps x3	1600x1250x500	With VSD
Expansion Tanks	1 off Ø1000x 800 high	Located at high level within plantroom
Wet/Dry Cooler	5000x3000x2000 (Externally Located)	Located on level 2
Chemical Dosing	1500x1500x1500	Water Treatment
VSD's	1800x400x2000	VSD's located in a panel installed against internal wall.
Controls Board	1200x400x1200	Located in a panel installed against internal wall.
MSSB	2x1800x400x2400	MSSB located against internal wall.
Geothermal Plant (40 bores)	Manifold Within Plant 2000x2000	Installation sized based on 5 rows of 8 bores with 8metres of separation from each bore.

Chilled water piping will be run to each tenant for future connection by tenant. (Air conditioning system installed by tenant during fitout.) The chilled water piping serves, restaurant, retail and the tavern.

1.3.5 OPTION 2b –Chiller Plant With Fluid Cooler Heat Rejection

This plant would provide same capacities to tenants as described in the previous Option with the exception being; all heat rejection would be performed through a larger Wet/Dry (fluid) cooler located on level 2 in lieu of Geothermal underground loops.

This option would require a larger plant space on level 2 which would encroach into the car parking spaces. Based on current heat load calculations this option would result in the loss of two car parking spaces.

Typical Fluid Cooler Installation with wetted pads

Air Conditioning Option 2b Spatial Requirements

Item	Size LxWxH (mm) Includes service Space	Comments
Chiller 350kWr	6000x3000x2700	Water Cooled
Future Chiller 330kWr	6000x3000x2700	Water Cooled
Storage Tank	Ø2250 x 2500 high	8,000L chilled water storage buffer tank.
Chilled Water Pumps x2	1600x1250x500	With VSD
Condenser Water Pumps x3	1600x1250x500	With VSD
Expansion Tanks	1 off Ø1000x800 high	Located at high level within plantroom
Wet/Dry Cooler	10500x3500x2500 (Externally Located)	Located on level 2
Chemical Dosing	1500x1500x1500	Water Treatment
VSD's	1800x400x2000	VSD's located in a panel installed against internal wall.
MSSB & Controls	3x1800x400x2400	MSSB located against internal wall.

Note the increase in size of the wet/dry cooler from Option 2a to Option 2b.

Due to the increased size of equipment and fan noise from the plant would also increase.

1.3.6 Controls

The intent is to extend the existing fish market BMS system to monitor the equipment within the new development If this is not possible provision will be made to connect the services to an independent Bacnet based system. Monitoring would continue to be done from the facilities office as is currently the case.

The system will control and monitor the mechanical services plant, but will also form the basis of a building management control system, with interface to lighting control, security and fire and life safety systems incorporated in the buildings.

Specialist alarms such as gas detection will also be connected to the BMCS.

1.4 MAIN BUILDING HEATING WATER PLANT (WITH BOTH OPTIONS 1 & 2)

The main heating hot water system shall consist of a condensing heating hot water unit (600kW) and associated hot water pump. The heating water plant sizing is based on a load of;-

- 300kW serving the retail shops, tavern and restaurants;
- 250kW serving the future level 1 offices + 50kW Spare capacity;

Due to its low capital cost when compared with chilled water, future provisions will be made for further expansion in relation to the first floor offices now. At this stage based on 2700m² of future office space the future heating hot water load would be in the order of 250kW.

The heating hot water unit is able to make use, through heat recovery, of the waste fluing heat thus reducing the amount of gas consumed. Up to 10% heat recovery can be achieved over conventional heating hot water units.

Heat Recovery Heating Hot Water Configuration

Hot Water Plant Spatial Requirements

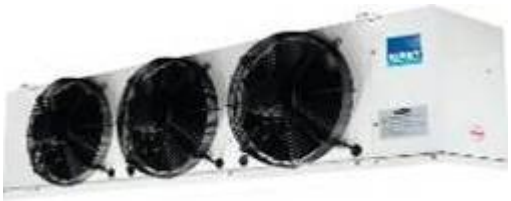
Item	Size LxWxH (mm) Includes service Space	Comments
Heating Hot Water Boiler 600kWr	4500x2000x1800	Requires a natural gas connection.
HHW Pumps x 2	1600x1250x500 (each)	Circulating Pumps
Hot Water Piping	N/A	Reticulated throughout plantroom at high level. Paths to be indicated on the detail design drawing.
Expansion Tanks	1off Ø1000	Located at high in plantroom
Chemical Dosing	1500x1500x1500	Water Treatment
Flue Exhaust Duct	Ø300 Run at High Level into riser	Double skinned and may require a booster fan.

Hot water piping will be run to each tenant for future connection by tenant. (Air conditioning system installed by tenant during fitout.) The heating hot water piping serves, restaurant, retail and the tavern.

1.5 REFRIGERATION OPTIONS

1.5.1 OPTION 1 – Dedicated Air Cooled Plant For Each Tenant

Kirby Condenser (Outdoor) Unit



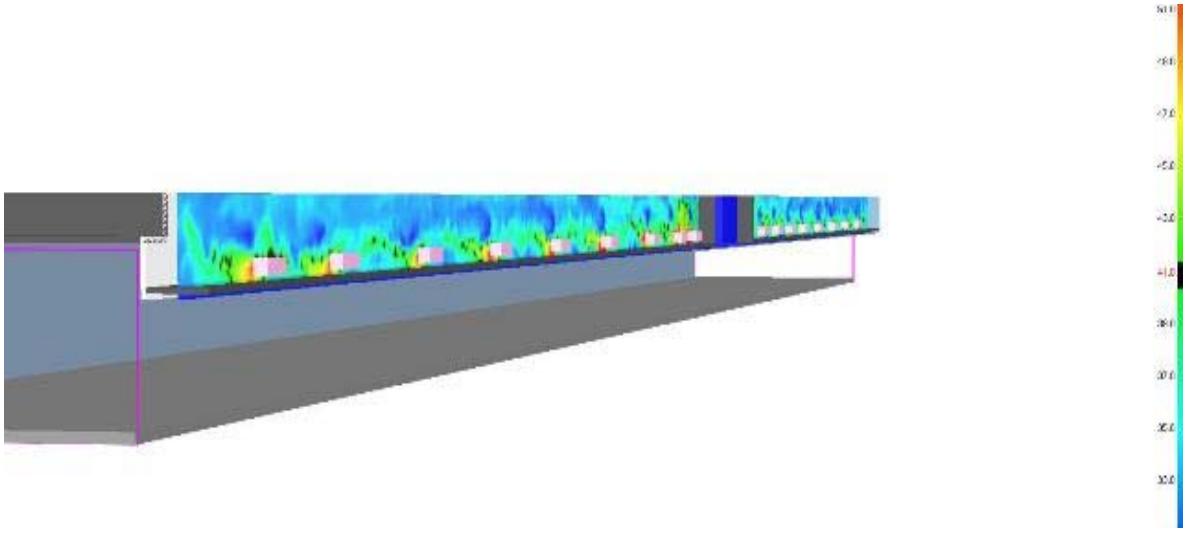
Kirby Evaporator (Indoor Unit)

1.5.1.1 Retail and Restaurants

A dedicated plant area within the ground floor carpark exhaust plenum will be provided for tenants to install their air cooled heat rejection equipment. The maximum capacity of refrigeration equipment will need to be agreed upon in the tenancy lease and documented within the fit-out manual. The exhaust plenum design allows a maximum of 100kW of heat rejection within each plenum totalling 200kW. Proposed tenant break-up is as follows;-

- Retail tenancies totalling 80kW of condenser heat rejection.
- Restaurants totalling 120kW of condenser heat rejection.

The restaurants shall have a higher allowance for condenser space as they have a greater need for refrigerated storage. The carpark exhaust plenum will be divided into two separate plenums in order to minimise the impact of heat build up within the plenums. Size required is 1.6m(h)x1.2(w) with an access panel and walkway for equipment service and maintenance.



Carpark Plenum CFD Model

Spray Water (Boost) System

Water harvesting to date has not been possible on site due to the quality of water being unsuitable for re-use; such as high pressure surface spraying due to risks of salmonella.

Water run off from tenancies would be captured and stored in a tank below ground and deionised for re-use to spray the refrigeration condensers within the exhaust plenum. The benefit of using run off from the wholesale and retail tenants as well as the roof is;

1. The amount of redundant ice washed down from fish storage which would result in lower water temperatures than potable water.

2. As the site is continually hosed down for cleaning purposes daily, water shortage issues would not become a factor.

A circulating pump would automatically be activated when temperatures within the plenum exceed 35°C (adjustable). Alternatively the system could be activated to operate more frequently (if humidity levels are suitable) to improve the refrigeration equipments efficiency.

Water from a mist spray via ultrasonic nozzles shall completely evaporate in order to minimise corrosion to the condensers coils. Water drainage to sewer shall be from the plenum floor.

Typical Water Spray Nozzle Installation

1.5.1.2 Wholesale

A mezzanine platform constructed along the northern wall 2400mm above the back of the wholesale outlets for tenant refrigeration plant. Weatherproof louvers cut into the wall would discharge the heat rejected from the condenser to outside. Service access to the platform will be integrated into the design and completed as part of the builders works.

Platform size will be 1.2m(d)x1.6m(h) running the length of the northern wall.

Based on current packaged air cooled condenser systems from Kirby the platform will have sufficient space for 15 x 24kW modules totalling 360kWr. Alternate combinations totalling 360kW is also possible.

1.5.1.3 Tavern

A condenser platform will be constructed on the roof of the tavern to house their refrigeration requirement. The plant shall be constructed between the skylights and accessible for service and maintenance via an access hatch from within the tavern.

Refrigeration Option 1 Spatial Requirements

Spaces created for tenant supplied "Kirby" type refrigeration systems.

Item	Plant Size LxWxH (mm)	Comments
Carpark Exhaust Plenum (Retail Restaurants)	Plenum 1 – 1600(h)x1200(w)x55,000(L) Plenum 2 - 1600(h)x1200(w)x30,000(L)	Wind Turbines to be Located Above Carpark Exhaust Discharge.
Wholesale Mezzanine	1600(h)x1200(w)x35,000(L)	Constructed at 2400mm above finished floor level along northern façade.
Tavern	4000(w)x4000(h) Open to sky.	Condensers to be Located Between Skylights
Kiosks	2000(w)x2000(h) Open to sky.	Condensers to be Located centrally on roof

1.5.2 Option 2 Central Glycol Plant

A central refrigeration plant reticulating ethylene glycol to the restaurants, retail stores and tavern should also be considered as an alternative to a tenant supplied system. The central plant would require a larger capital cost to install but would require significantly less power to operate. The overall special requirement is less for the central glycol plant. The equipment would be housed within the same room as the air conditioning plant. Glycol at temperatures of -20ºC would be reticulated to the tenants for connection into cool rooms, freezers and ice making equipment.

The central plant installation requires the Sydney Fish Market to provide the main refrigerant equipment and infrastructure as opposed to option one where the tenants are provided with plant space for the installation of their own equipment. Installation costs would be paid back over time by charging tenants for the use of the glycol refrigeration. This can be done by charging tenants based on their usage or a fixed rate based on the size of their tenancy.

Central plant would be designed to provide 600kW of refrigeration. This includes for;-

- Retail tenancies totalling 80kW of refrigeration capacity;
- Restaurants totalling 120kW of refrigeration capacity;
- Wholesale totalling 300kW of refrigeration capacity;
- Tavern totalling 30kW of refrigeration capacity; and
- Ice Making / Spare 70kW.

Refrigeration Option 2 Spatial Requirements

Item	Plant Size LxWxH (mm)	Comments
Glycol Chillers x2	6000(w)x9000(L)x2000(h)	
Water Storage Tank	Ø2200 diameter	
Water Treatment Plant	1800(w)x1800(L)x1500(h)	
3C Coolers (On Roof)	5000(w)x12,000(L) (Open to sky)	
Circulating pumps	3000(w)x3000(L)x1500(h)	
Chilled Water Piping	Located at high level	
Condenser Water Piping	Located at high level	
Heat Exchangers	1000(w)x2000(L)x1500(h)	

Total Plant Space required internal; 15m x 20m or 300m²

Total Plant Space required external; 5m x 12m or 60m²

1.6 VENTILATION SYSTEMS

1.6.1 Toilet Exhaust Ventilation

Ground Floor - The public toilets on the ground level shall be extracted across to the tavern via ductwork and discharged vertically via a roof mounted fan on top of the tavern.

First Floor - Toilets and cleaners room behind the restaurants on level 1 shall be ducted to the roof and extracted via a roof mounted fan.

Tavern – Toilet exhaust systems serving the tavern shall be provided by tenant during fitout.

1.6.2 Wholesale Supply Ventilation

Filtered supply air shall be provided at high level to satisfy the minimum ventilation requirements of AS1668.2 (1991). Air will be drawn in via a louvre and fan from the eastern façade. The fan will be located within a fan room.

1.6.3 Carpark Supply and Exhaust Ventilation

Ground Floor - Carpark exhaust shall be ducted via an air tight plenum running the length of the southern end of the carpark. The exhaust plenum will be extracted at two points to fan rooms and discharged to atmosphere vertically. Extraction point to be 3m above the top level of the trafficable carpark.

Supply or “make up air” shall be drawn horizontally from the eastern end of the carpark and supplied along the northern end via exposed ductwork.

First Floor – Exhaust and supply air is required for a small proportion of the carpark on level 1. Exhaust and make up air shall be provided via a riser from roof level.

The need for supply and exhaust air to the first floor may be eliminated via an engineered modelling solution.

Second/Third Floor – Provided natural ventilated openings of 1m² free area is provided per car parking spot, mechanical ventilation would not be required for these levels.

1.6.4 Kitchen Supply and Exhaust Ventilation

Ground Floor – Provision for a capped exhaust ducts for each retail tenancy with the ability to provide 900L/s of exhaust air. Ductwork will be run from the roof to each tenancy and will be ready for connection to an exhaust hood (by tenant) during their fitout.

First Floor – Provision for a capped exhaust ducts for each restaurant with the ability to provide 3000L/s of exhaust air. Ductwork will be run from the roof to each tenancy and will be ready for connection to an exhaust hood (by tenant) during their fitout.

Duct access panels will be provided at regular intervals for cleaning purposes.

Supply air ductwork will be run from intake louvres and capped of within each tenancy for future connection.

Note: Kitchen exhaust ductwork passing through separate tenancies are required to be fire sprayed to maintain fire ratings between tenancies.

Tavern – Tavern exhaust shall be provided by tenant during fitout.

1.6.5 Miscellaneous Ventilation

- Plantroom Ventilation (Exhaust)
- Sprinkler Valve Pump Room Ventilation (Exhaust)
- Stair Pressurisation Ventilation (Supply)
- Tenant Supplementary Outside Air (Supply)
- Waste and Recycle Room Ventilation (Exhaust)
- Electrical Switch Rooms

1.6.6 Riser Requirements

Four main ventilation risers are provided for the reticulation of kitchen exhaust, dish washing exhaust, carpark exhaust and toilet exhaust ductwork for the retail and restaurant tenancies.

Item	Size LxW	Usage
Riser 1	5.0mx2.5m	• Carpark exhaust riser 1, • Boiler Flue's • Future chilled and Hot water to Level 1
Riser 2	5.0mx2.5m	• Carpark exhaust riser 2 • Electrical
Riser 3	5.0mx2.5m	• Kitchen exhaust ductwork • Dish wash/general exhaust
Riser 4	5.0mx2.5m	• Kitchen exhaust ductwork • Dish wash/general exhaust • Toilet Exhaust

1.7 OPTION SUMMARY

Project Costing Summary and Geothermal Payback

	OPTION 1 AIR COOLED CHILLER	OPTION 2a GEOTHERMAL	OPTION 2b WATER COOLED CONDENSER
Energy Tariff			
Peak ($/kW) *(20 year mean)*	$0.20	$0.20	$0.20
Off-Peak ($/kW) *(20 year mean)*	$0.12	$0.12	$0.12
Water Tariff			
Water Supply ($/m3) *(20 Year Mean)*	$2.40	$2.40	$2.40
Water Waste ($/m3) *(20 Year Mean)*	$2.45	$2.45	$2.45
Car Parking			
Car Parking Spot *($/year)*	$20,000	$20,000	$20,000
Energy Usage (p/a) *(kW/hrs)*	220,500	144,000	175,750
Off-Peak Energy Use (p/a) *(kW/hrs)*	73,400	40,300	56,500
Energy Costs	$58,780	$36,860	$46,450
Water Supply+Sewer Costs	$0	$3,680	$13,820
Car Parking ($/spot)	$40,000	$0	$40,000
Maintenance	$6,000	$5,000	$6,000
Plant Operational Costs P/a	$104,780	$45,540	$106,270
Capital Cost	$1,100,000	$1,400,000	$1,100,000
Against Option 2b			
Simple Payback *(Years)*		**4.94**	
Payback Years *(Not concidering Car parking)*		**14.47**	

Notes;

Payback and costings based on preliminary mechanical budgets.
Option 1 will require a larger space for outdoor plant resulting in a loss of 1 parking spot.
Option 2 will require a larger space for outdoor plant resulting in a loss of 2 parking spots.
Waste water rate is calculated at 80% of actual to allow for run off on site.

1) Allow an extra $205,000 to provide air cooled provisions for future air conditioning to a 2700m² office on Level 1.
2) Allow an extra $295,000 to provide water cooled provisions for future air conditioning to a 2700m² office on Level 1.

1.7.1 Air Conditioning Option Summary

Options	Capital cost ($)	Energy consumption (KWhr/annum)	Water consumption	Maintenance ($ per annum)	Life Span (Years)	Plant Space (m2)
1- Air cooled System	1,100,000	293,900	Nil	$6,000	25	120m2 + 60m2 External Plant
2a- Water Cooled Geothermal	1,395,000	184,300	Low	$5,000	25	130m2 + 20m2 External Plant
2b- Water Cooled Wet/Dry Cooler	1,100,000	232,250	Low	$6,000	25	130m2 + 37m2 External Plant

Based on the assessment carried out by Umow Lai, we recommend the water cooled chiller plant Option 2a be implemented as it provides the best long term benefit for the Sydney Fish Market in relation to plant space, water and energy savings. Life expectancy for both options is 25 years. Risk of Legionella is eliminated for both options as the condenser water system for option 2 would be via a Geothermal closed loop.

The water cooled option will required less maintenance work and will reduce issues associated with corrosion from salt laden air. Corroded coils reduce the efficiency of the system which over time will result in increased energy costs. Replacing the coil becomes expensive for additional material and labour costs. Equipment downtime would result in tenanted spaces without air conditioning.

The mechanical ventilation system costs are factored into each option.

1.7.2 Refrigeration Option Summary

Options	Capital cost ($)	Energy consumption (KWhr/annum)	Water consumption	Maintenance ($ per annum)	Life Span (Years)	Plant Space (m2)
1-Tenant Supplied Systems	Builders Works and Spray Water System By Others	By Tenant	Low	By Tenants	N/A	Spaces Integrated Into Building
Central Refrigeration Plant	$480,000	550,400	Low	$6,000	25	Internal-300m² *External 60m²*

The central refrigeration plant (Option 2) would provide a very high initial cost which would be paid back over time based on tenant usage. The main benefit for the central refrigerant plant is that it would require significantly less power to operate when compared with Option 1. This however, is not factored into the payback as the tenants pay for there own electricity consumption.

Back up power generation for the tenants refrigeration plant will not be available.

Tenants will be required to provide their own back up generation for their refrigeration equipment.

Option 1 would locate tenant supplied refrigeration units on roofs, mezzanine platforms and specifically designed into the carpark exhaust plenum. This would provide the following benefits;

- Refrigeration equipment is supplied and installed by tenants;
- Tenants maintain there own equipment;
- Service and repairs for the refrigeration equipment will be by the tenants; and
- Plant space required for services on the ground floor and carpark roof level is reduced, increasing the buildings net let able area.

Based on the above benefits Umow Lai would recommend refrigeration Option 1 be taken.

1.8 ADDITIONAL OPTIONS CONSIDERED

The following were considered but deemed not appropriate.

1.8.1 Tri-generation

Consideration was given for a tri-generation plant to provide electrical power and some cooling to the central air conditioning plant. Preliminary analysis indicates that the central air conditioning plant would provide insufficient base load requirements with an unstable demand profile making it unsuitable for connection to the tri-generation plant. (There is minimal to zero load requirements in winter)

As noted in section 2 of the mechanical report the existing R22 central refrigeration plant serving the main building and retail outlets provides a base load requirement that is of sufficient scale with a relatively stable demand profile which makes it suitable for connection to the tri-generation plant in island mode.

Diagram below shows the typical tri-generation schematic. Tri-generation is most effective when used on a consistent demand to avoid dumping unused heat and running the system at low efficiency.

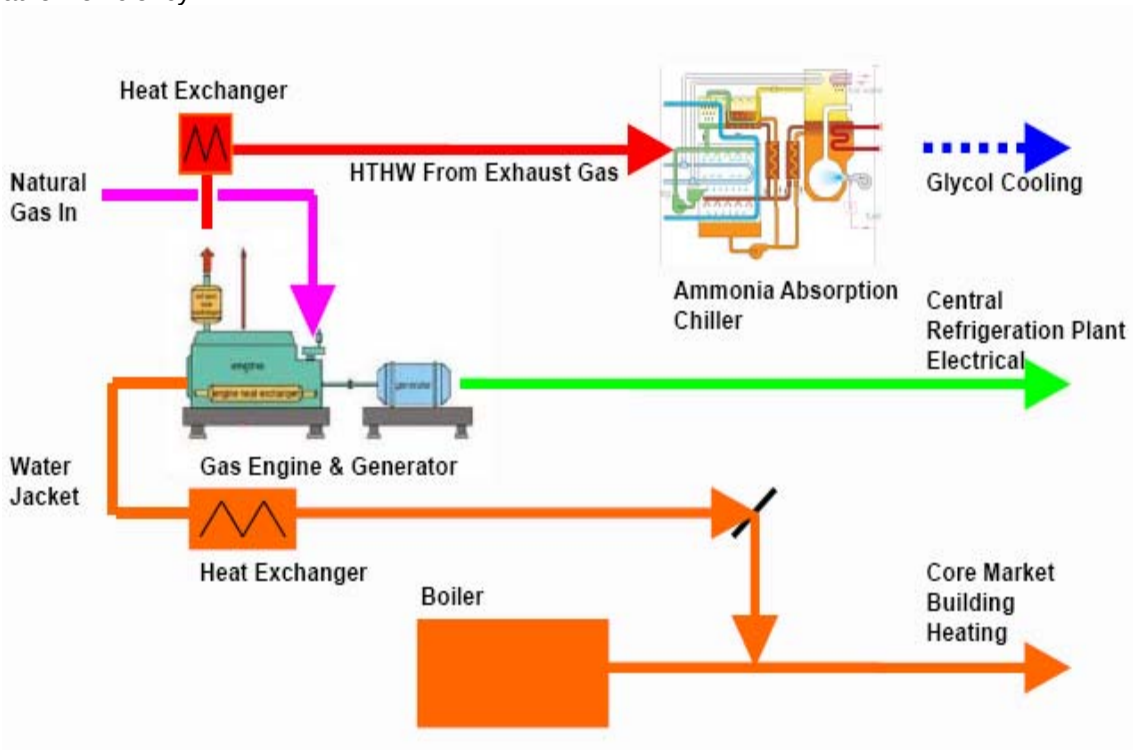


Figure 1 *Schematic of a Tri-generation system*

1.8.2 Anaerobic Digestion Plant

An anaerobic digestion plant generates electricity and heat by burning off the methane that it produces. This is a highly beneficial process as the methane has 21 times the global warming potential of carbon dioxide. Although the industry is in it's infancy in Australia. This technology appears to be the future for waste management.

The use of an anaerobic digestion plant producing "bio gas" is made feasible when combined with a tri-generation plant or system which requires large quantities of natural gas such as large boiler plant or gas fork trucks.

As there is currently no major requirement for natural gas for the site anaerobic digester was not practicable.

1.8.3 Harbour Water Heat Rejection

Geothermal heat rejection was preferred to Harbour heat rejection for the following reason;

- Heat rejection performance may be effected due to low water depths and the circulating current within Blackwattle bay. A performance study would need to be conducted.
- Approval from authorities appears to be “difficult” to obtain.
- Installation costs of Geothermal would be similar to river heat rejection.
- Geothermal is virtually maintenance free while river heat rejection requires regular maintenance involving scuba divers cleaning out centrifuge filters, pipe inlet and outlets etc.

2 ELECTRICAL SERVICES

2.1 DESIGN SUMMARY

The installation will generally comply with:

a) The Building Code of Australia.

b) Relevant Australian and International Standards and Codes.

c) NSW Service and Installation Rules.

d) Other requirements of regulatory authorities having jurisdiction over the works.

The design of electrical services must consider the following factors:

a) Quality of workplace environment.

b) Environmental and ecological sustainability.

c) Life cycle cost optimisation.

d) Avoidance of obsolescence.

2.2 ENERGY AUSTRALIA SUBSTATION AND CABLE RETICULATION

The area to be redeveloped is presently supplied by EnergyAustralia chamber substation No. 2179, located at the south-east corner of the retail building on Banks Street. The existing substation is rated to 1270A and has had a maximum demand reading of 1024A. It has insufficient capacity to support Stages 2-4 of the development.

Application for supply has been made to the relevant authority, EnergyAustralia, for the provision of an upgraded electrical service to the proposed development. Additional substation requirements are subject to final determination by EnergyAustralia. It is anticipated that new substation(s) and associated high voltage easements will be required to serve the redevelopment.

Existing EnergyAustralia underground cabling runs underground on the west and east sides of Bank Street (EA Drawing E18268221_GMLA0 refers). The underground cabling consists of direct-buried cables and cables enclosed in conduits. EnergyAustralia conduits cross Bank Street in the vicinity of substation No. 2179 and near the north-east corner of the main Fish Market building. Existing pits on the east side of Bank St may require relocation in order to align with the proposed surfaces. It is envisaged that existing aerial cabling to the east of the Stage 2/3 area, identified in the Arboricultural Assessment (2002), will be made redundant by the redevelopment.

2.3 MAIN SWITCHBOARD AND POWER FACTOR CORRECTION

The existing main switchboard is located in a switchroom adjacent to the existing substation No. 2179. Current transformer (CT) chambers and protection devices for submains to tenancies are generally mounted directly on the wall.

Existing electrical distribution is generally arranged as follows:

1. Submains to the building adjacent to the substation are derived directly from the main switchroom with metering located in the main switchroom.

2. Submains run from the main switchroom to two(2) feeder pillars located near the north-east corner of the main fish market building, from which submains run to a meter cupboard adjacent to the "Claudio's" building. Electricity retailer metering is located in the cupboard. Submains run from the meter cupboard to tenants located at the south-west corner of the area to be redeveloped and supplies the existing wharf (including security) services located near the north-west of the site.

3. Submains run from the main switchroom to external meter panels mounted on the eastern face of the "Doyle's" building. Tenants within the building, as well as boom gates and CCTV camera(s), are supplied from the meter panels.

The existing electrical distribution is generally beyond its economic life and will generally be removed.

New main switchboard(s) will be constructed. Surge diversion will be provided to reduce the risk of damage resulting from lightning strikes and other transient overvoltages.

Connection terminals will be provided at each main switchboard for the connection of temporary standby generator(s) during supply failures.

Electricity retailer metering will be provided for each main switchboard. Tenants will not be provided with separate electricity distributor-owned metering but will be provided with submetering for billing by the landlord.

Power factor correction will be installed within the main switchroom to ensure compliance with the NSW Service and Installation Rules.

Temporary electricity supplies will be provided to the proposed Stage 1 area, derived from the existing main switchroom, subject to EnergyAustralia approval.

2.4 SUBMAINS

Submain cables shall generally emanate directly from the main switchboard and meter panel to their respective distribution boards and mechanical control panels. Fire-rated cables shall be provided where necessary to comply with AS/NZS 3000 and the Building Code of Australia.

2.5 DISTRIBUTION BOARDS

Each landlord distribution board and substantive mechanical and hydraulic switchboard will be provided with kWh sub-metering to enable building managers to fine-tune operational procedures to minimise consumption and to detect operational problems early.

Submetering will be interfaced to a remote meter reading system for ease of monitoring and billing.

Each tenant will be provided with a distribution board as nominated in the tenancy fitout guide. Upgrades of submains and distribution boards following construction will be at the tenant's own cost.

2.6 SMALL POWER AND MISCELLANEOUS SYSTEMS

Socket outlets and isolators will be provided to the new building. The installation must comply with AS/NZS 3000.

One double socket outlet will be provided within each tenancy adjacent to the tenant's distribution board.

2.7 LIGHTING

Internal and external lighting shall be provided to comply with the requirements of AS 1680 and AS/NZS 1158.3.1.

Light sources shall be energy efficient and provided with the appropriate colour rendering. Maintained illuminance values will be designed to meet AS 1680. High-efficacy linear fluorescent lamps will be installed within the building. Possible use of LED lighting will be investigated at the detailed design stage. Ballasts are to be electronic wherever possible.

Automatic switching in conjunction with daylight sensing will be employed wherever practicable to minimise energy consumption.

Security and access lighting will be installed at the building perimeter. External lighting will generally consist of high-efficacy light sources controlled by photoelectric cells and timeclocks. Feature lighting will be installed at main pedestrian entrances.

Covered carpark lighting will consist of fluorescent luminaires with polycarbonate diffusers. Covered carpark lighting will be controlled via presence detection and/or timeclock. External carpark lighting will be controlled via photoelectric cell combined with timeclock and/or presence detection.

Lighting within tenancy shell spaces will generally consist only of one fluorescent luminaire located near the front of the tenancy.

2.8 EMERGENCY ESCAPE LIGHTING AND EXIT SIGNS

A new emergency escape lighting and exit sign system will be provided to new areas to comply with the requirements of the BCA and AS/NZS 2293.

Emergency luminaires will generally consist of non-maintained self-contained units. Exit signs will consist of maintained internally-illuminated self-contained fittings.

Manual emergency light test switches with timeclock controls will be provided at each landlord distribution board.

2.9 UNINTERRUPTIBLE POWER SUPPLIES

Uninterruptible Power Supplies (UPS) will be not be provided as part of the construction project. Any UPS units required for communications racks will be supplied and installed by the Principal.

2.10 VOICE AND DATA SYSTEMS

2.10.1 Voice Systems

Telstra pits and conduits are located in the Bank St footpath that runs adjacent to the east side of the proposed Stage 2/3 building and at the north end of the site (Telstra Sequence No. 18268218 refers). Telstra conduits to individual customers on the site run directly from the Telstra pit/duct network to their respective tenancies. Each existing tenant has its own Telstra service connected directly to Telstra's network via underground conduit.

The existing two(2) Telstra pits and the associated pit/duct system located adjacent to the Stage 2 and 3 areas will require renewal, due to damage from nearby trees and changes to the surface levels.

An Intent To Develop (ITD) application has been made to Telstra for the redevelopment. A 200-pair Telstra lead-in cable has been requested for an MDF located within a communications cupboard within the new Stage 2/3 building.

2.10.2 Data Systems

The existing tenants are not provided with data services from the main fish market building. Any existing data services for the tenants originate directly from the telecommunications carriers' networks.

A communications cabinet will be provided within a communications cupboard in the new building. Optic fibre backbone cabling will be provided from the main Fish Markets Building to the new rack. Category 6 and/or optic fibre cabling will be provided from the communications rack to CCTV cameras.

Data cabling will not be provided to tenancies as part of the development.

2.11 LIGHTNING PROTECTION

A lightning protection system will be provided to cover the building as required to meet AS/NZS 1768:2007.

2.12 SECURITY

The building will be provided with electronic intruder detection, CCTV and access control as ultimately briefed.

The existing site's IP CCTV system will be extended to the new development.

3 VERTICAL TRANSPORTATION SERVICES

3.1 DESIGN SUMMARY

The redevelopment will include the provision of passenger lifts for compliance with disabled access requirements and for general movement of persons and goods. The lifts will be suitably durable for general commercial and retail activities.

The lifts will serve each occupied floor of the new construction.

4 HYDRAULIC AND FIRE SERVICES

4.1 AUTHORITIES/INFRASTRUCTURE

The site appears adequately serviced by existing Sydney Water Authority sewer and water main services. Further advice regarding necessary upgrade works or developer required contributions will be advised further to the lodgement of a Section 73 Notice of Requirements. Natural gas services to the site appear adequate for the existing and proposed future loads however confirmation from the gas authority is required to corroborate this advice. Stormwater mains adjacent the site will require Authority advise (subject to future submissions of technical details) a new stormwater discharge point to the harbour is envisaged for servicing this development. The relevant Authorities will advise of any required upgrade works.

Hydraulic & Fire services designs for the Sydney Fish Market project will be in accordance with the relevant Sydney City Council Requirements, Sydney Harbour Foreshore Authority, Maritime Services and miscellaneous Works (DCP-2002), and with the Building Code of Australia BCA .

4.2 REGULATIONS

The hydraulic services will be designed in accordance with the current versions of the following Australian Standards and publications as a minimum and with due regard to cost viability: -

AS 1221	Fire Hose Reels
AS 1428	Design for Access and Mobility
AS 2118.1	Automatic Fire Sprinklers Systems
AS 2419.1	Fire Hydrant Installations
AS 2441	Installation of Fire Hose Reels
AS 2444	Portable Fire Extinguishers and Fire Blankets
AS 2941	Fixed Fire Protection Installation – Pumpset Systems
AS 3500.0	Glossary of Terms
AS 3500.1	Water Services
AS 3500.2	Sanitary Plumbing and Drainage
AS 3500.3	Stormwater Drainage
AS 3500.4	Heated Water Services
AS 5601	Gas Installations
NSWCOP	Plumbing and Drainage
HB 230	Rainwater Tank Design and Installation Handbook.
AS 1668/AS 1670	Fire Detection and Alarm Systems
AS 2220	Emergency Warning & Intercommunication System

4.3 BACKFLOW PREVENTION DEVICES (B.F.P.D.)

BFPD's will be provided in the following locations in accordance with Section 4 of AS3500.1.2003: -

- Property Containment through the installation of a Reduced Pressure Zone Device to the existing water meter located in the plant room in level 1 of the existing Sydney Fish Market Building and individual containment to the new subsidiary water meters at the proposed restaurants and wholesalers.

4.4 ZONE PROTECTION AND INDIVIDUAL PROTECTION

- Individual Protection (Hazardous fixture) e.g. hose taps near grease trap/s.
- STW reuse tank make-up.

  N.B Tundishes are to be provided under the exhaust ports of Reduced Pressure Zone Devices (RPZD) to prevent damage to finished floor finishes.

- Connections to mechanical plant

4.5 COLD WATER SERVICE

The cold water supply for the project will feed from the current 100mm tee and valve plus 80mm water supply to the existing Fish Market building located underneath loading dock 1, subject to advice received in the Section 73 Notice of Requirements. It is proposed that each tenant, restaurant and wholesale property be fitted with a water meter that is data logged back to a central data read point.

The potable cold water service will be constructed from copper piping and copper/brass fittings.

Pressure limiting valves will be utilised so that water pressure will not exceed the 500kPa maximum stipulated in AS 3500. Flow control devices will be fitted to taps at WELS recommended flow rates for each fixture type.

Valves will be used to isolate groups of fixtures in accordance with AS 3500.

Internal water supply pipe work will be located in ceiling spaces with droppers to amenities and wet areas below. Isolation valves will be located for easy access.

Non-food retail tenancy areas will be supplied with 20mm cold water provisions. Isolation valves will be located 300mm-450mm above finished floor levels of retail tenancies with individual water meter assemblies.

Food retail tenancies will be supplied with a 25mm cold water supply provision. Isolation valves will be located 300mm-450mm above finished floor levels of retail tenancies and be fitted with individual water meter assemblies.

4.5.1 Existing Infrastructure

Currently the water usage at the Sydney Fish Market is 230 KL/day and the expected requirement for the proposed development is an additional 270 KL/day. This will give the site at total daily water requirement of 500 KL/day. As previously stated we have lodged an informative Section 73- Notice of Requirements which will confirm whether a new connection to the existing sites water supply is possible or whether the Sydney Water main will require amplification.

In order to reduce PCW consumption a STW reuse system is proposed as decribed under 4.9 rainwater reuse system.

4.6 GAS SERVICE

4.6.1 Property Service Isolation Valve

The gas supply to the new development is proposed to be fed via the existing Natural Gas supply to the site. The natural gas supply to the individual tenants will be complete with isolation valves and subsidiary meters that will be pulse emitting, Data logger system meters monitored back to the Fish Markets existing Master Data logger system. A gas service will be provided with adequate provision to accommodate hot water plant, mechanical plant, restaurants, tavern, tenants, wholesalers, etc.

4.6.2 Pressure Reduction Station (P.R.S)

A pressure reduction station may be installed to reduce high pressure down to low pressure. An over pressure shut off regulator (O.P.S.O.) which lowers incoming pressure needs to vent to open atmosphere. Due to the ventilation requirements the regulator assembly is generally located within a cupboard which can be ventilated directly outside the building (on the building perimeter). The O.P.S.O is not large but the P.R.S needs approx. 4m2 in footprint.

4.6.3 Meters (Master + Sub)

The location of the consumer billing meter (Master Meter) is level 1 in the existing Fish Market Building in the Plant Room. New sub meters are to be ventilated by natural ventilation from outside, an adjacent room or mechanically. Additional meters will be required at branches to points of use (sub-meters). Sub-meters shall be magnetic pulse type and be fitted with data cables to a central data logger reading point as per hot water meters.

Gas sub-meters will be provided for in the ground level food retail tenancies and level two restaurants via a pipe service and plugged isolation valve which is to be located 300mm-450mm above tenancy floor level. Sub meters shall also be provided to the tenancies out front on harbour side of the main building and at the hot water plant.

4.6.4 Pipework

Pipework within the property is to be constructed from copper tubing (Type B) in accordance with AS 5601-2004 (Section 3) and signage attached indicating gas type and pressure.

4.6.5 Gas Safety Shutoff System

As the project will be sprinkler protected a gas safety shutoff system will be interlocked to the natural gas supply system such that in the event of a fire alarm the gas service will be shutdown.

4.6.6 Existing Infrastructure

There is currently 2 x 50mm Gas Meters located at the existing site. One is located in the plant room on level 1 of the existing Fish Market Building and the other located near the edge of existing sea wall at the Pier Head. The gas supply to the Meters is high pressure.

4.7 HOT WATER SERVICE

4.7.1 Hot Water Units- Geothermal Option

For details refer to Mechanical Section 3.3. Option 2.

Geothermal for hot water pre-heat uses the same principle as the geothermal heat rejection detailed in Mechanical Section 3.3, however a refrigerant gas will be used for the ground loop instead of water.

4.7.2 Hot Water Pipework

Hot water pipework shall be constructed from copper tube and insulated in accordance with AS 3500.4. A hot water flow and return reticulating pipe system will be used complete with dual hot water circulating pumps and balancing valves. Pumping systems will be connected to a control panel allowing stand-by/duty pumps with automatic change over at 24 hour periods. Time clocks with hours run meters for each pump are to be incorporated.

4.7.3 Hot Water Temperature Control

Provisions will be incorporated to control hot water temperatures at fixture outlets in accordance with AS 3500.4 Section 1.9.

4.7.4 Hot Water Metering

Hot water meters will be located at branch take off points for each tenancy as described for gas meters. All hot water meters will be of the magnetic pulse type and be fitted with data cable to a remote meter reading point (data logger). A separate phone line shall be provided to the metering area allowing meter reading via phone/modem facility.

4.8 RAINWATER REUSE SYSTEM

4.8.1 Rainwater - Clean

Run-off from the awning area above level 1 shall be collected into a storage tank to be located at Ground Level below the proposed Tavern.

Rainwater will potentially be reused for W.C. flushing and wash down of wholesale area. A Rocla Volume Filter will be provided before the tank inlet to ensure the quality of the stored water.

The calculated clean water requirement for W.C flushing amounts to approximately 8,300L per day plus an additional 5000L per day of clean required for the hose down of wholesale areas. This is a daily clean water requirement of 13,000L and allowing for duration between suitable rainfall events, a 10 day storage requirement of 100,000L is recommended. Due to the limited clean catchment of the new development however, a water balance assessment indicates the clean rainwater storage should be reduced to 100,000L. A 260,000L tank would very rarely ever fill up, hence would not be cost effective.

4.8.2 Stormwater

Run-off from the level 3 Car park and driveway ramp shall be collected into a storage tank to be located at Ground level below the proposed Tavern parallel to the clean water tank. This stormwater will potentially be used for irrigation of foreshore area, promenade, hosing down of the truck service lane, grease arrestor and loading dock wash down plus cooling of condensers in the mechanical service duct.

The calculated stormwater requirement for re-use is approximately 10,000L per day for irrigation and hose down purposes plus 10,000L per day for the cooling of condensers. This amounts to a daily requirement of 20,000L and a recommended 20 day storage requirement of 400,000L. Further to a water balance assessment it was found that a storage volume of 400,000L is viable.

4.9 SIPHONIC STORMWATER DRAINAGE

A siphonic drainage system comprising of gutters, rainwater outlets and downpipes will be used to drain the Level 4 carpark and the awning above Level 2 outdoor area.

4.9.1 Existing Infrastructure

We propose Sewer drainage to gravitate from fixtures, stacks, etc. and further to the Authority's 300mm sewer main located underneath the existing car park driveway in Jones Street. Again this will be subject to the outcome of the Informative Section 73- Notice of Requirements. There section of exiting sewer drainage that is located under the proposed building will need to be relocated.

4.10 SANITARY PLUMBING

A gravity system is to be utilised with wastewater discharging to the sewer drainage system. A system comprising stacks and vents will be used to convey waste from fixtures to the sewer drainage. Air admittance vents will be specified to reduce the cost of the branch/group vent piping component of the plumbing system.

A 100mm sanitary connection point will be provided to each retail wholesale and restaurant tenancy.

Main vents will discharge to atmosphere and terminate 3 metres above Level 4 carpark.

4.11 SANITARY DRAINAGE

Pipework material: PVC-U.

Vents will discharge to atmosphere and terminate 3 metres above Level 4 carpark.

4.12 TRADE WASTE (PRE-TREATMENT)

Pre-treatment shall be provided comprising the following items: -

(a) Stainless steel basket trapped arrestors, with removable primary SS baskets.

(b) Dry Basket Arrestor pit for the Oyster Bar.

(c) Grease arrestor (capacity subject to final loading) provisionally 5000litres x 4.

Grease waste drainage shall be constructed with high-density polyethylene pipe (H.D.P.E.) with electro fusion joints to be used.

4 x 5000L Grease arrestors are to be located at ground level. Two Grease arrestors will be located in close proximity to the future tavern area and two Grease arrestors will be located in the Loading dock area. A Suction line is to be provided complete with `Kam-lok' connection to allow truck maintenance.

Stainless steel bucket trap floor wastes are to be provided in the Service lane on Level 1 to allow collection of floor wash down waste water.

Stainless steel bucket traps with removable primary strainer baskets are also to be used in garbage collection/storage areas and at points within all areas requiring trade waste drainage.

A Ø100 trade waste connection point will be provided to each proposed retail, wholesale and restaurant area.

4.12.1 Existing Infrastructure

Currently there are four existing Grease Arrestors serving the Fish Market. The Total capacity of the Grease Arrestors is roughly 14,000L. Two of the existing Grease Arrestors will be removed as they are serving tenants located next to Jones Street which will be demolished as part of the redevelopment. The redevelopment will require an additional 4 x 5000L Grease Arrestors which is a total of 20,000L in Grease Arrestor storage volume.

A Trade Waste Agreement between the Owner and the controlling Authority shall be entered into at the Design Stage. The Agreement shall include any arrangement for removal of prohibited materials such as grease generated by a kitchen or takeaway food shops where cooking takes place.

4.13 SANITARY WARE AND TAP WARE SCHEDULE

All fixtures shall be 1st quality free of manufacturing imperfections and equal to Caroma Leda 2000 back inlet smartflush suites and Caroma Leda Vasque vanity basins.

Colour of sanitary ware fixtures and toilet seats shall be white. All fixtures shall be 5-star wells rated.

Finish to tap ware will be satin chrome incorporating sensor taps (movement sensor activated) or push button timer tap ware. All tap ware will be fitted with flow control devices equal to the highest available approved WELS rating scheme. Individual isolation valves at each fixture shall be provided for ease of maintenance purposes.

4.14 LIST OF ASSUMPTIONS

- Water stored in the car park, courtyard and promenade rainwater tank will be utilised for the wash down of the Truck service lane. Due to the likely pollution of this area with oils and possibly fish waste recycled stormwater is preferred to be used in this area for wash down to prevent the wastage of clean rainwater. We believe that the vast majority of trucks entering the service lane will be in the morning so the service lane wash down will be after hours when the area is the least populated.
- Due to the probability of large scale bird faeces and limited space on level 3 we believe the Geothermal option for Hot Water is preferred to Solar. This option uses the ground and is not effected by bird pollution.
- Total Grease Arrestor storage will be a maximum of 20,000L to avoid the required installation of a Dissolved Air Flotation Filtration (DAFF) Plant. Currently the maximum Grease Arrestor storage volume for a site to avoid the installation of a (DAFF) plant is 30,000L however it is expected that in coming months Sydney Waters Trade Waste Department will introduce a new regulation allowing a maximum of 20,000L Grease Arrestor storage volume per site. Trade Waste storage exceeding 20,000L at any site will require the installation of a (DAFF) plant.

4.15 FIRE SERVICES

4.15.1 Fire Hydrant System

Hydrants will be provided in accordance with BCA E1.3 'Fire Hydrants' (a) (i) (Building >500m2 in total area). The hydrant service is to be fed from the existing 100mm Fire Hydrant connection currently serving the Fish Markets existing car park/wharf area. The existing Fire Hydrant Booster assembly will need to be upgraded and relocated to satisfy the requirements AS2419.1-2005. The installation will be provided with a Double Detector Check Valve assebly to achieve Backflow Prevention requirements as per AS 2419.1- Fire Hydrant Installations and NSWCOP. This Fire Hydrant connection will be used to supply both the existing Sydney Fish Market and the proposed new development. A new Block Plan of the Fire Hydrant system will be provided for the entire site.

Hydrants will be located on the landing at each level within fire stairs for access by the Authorities (Fire Brigade). Where adequate coverage cannot be achieved, additional Fire Hydrants will be provided as necessary.

Coverage is generally required by a 30m hose extending from the hydrant outlet, with a minimum 1m of hose extending into all rooms. Complete coverage must be achieved from a 10 metre spray being issued from the outlet nozzle fitted to the end of the hose (30m hose + 10m of direct spray). The hose length is to be measured around all partitions.

Hydrants (attack hydrant unassisted) are to have a minimum 700kPa residual pressure (NSW) and a maximum 1200kPa residual pressure while issuing the minimum required flow rate (10L/s per required outlet).

A Diesel Hydrant booster pump will be required.

4.15.2 Fire Hose Reels

FHR's will be provided in accordance with BCA E1.4 'Fire Hose Reels' (Buildings>500m2 fire compartments and as required by Authorities)

Coverage from a FHR is 36m and they are to be located <4m from an exit (generally the fire exists). FHR's are normally located within a cupboard and within painted cabinets to carpark & retail areas.

FHR's are to have a minimum pressure of 220kPa and a minimum flow of 0.33 l/Sec.

4.15.3 Fire Sprinklers

A wet pipe sprinkler system will be provided on level 1 & level 2 of the building. The sprinkler system will be fed from the existing Fire Hydrant connection currently serving the main Fish Market building. A new Fire Sprinkler Booster will be provided adjacent to the proposed new fire Hydrant booster that will be complete with a Backflow Prevention Device and utilised only for the Fire Sprinklers in the new Fish Market development.

4.15.4 Fire Detection and Alarm Systems

High sensitivity below ceiling smoke detectors, analogue/addressable type are to be installed on level 3 & level 4 (yet to be confirmed with BCA consultant) and as part of the mechanical smoke hazard management system.

Smoke detectors will be photoelectric type with sensitivity not greater than 5%ob/m. Smoke detectors associated with air pressurisation systems will comply with AS 1668.1.

An analogue/addressable Fire Indicator Panel will be provided in the Fire Control Centre.

The fire detection system will transmit to the Fire Indicator Panel, NSW Fire Brigades, door closing control mechanisms, Emergency Warning System and mechanical air pressurisation systems.

4.15.5 Sound System and Intercom Systems for Emergency Purposes (SSISEP)

A Sound System and Intercom Systems for Emergency Purposes (SSISEP) will be provided throughout the building. The SSISEP system sound level will achieve a minimum 10 dB(A) above the ambient background noise level to be achieved throughout the building. The sound level at any point will not be less than 65 dB(A) nor greater than 105dB(A).

The typical floor will be provided with 100mm recessed warning speakers, basement and carpark levels will be provided with horn type warning speakers. A warden Intercom Point (WIP) will be located at each level with the fire hose reel enclosure.

5 ECOLOGICALLY SUSTAINABLE DEVELOPMENT

This section presents a summary of ecologically sustainable development (ESD) principles that are recommended for the proposed Sydney Fish Market project. Most of these initiatives have been discussed in greater detail in the main body of the report.

5.1 PASSIVE BUILDING DESIGN

Passive design principles are vital in producing a holistically sustainable development, and if incorporated early into the design, do not add significant costs to the development. It involves using passive technologies and the natural local conditions to achieve enhanced operational efficiency. Passive design is the optimum method of reducing energy consumption, improving indoor quality and comfort, and delivering an overall sustainable development.

5.1.1 Building Fabric

An optimally designed building fabric is the most cost-effective way to reduce the size and the cost of mechanical and electrical services infrastructure as well as the operating costs of these systems.

The Deemed-to-Satisfy (DTS) provisions of the 2010 BCA Section J set out the minimum thermal performance requirement for building elements, including roofs, walls, floors and façade glazing. Bulk insulation material such as Bradford Glass wool Partition Batts, complete with reflective foil sarking, will be used to exceed the following Section J requirements.

Table 1 *BCA DTS building fabric requirements*

Building Element	BCA DTS Minimum R-value (W/m^2K)
Roof	3.2
Walls	2.8
Floors	2.0

5.1.2 Orientation & Façade Design

Due to the orientation of the building, horizontal shading will not be very effective on the prominent western facade, as the sun angle falls below the line of the shading.

Two methods are available to mitigate this effect of high solar loads on the western façade – high performance glazing or a system of vertical shading devices. The latter option may prove to be non-consistent with the architectural vision of the project. Hence, we recommend the investment in high-performance glass for the west façade. This will cost approximately 30% more than standard single paned clear glass. However, this will not only assist in satisfying the BCA Section J glazing requirements, but also significantly reduce the capital and energy consumption associated with the HVAC system.

We recommend the use of 6.38mm Viridian ComfortPlus clear glazing, with the following specification:

- U value of 3.6 W/m^2K
- SHGC 0.51

5.2 HEATING, VENTILATION AND AIR CONDITIONING

5.2.1 Natural Ventilation

Substantial improvements in both indoor air quality and energy efficiency can be achieved by an adaptive air-conditioning system. This system involves the use of sliding glass panels for the retail tenancies, which will then be integrated with the air-conditioning system.

When the outside ambient conditions are favourable, the sliding glass panels can be opened to allow natural air to ventilate the tenancies, and switching off the air-conditioning system. Throughout the year, this will significantly reduce the energy consumption associated with the mechanical HVAC system.

Figure 2 *Sample sliding glass panels precedents*

5.2.2 Chilled Water Systems with Geothermal Energy

As expounded in the Mechanical Services section of this report, a number of options for air-conditioning heat rejection are being considered for this project.

The most energy efficient option proposed is the water-cooled system, which involves the innovative use of geothermal technology for heat rejection. The plant consists of two duty/standby pumps and a water-cooled chiller configured with a separate condenser water loop to allow for geothermal heat rejection.

Geothermal heat exchange systems use the relatively stable and moderate temperature of the ground as an energy source. The system involves the drilling of 30 metre boreholes and running insulated refrigerant pipework to allow for a direct heat exchange with the ground. The system will be integrated with both the mechanical air conditioning and the domestic hot water supply systems, providing substantial free tempering.

The design of an individual tenant system is recommended over a central system, as the size of the site will require too long refrigerant runs, thereby reducing the system efficiency. Individual borehole, air-handling and hot water systems will be provided for each tenant, allowing for direct monitoring of the energy consumption of each tenant.

When combined with the natural ventilation system outlined previously, the overall air-conditioning system has the potential to only use electrical energy during peak load, thereby greatly reducing the total energy consumption.

'Direct Energy' are the main suppliers in Sydney and can provide the entire package of works – supply, install, commission and maintenance.

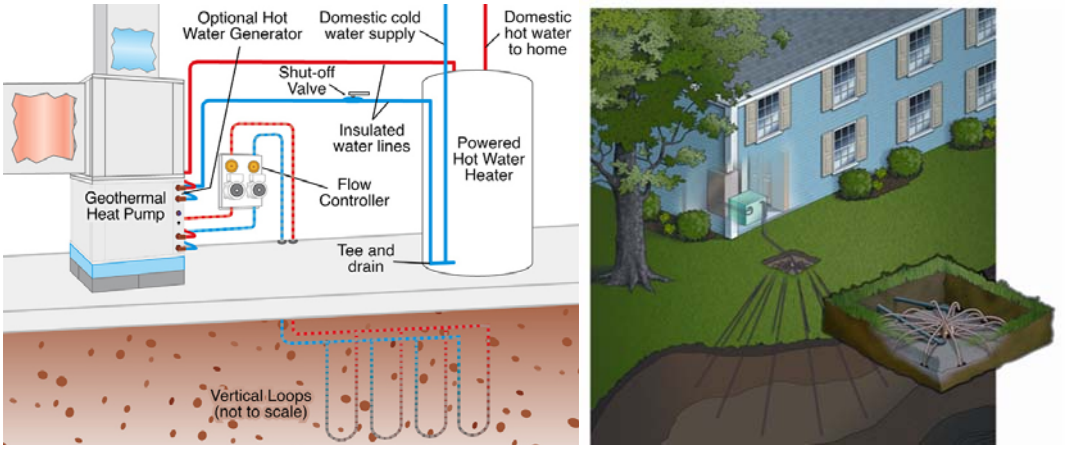


Figure 3 *Example geothermal thermal schematic and illustration*

5.2.3 Wind Turbine from Car Park Exhaust

Wind turbines work by generating power from an electrical turbine connected to rotor blades that revolve, powered by the wind. A novel idea that is currently under consideration by the design team is the use of the carpark exhaust system to power the wind turbine.

Being an innovative design, a number of technical issues are currently being worked through to determine whether the system is able to deliver electrical energy savings for the facility.

Figure 4 *Example geothermal thermal schematic and illustration*

5.3 ELECTRICAL SYSTEMS

5.3.1 Artificial Lighting

In addition to meeting the regulatory AS1680 and AS1158.3.1 requirements, luminaires will be high-efficiency T16 linear fluorescent lamps, which generally reduce electrical energy consumption by up to 20%.

High energy efficient LED lighting is recommended for toilet and corridor areas, in coordination with the architectural design.

5.3.2 Natural Day lighting

The rooftop car park will be zoned to allow for photoelectric daylight sensors control of perimeter zones. This will allow the pertinent light fittings to be switched off whenever there is adequate levels of natural daylight, thus reducing the electrical energy consumption.

General area lighting will also be controlled by photoelectric daylight sensors, in conjunction with timeclock and/or occupancy sensors.

5.3.3 Occupancy Detection

Occupancy detection control will be utilised in the internal car park areas as well as in corridor and toilet amenities.

5.3.4 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;
- Air handling fans;
- Heat pumps;
- Common area light and power; and
- Additional items which have a large energy use.

5.4 WATER SERVICES

5.4.1 Water Efficient Fittings

Only water efficient fixtures and fittings will be used throughout the project. This includes the specification of 5-star WELS-rated fixtures and fittings for water basins, water closets and urinals.

As they are fast becoming the norm, the purchase cost of these units is not substantially higher than conventional units and is easily repaid by the savings in potable water consumption.

5.4.2 Water Harvesting

Water harvesting to date has not been possible due to quality concerns. Among the water efficiency measures being considered are rainwater harvesting, with collection of run-off from the roof areas, and reuse of tenancy run-off. The design of the system must allow for substantial treatment and filtration of the collected rainwater.

Reused water can potentially be reused for toilet flushing, general and loading dock wash-down, irrigation and high-pressure roof wash-down. Substantial analysis will be required to control the wash-down processes to ensure that the currently significant demand for potable water is minimised, without jeopardising health standards.

5.4.3 Domestic Hot Water

Similar to the mechanical heat rejection, a geothermal loop with gas-fired boost is also recommended to provide domestic hot water. The system currently under consideration involves a separate loop for the domestic hot water that uses refrigerant as the working medium, thereby providing pre-heating all year round.

Furthermore, the use of natural gas provides greater environmental benefits over electric heating, as the greenhouse gas emissions are significantly lower for gas.

5.4.4 Water Meters

It is recommended that all major uses of water be metered in order to monitor and improve rates of water consumption. This includes central domestic hot water and domestic cold water, irrigation systems, rainwater system and food court water consumption.

By connecting the water meters to a BMS (building monitoring system), this will also function as a water leak detection system to prevent excessive amounts of wasted potable water.