Technical Feasibility Assessments and Concept Designs

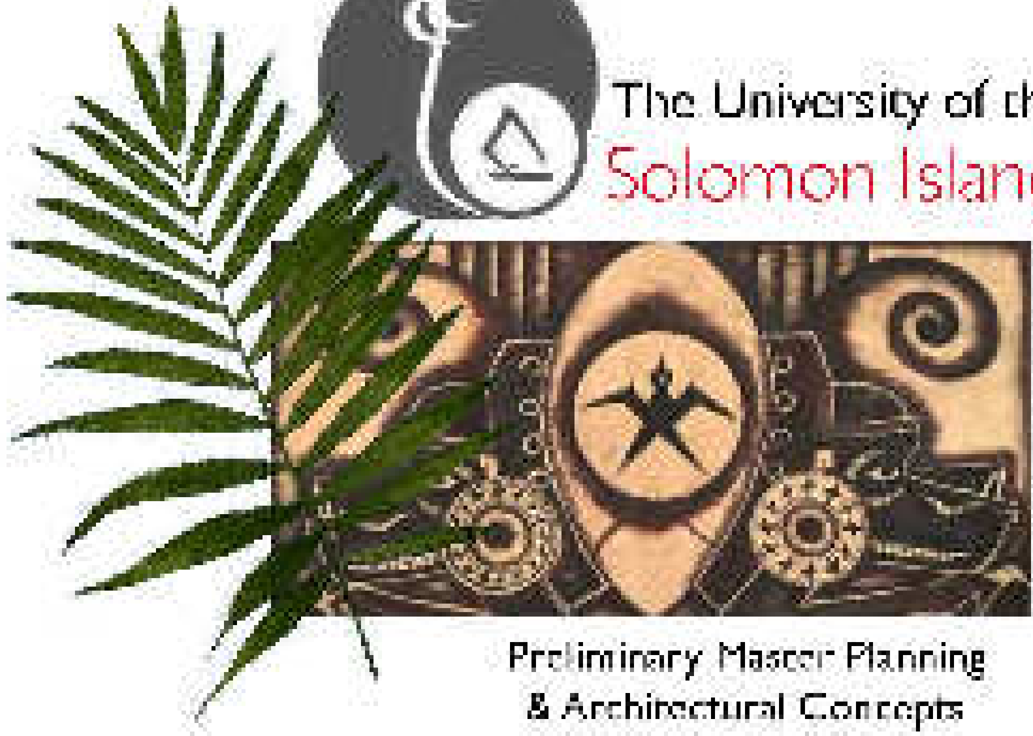
Project No: 42291-026
Date: September 2016

REG: Higher Education in the Pacific Investment Program (Tranche 2) – Solomon Islands USP Campus Development

Prepared by the University of the South Pacific and Beca for the Asian Development Bank.

The University of the South Pacific

Solomon Islands Campus



Preliminary Master Planning
& Architectural Concepts
September-April 2016

A R C H I T E C T S   P A C I F I C

Architects Pacific Limited 108 Amy Street PO Box 1171 Suva FIJI
Phone +679 330 3855 Fax +679 330 2174
L3, 26 Hobson St, PO Box 106 943, Auckland NZ
Phone +64 9 354 4743

mail@architectspacific.com
www.architectspacific.com

The Manager Procurement
The University of the South Pacific
Ground Floor – Administration Building
Procurement Office
Laucala Campus **By email**
Suva 11th March 2016

Dear Sir,

ARCHITECTURAL CONSULTANCY DESIGN FOR NEW SOLOMON ISLANDS CAMPUS - EOI 302/16
Expression of Interest

This submission is in response to your advertisement in the press seeking Expressions of Interest for the architectural concept design of the new Solomon Islands Campus.

For the purposes of this exercise we have put together the following team of consultants:

- Architects : Architects Pacific - Fiji and NZ
- Quantity Surveyors : Knapman Clark - Fiji and Brisbane
- Building Services : Temo Consulting - Fiji
- Structural and Civil : Kapadia Consultants - Fiji

Please note that Architects Pacific prepared the Master Plan and Architectural Concepts for the new SI Campus last year resulting in a review by BECA appointed by ADB.

Architects Pacific is a very well established firm of architects with offices in Fiji and New Zealand. We have completed many substantial and successful projects in the Pacific and overseas - particularly China, Nepal, Australia and New Zealand. Architects Pacific designed the new Fiji National University Nadi Namaka Complex and the University of the South Pacific AusAid Theatre and Tutorial Complexes at the Laucala Campus.

1. Office Profile

In recent years we have specialised in the master planning of large projects and some of these are featured in the Office profile appended to this submission.

2. Indicative Timeline for final design report submission

We expect that the work in this commission will take three weeks from date of confirmation.

3. Similar Architectural Work

The following projects undertaken and completed are a testimony to Architects Pacific's experience in institutional planning and in particular, a thorough knowledge of Master Planning and Architectural Conceptualisation.

- USP - SSED Buildings - what is now known as FALE
- USP - Faculty of Business and Economics known as FBE Buildings
- USP - New Administration Building - now housing the USP Central Admin
- USP – Kiribati Campus
- FNU - New Namaka Campus, Nadi
- FSM - New Library, Suva
- South Pacific Forum Secretariat – Ratu Sukuna Road Suva
- South Pacific Commission Complex, Noumea, New Caledonia
- New Nausori Hospital – Tender Stage
- Additions to Sigatoka Hospital
- The Reserve Bank Building, Suva

4. Specific Personnel for this Project

Stuart Huggett is Managing Director of Architects Pacific and has a wide range of experience and more importantly, and appropriately for USP, in Master Planning in recent decades. Stuart started his career in Fiji as the resident architect for USP projects under the Aid programme in 1969.

Adish Naidu is Senior Associate and Architect, is very familiar with the Solomon Islands proposed site and was the architect for the new USP Campus design in Tarawa completed at the end of September 2015. He is also very familiar with the proposed new Solomon Islands Campus project and was Director of Properties and Facilities at USP from 2009 to the end of 2014. He has a thorough knowledge of the requirements of USP and in particular, space planning for Learning and Teaching Facilities.

Amitia Huggett has recently become a Director of Architects Pacific and has a wide range of experience particularly in hospitality and Institutional projects. She has a Bachelors Degree in Architecture from University of New South Wales and a Masters in Architecture from University of Auckland.

5. Ability to deliver within Timelines

Architects Pacific with 20 staff, including six qualified/professional architects are well placed to deliver this project within a strict timeline. The confidence of having some of the best and most experienced architectural technicians is an added advantage on large-scale projects. Architects Pacific have recently delivered design and documentation to several large projects here and overseas - the new $38m Nausori Hospital, a new $50m Casino and Hotel in Nepal currently under construction and two, 100 and 200 room hotels in Nepal, recently documented.

The new Vinod Patel Shopping Centre Complex in Nadi is due to commence construction in three months. Recent commissions include a new resort in the Caribbean and the major reconstruction of a resort in Fiji.

Architects Pacific is in a position to handle projects of any size and with added assistance from our Auckland office makes work easier.

6. Experience with International Financial Institutions

We have worked on projects financed by institutions such as ADB, EU, NZAid and AusAid

7. Other Consultants

The consultants we have proposed working with us on this project – [illegible] Consulting, [illegible] and [illegible] Consulting are very well known to us and we have worked with them on several project in Fiji and overseas.

7. Fees

We propose the total fee for this work inclusive of the consultants fees above and for the scope of work in the ToR is **FJD$17,500 VEP.**

We understand that this TOR is for Concept Design only and, in the event USP awards this first stage to Architects Pacific we will not be precluded from bidding for other stages of the project in future.

8. Design/build

We have investigated the potential for a design/build approach to this project with a reputable building company and suggest that this approach could work well for USP given the stringent budget constraints and the simple nature of the buildings required. We can provide you with further information on this should you wish.

Please don't hesitate to contact us if you require any further information or clarification.

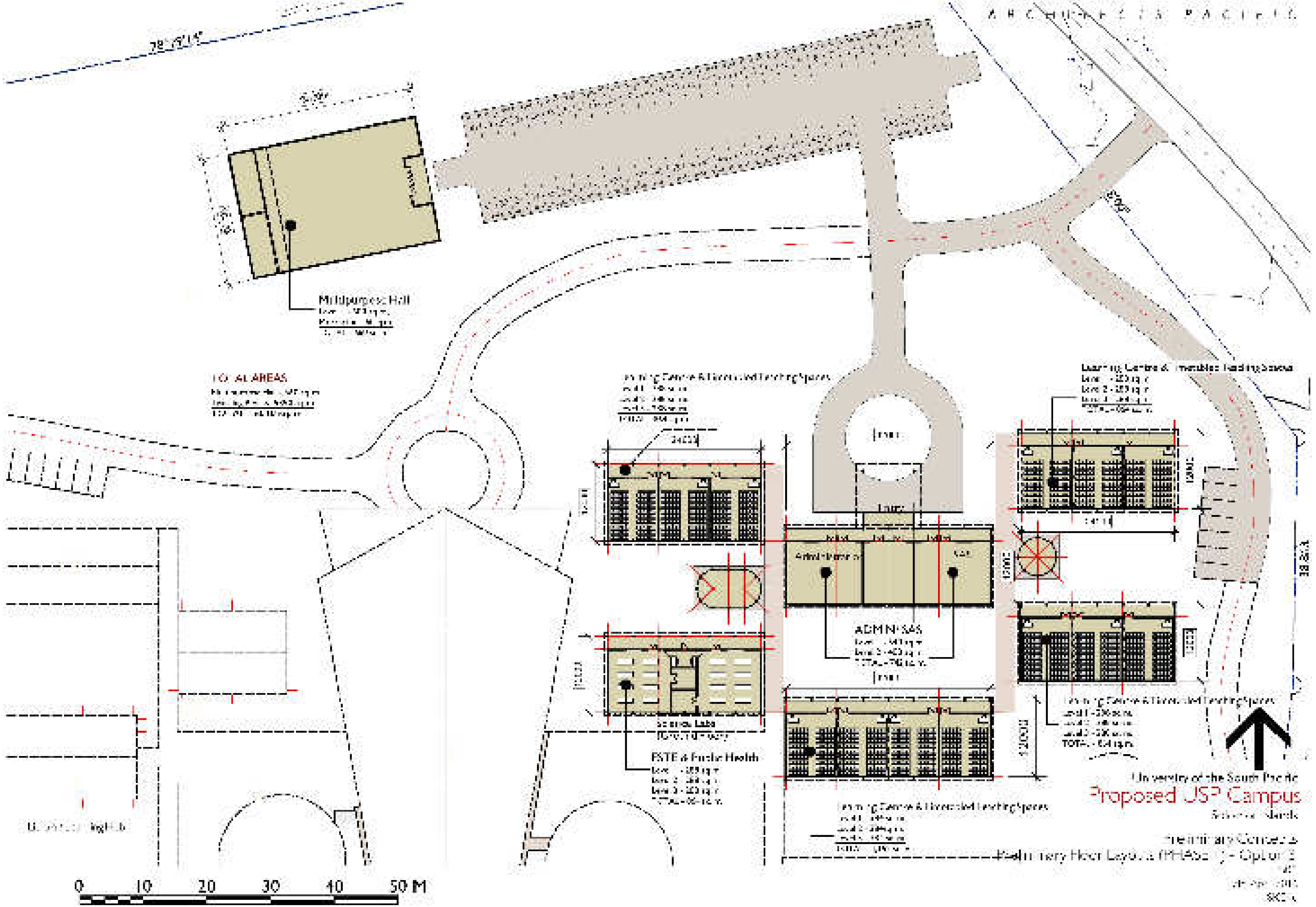
Thanking you in anticipation

Sincerely

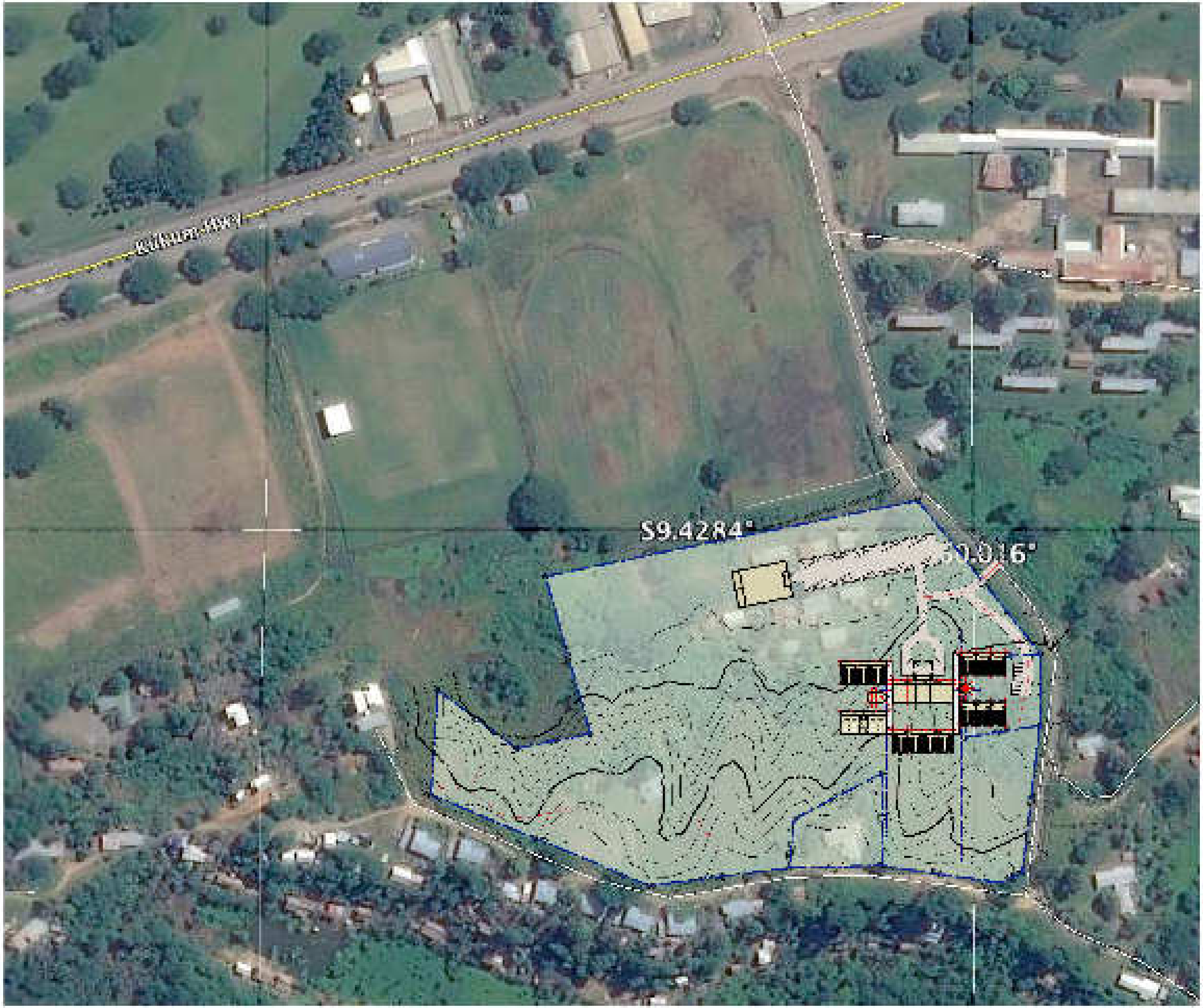
[illegible] Huggett
Managing Director
Architects Pacific Ltd

The University of the South Pacific
Solomon Islands Campus

Option 3 Masterplanning
3D Renderings



Multipurpose Hall
TOTAL AREAS
ADMIN / SAS
Science Labs
FSTE & Public Health
Learning Centre & Timetabled Teaching Spaces
University of the South Pacific
Proposed USP Campus
Solomon Islands
Preliminary Concepts
0 10 20 30 40 50 M



University of the South Pacific
Proposed USP Campus
Solomon Islands

Preliminary Concepts
Master Plan - Phase 1 - Option 3
[illegible]
April 201[illegible]
MP01

University of the South Pacific

Proposed USP Campus

Solomon Islands

Preliminary Concepts

Master Plan Studies - Option 2

April 2015

SK01

THE UNIVERSITY OF SOUTH PACIFIC
SOLOMON ISLANDS CAMPUS - PHASE 1 - OPTION THREE

Bill Ref.	Description	Quantity	Unit	Rate	Total
A	**PRELIMINARIES**				
	Preliminaries - 16%				1,386,969.76
B	**SITEWORKS**				
	Clear site	15,000.00	m2	0.75	11,250.00
	Bulk cut and fill	7,500.00	m2	20.00	150,000.00
	Allowance for Site signage	1.00	LS	25,000.00	25,000.00
	Allowance for Entry feature walls and gates	1.00	LS	25,000.00	25,000.00
	Grassing/planting/trees/seating	2,500.00	m2	10.00	25,000.00
	Gabion retaining walls	214.00	m	150.00	32,100.00
	Roading/carparking	2,560.00	m2	35.00	89,600.00
	Covered Ways	280.00	m2	125.00	35,000.00
	Paving	250.00	m2	45.00	11,250.00
	Open fales (2No)	126.00	m2	550.00	69,300.00
C	**SERVICES**				
	ELECTRICAL				
	Electical main reticulation- 11kva	140.00	m	165.00	23,100.00
	1000 kvaTransformer	1.00	LS	92,000.00	92,000.00
	1000kva standby generator	1.00	LS	103,500.00	103,500.00
	Main Switchboard	1.00	each	46,000.00	46,000.00
	External lighting	7.00	each	2,470.00	17,290.00
	Supply and install sub main cabling	1.00	LS	69,000.00	69,000.00
	Electrical Services to Walkway	280.00	m2	20.00	5,600.00
	Building enclosure for generator	50.00	m2	500.00	25,000.00
	5,000 diesel storage tank (double skin steel "Super - Vault"type) including plinth & compound fence	1.00	no	20,000.00	20,000.00
	MECHANICAL SERVICES				
	Mechanical Services to SAS	340.00	m2	incl	0.00
	Mechanical Services to Admin	400.00	m2	incl	0.00
	Mechanical Services to Science Blk	864.00	m2	incl	0.00
	Mechanical Services to Fale	1,152.00	m2	incl	0.00
	Mechanical Services to Tuts (3no)	2,592.00	m2	incl	
	COMMUNICATIONS				
	Fibre Optic cable	340.00	m	78.00	26,520.00
	Main Distribution frame	1.00	LS	6,325.00	6,325.00
	Rack and Patch Panels	1.00	LS	7,475.00	7,475.00
	WATER				

	Connect to main water supply	1.00	no	3,680.00	3,680.00
	Supply and reticulate to site	760.00	m	50.00	38,000.00
	Water pump station	1.00	each	33,235.00	33,235.00
	200m3 water storage tank	1.00	no	44,170.00	44,170.00
	Water Filtration system	1.00	no	11,050.00	11,050.00
	100mm water main	100.00	m	61.00	6,100.00
	SEWER				
	Sewer reticulation	300.00	m	50.00	15,000.00
	Manholes	14.00	no	1,380.00	19,320.00
	Wastewater treatment plant	1.00	LS	177,100.00	177,100.00
	Sewer pump station	1.00	each	38,650.00	38,650.00
	Sewerage disposal 60mm pipe	500.00	m	28.00	14,000.00
	FIRE SERVICES				
	Fire pump station	1.00	no	34,500.00	34,500.00
	Fire hydrants	7.00	no	2,460.00	17,220.00
	Isolation Valves	26.00	no	1,106.00	28,756.00
	200m3 water storage tank	1.00	no	44,170.00	44,170.00
	STORMWATER				
	Swale open drain	544.00	m	65.00	35,360.00
	Stormwater management	1.00	each	7,500.00	7,500.00
	Rec channel 300mm	200.00	m	100.00	20,000.00
	Rec channel +300mm	100.00	m	150.00	15,000.00
	Culvert	50.00	m	200.00	10,000.00
D	**BUILDINGS**				
	Central Facilities - Admin/SAS	742.00	m2	1,120.00	831,040.00
	Tutorial Blocks (3 no)	2,592.00	m2	1,175.00	3,045,600.00
	Roof Structures - Entry Canopy	84.00	m2	500.00	42,000.00
	Roof Structures - Admin/SAS	420.00	m2	200.00	84,000.00
	Allowance for kitchen joinery and appliances	1.00	LS	75,000.00	75,000.00
	FSTE & Public Health	576.00	m2	1,200.00	691,200.00
	Science lab	288.00	m2	1,650.00	475,200.00
	Roof Structures (4 No) Note: Area adjusted for true roof area	1,305.00	m2	200.00	261,000.00
	Allow for fittings	1.00	LS	100,000.00	100,000.00
	Fale	1,152.00	m2	1,200.00	1,382,400.00
	Roof Structures (1 No) Note: Area adjusted for true roof area	540.00	m2	200.00	108,000.00
	Roof Structures - Covered Walkways. Note: Assumed flat roof	300.00	m2	150.00	45,000.00
	Multi purpose Gymnasum	660.00	m2	950.00	627,000.00

THE UNIVERSITY OF SOUTH PACIFIC
SOLOMON ISLANDS CAMPUS - PHASE 1 - OPTION THREE

E	**CONTRACTOR"S MARGIN**				
	Margin - 8%				854,602.46
F	**SUB - TOTAL CONSTRUCTION**				11,537,133.22
G	**SUNDRIES**				
	Furniture , Fittings and Equipment	1	Prov	750,000.00	750,000.00
H	**PROFESIONAL FEES**				
	Professional Fees - 13.50%	1.00	13.50%	12,287,133.22	1,658,762.98
	Architectural				
	Structural & Civil Engineering				
	Geotechnical Engineering				
	Building Services				
	Land Surveyor				
	Landscaping				
	E.I.A. Study				
I	**CONTINGENCY SUM**				
	Contingency Sum - 10%				1,394,589.62
	Correction				14.17
Total				**USD**	**15,340,500.00**

Kenneth John McNamara AAIQS, MNZIQS, AFIQS

The Estimate exclusions as stated in BECA's report are applicable to this estimate as well.

USP SOLOMON ISLANDS CAMPUS
PHASE 1 - STAGE 1

Ref	EXCLUSIONS	BECA'S ESTIMATE 20-11-2015	ARCHITECT PACIFIC'S ESTIMATE
1.02	Clear Site of trees etc	Excluded	Allowed for
3.01	Stormwater drainage from site boundary to ocean outlet	Excluded	Excluded
4.02	Pedestrian Crossings	Excluded	Excluded
4.03	Taxi / bus sidings	Excluded	Excluded
5.01	Water bore for irrigation (17m)	Excluded	Excluded
5.02	Water bore for domestic drinking (60m)	Excluded	Excluded
5.04	Water treatment plant including installation and ancillary equipment	Excluded	Excluded
8.01	Photo Voltaic Solar Power Generation (Grid Connected) - Panels, Mounts & Inverter	Excluded	Excluded but Lump Sum provided for Works if required
8.02	Interpanel cabling	Excluded	Excluded
8.03	Battery bank storage	Excluded	Excluded
8.04	Structural frame for solar panel mounting on roof	Excluded	Excluded
8.09	1MVA generator	Excluded	1000 kva Included
8.10	Building enclosure for generator	Excluded	Included
8.11	5,000L diesel storage tank (double skin steel 'Super-Vault' type) including plinth & compound fence, etc	Excluded	Included
8.20	Customs clearance & duty	Excluded	Excluded
9.01	Telecommunication Services including communication Tower	Excluded	Excluded
9.02	Incoming fibre-optic cabling	Excluded	Included
9.03	Network Panel	Excluded	Included
9.04	Site reticulated fibre-optic cabling	Excluded	Included
9.05	Wifi	Excluded	Excluded
10.08	Lecture (5)	Excluded	Excluded

10.12	Roof Structures - Central Facilities (Large Section) Note: Area adjusted for true roof area		Excluded		Excluded
10.17	Allowance for Lecture Theatre Seating		Included		Excluded
10.18	Allowance for audio/visual equipment		Included		Excluded
10.20	Allowance for Artwork		Included		Excluded
11.02	Rock facing to gabion walls		Excluded		Excluded
11.03	Allowance for site furniture (i.e. seating, tables, rubbish bins, etc)		Excluded		Included
11.04	Allowance for site signage		Excluded		Included
11.05	Allowance for entrance feature walls and gates		Excluded		Included
11.06	Allowance for soft landscaping		Excluded		Included
11.07	Allowance for irrigation		Excluded		Excluded
12.02	Building Consent Fees		Excluded		Excluded
12.03	Planning/Resource Consent Fees		Excluded		Excluded
12.04	Client Management Costs		Excluded		Excluded
12.05	Client/Teaching Decanting Costs		Excluded		Excluded
12.06	Project Insurances		Excluded		Excluded
12.07	Legal Costs		Excluded		Excluded
12.08	Land Acquisition Costs		Excluded		Excluded
13.04	High Probability Risks		Excluded		Excluded

UILDIN SERVICES

ENERAL

The Building Services systems shall comply with the following except where otherwise noted:

a) Solomon laws, Government and local authority Regulations.

b) The latest issue of the applicable ASHRAE and AS/NZS standards.

c) Good engineering practice.

MECHANICAL SYSTEM

System Des ription

The air conditioning system for LECTURE HALL shall be ducted split with associated air distribution ductworks. The SAS, ADMIN and SCIENCE LAB shall be served with free blow split. The outdoor unit will be located in ground level mounted on concrete plinths. Each unit shall have a standalone thermostat control.

Toilet ventilation shall be served with wall mounted fans and operated via light switch

The science laboratory shall have in-line fans for extraction of fumes. The location of fumes extract shall be provided by laboratory equipment supplier

Le ture Hall air onditionin system

Maintaining humidity levels at a comfortable range is a factor in lecture theatre. A standard DX ducted split unit is preferred considering a sitting capacity of 300 pax. Introduced with fresh air, this space will have comfortable conditions suitable for learning.
The air conditioning system will be composed of ducted indoor unit hidden above false ceiling, an outdoor unit will be situated outside the building along the wall. The unit shall utilize HFC free refrigerant and scroll compressor. A standalone thermostat will be provided located inside the room. Air distribution ducts above false ceiling will distribute air evenly inside the room thru air outlets.

SAS and Administration uildin air onditionin system

Standard split air conditioners wall mounted type will be used suitable for multiple partitioned rooms.

The units shall consist of an indoor unit mounted on wall and outdoor unit mounted on ground or high level outside the building. Each unit shall have a wireless thermostat. The air conditioner shall utilize HFC free refrigerant and inverter rotary compressor.

La oratory uildin air onditionin system

The laboratory shall be air conditioned with cassette type split units. The number of the split units shall be limited to 2 medium size capacity units.

The units shall consist of an indoor unit mounted on wall just high below the ceiling and outdoor unit on ground high level outside the building. Each unit shall have a wireless thermostat. The air conditioner shall utilize HFC free refrigerant and inverter rotary/scroll compressor.

Toilet Ventilation System

Toilet exhaust will be provided to SAS and Administration building in accordance with the relevant standards.
Toilets will be provided with mechanical ducted exhaust systems or a standard wall mounted fan.

La oratory ume e tra t system

Fume exhaust will be provided to science laboratory building as required by standards and local building code. Ducted system or wall mounted fans will be provided

ELECTRICAL SYSTEM

In omin Po er Supply

The mains power supply will be sourced from the existing 11kV overhead Solomon's Islands Electricity Authority (SIEA) infrastructure along the KGVI road. It is assumed that there is enough capacity on these transmission lines for the connection of new loads from the USP development. A 11Kv HV line will be tapped from the SIEA overhead lines and run underground to a dedicated 1000KVA transformer located in the central building.

Main S it oard

The Main Switchboard for the new Building will be located in a dedicated switch board room at Central building. The capacity of the switchboard will match the supply transformer rating plus 20% extra capacity.

The power supply data at each switchboard will be monitored and displayed by a dedicated power-metering device and power analyser to analyse further requirements for capacitors banks for power factor correction to reduce energy cost.

Diesel enerator a k-up

A diesel powered LV generation system will be provided to power 100% loads under normal power interruption for the new Building. The diesel generator back up system will have proprietary integrated control systems, automatic changeover switches, switchgear panel and be supplied complete with in a weather proof acoustic enclosure.

Solar Po er

Should there be sufficient budget, a Grid connect Solar power system will supplement the SIEA power supply and the backup generator. The proposed system is based on a Hybrid system whereby in times of low supply from solar system, the SIEA power grid will supply the energy seamlessly therefore eliminating the risk of power outage. During the time of high supply from solar system there is an opportunity to sell any excess energy generated to SIEA through the same grid. This would be mostly during the weekends when energy will continue to be generated, but with very little consumption.

Distri ution oards

Three phase distribution boards will have 100% essential power. For smaller loads, wherever possible single-phase distribution will be used with a single supply circuit. The construction, segregation rating and capacity of the three phase distribution boards will be Form 2b segregation and IP42 protection rating.

Single phase distribution boards located within each floor will be Form 1 type, proprietary polycarbonate construction, and wall mounted.

Li ts

General and emergency lighting will be provided as per provisions of the AS/NZS 1680 and AS/NZS 2293 standards and the Solomon's National Building code.

All fittings will have new generation high efficiency LED fixtures.

The type, selection, and control of light fittings will comply with the AS/NZS Electrical standards and the architect's specification. However, we advise that wherever possible the use of energy efficient, compact fluorescent or LED type fittings be used to both minimise energy use and provide longer lamp life.

Emer en y Li ts

Emergency lighting will provide for safe movements as prescribed by the aforementioned standards. All such light fittings will be the self-contained type with integral batteries and chargers. These lighting circuits will be supplied from essential section of the respective distribution boards with diesel generator back-up.

COMMUNICATION SYSTEM

System Des ription

A fibre optic cable will be installed to the Building from the existing "Our Telekom" Infrastructure cabling running along Kukum highway, which will provide the bandwidth necessary to support both voice and data channels throughout the site. The fibre optic cable will be terminated on switching equipment in a dedicated communications room at the Central Building. Data Switches, patch panels and voice distribution frames will be provided at this point. The data cabling will be UTP CAT 6e cable. The voice cabling will be provided on standard UTP CAT 6e cable. Network racks will be provided to each building and will be connected to the main rack in the central building. Structured cabling will be connected to the wall outlets to the network racks. For each building cabling will be provided to suit the number and type of outlets required.

i i System

The Wi-Fi system will provide full blanket Radio Frequency coverage of the Entire Campus. The Wi-Fi system shall consist of the Cat5e outdoor cabling, cat6 indoor cabling, and Access Point, Bridge/Repeaters, Client Bridge, POE (Power over Ethernet) and Wi-Fi main equipment's and Associated Software's.

A Wi-Fi-enabled device can connect to the Internet when within range of a wireless network which is configured to permit this. The coverage of one or more (interconnected) access points called hotspots can extend from an area as small as a few rooms to as large as the entire Campus.

Coverage in the larger area may require a group of access points with overlapping coverage Routers that incorporate a digital subscriber line modem or a cable modem and a Wi-Fi access point, provide Internet access and internetworking to all devices connected to them, wirelessly or via cable. Wi-Fi structured cabling shall be part of communication contractor and the Main Wi-Fi system and associated software's shall be by a third Party contractor.

Se urity and A ess Control system

The access control system will typically consist of the following components and features:

- Central Controller Module linked to VOIP System
- Access detectors (PIR sensors, REED Switches)
- Keypads and Alerting Buttons
- Sounders (linked to the PA / BGM system)
- Paging Stations (part of and linked to the PA / BGM system)
- CCTV (linked to the MATV system) – for lobby, cafe, retail and other designated areas
- Proximity Cards and Readers - for lobby, admin and designated areas (optional feature)

All security related equipment will cover the designated areas that require limited access to general public and students.

Security and CCTV will be discreet, unobtrusive and low-key. CCTV will be deployed at entrances and exits, main vehicle entrances and exits.

The system is not expected to be actively monitored, hence cameras will be fixed rather than steerable, and recording will be automated on Network Video Recorders. Monitors will be provided in the Security Room.

Typically, entrance to sensitive areas such as the Communications Room and selected plant items, and areas where high value stock is held will be access controlled, and may have intruder detection fitted.

There are a number of advanced systems available for CCTV components such as those utilizing digital cameras and recorders. These can be linked into the site's computer network and the communications network. A detailed study and costing can be carried out if required at the detailed design stage.

HYDRAULIC SYSTEM

Domesti Cold ater

Incoming water supply will be taken from the adjacent town supply main via a meter located at the boundary with isolation and filter and backflow prevention valves as required. Incoming water supply from the water meter will discharge into the campus water storage tanks. A duplex variable speed drive booster pump set will be provided at the services area. Water supply will be purified via filtration system before the water is reticulated throughout the campus. Water supply into the building will be via riser ducts and within the ceiling spaces of the building. Local backflow preventers will be provided as required.

Rain ater Harvestin

As maybe required rain water will be collected via a separate storage tank. A screening membrane will be provided at the inlet of the storage tanks to avoid large materials passing through into the storage tank. Rain water booster pump will be provided to supply rain water to the toilets and landscaping purposes only.

Sanitary Plum in

All sanitary and waste drainage pipework shall connect to inspection chambers located outside the buildings and then to the sewer pump station. Wastewater from the pump station is pumped into the WWTP located at the services area. Sewer waste is treated within the WWTP and treated effluent from the WWTP is discharged into the landscape or soakage trenches. Floor drains will be located as required and in all wet areas. Tundishes will be provided for Mechanical equipment.

FIRE PROTECTION SYSTEM

Automati Fire Alarm System

An analogue fully automatic addressable Fire Detection System including all thermal and smoke detectors, duct detectors (for air handling units), break glass units, and connect back to a new Fire Indicator Panel to be located near the main entry into the campus.

Anti-tamper alarms will be fitted to each call point so that an alarm local to the call point will sound if an attempt is made to operate the device.

A Main Fire Alarm Panel shall be installed and equipped with Alarm Signalling Equipment (ASE) in a location approved by the Local Fire Authority. It shall be fully programmable, with programming able to be carried out in the field. Programming shall be stored in non-volatile memory, which can retain data if the power supply is removed.

The fire control panel shall have a mimic display at the front, which displays the layout of the building and indicates the zone/room/area in which the fire has occurred.

Fire Hydrants

Fire Hydrants shall be spaced no more than 100m apart. A weatherproof cabinet shall be positioned next to each Fire Hydrant and shall contain the necessary coupling and hose for connection to the fire hydrant.

Internal fire hydrants will be provided at each level located near the required exit

Fire hydrant valves shall comply with the Local Fire Authority standards. The hydrant valves shall be supplied complete with isolation valves and stop cock.

All hydrant valves and fire hydrant hose cabinets shall be clearly identified with the labels mounted in clear view.

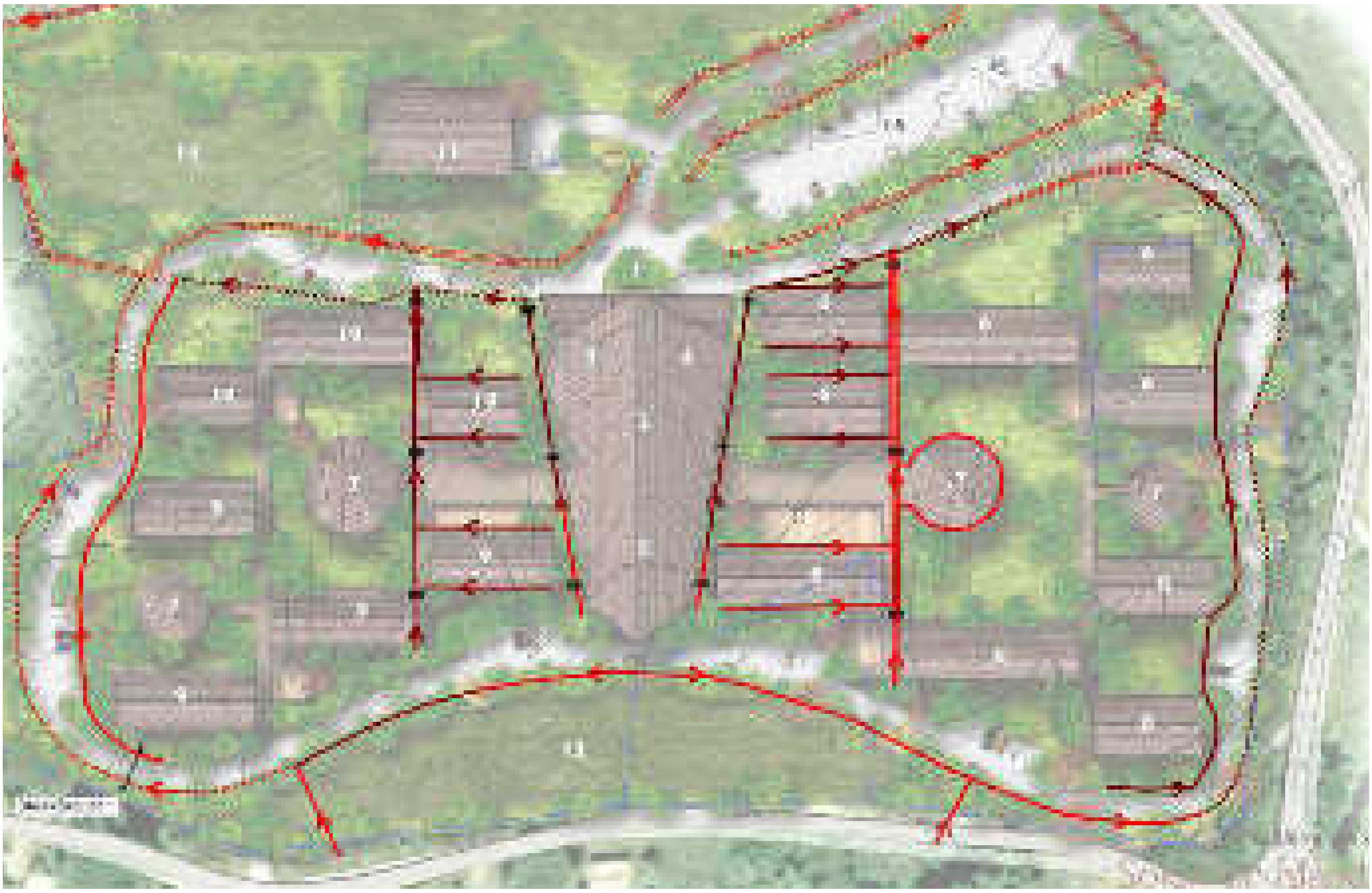
Report

Solomon Islands Higher Education Assessment - Stormwater

Prepared for Asian Development Bank

Prepared by Beca Ltd (Beca)

10 December 2015



Revision History

Revision Nº	Prepared By	Description	Date
0	Gerd Baker	Issued for inclusion in NCDP	10 Dec 2015

Document Acceptance

Action	Name	Signed	Date
Prepared by	Gerd Baker		10/12/15
Reviewed by	Graham Levy		10/12/2015
Approved by	Alister McCraw		10/12/15
on behalf of	Beca Ltd		

Contents

Appendices

1 Executive Summary

The southern part of the site is relatively steep (about 1 in 20) while the northern half is relatively flat sloping towards the north. Terraces will be constructed to provide for the building platforms in the central part of the site. Stormwater reticulation, mainly in the form of open channels, will be provided to divert upstream runoff around the central building platforms. The platforms will be drained by open channels along the buildings and perpendicular collector channels running south to north which discharge either across the terraces or along a circular perimeter road to the lower part of the site.

Reliable rainfall data was not available and a preliminary assessment in terms of depth, duration and frequency was carried out. This information was used to assess the proposed concept stormwater reticulation. Stormwater has been assessed in terms of quantity and peak flow rates for pre and post development conditions but stormwater detention and treatment have not been considered. The increase in total runoff flow rate is in the order of 46%.

The discharge points of the stormwater runoff remain unchanged and the discharge is conveyed through two existing stormwater drains towards the Kukum Highway drainage system north of the existing sports fields. The Kukum Highway is programmed to be upgraded in the near future which will include the upgrading of the highway stormwater drainage system.

2 Introduction

The site contour has a general fall towards the north with a number of north-south running ridges and valleys throughout the proposed campus site. The higher southern side bounds onto an east-west running road reserve with a height in the order of RL24 m to RL28 m based on the provided survey information. Only a small area on the outside and to the south of the site drains onto the campus site.

The northern part of the site is a flattish, flood prone area with an elevation ranging between RL6 m to as low as RL5 m. North of that area are existing sports fields which apparently regularly flood during more severe storm events. No flood level data is available from official sources but anecdotally the floodwater on site was in the order of 200 to 300 mm deep during the April 2014 flood event.

The steeper undulating part of the site will be re-contoured in a number of east west running terraces on which the campus buildings will be located. A ring road surrounding the building platforms linking the lower and the higher parts of the site is allowed for.

Rainfall data in terms of intensity, duration and frequency (IDF) for the Honiara area was not available at the time of this assessment and a preliminary assessment of design rainfall intensities for Honiara was carried out. This has been developed in the following way:

- The annual series of daily maximum rainfall for Honiara from the '*Climate Variability, Extremes and Change in the Western Tropical Pacific: New Science and Updated Country Reports*'
- Extreme value analysis of that data and adjusting to generate 24 hour rainfall depths for a range of return periods
- Using data from a design guideline for PNG (specifically for Madang and Rabaul) to derive an intensity relationship between 24-hour rainfall and shorter durations.

The outcome of the analysis is shown below for a range of durations and return periods.

HONIARA	Return period rainfall intensity (mm/hr)				
Duration (mins)	2yr	5yr	10yr	50yr	100yr
10	145	188	212	249	280
15	128	165	187	218	242
30	99	129	148	173	191
60	69	89	103	124	139
120	45	60	72	87	99

It should also be noted that this analysis is an approximation only and ideally for the preliminary design stage better local data for shorter durations should be obtained.

3 Needs Assessment

3.1 Existing situation

The existing site drains towards the north with excess runoff discharging either directly onto the adjacent sports fields to the north of the site or collected by an existing small west-east running cut-off drain. There are two receiving open drains, one in the north-east and, one in the north-west corner of the site which convey runoff towards the north and the Kukum Highway drainage system.

The drain in the north-east corner is aligned along the KGVI access road and the drain in the north-west corner of the site is aligned between the sports fields north of the campus. It is understood that these drains will not be upgraded as part of the development which may increase the frequency of flooding as a result of the increased runoff due to the proposed USP development.

Currently the sports fields flood during periods of heavy rain which is due to limited capacity drainage across the Kukum Highway. Drainage improvements are planned for in the 2016/2017 highway upgrading project and will include consideration for upstream development such as the proposed USP site.

Based on discussions with the Ministry of Infrastructure and Development there is no requirement to provide onsite and/or offsite stormwater detention or water quality treatment and this has therefore not been further considered.

3.2 Proposed stormwater drainage

Stormwater runoff from a small, approximately 0.25-0.30 ha, catchment upstream of the site discharges onto the campus grounds. No contour information is available for this area directly to the south of the boundary road and it is assumed that storm runoff crosses the road in a few low locations. Where it crosses the road and enters the campus site the runoff will be captured by dedicated drainage channels and be diverted to the new ring road drainage system.

It is proposed to grade the terraced areas towards the north to ensure no ponding of stormwater will occur on the terraces. Generally open drains are proposed to reduce the risk of blockage due to accumulation of debris, and facilitate maintenance. Culverts will only be used where stormwater channels cross roads. Channels and drains below footpaths will be either grated or covered.

Where the ring road runs east-west an open channel will be provided along the south side of the road and the road cross-fall graded towards the channel. This drain will act as a cut off drain collecting stormwater runoff from upstream and directing it westwards and eastwards towards the outside of central hub (refer Stormwater plan appended in Appendix A).

Along the north-south running sections of the ring road stormwater channels will be provided on both sides of the road to collect stormwater from the terraced areas on the inside and to convey road runoff and diverted upstream stormwater on the outside. The gradients of these drains will be significantly steeper than those in other areas of the site and provision may have to be made to protect the drains from erosion by either providing a rougher surface to reduce the velocity or providing a structural channel liner with dissipating structures.

On the terraced areas where the buildings will be located east-west running channels will be provided along two sides of the buildings. These channels will be discharging into north-south running collector drains which discharge, through protected channels (cascades) down the face of the terrace embankments, to the lower northern area and where the flow is directed sideways through open drains either to the west or the east to link with the perimeter drains.

The in-situ existing coral rock on the site is apparently very resistant to scouring and even reworked engineered filled coral rock appears to be very stable even in wet conditions. It is therefore assumed that in cut areas the drains will be formed in the coral rock without a lining and in fill areas the drains will be either concrete lined or stone pitch lined. Where traffic loads are close to drain edges the drain linings will be reinforced concrete. In the flatter lower area unlined swale type drains and/or open drains will be used to collect and discharge the site stormwater to the open drains along the site perimeter.

3.3 Stormwater assessment

The following assumptions have been made to select the rainfall intensities for the assessment of the stormwater concept outlined above: a 10-minute catchment duration; a 5 year return period for the primary system and a 50 year return period for the secondary system. Therefore rainfall intensities of 190 mm/hr and 250 mm/hr have been adopted from the above mentioned rainfall intensity table for primary and secondary flows respectively.

A rational formula assessment of the current stormwater runoff based on a runoff coefficient 'c' of 0.40, a rainfall intensity of 190 mm/hr (5 year return period) and a total catchment area of approximately 5.5 ha including the area south of the southern boundary road (excluding the water tank area) results in a maximum peak flow rate of approximately 1.16 m^3/s in the 5 year storm event.

Post development runoff assessment based on 'c' = 0.4 for pervious areas and 'c' = 0.9 for impervious areas (composite 'c' of 0.57) results in a 5-year peak runoff flow rate of 1.70 m^3/s. The increase in flow rate is therefore 46%. This assessment does not take into consideration the effects of rainwater harvesting, which may be applied to the selected building roofs, although in severe storms these may well overflow and not materially reduce the peak flow rates.

A concept layout plan is shown on the First Phase Plan and the Final Phase Plan in Appendices A & B respectively. If rainwater harvesting is undertaken, it is recommended that the full drainage system be retained around all buildings, as larger storms will exceed the capacity of the rainwater harvesting system and therefore drainage will still be required.

For the next stage assessment of the USP campus development additional design information will be required including; detailed analysis of sub-catchments area and confirmed future finished ground levels; confirmed rainfall intensities (if available); establishment of a detailed design basis report listing design assumptions and methodologies.

4 Options & Phasing

The stormwater reticulation outlined above is considered to be the most cost effective solution as it endeavours to divert upstream stormwater around the highly developed central hub and direct it towards the side. This results in having potentially the smallest channels and drains in the congested building areas.

The proposed phasing of the project requires the central section of the site to be constructed during the first phase. This requires that the entire site's earthworks will also have to be carried out during the first phase including the majority of the site's stormwater system. Only some smaller localised drainage infrastructure in the central hub area may be able to be constructed as part of the final phase.

If the development of the first phase could be carried out on the eastern extent of the site (as opposed to the currently proposed central location of the site) there may be opportunities to reduce the scope of the first phase of the stormwater infrastructure significantly. This scope reduction is also reflected in a similar way on other disciplines such as earthworks, on-site transportation, and water reticulation and, maybe to a lesser extent wastewater reticulation. This has not been further investigated.

5 Recommendations

- We recommend that prior to the preliminary design stage commencing a stormwater design basis report listing design assumptions and methodologies is prepared
- We recommend that further assessment be carried out and/or confirmation be obtained of local rainfall data in terms of intensity, duration and frequency for short duration peak intensities
- We recommend that an assessment is carried out and/or confirmation be obtained of actual and predicted flood levels in the lower part of the site (in terms of the site datum used for the topographical survey)
- We recommend that the stormwater design be carried out as outlined above and, as a minimum, in accordance with the requirements of the following codes and requirements:
    - requirements of the National Building Code (Solomon Islands) as and where appropriate or in lieu thereof requirements of the New Zealand Building Code
    - rational formula stormwater calculations using the criteria mentioned above and/or criteria determined based on further assessments outlined above
- We recommend that the key stormwater infrastructure be installed during the first phase development of the project with minor expansion during the final phase development
- We recommend that the location of the first phase development is reconsidered to enable cost savings in order to meet budgetary constraints.

Appendix A

Stormwater First Phase - Plan


LEGEND
NW Corner
NE Cnr
The Masterplan
Beca
Campus

Appendix B

Stormwater Final Phase - Plan

NE Corner
NW Corner
The Masterplan
Beca

Report

Solomon Islands Higher Education Assessment - Water Treatment

Prepared for Asian Development Bank

Prepared by Beca Ltd (Beca)

8 December 2015

Revision History

Revision Nº	Prepared By	Description	Date
0	**Jessica Daly**	Issued for Client Review	8/12/2015

Document Acceptance

Action	Name	Signed	Date
Prepared by	**Jessica Daly**		8/12/2015
Reviewed by	**Malcolm Franklin**		8/12/15
Approved by	**Alister McCaw**		
on behalf of	Beca Ltd		

Contents

Appendices

1 Introduction

1.1 Background

Beca have assessed water treatment options and the associated capital and operating costs for a proposed University of South Pacific (USP) development in the Solomon Islands for the Asian Development Bank (ADB).

We understand that there is a reticulated town water supply that the university development could connect to. We have looked at onsite treatment options that utilise the existing reticulated supply as a source, as well as development of an independent supply.

1.2 Needs Assessment

The development is expected to take place in two stages. The population allowance for Stage 1 is for 1650 full time equivalent students (FTES) and 80 staff present onsite during the day. The population allowance for Stage 2 is for an additional 200 resident staff and students. The expected water demand for the development is shown in Table 1.

Table 1: Water Demand for South Pacific University Development

	Population	Allowance	Water Demand
Stage One	1730 FTES	20 L/pp/day	35 m^3/d
Stage Two	200 resident students and staff	200 L/pp/day	40 m^3/d
Total			**75 m^3/d**

We have assumed that the water demand will be equal to the expected wastewater flows. This is based on the following assumptions:

- Outdoor uses will be supplied from rainwater tanks e.g. for irrigation.
- No allowance has been made for losses i.e. there will be no significant leakage from the system such as leaking taps or toilet cisterns.

The Stage 1 daytime allowance of 20L/pp/day (litres per person per day) is based on suggested domestic flow allowances per capita for schools from *On-Site Wastewater Systems: Design and Management Manual (Auckland Regional Council TP58, 2004).* This figure has been verified against actual metered flows measured at five schools in New Zealand. The Stage 2 resident allowance of 200L/pp/day is based on suggested domestic wastewater flow allowances per capita for households with standard fixtures *(Auckland Regional Council TP58, 2004)*.

For this assessment we have considered “drinking water” to be water of a quality that would meet the Drinking Water Standards for New Zealand (DWSNZ).

2 Source Water and Treatment Options

2.1 Source Water Options

2.1.1 Connecting to Town Reticulated Supply

Honiara has a reticulated water supply and we understand that there is sufficient capacity to supply the university development. There can be good advantages from connecting to a reticulated town supply such as security of supply and water pressure, and it removes the requirement for operation and maintenance by USP.

Water Quality

Water quality for the treated reticulated supply has been provided by the Solomon Islands Water Authority. A summary of the key water quality parameters is shown in Table 2.

Table 2: Reticulated Water Quality

Parameter	Units	No. Samples	Average	Range
Free chlorine residue	mg/L	75	0.22	0.01 - 0.58
pH		62	7.24	6.37 - 8.14
Temperature	°C	62	26.9	24.6 - 29.6
Turbidity	NTU	70	4.59	0.26 - 37.7
Total coliform	MPN/100mL			10 samples >10MPN/100mL
E.coli	MPN/100mL	62		7 contaminated samples

We do not have details of the treatment process or source, however from the water quality results the following can be assumed:

- The water is chlorinated.
- There does not appear to be adequate turbidity removal.
- There does not appear to be any effective treatment for protozoa.
- Turbidity is reported to increase rapidly during rainfall events.
- The maximum recorded turbidity in the data supplied is 37.7 NTU, but actual maximum turbidity may be much higher than this.
- The reticulated water supply does not consistently meet a recognised drinking water standard.

Water Tariff

Assuming 300 operating days per year and a water tariff of SBD$26.96/kL for “commercial” water demands of 30-60 kL and SBD$29.94/kL as advised by SIWA for demands greater than 60kL, the expected annual water costs if the development were to connect to the town supply are shown in Table 3.

Table 3: Expected Water Tariff for Stage 1 and 2

	Volume Required	Expected Yearly Volume (m^3/yr)	Water Charges (Tariff in NZD)
Stage 1	35 m^3/d	10,500 m^3	$55,000/yr
Stage 1 + 2	75 m^3/d	22,500 m^3	$125,000/yr

2.1.2 Develop Bore Water Supply Onsite

If a good quality groundwater source with sufficient flow to meet the demand could be developed, this would be a sound sustainable option. Treatment requirements are likely to be simple, water quality consistent and not subject to flooding water quality issues.

However, groundwater investigations carry the risks of a number of unknowns. The available water quality and quantity will not be known until drilling is completed. Further investigations and accurate cost estimates would be required to determine the economic viability of this option.

In addition, without investigating the hydrogeology or the characteristics (yield and quality) of other bores in the area it is difficult to assess the chance of developing a good groundwater source to supply the site.

2.1.3 Rainwater Harvesting

Rainfall in Honiara is relatively high with an annual rainfall of approximately 2000 – 3000mm, so rainwater harvesting could be a viable option for the development. Treatment of rainwater is relatively simple, with disinfection being the most common level of treatment applied. This removes the issue of high solids loads during storm events that can be associated with surface water or shallow bore sources. If rainwater tanks are used, they must be secured and cleaned periodically to prevent vermin or other animals contaminating the supply.

Historically the driest months in Honiara are June – September with monthly rainfall approximately 100mm (*Climate variability and change in the Solomon Islands – Solomon Islands Meteorological Service)*. Assuming an average daily rainfall of 3mm/day, the capture area required to supply the site with water is shown in Table 4. Drinking water volume is based on 2L/pp/day.

Table 4: Capture Area Required for Rainwater Harvesting

	Volume Required	Capture Area required
Drinking Water only Stage 1	3.3 m^3/d	1100 m^2
Drinking Water only Stage 2	0.4 m^3/d	150 m^2
Stage 1	35 m^3/d	12,000 m^2
Stage 1 + 2	75 m^3/d	25,000 m^2

Given the capture area required for the total demand is relatively high, we do not consider rainwater harvesting for the entire site supply to be a viable option. However, providing rainwater for drinking water only could be a suitable option. The assessment is based on an average daily rainfall, but there will be periods when there is no rainfall for extended periods. Suitable storage would need to be provided for periods of no rainfall. If 75 m^3 of storage was provided (with say 3 x 25m^3 polyethylene tanks), then up to 20 days of drinking water storage would be allowed for. There is also the potential to reduce the drinking water storage and utilise the onsite water storage if the rainwater storage is empty. A suitable storage volume could be assessed further at a later stage of design.

2.2 Water Treatment Options

2.2.1 Full Treatment Onsite of Reticulated Supply

To consistently achieve water of a potable standard, the reticulated town supply could be further treated onsite with one of the following options:

- Membrane filtration plant
- Conventional plant (clarification and sand filtration)

The relative advantages and disadvantages of the full treatment options are summarised in Table 5.

Table 5: Advantages and Disadvantages of Onsite Full Treatment Options

Treatment Option	Capital Cost	Pros	Cons
Membrane Treatment	$750k	Robust treated water quality – consistently achieve potable water with varying water quality Package supply and install of process equipment simplifies construction Compact footprint Simple operation – well suited to small and remote communities	High operating costs Access to service technicians and support may be difficult
Conventional – Lamella clarifier + pressure sand filters	$500k	Likely to achieve potable water quality during normal conditions Compact footprint	Risk of non-compliance with potable standards during storm events Higher operator input/ skilled operation required

2.2.2 Point of Entry Treatment

As an alternative to full treatment, point of entry treatment could be provided at designated “drinking water” taps in each building. Point of entry treatment consists of cartridge filtration followed by a UV reactor to achieve both bacterial and protozoal inactivation. The units are supplied pre-fabricated on a board and are relatively simple to install. Refer to Appendix A for further details on a possible unit.

If connected to the reticulated supply, then during normal conditions (i.e. not storm events) the units would be capable of producing water to a drinking standard. However, during storm events when the suspended solids load in the reticulated water is high, the filters are likely to block and hence the drinking water taps would not be able to be used during these periods. During storm events, the filters would have to be by-passed or taken offline to prevent them blocking. If connected to the reticulated supply, the frequency and intensity of storm events should be assessed at a later stage of design to determine how frequently the filters would be likely to block and hence how frequently the “drinking water” taps would be off-line.

Point of entry treatment could also be used on a dedicated rainwater supply to provide safe drinking water for the site.

Cartridge life varies between 1-6 months with life dependent on the suspended solids load in the source water. UV lamps typically require replacement every 1-2 years and the UV sensor requires replacement every 2-3 years.

2.2.3 Homespring Units for Reticulated Supply

Homespring units are a small scale package water treatment system using hollow fibre ultrafiltration membrane technology to provide treated water. Typically one unit is installed per house, however there are some installations where multiple units have been installed in parallel for larger complexes. A bank of 6-7 units could be used to treat the entire university supply. Units must be serviced yearly and membranes replaced every 7 years for optimal results. Locating a suitable service technician may be difficult given the location. Units are approximately NZD$7000 each.

Whilst the units do provide improved water quality, they are not validated against a potable water quality standard e.g. the Drinking Water Standards for New Zealand (DWSNZ). In order to achieve a validated water quality standard, UV treatment would be required after the units.

In order for this option to be viable, sufficient mains pressure (minimum 200 kPa) would be required and some pre-treatment may be needed upstream of the units to reduce the solids loading on the membranes during storm events. Further investigation into the technical viability of this option would be required at a later stage in design.

2.3 Discussion

2.3.1 Source Water

The town reticulated supply could be used to meet the full water demand for the site. Connecting to a town supply provides the advantages of security of supply and water pressure and it removes the requirement for operation and maintenance by USP. The town supply is chlorinated only and hence does not meet a recognised drinking water standard. Additional treatment would be required in order to provide “drinking water”.

Rainwater harvesting for drinking water could be considered as an option for the site, this would remove the issue of poor quality water during rainfall events that is experienced by the town supply. Assessment of rainfall frequency and intensity over a year would be required to determine more accurately storage requirements and the roof capture area required. We recommend assessing this at a later stage of design.

As an alternative to using the town reticulated supply, a groundwater source could be developed for the site. However, groundwater investigations carry a number of unknowns and developing a source of the required quality and quantity is not certain.

At this stage in design we consider the preferred option for the site is to connect to the town reticulated supply for the bulk of the site water demand. To supplement this we recommend rainwater harvesting be implemented to supply drinking water. This would eliminate the issues with poor quality reticulated water compromising drinking water safety during rainfall events.

2.3.2 Treatment

A compact onsite treatment facility, such as a package membrane plant, could be supplied to consistently treat the town reticulated supply to a drinking water standard. However, when taken in the project context they have relatively high costs (both capital and operating) and potential difficulties with servicing and maintenance, operator availability, chemical delivery and technician support. For these reasons we do not consider either of these treatment options viable for the university development.

A bank of homespring units could be provided to treat all the site water. Whilst this would be less expensive than a package membrane plant, additional treatment would be required to validate the treated water against the DWSNZ and the units may be difficult to service and maintain.

Point of entry treatment (cartridge filter and UV) could be provided at a number of dedicated “drinking water” taps. Point of entry treatment is a suitable option for disinfecting collected rainwater so it is safe to drink. The units are a relatively low capital cost option and are simple to operate and maintain. This option provides a good balance between treated water quality and economy. For these reasons we consider point of entry treatment for drinking water the best treatment option for this site.

3 Preferred Option Costs: Point of Entry Treatment

3.1 Capital Costs

The estimated capital costs for a point of entry treatment system are shown in Table 6. Note that the capital cost is per unit and all costs are in NZD.

Table 6: Capital Cost for Point of Entry Treatment Unit (per unit basis)

Item No.	Item	Costing Basis	Cost (NZD)
1	AQPRO10 unit	Board mounted cartridge filter and UV unit	$ 4,000
2	Jumbo Filter Set-up	Pre-filter unit to reduce solids loading on 5μm cartridge	$1,000
3	Installation	Allowance for local install	$ 500
Total			**$5,500 per unit**

Exclusions:

- Prices are ex NZ and do not include delivery to the Solomon Islands.
- GST.

The capital costs for drinking water storage are shown in Table 7. Note that all costs are in NZD.

Table 7: Capital Cost for Drinking Water Storage

Item No.	Item	Costing Basis	Cost (NZD)
1	Storage Tanks	3 x 25,000L PE Tanks (incl install)	$ 30,000
2	Drinking water supply pump	Pre-filter unit to reduce solids loading on 5μm cartridge	$5,000
Total			**$35,000**

Exclusions:

- Prices are ex NZ and do not include delivery to the Solomon Islands.

- GST.

3.2 Operating Costs

The estimated operating costs for a point of entry treatment system are shown in Table 8. Note that the operating cost is per unit and all costs are in NZD.

Table 8: Operating Cost for Point of Entry Treatment Unit (per unit basis)

Item No.	Item	Costing Basis	Cost (NZD)
1	Cartridge	2-monthly replacement of cartridges (50µm + 20 µm + 5 µm) @ $40/cartridge	$720
2	UV Lamp	UV lamp replaced yearly	$350
3	UV Sensor	Replacement every 3 years	$150
Total			**$1220 /annum per unit**

Exclusions:

- Prices are ex NZ and do not include delivery to the Solomon Islands.
- GST.
- Labour costs.

4 Recommendations

- We recommend the master plan design is based on connecting to the town reticulated supply for the site.
- We recommend that point of entry treatment (cartridge filters and UV) is provided at a number of dedicated drinking water taps around the site.
- We recommend that rainwater is harvested for drinking water purposes or from the town supply. In any event point of entry treatment for rainwater is recommended.
- We recommend assessing rainfall data to determine the likely duration of “no rainfall” periods, and hence better determine storage requirements for this option, at a subsequent stage in design.

Appendix A

Point of Entry Treatment Unit

AQPRO10

As discussed, please see below our pricing and information on the Aquaflo/ Trojan AQPRO10.

AQPRO10 Complete with filters and Comms Centre $4,002.00

The AQPRO10 is designed as a complete one stop system to meet and exceed the New Zealand Drinking Water Standards 2008. These standards provide bacteria/giardia and cryptosporidium free water, that is safe to drink.

Includes the following features:

- Cool touch fan to prevent overheating
- Comms centre to provide data logging With LCD read out of mj/cm²
- Audible and visual lamp failure alarm
- Alarm Reset
- Elapsed time meter
- Dynamic flow restrictor
- Lamp replacement reminder
- UV Intensity Monitor
- Electro polished Exterior 316 S/S
- Dry contacts for alarm outputs
- Complete board mounted system ready to install
- Multi voltage ballast, helps in fluctuation power installations
- 2 year lamp life

Optional extra's: 4-20mA output	2067268-R	$146.00
: Solenoid & Cable	650627	$300.00

Consumables

1 X AQ8PP5 Cartridge	@	$ 26.05
1 X 602854 Pro 10 Lamp	@	$352.00

Filtration Technology Ltd
Unit 4, 98 Main Road, Tawa
P.O.Box 51-261, Tawa, Wellington, N.Z.
Telephone: 0-4-232 2402 Facsimile: 0-4-232 2403
Email: filtecwn@filtec.co.nz www.filtec.co.nz

Note:

1. An alarm must be fitted to alert operator.
2. Page 84 of NZDWS 2008 section 5.16 4a. Water entering UV either has been pre filtered with a cartridge nominally rated @ 5 micron, or smaller to remove and hold dirt without unloading. Turbidity never exceeds 2NTU (except where turbidity has been shown to be due to colloidal material that is consistently below 1 micron, when the Drinking water assessors may approve different criteria.
3. Trojan Pro10 UV is listed by NSF55 ClassA UV System. This has been approved by NZ Ministry of Health.

The Specifications for AQPRO10 are as follows:

Flow rate of water	:	0-38 litres per minute
Maximum Water Pressure	:	80psi (5.5 bar, 550 KPA)
Power (Multi-voltage Ballast)	:	99-264Vac 50Hz 100watts
UV Output	:	Exceeds 40mJ/cm^2 @ >80% UVT transmission
Inlet & Outlet Connection	:	1” Female
Pre Filter	:	10” Jumbo Housing
Pre Filter Cartridge	:	AQ8PP5, 5 micron
Outlet connection	:	1 ¼ NPT Male or 1” Female NPT

General Terms of Sale

Pricing exclusive of G.S.T, freight, installation and commissioning.
Delivery 1 week from date of order subject to prior sale.
Pricing valid for 30 days after which confirmation is required.
Validity – 30 days from above date after which confirmation is required.
Payment 20th of the month, following invoice.

I trust the above meets your requirements, if you require any further information please do not hesitate to contact me.

Regards,

CRAIG FREEMAN
Technical Director
Mobile: 0274-432-103
Email: craig.freeman@filtec.co.nz

Report

Solomon Islands Higher Education Assessment - Fire Protection Services

Prepared for Asian Development Bank (ADB)

Prepared by Beca Ltd (Beca)

8 December 2015

Revision History

Revision Nº	Prepared By	Description	Date
0	Matthew Carden	Released for inclusion in MCDP	8 Dec 2015

Document Acceptance

Action	Name	Signed	Date
Prepared by	Matthew Carden		8 Dec 2015
Reviewed by	Hamish Denize		8 Dec 2015
Approved by	Alister McGaw		8 Dec 2015
on behalf of	Beca Ltd		

Contents

Appendices

1 Introduction

1.1 Background

Beca have assessed the fire protection services principles for a proposed University of South Pacific (USP) development in the Solomon Islands for the Asian Development Bank (ADB).

During the site visit Beca met with the Director of the Solomon Islands Fire Service, to determine the response capability for the proposed campus. In essence, response from Emergency Fire Services will be limited, and may take more that 20-35 minutes owing to traffic congestion within central Honiara. Therefore, until the emergency fire services arrive, the campus will be self-sustaining in terms of fire suppression, via use of hose reels and hand held fire extinguishers.

1.2 Fire System Needs Assessment

The development is expected to take place in two stages. The population allowance for Stage 1 is for 1650 full time equivalent students (FTES) and 80 staff present onsite during the day. Phase 1 is expected to consist of 9 buildings of which the largest fire cell will be the Lecture Theatre. The population allowance for Stage 2 is for an additional 200 resident staff and students. Phase 2 is expected to consist of 15 additional buildings of which the largest fire cell will be the Multi-purpose Hall.

The expected water demand for the fire protection system is shown in Table A.

As requested by the Honiara Fire Service we have included the following items:

- Two points of access to the Campus
- On site storage minimum of 20,000 litres (20m3) of fire water
- Six fire hydrants evenly distributed around the buildings on a reticulated fire main ring.
- Hose reels located in each building
- Smoke detectors as a part of the fire alarm system

1.3 Design Code

We understand the application of fire engineering is controlled by the Draft National Building Code for the Solomon Islands, but is variable in its application. The authorities (Ministry of Housing, Lands and Survey, Ministry of Internal Development, Honiara City Council) however aspire to comply with appropriate AS/NZ Standards.

We have assumed that the NZ Building Code (and applicable fire protection standards) will be accepted for this campus. A fire engineering design will need to be prepared which will demonstrate compliance in terms of escape route locations, fire ratings and systems for each building.

The New Zealand standards have therefore been applied for this fire protection services assessment. In particular SNZ PAS 4509:2008 NZ Fire Service Fire fighting Water Supplies Code of Practice has been used to assess the appropriate fire water flow rates and storage requirements.

3 Reticulated Firefighting Water

The firefighting water supply demand is determined by applying. PAS 4509 Tables 1 and 2 and associated notes and definitions. The buildings are classed as Lecture Halls according to PAS 4509 and are therefore considered Fire Hazard Category 1 (FHC1). The buildings will not be equipped with sprinklers and are therefore non-sprinklered structures. The largest fire cell for phase 1 is 370m2 (Lecture Theatre) and for phase 2 it is 500m2 (Multi-purpose Hall). PAS 4509 Table 1 provides a Fire Water Classification of FW3. Table 2 states that an FW3 requires water flow rate of 25 ℓ/s within a distance of 135m (from a fire) with an additional supply of 25 ℓ/s within a distance of 270m. These flow rates must be supplied by no more than 3 hydrants.

Table A: Fire Fighting Water Supply by Hydrants (based on NZ Fire Service Firefighting Water Supplies Code of Practise)

Phase	Largest Fire Cell	Floor Area (sq.m)	Water Supply Classification	Reticulated Minimum Water Flow Within Distance of 135 m (L/s)	Reticulated Minimum Water Flow Within Distance of 270 m (L/s)	Maximum Number of fire Hydrants	Non-Reticulated Minimum Water Storage (m3)
1	Lecture Theatre	370	FW3	25	25	3	180
2	Hall	500	FW3	25	25	3	180

Reference: SNZ PAS 4509:2008 NZ Fire Service Firefighting Water Supplies Code of Practise, Page 19, Table 1 and Table 2– Method for determining firefighting water supply

Six Fire hydrant outlets are proposed on a potable water ring main network. The location of outlets will be positioned to provide coverage to each building. The hydrant outlet type will need to be compatible with the island's Fire Service couplings/hoses. For the purpose of the master plan development we have assumed the use of above-ground hydrant outlets similar to those in Australia (compatible with AS2419.1), refer to Appendix A for an example hydrant. Alternatively NZ below-ground sluice valve outlets could be provided. The potable water supply will be up-sized to accommodate several hydrant outlets flowing simultaneously in accordance with PAS 4509.

Pipework and pumping requirements for fire fighting purposes will be based on the water demand requirements in accordance with PAS 4509. A combined pumping facility comprising two fire pumps and two potable water pumps will be located near the water storage tanks.

Two water storage tanks of 200m^3 each are proposed to be located on site. They will each be used for combined fire and potable storage. Potable water will be drawn off approximately halfway up each of the tanks and fire water will be drawn off from the bottom of the tanks. This design provides a minimum combined reserve for fire water of 200m^3, while also providing redundancy and the ability to do maintenance work on each tank, but still retain fire water storage when one tank is out of service.

The Fire Service will need to connect their appliance (trucks) to the site hydrants to obtain water and from there attack a fire. For a ground story fire this would be from their fire appliance truck.

Figure 1: The largest of the Honiara Fire Service Appliance/Truck (HOWO) provided by the Chinese,.

4 Building Fire Hydrant and Hose Reel Systems

In accordance with New Zealand standards, hydrant risers will be located inside the stair wells of each building with hydrant riser couplings on each floor above the ground floor, these risers will be connected to fire service inlet connecter boxes positioned on the outside of the buildings at ground floor level. The fire service will need to connect hoses from their fire appliances (trucks) to the fire water connector boxes on the building to charge and boost the building riser and hydrant system. The fire service will use their own hoses within the building, connected to the stair hydrant riser couplings to fight the fire on each floor.

Fire hose reels will be provided in each building outside of stair wells, these will be connected directly to the fire/potable water main. These hose reels will have a 36m hose length to cover all internal areas and enable a rapid response to control a moderate sized fire by the people on campus before the arrival of the fire service.

Figure 2: Example internal building hydrant riser and hose reel.

5 Building Fire Extinguishers

Handheld fire extinguishers will be provided on each floor of the buildings to allow a response to small fires.

Figure 2: Example internal building hydrant riser and fire extinguisher.

6 Fire Detection

Building fire detection (heat and smoke) and alarming systems will be in accordance with New Zealand standards and will be fitted to all buildings. The existence of automatic fire alarm paging to the Honiara fire service has not been confirmed. However if this system is available, the campus fire alarming system will be connected to the fire service to initiate automatic call out.

7 Discussion

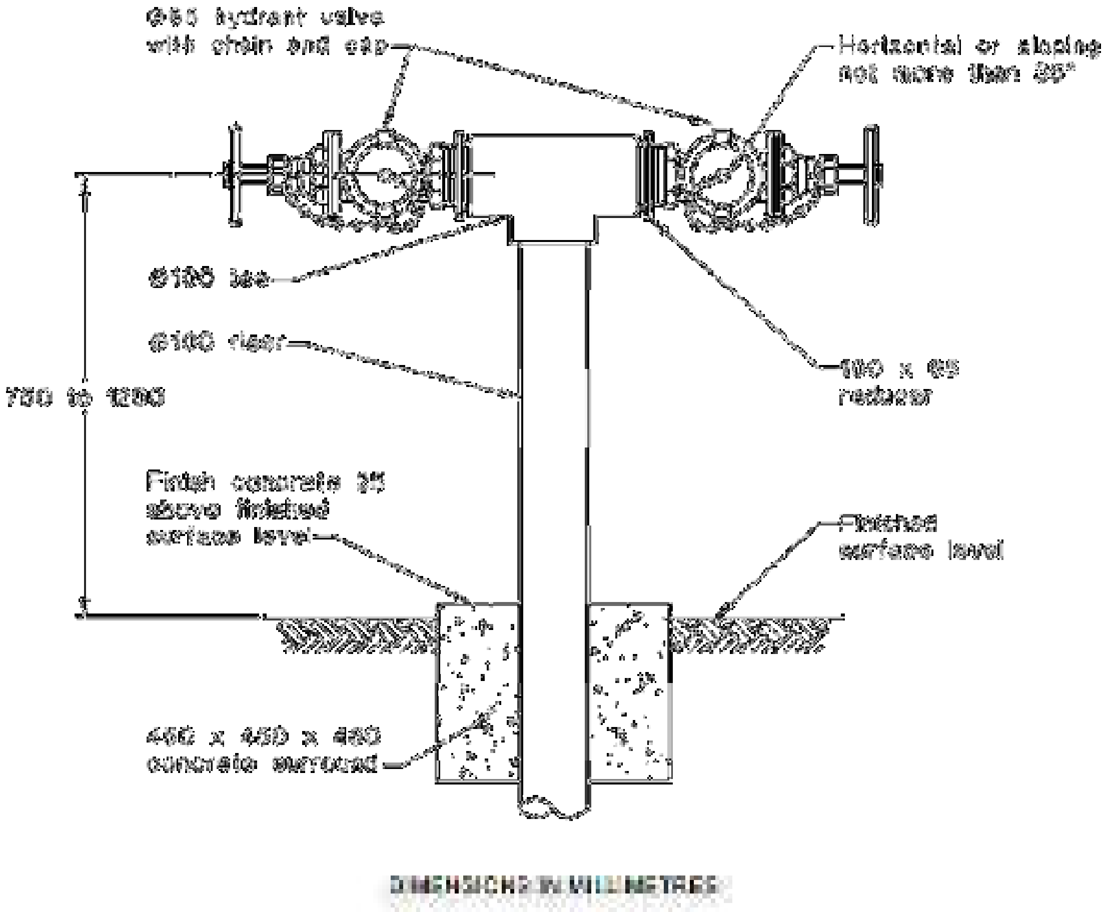
Both the New Zealand and Australian standards were considered for the building fire water systems. The Australian standard specifies charged building hydrant risers, which for this campus layout would require multiple pipe work connections to every building from the fire/potable water ring main pipe. The cost for this type of design is high therefore the New Zealand standards were applied as this specifies building hydrant risers with no permanent connection to the fire water ring main. We consider this to be an appropriate and cost effective solution for this USP Campus site. The cost of the fire system is covered in the building construction cost and the reticulated water system costs.

The USP campus site is expected to be developed two phases (Phase 1 and Phase 2), however the fire design is not affected by this phased development of the site. The six fire water hydrants will all be installed in phase 1 as part of the water reticulation ring main system. Each building will be constructed to include the same fire design features regardless of what development phase it is in.

Appendix A

Example of External Fire Hydrant

Example of an external fire hydrant from AS 2419.1 - 2005



Note: Bollards must be installed where the hydrant is at risk of damage (eg from vehicles)

Report

Solomon Islands Higher Education Assessment - Wastewater Treatment

Prepared for Asian Development Bank

Prepared by Beca Ltd (Beca)

8 December 2015

Revision History

Revision Nº	Prepared By	Description	Date
0	Jessica Daly	Issued for Client Review	8/12/2015

Document Acceptance

Action	Name	Signed	Date
Prepared by	Jessica Daly		8/12/2015
Reviewed by	Malcolm Franklin		[illegible]
Approved by	Alister McCaw		
on behalf of	Beca Ltd		

Contents

Appendices

1 Introduction

1.1 Background

Beca have assessed wastewater treatment options and the associated capital and operating costs for a proposed University of South Pacific (USP) development in the Solomon Islands for the Asian Development Bank (ADB).

We understand that there is no reticulated sewer system that the university could connect to, hence onsite treatment will be required. However, the neighbouring King George VI School has a pumpstation and ocean outfall that could be utilised by the university. We have assumed that the ocean outfall will be the ultimate post-treatment disposal route for the wastewater.

1.2 Needs Assessment

The development is expected to take place in two stages. The population allowance for Stage 1 is for 1650 full time equivalent students (FTES) and 80 staff present onsite during the day. The population allowance for Stage 2 is for an additional 200 resident staff and students. The expected wastewater volumes for the development are summarised in Table 1.

Table 1: Wastewater Demand for South Pacific University Development

	Population	Allowance	Wastewater Demand
Stage 1	1730 FTES	20 L/pp/day	35 m^3/d
Stage 2	200 resident students and staff	200 L/pp/day	40 m^3/d
Total			**75 m^3/d**

The Stage 1 daytime allowance of 20L/pp/day (litres per person per day) is based on suggested domestic flow allowances per capita for schools from *On-Site Wastewater Systems: Design and Management Manual (Auckland Regional Council TP58, 2004).* This figure has been checked against actual water flows measured at five schools in New Zealand. In this application we expect wastewater and water flows to be similar. The Stage 2 resident allowance of 200L/pp/day is based on suggested domestic wastewater flow allowances per capita for households with standard fixtures *(Auckland Regional Council TP58, 2004)*.

Given the projected wastewater flows are relatively small for this project, we do not consider there to be a substantial cost saving by staging the construction of the wastewater treatment plant. We have allowed for the full Stage 2 wastewater flows in sizing the treatment options.

1.3 Effluent Quality

As a limited treatment level, primary treatment could be undertaken to achieve some removal of total suspended solids (TSS) and biological oxygen demand (BOD). This is in-line with the *Australian Guidelines for Sewerage Systems (*ANZECC, 1997*)* recommendations for a discharge to coastal waters via an extended outfall.

For a higher quality effluent, secondary treatment could be undertaken to achieve approximately 90% reduction in solids and BOD. This is in-line with the ANZECC recommendations for a discharge to coastal waters near the shore. If the receiving environment is sensitive to other contaminants e.g. pathogens, then tertiary treatment (in the form of disinfection) could be undertaken to achieve pathogen reduction.

Marine environments are generally less sensitive to effluent nutrient concentrations than surface water environments. Given the ultimate disposal route is an ocean outfall, we do not consider nutrient removal (phosphorus and nitrogen) to be necessary.

We have assessed process options to achieve three, alternative effluent quality standards (Table 2).

Table 2: Effluent Quality Standards

"High" Effluent Quality	"Medium" Effluent Quality	"Low" Effluent Quality
TSS reduction (up to 95%) BOD reduction (up to 90%) Pathogen reduction e.g. *E.coli* < 1,000 MPN/100mL No nutrient removal – some ammonia reduction may be achieved. Tertiary Treatment.	TSS reduction (up to 90%) BOD reduction (up to 90%) Limited pathogen reduction. No nutrient removal. Secondary Treatment.	TSS reduction (50-70%) BOD reduction (approx. 30%) Limited pathogen reduction. No nutrient removal. Primary Treatment Only.

Due to the limited information about the receiving environment and outfall structure, we recommend that a minimum of the "medium" effluent quality is targeted. We recommend further information about the receiving environment is obtained at the next design stage, such as:

- Location of the ocean outfall,
- Level of treatment and location of other discharges,
- Water quality results for the receiving environment,
- Uses of the receiving environment e.g. recreational use, fishing, shellfish gathering etc.

This information will enable confirmation as to whether a "medium" effluent quality is appropriate.

2 Wastewater Treatment Options

2.1 Septic Tank – Low Effluent Quality

Three septic tanks ($40m^3$ + $20m^3$ + $20m^3$) could be installed in series to treat the effluent. Tanks installed in series typically achieve better solids removal rates than an equivalent larger tank. A reasonable solids removal rate and some BOD reduction could be expected with a septic tank system. The septic tanks would be large enough to balance diurnal flows.

The tanks could either be concrete (constructed onsite) or of a modular glass reinforced plastic (GRP) design. In a potentially acidic environment, GRP tanks may be more corrosion resistant than concrete tanks.

Normally septic tank effluent is distributed over a land area to complete the treatment process. Residual BOD and pathogen reduction is achieved through the soil profile. Loading rate is dependent on soil characteristics such as the drainage rate. A poor draining soil (such as clay) may have a hydraulic design rate of 3mm/day while a free draining soil may have a higher hydraulic design rate of up to 20mm/day. For a wastewater volume of 75 m^3/day, an area of 0.4-2.5 H.a. would be required for a suitable disposal field. Finding an appropriate land area of this size on site may be difficult. Rather than discharge the effluent from the septic tank to land, it could be transferred to the ocean outfall for disposal.

Septic tanks require little maintenance apart from periodic desludging to prevent solids build up. Septic tanks are a common sewage treatment option in Honiara, and hence locating a local contractor to desludge the septic tanks should not be an issue. The frequency of desludging is dependent on the tank loading rate, but is typically required every 1-4 years.

To avoid excessive scum build-up in the septic tanks, a grease trap would need to be fitted on any centralised food preparation facilities (such as a cafeteria or communal kitchen).

2.2 Septic Tank and Rotating Biological Contactor – Medium Effluent Quality

A rotating biological contactor (RBC) could be installed after a series of septic tanks to further treat the wastewater. Installation of an RBC would result in improved solids and BOD removal. Removal of 80-90% solids and BOD could be expected with a well operated system.

An RBC consists of a series of closely spaced circular discs of polystyrene or polyvinylchloride that are attached to a horizontal shaft. The RBC unit is partially submerged in a tank containing the wastewater and the discs rotate slowly through the wastewater. Biological growth on the surface of the discs degrades organic material present in the wastewater.

A general arrangement drawing for a similar sized installation to that required for this application is included in Appendix A.

2.3 Package Wastewater Treatment Plant - High Effluent Quality

A package wastewater treatment plant could be provided to treat all the wastewater from the university development. A process such as a Fixed Activated Sludge Treatment (FAST) package plant by Smith and Loveless would provide a relatively high level of treatment including solids, BOD and pathogen removal.

The FAST treatment plant is largely pre-fabricated offsite and designed to fit into 20ft or 40ft shipping containers. This minimises the construction and installation required onsite. The following items are typically included in the supply of a FAST package plant:

- Inlet fine screen
- FE tank (aerated)
- FAST reactor
- Clarifier
- Filter buffer tank
- Filter
- UV disinfection
- Treated Effluent storage tank
- WAS tank (aerated)
- All transfer pumps and pipework
- All process instrumentation
- MCC and PLC system with HMI
- Duty / standby blowers – with acoustic weather-proof enclosures
- Access walkways and stairs
- Roof cover for blowers / MCC / filter / UV

A general arrangement drawing for the process is included in Appendix B. The package plant includes an inlet tank to balance diurnal flows.

Whilst this option would provide treated wastewater of a high quality, when taken in the project context a package treatment plant has relatively high costs (both capital and operating) and potential difficulties with servicing and maintenance, operator availability and technician support. These issues must be carefully considered when selecting a sustainable treatment process.

There are multiple types of package wastewater treatment plants offered by different suppliers. If this option was to be progressed further, more detailed information about other package plant options could be investigated.

3 Options Comparison

3.1 Option Attributes

The relative capital cost, advantages and disadvantages of the treatment options are summarised in Table 3. All prices are in NZD.

Not that the indicative capital costs below are to be used for comparative purposes only to aid with preferred option selection. These are order of magnitude costs only and are not to be used for budget setting.

Table 3: Advantages and Disadvantages of Onsite Full Treatment Options

Treatment Option	Indicative Capital Cost (NZD)	Pros	Cons
FAST Package Treatment Plant	$1 M	Robust treatment process with good solids, BOD and pathogen removal Package supply and install of process equipment simplifies construction – plant designed to fit into 40 ft shipping containers Compact footprint Simple operation – well suited to small and remote communities	High operating costs Access to service technicians and support may be difficult Mechanical components will require maintenance e.g. screen, blowers, pumps etc
Septic Tank and RBC	$500k	Good solids and BOD removal achieved Compact footprint Less mechanical components than a more advanced treatment process therefore less maintenance required. Additional process steps can be added to improve effluent quality if required e.g. UV, filtration	Access to service technicians and support may be difficult High operating costs
Septic Tank	$100k	Simple operation with low maintenance requirements Treatment will result in solids reduction and some BOD reduction	Treatment is limited to solids and some BOD reduction – does not provide full treatment

Treatment Option	Indicative Capital Cost (NZD)	Pros	Cons
		(approx. 30%) Compact footprint Low operating costs	

3.2 Discussion

A compact onsite treatment facility, such as a FAST package wastewater treatment plant, would consistently provide the best treated effluent quality of the options considered. However, a package wastewater treatment plant has high capital costs, high on-going operating costs as well as the potential difficulties with servicing and maintenance and technician support.

A septic tank with a RBC would provide a good balance between treated effluent quality and economy. This type of system also seeks to minimise mechanical processes and hence reduces power costs and simplifies on-going maintenance. For these reasons we consider a septic tank with a RBC the best option for the site.

Whilst a septic tank alone would be the least expensive option, the treated effluent quality would be the poorest of the options considered. If a low effluent quality is acceptable, then this option could be considered further.

4 Preferred Option Costs: Septic Tank with RBC

4.1 Capital Costs

The estimated capital costs for a septic tank and RBC is shown in Table 4. Note that all costs are in NZD.

Table 4: Capital Cost for Septic Tank and RBC System

Item No.	Item	Costing Basis	Cost (NZD)
1	Septic Tank	Budget price from supplier + 20% allowance for budget to tender prices	$ 100,000
2	RBC	Budget price from supplier + 20% allowance for budget to tender prices	$ 290,000
3	Installation	Suggested allowance from supplier	$ 75,000
Total			**$ 465,000 NZD**

Exclusions:

- Prices are ex NZ and do not include delivery to the Solomon Islands.
- GST
- Project costs (P&G, contractor margins, design, specifications)
- Contingency
- Commissioning
- Wastewater conveyance (from source to the treatment plant and from the treatment plant to the ocean outfall)

4.2 Operating Costs

The estimated operating costs for a septic tank and RBC treatment system are shown in Table 5. Note that the operating cost is in NZD.

Table 5: Operating Cost for Septic Tank and RBC System

Item No.	Item	Costing Basis	Cost (NZD)
1	Maintenance	2% of mechanical cost	$6,000
2	Power	Assumed power cost of NZD$1.25/kwhr	$54,000
Total			**$60,000/annum NZD**

Exclusions:

- Prices are ex NZ and do not include delivery to the Solomon Islands.
- GST.
- Labour costs.
- Pumping costs associated with conveyance i.e. to/from the treatment plant.

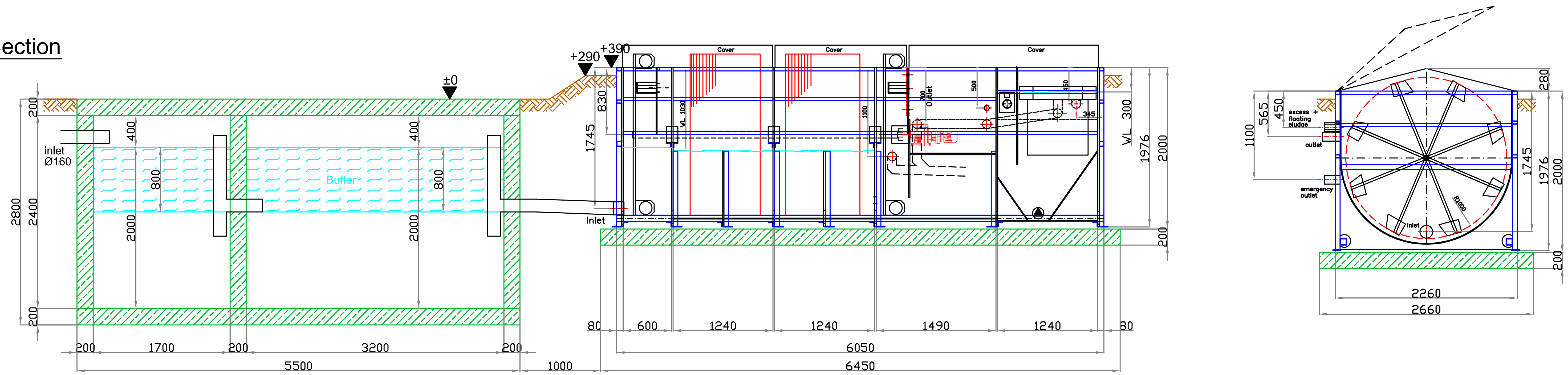
5 Recommendations

- We recommend that a series of septic tanks followed by a rotating biological contactor is installed to treat all the wastewater from the site to a “medium” effluent quality (90% BOD and TSS reduction). Treated wastewater from the rotating biological contactor would be discharged to the ocean via the pumpstation and ocean outfall located at the neighbouring King George VI high school.
- To confirm the acceptability of a “medium” effluent quality approach, we recommend further information about the receiving environment is obtained at a subsequent design stage, such as:
  - Location of the ocean outfall,
  - Level of treatment and location of other discharges,
  - Water quality results for the receiving environment,
  - Uses of the receiving environment e.g. recreational use, fishing, shellfish gathering etc.
- If a low effluent quality is assessed to be acceptable at a subsequent design stage, a less expensive solution such as a series of septic tanks could be considered.

Appendix A

Septic Tank and RBC – GA Drawing

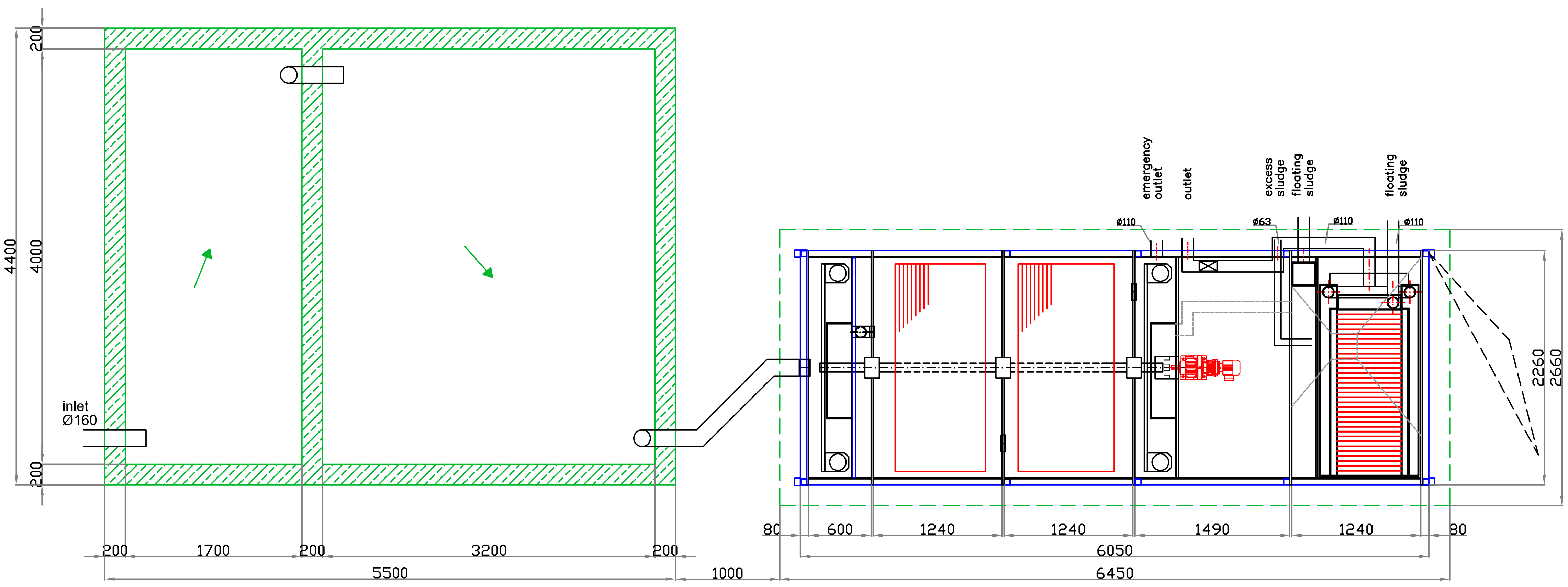
Section



Multi-chamber-pit
~39m³

KKA-E-2000-578/2-7/1-S

Top View



System S&P Vertriebs-GmbH
Dr. Scholz und Partner GmbH

System S&P
The Natural Wheel
Compact Module Sewage Plants

Ahornstr.27 * D-74592 Kirchberg/Jagst
Tel.+49 (7954) 9804-0, Fax +49 (7954) 9804-20
http://www.system-s-and-p.de   info@system-s-and-p.de

GENERAL INFORMATION
1. Do not scale the drawing.
2. Unless otherwise specified, dimensions are given in millimeters.
3. The contracting party shall be notified immediately of any discepancy found therein.

LEGAL INFORMATION
1. Dr. Scholz und Partner GmbH reserves the copyright of this drawing.
2. The drawing shall not be made available to third parties without prior written consent by Dr. Scholz und Partner GmbH.
3. The drawing should not be multiplied without prior written by Dr. Scholz und Partner GmbH.
4. In case of misconduct, Dr. Scholz und Partner GmbH reserves the right to press charges.

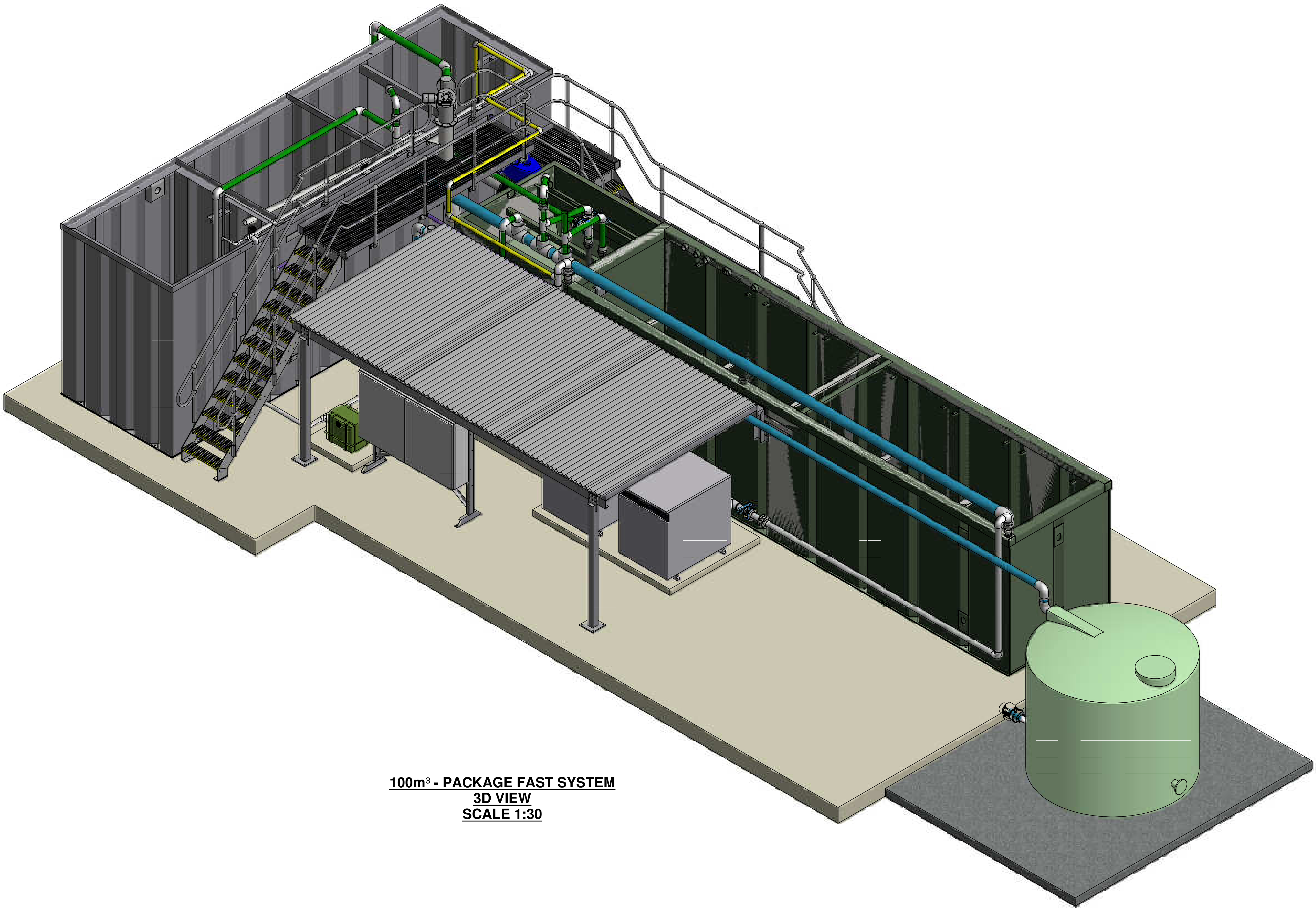
TOP VIEW, SECTION

Samoan beach resort
Flow 40m³/d

date: 11/03/2011	scale: 1:50	A3
	page: 1/1	
drawn. No.: EH-11-34-019-001	drawn by : rs	insp by : eh

Appendix B

FAST Treatment Process – GA Drawing

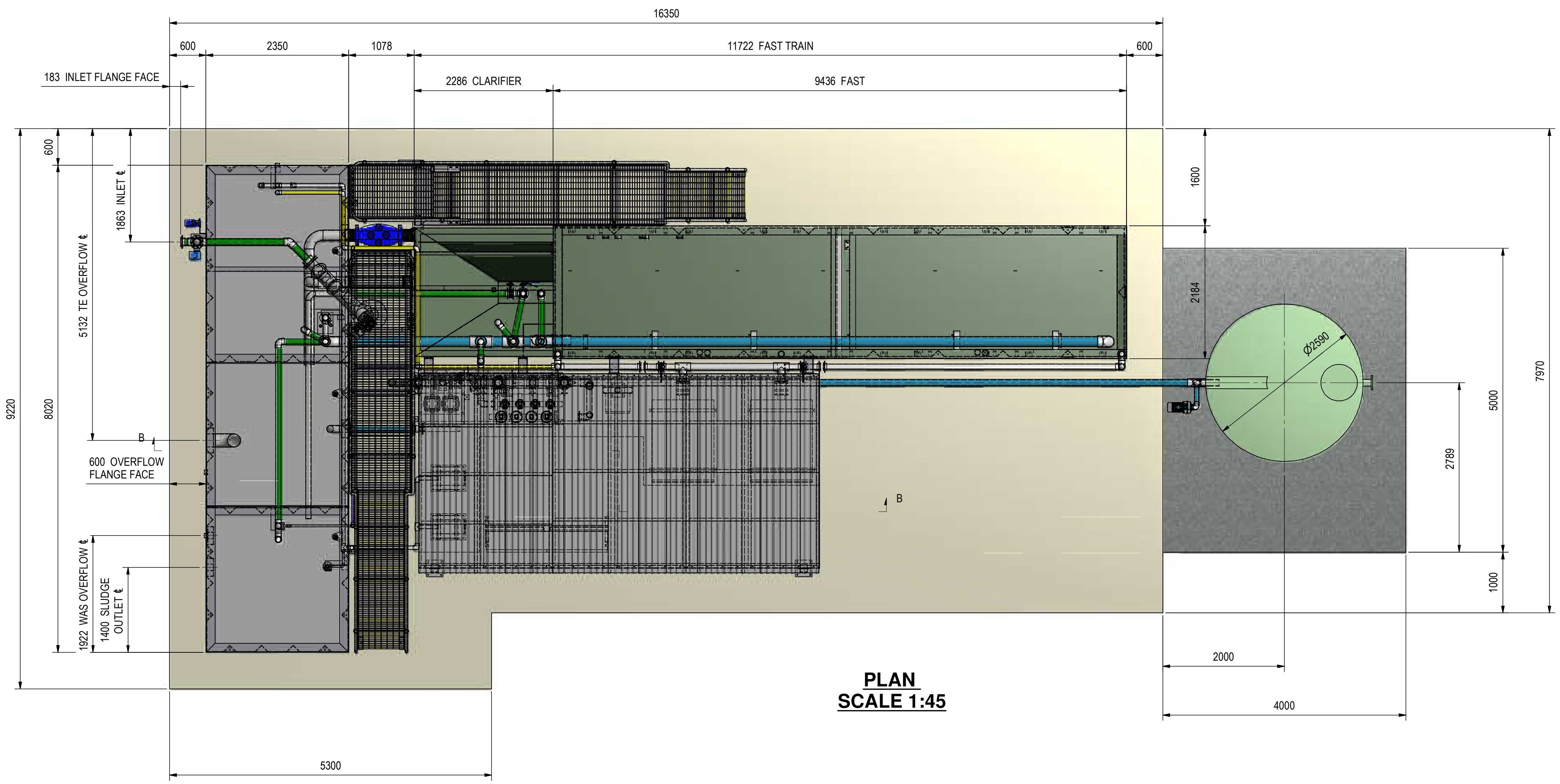


100m^3 - PACKAGE FAST SYSTEM
3D VIEW
SCALE 1:30

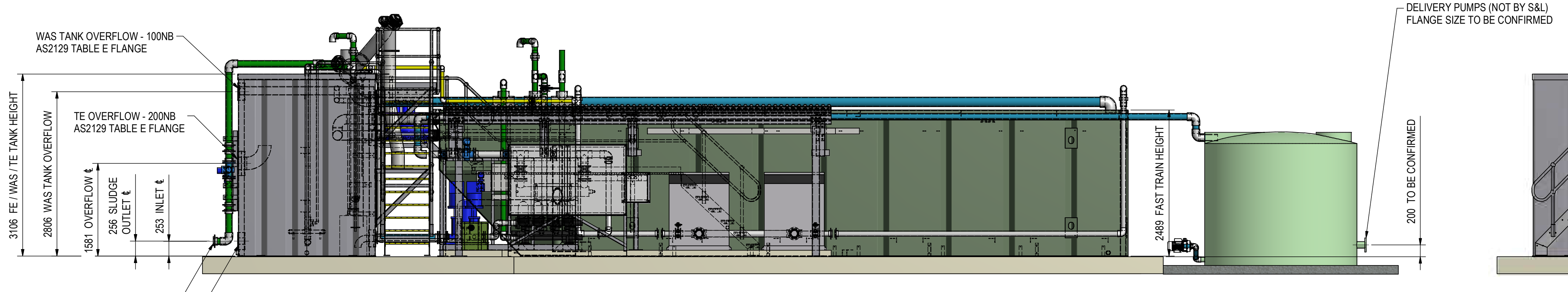
REV:	DATE:	DESCRIPTION:	DRN:	APP:

DRAWN BY: DJM	DATE: 16/02/2015	FOR	
CHECKED BY:	DATE:	100m3 CAPACITY PACKAGE FAST SYSTEM	
APPROVED BY:	DATE:	GENERAL ARRANGEMENT	
SCALE:	CODE:	SIZE A1	PLOT SCALE
LET / ECN NO / DATE / BY APPV'D		FILE NAME S15-17-3-S001.iam	SHEETS IN SET 3
ORIGINAL ISSUE		PROJECT NO S15-17-3 / DWG NO S001_1	REV A

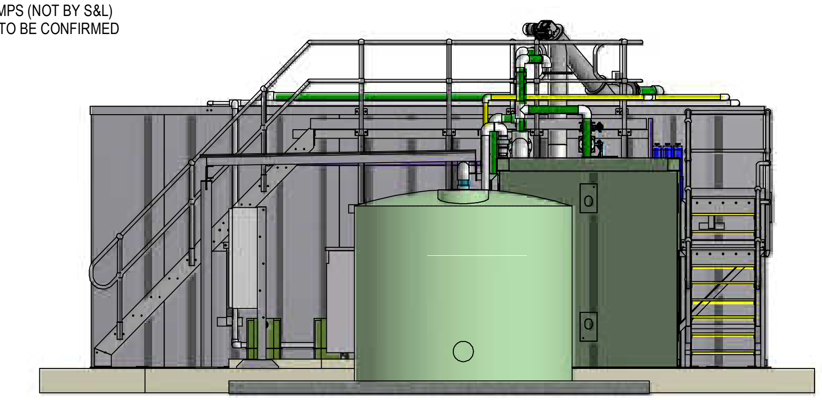
Smith & Loveless NZ



PLAN
SCALE 1:45



ELEVATION
SCALE 1:45



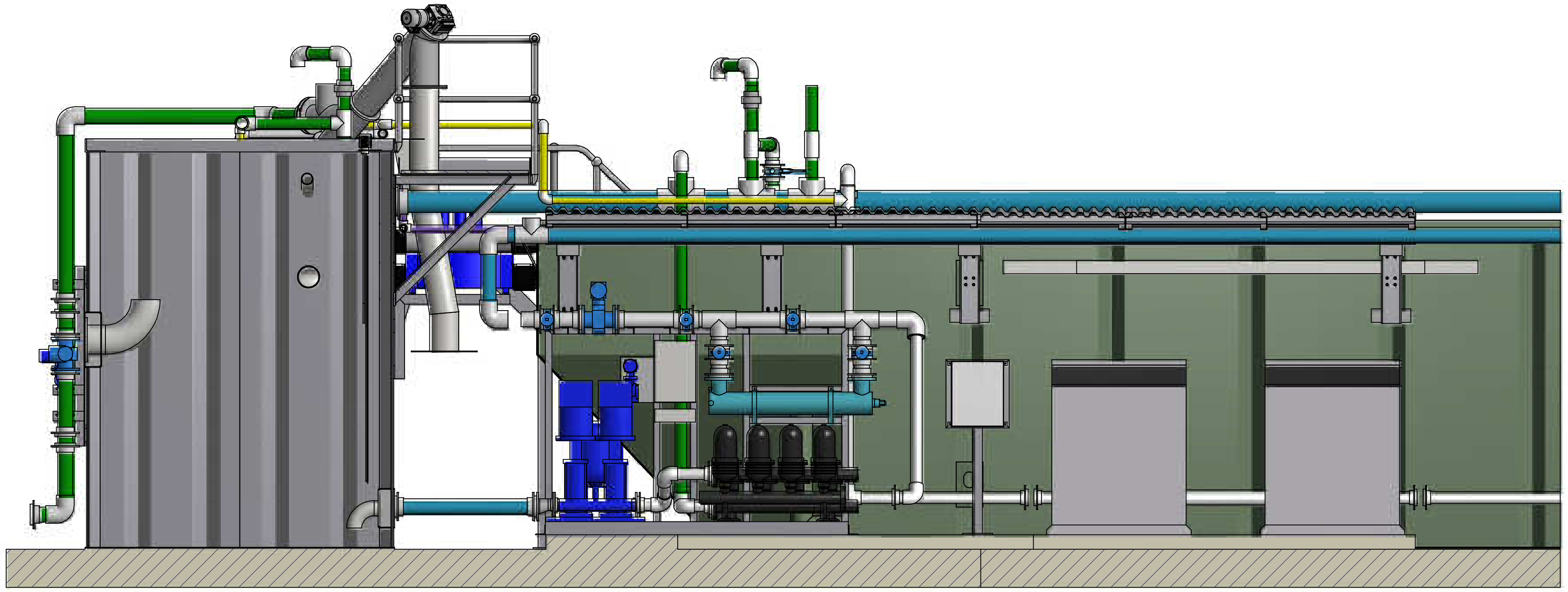
END VIEW
SCALE 1:45

REV:	DATE:	DESCRIPTION:	DRN:	APP:

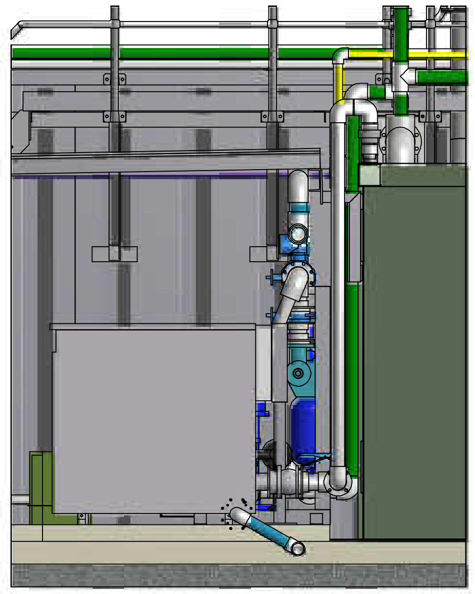
LET	ECN NO	DATE	BY APPV'D
ORIGINAL ISSUE			

DRAWN BY: DJM	DATE: 16/02/2015	FOR	
CHECKED BY:	DATE:	100m3 CAPACITY PACKAGE FAST SYSTEM	
APPROVED BY:	DATE:	GENERAL ARRANGEMENT	
SCALE:	CODE:	SIZE A1	PLOT SCALE
		FILE NAME S15-17-3-S001.iam	SHEETS IN SET 3
		PROJECT NO S15-17-3	DWG NO S001_2	REV A

Smith & Loveless NZ



SECTION B-B
SCALE 1:25



SECTION B-B - END VIEW
SCALE 1:25

REV:	DATE:	DESCRIPTION:	DRN:	APP:

LET	ECN NO	DATE	BY APPV'D
ORIGINAL ISSUE			

DRAWN BY: DJM
DATE: 16/02/2015
CHECKED BY:
DATE:
APPROVED BY:
DATE:
SCALE:
CODE:

FOR

100m3 CAPACITY
PACKAGE FAST SYSTEM

GENERAL ARRANGEMENT

SIZE A1
PLOT SCALE
FILE NAME S15-17-3-S001.iam
SHEETS IN SET 3
PROJECT NO S15-17-3
DWG NO S001_3
REV A

Smith & Loveless NZ

Report

Solomon Islands Higher Education Assessment - Electrical Systems

Prepared for Asian Development Bank (ADB)

Prepared by Beca Ltd (Beca)

8 December 2015

Revision History

Revision Nº	Prepared By	Description	Date
0	Matthew Carden	Released for inclusion in MCDP	8 Dec 2015

Document Acceptance

Action	Name	Signed	Date
Prepared by	Matthew Carden		8 Dec 2015
Reviewed by	Khaled Hassan		8 Dec 2015
Approved by	Alister McCaw		8 Dec 2015
on behalf of	Beca Ltd		

Contents

Appendices

1 Introduction

1.1 Background

Beca have assessed electrical power system options and the associated capital and operating costs for a proposed University of the South Pacific (USP) development in the Solomon Islands for the Asian Development Bank (ADB). It is understood Australian and New Zealand Standards are accepted in the Solomon Islands and have therefore been applied for this concept design.

It is noted that existing 11kV overhead power lines are running along the road on the eastern side of the proposed USP site. The power supply capacity of these lines is unknown. It is assumed the load demand for the USP can be accommodated by these power lines. If this assumption is not correct, the installation of new 11kV transmission lines will be required to connect the USP to nearest point which has power supply capacity. It is likely this point will be at the Kukum Highway, where existing transmission lines are running along the road. At time of writing this report we had not received an offer or technical details from Solomon's Islands Electricity Authority (SIEA). This offer was expected to include who would pay for the connection costs SIEA or the USP. As this information is unknown, the grid connection detail and cost has been excluded. Refer to Appendix A.

1.2 Needs Assessment

The development is expected to take place in two phases. Phase 1 is expected to consist of 9 buildings with a total floor area of 6526m^2 of these building the Administration, Student Services and Lecture theatre are expected to have a higher load due to more intensive services. Phase 1 will also include installation of a potable and fire water pump station and a waste water treatment plant, both of these will be sized to cater for phase 1 and 2. The population allowance for phase 1 is for 1650 full time equivalent students (FTES) and 80 staff present onsite during the day. Phase 2 is expected to consist of 15 additional buildings with a total floor area of 11192m^2 The population allowance for phase 2 is for an additional 200 staff and students resident on site. The expected installed power demands for the USP are summarised in Table 1. The buildings power demand has been estimated on the basis of W/m^2 of floor area.

Table 1: Installed Power Demand for South Pacific University Development

Phase	Description	Buildings Floor Area	Installed Power Demand Estimate
Phase 1	1650 students and 80 staff and buildings	6526 m^2	560kW
Phase 1	Potable and fire water pump station		30kW
Phase 1	Waste water treatment plant		10kW
	Phase 1Total		**600kW**
Phase 2	200 resident students and staff and buildings	11192 m^2	900kW
	Phase 2 Total		**900kW**
	Phase 1 & 2 Total	**17718 m^2**	**1500kW**

1.3 Power Supply Reliability

The existing Honiara main electrical transmission grid has reliability issues and experiences unplanned outages 2 to 3 times a week for between 1 to 3 hours at a time. To improve the reliability of electricity supply within the campus, on site sustainable power generation is being proposed for the Campus. It is proposed that the Solomon's Islands Electricity Authority (SIEA) will supply electrical power to the new USP campus through a connection to the Honiara main electrical transmission grid. In addition power will be generated on the campus site from two other sources namely Solar power and diesel generators.

Uninterruptable power supplies (UPS) should be connected to critical or sensitive equipment such as the Telecommunications or computer equipment to reduce the risk of equipment damage or data loss.

2 Electrical System Options

2.1 General

The design philosophy has been developed to enable the future phase 2 buildings and electrical loads to be installed so that they cause minimal disruption to operating phase 1 USP campus. Therefore some electrical infrastructure will be sized at phase 1 installation to cater for the future phase 2. This will allow phase 1 electrical equipment to be effectively duplicated for phase 2 and installed in parallel.

The site layout shows the phase 1 development centrally located with radial expansion out in phase 2. The electrical infrastructure will follow this layout. The 11kV power will be run into a central point on the site where the transformers and low voltage (415V) main switchboards and diesel generators will be located. This will allow the run lengths of the low voltage cabling to be minimised. Long low voltage cable runs become large and expensive and difficult to install, this layout will minimise these issues.

Refer to Appendix A Proposed Power Supply Layout for more details.

2.2 On-Grid Power Supply

It is proposed that the Solomon's National Power Grid owned by the Solomon's Islands Electricity Authority (SIEA) will supply electrical power to the new USP campus. Total power demand for the new campus is approximately 1500kW (600kW for phase 1 and 900kW for phase 2).

The phase 1 development will install a set of high voltage underground cables (11kV) laid from a fused switch located on road on the eastern side of the campus near the main road and run to an 11kV ring main unit (RMU), which will located near the main central buildings. These 11kV cables will be sized to provide the power infrastructure for the total phase 1 and 2 load. The cost to install the approximately 150m run of cable in a trench means it is better to install a larger cable size at Phase 1 than to install additional 11kV cables in phase 2.. The RMU will be sized to include two transformer feeders in preparation for connection of phase 2. A 1MVA transformer will be installed in phase 1 near the location of the RMU this will connect to a low voltage (415V) main switchboard which will be located in the administration building. This main switchboard will distribute power to the buildings and electrical equipment for the phase 1 development. The load demand of the phase 2 development, will require an additional 1MVA transformer and low voltage main switchboard to be installed adjacent to the phase 1 transformer and main switchboard. Some phase 2 loads will be added to the phase 1 main switchboard to balance the load distribution on the transformers.

The proposed electrical low voltage distribution configuration is to install power distribution boards in each building on the campus to service the local building loads. Each building distribution board will be supplied with power from one of the two main switchboards.

The main switchboards will be equipped with circuit breakers and transfer switches to allow connection of alternative power supplies.

2.3 Solar Power

The geographical location of the Solomon Islands provides a good source of solar potential. The proposed USP campus site offers a limited available unused land area, therefore a roof mounted solar panel system is considered the best option for power generation for this site. Solar power generation will offset the electricity demand requirements taken from the main grid. Suitable angles (tilt and azimuth) for the solar panels will need to be designed into the roof or support structures to ensure maximum sunshine is obtained during the day. Utilising the roof areas which face in the appropriate direction, it is estimated that the total solar power generation will be on average be 175kW per day (with 75kW for phase 1 and 100kW for phase 2). This depends on the installed capacity and efficiency of the solar panels. It must be noted that the large main central building roof contributes 40kW to the average power generation per day stated for phase 1. As this roof is designed as an iconic architectural feature the aesthetic impact of covering this roof with solar panels will need to be considered. If this central building roof is not used to mount solar panels on, then the phase 1 power generation will reduce to an average of 35kW per day. The cost of the 175kW solar power generation asset (including installation for phase 1 and 2) is approximately at NZD$612,500 (based on NZ$3.50 per watt).

Battery storage for power has been considered, but has been ruled as too unreliable due to issues with battery cooling. Batteries suffer from over temperature problems in the hot environment of the Solomon Islands, this leads to battery failures. The capital cost of battery storage and on-going maintenance is also high. Therefore the solar power system will be connected to the main power grid via the main switchboards.

The phase 1 main switch board will provide a connection point for the phase 1 solar power system. Likewise the phase 2 main switch board will provide a connection point for the phase 2 solar power system. Some solar generation may need to be moved from the phase 2 main switchboard to the phase 1 switchboard to balance the power between the two switchboards.

2.4 Diesel / Coconut Oil Generator

The unreliability of the power supply from the main grid means that having onsite diesel generators to provide power in the event of a main grid power failure allows the USP campus to continue operating and providing classes to the students. Diesel generation is common in the Solomon Islands. However the local supply of diesel is unreliable and it has a high cost as a fuel source for power generation. Therefore locally sourced coconut oil has been considered as a fuel source. A diesel generator supplier confirmed that some diesel generators can run on coconut oil. It is understood that a coconut oil powered generator has been successfully tested in the Solomon Islands. This would provide a locally sustainable power source for the campus.

The phase 1 development would install a 1MVA diesel/coconut oil generator which would be connected to the phase 1 main switchboard. Phase 2 would install another dedicated 1MVA generator connected to the phase 2 main switchboard. An automatic or manual changeover switch would be provided at each switch board to allow the switch board to be supplied with either Mains or Generator power. There is no intention to synchronise the generators with the main grid. When the generators are running, the campus would operate off the grid. Each generator will have its own dedicated fuel tank to provide 2 to 4 days running time depending on the load.

Total cost of the diesel/coconut oil generator is shown in Table 2.

3 Options Comparison

3.1 Option Attributes

The relative capital cost, advantages and disadvantages of the power system options are summarised in Table 2. All prices are in NZD.

Note that the indicative capital costs below are to be used for comparative purposes only to aid with preferred option selection. These are order of magnitude costs only and are not to be used for budget setting.

Table 2: Advantages and Disadvantages of Power System Options

Power System Option	Indicative Capital Cost (NZD)	Advantages	Disadvantages
On-grid Power System (Phase 1 - 600kW) (Phase 2 – 900kW)	Phase 1 $400,000+extra Phase 2 $285,000+extra **Total** $685,000+extra	Simple operation SIEA should maintain the system	Unreliable supply High power cost NZ$1.25 per kWhr
Solar Power (Phase 1 - 75kW) (Phase 2 – 100kW)	Phase 1 $262,500+extra Phase 2 $350,000+extra **Total** $612,500+extra	Provides sustainable power generation from a free energy source. Low maintenance cost	Roof mounted solar panel option has limited generation capacity due to available roof area Aesthetic issues if central building roof used for solar panels Access and working at height for maintenance of panels Local support technicians may be an issue
Diesel / Coconut Oil Generator & Fuel Tank (Phase 1 – 1MVA) (Phase 2 – 1MVA)	Phase 1 $450,000+extra Phase 2 $450,000+extra **Total** $900,000+extra	Provides backup power in the event of mains failure from the grid. Allows the USP campus to operate off-grid if required. Simple operation with low maintenance requirements	Requires noise attenuation as located centrally in campus. Fuel tanks need to be accessible and may present aesthetic issues Unknown fuel price and delivery Local support technicians may be an issue

3.2 Discussion

A combination of grid connected and on campus generated solar power and diesel generator backup power would offer both lower operating cost and power supply security for the USP campus. However the capital cost for this combination is high.

Running the diesel generator on coconut oil appears to provide a sustainable local source of power. However the cost and availability and quality of the coconut oil are unknown and will require further investigation. If the fuel cost is low and both the quality and availability of the oil is high then the USP campus may be able to go “off grid” and supply all its own power on site.

If the diesel generators are regularly run to provide all the power requirements for the campus, the maintenance costs associated with the generator will increase and it may be necessary to employ staff to ensure the generators are operated and maintained correctly.

The solar power generation capacity is limited by the available roof space and can only provide approximately 12.5% of the Phase 1 load and 12% of the total Phase 1 and 2 load. There is a question about aesthetics and the practicality of construction to fit solar panels to the large central building roof. If solar panels cannot be fitted on the large central build roof then the phase 1 solar generation is reduced to only provide 6% of the phase 1 load and 9% of the total Phase 1 and 2 load. However the operating cost is low for the system. This solar power system will supplement the power demand and reduce the cost of power supply from the grid (SIEA).

Some consideration has been given to the possibility of changing the site layout to effectively split the site in half with phase 1 development on one side and phase 2 on the other side. The basic philosophy to minimise low voltage cable lengths would be retained, by having a dedicated main switchboard and transformer located at a central point in each phase of development, with low voltage cables running radially out to the building distribution boards for that phase. The key difference is each phase would have its own 11kV cable run in from the road fuses directly to each transformer. The on-site Ring Main Unit (RMU) would not be required in this arrangement and each 11kV underground cable would be sized to cater for the 1MVA transformer for that phase.

.

4 Preferred Option Costs: Combination of all proposed power supply systems

4.1 Capital Costs

The estimated capital cost for power supply systems is shown in Table 3. Note that the capital costs are in NZD and are to be used for qualitative comparison purposes only.

Table 3: Capital Cost for Power Supply Systems

Item No.	Item	Costing Basis	Phase 1 Cost (NZD)	Phase 2 Cost (NZD)
1	On-Grid Power System	Estimate based on materials only	$400,000	$285,000
2	Solar Power	Allowance of installed cost per kW	$262,500	$ 350,000
3	Diesel / Coconut Oil Generator & Fuel Tank	Budget estimate from supplier	$ 450,000	$ 450, 000
Total			**$1,162,500**	**$1,085,000**

Exclusions:

- Prices are ex NZ and do not include delivery to the Solomon Islands.
- Goods and Services Tax (GST)
- Project costs (Preliminary and General, contractor margins, design, specifications)
- Contingency
- Commissioning
- Connection from the USP entrance to the 11kV main grid (SIEA costs)
- Low voltage cables to the building distribution boards
- Any electrical equipment in buildings including building distribution boards

4.3 Operating Costs

The estimated annual operating costs for the combined system power supply are shown in Table 2. Note that the capital cost costs are in NZD and are to be used for qualitative comparison purposes only.

Table 2: Annual Operating Cost for Power Supply Combined System

Item No.	Description	Costing Basis	Phase 1 Cost (NZD)	Phase 2 Cost (NZD)
1	On grid power supply	Assumed power cost of NZD1.25.kWhr	$910,000	$850,000
2	Diesel or Coconut Oil generator operating to supply the complete site load demand with no grid power supply connection.	Diesel Fuel cost of NZ$2.20 per litre. Note the coconut oil cost is unknown.	$380,000	$370,000
3	Maintenance on generator	Estimate for annual inspection and tuning by a technician.	$20,000	$10,000
4	Maintenance on solar panel system	Estimate of annual panel cleaning cost and inspection by technician	$15,000	$20,000

Note: Appropriate diversity factors have been applied to the installed demand to create this estimate.

Exclusions:

- Prices are ex NZ and do not include delivery to the Solomon Islands.
- Goods and Services Tax (GST)
- Replacement parts

5 Recommendations

The recommendation is to install the combination of grid connected power supply from SIEA and also have on site generation from a roof mounted solar panel system and diesel/coconut oil generators.

However if there are cost limitations we recommend the solar panel system installation be deferred until later, but retain the grid connection and the diesel/coconut oil generator. The generators provide the USP with the ability to supply all its power needs on site and ensure security of power supply to the campus while reducing the operating cost associated with purchasing electricity from SIEA.

If the site layout is reconfigured with phase 1 on one half and phase 2 on the other half, it is recommended that dedicated 11kV cables be run from the grid connection into a central point in each phase, where a transformer and switchboard will be located. This design provides a modular expansion while allowing flexibility with the cabling and minimising costs for the installation and materials.

Appendix A

Proposed Power System Layout

Beca

www.beca.com

Report

Solomon Islands Higher Education Assessment - Telecommunications System

Prepared for Asian Development Bank (ADB)

Prepared by Beca Ltd (Beca)

8 December 2015

Revision History

Revision Nº	Prepared By	Description	Date
0	[illegible]	Released for inclusion in [illegible]	[illegible] Dec 2019

Document Acceptance

Action	Name	Signed	Date
Prepared by	[illegible]		[illegible] Dec 2019
Reviewed by	Jonathan [illegible]		[illegible] Dec 2019
Approved by	[illegible]		[illegible] Dec 2019
on behalf of	Beca Ltd		

Contents

Appendices

1 Introduction

Background

Beca have proposed a telecommunications system and the associated capital costs for a proposed University of South Pacific (USP) development in the Solomon Islands for the Asian Development Bank (ADB).

The sole supplier of telecommunication services in the Solomon Islands is “Our Telekom”. All connections to the main telecommunications system and the various services such as phone and internet will be arranged through “Our Telekom”. The on-site USP campus telecommunications system installation and future maintenance can also be provided by “Our Telekom”, equally other registered suppliers could undertake the onsite installation and maintenance work. An existing main fibre optic cable runs along the Kukum highway, this forms the fibre backbone for the Honiara telecommunications system and will be the nearest connection point for the campus to the Telekom network. “Our Telekom” have also committed to install a new cell phone tower on the opposite side of the Kukum highway, which will provide cellular coverage to the new proposed USP campus

1.1 Needs Assessment

The USP campus development is expected to take place in two phases. The buildings will generally be 2 or 3 story buildings with 2 or 3 classes per floor. The administration building is expected to have more intensive network requirements due to the services it is providing to the campus staff and students. Phase 1 of the development is expected to consist of 9 buildings with a total floor area of 6526m^2. The population allowance for phase 1 is for 1650 full time equivalent students (FTES) and 80 staff present onsite during the day. Phase 2 is expected to consist of 15 additional buildings with a total floor area of 11,192m^2 The population allowance for phase 2 is for an additional 200 staff and students resident on site.

The USP campus requires phone and high speed internet connection to the outside world. Onsite the network will need to provide “Smart Classrooms” with interactive learning technology. The Solomon Island USP campus network will include connection to other campus sites, in particular the Suva Fiji campus. Suva USP may act as a hub for connection to other campuses and access to learning resources.

2 Telecommunication System Design

2.1 General

The design philosophy has considered the phased development of the campus site. The aim is to enable the future phase 2 buildings and services to be installed so that they cause minimal disruption to operating phase 1 USP campus. Some telecommunication infrastructure will be sized at phase 1 installation to cater for the future phase 2. This will allow modular expansion of the system, using the same types of equipment for phase 1 and phase 2.

2.2 Main Network Connection

The main telecommunications connection to the USP campus site will be at the Kukum highway via fibre optic cable. It is proposed that a new underground duct will be installed from the Kukum highway, along the road that runs on the eastern side of the campus, then entering the site at the main USP campus entrance to and terminating at a central point on the site. This duct is expected to be about 75mm diameter and capable of housing all the communications cables required, with a space allowance for future cabled services. The installation and connection of this fibre optic will be made by Our Telekom.

2.3 On Campus Network

The campus administration building is centrally located on the USP site and it also has the most intensive demand for network services. The administration building is therefore most efficient place to locate the network equipment core rack for the campus network. The main fibre cable from the Kukum highway will connect to a central switch-router in the core rack, with a proposed star network topology for the campus network layout. The main fibre cable will have sufficient size to cater for both phase 1 and phase 2 developments.

The core rack provides space for connection to the internet service provider (Our Telekom), via the main router, firewall(s), and edge switch and to a local server. Structured cabling will connect from the core rack to small network racks located in the each of the other buildings.

Each local building network equipment rack and the core rack will provide space for an edge switch and structured CAT6 cabling to wall outlets, to permit connections for computers, wireless access points or other devices.

Each building floor and individual class rooms will be equipped with Wifi access points. The classrooms and lecture theatres will be equipped with digital media tools, such as projectors, computers, printers/photo copiers. We have allowed one computer per class room for teaching purposes and more . All equipment will be networked where possible. Refer to Appendix A for Network Layout and Appendix B for concept design.

The network will also allow for connection of other equipment such as CCTV/IP camera systems, card access control and security, or other required systems.

Fixed line phone services are expected to be Voice Over Internet Protocol (VOIP) rather than via a traditional PABX system.

The USP Suva Fiji campus IT department suggested satellite communications should be employed as a primary means of connection between the Honiara and Suva campuses for the WAN. This was based on the speed and reliability of the internet services currently available in Honiara. However it is understood that a new Solomon Islands submarine fibre-optic cable is planned to be in operation by 2018. The expected timing for Phase 1 construction of the new Solomon Islands USP Campus is after 2018. Therefore the USP campus can make use of the proposed submarine fibre optic cable at this time. Based on this information, satellite communication has not been considered for the new USP site.

Specific software has not been defined for the USP Campus at this stage. It is not expected there will any large software licencing of configuration costs. The standard suite of office type software has been allowed for.

3 Capital Costs

The estimated capital costs for Telecommunications system are shown in Table 1. Note that the capital cost costs are in NZD and are to be used for qualitative comparison purposes only.

Table 1: Capital Cost for Telecommunications system (per unit basis)

Description	No.	Cost each (NZD)	Total Cost (NZD)
Phase 1			
Ethernet Rack (rack, cables, telecom outlets, switches)	8	$20,000	$160,000
Trench & Fibre Optic Cable between Kukum highway and central building & installation	1	$102,500	$102,500
Conduits, fibre optic cables	8	$10,000	$80,000
Core rack (phase 1&2)	1	$100,000	$100,000
Computers for classrooms	60	$2,000	$120,000
Computers/Printers/Photo copiers for admin area	20	$2,000	$40,000
Wifi Access Points	100	$200	$20,000
Construction cost	8	$10,000	$80,000
Total phase 1			**$702,500**
Phase 2			
Ethernet Rack (rack, cables, telecom outlets, switches)	15	$20,000	$300,000
Conduits, fibre optic cables	15	$20,000	$300,000
Computers for classrooms	105	$2,000	$210,000
Wifi Access Points	105	$200	$21,000
Construction cost	15	$10,000	$150,000
Total phase 2			**$981,000**
Total for phase 1&2			**$1,683,500**

Exclusions:

- Prices are ex NZ and do not include delivery to the Solomon Islands.
- Exclude project management, IT engineering design and software support
- GST.

Our Telekom provided a budgetary offer based on the above design, but with no cost breakdown details. However the overall cost stated in the offer aligned closely in value with the engineering estimate shown in Table 1 above.

4 Discussion

The proposed telecommunications infrastructure for the new Solomon Islands USP campus will provide the students and staff with a connection to the internet through multiple access points (Wifi and Copper) at all buildings on site. Links with the USP Suva Fiji campus will enable collaboration and data sharing, which will enhance the learning process for both students and staff. The key assumption is that the planned submarine fibre optic cable will be installed by 2018, this work is outside the control of the USP development.

The overall design is simple and allows for expansion with the phased development of the USP campus site.

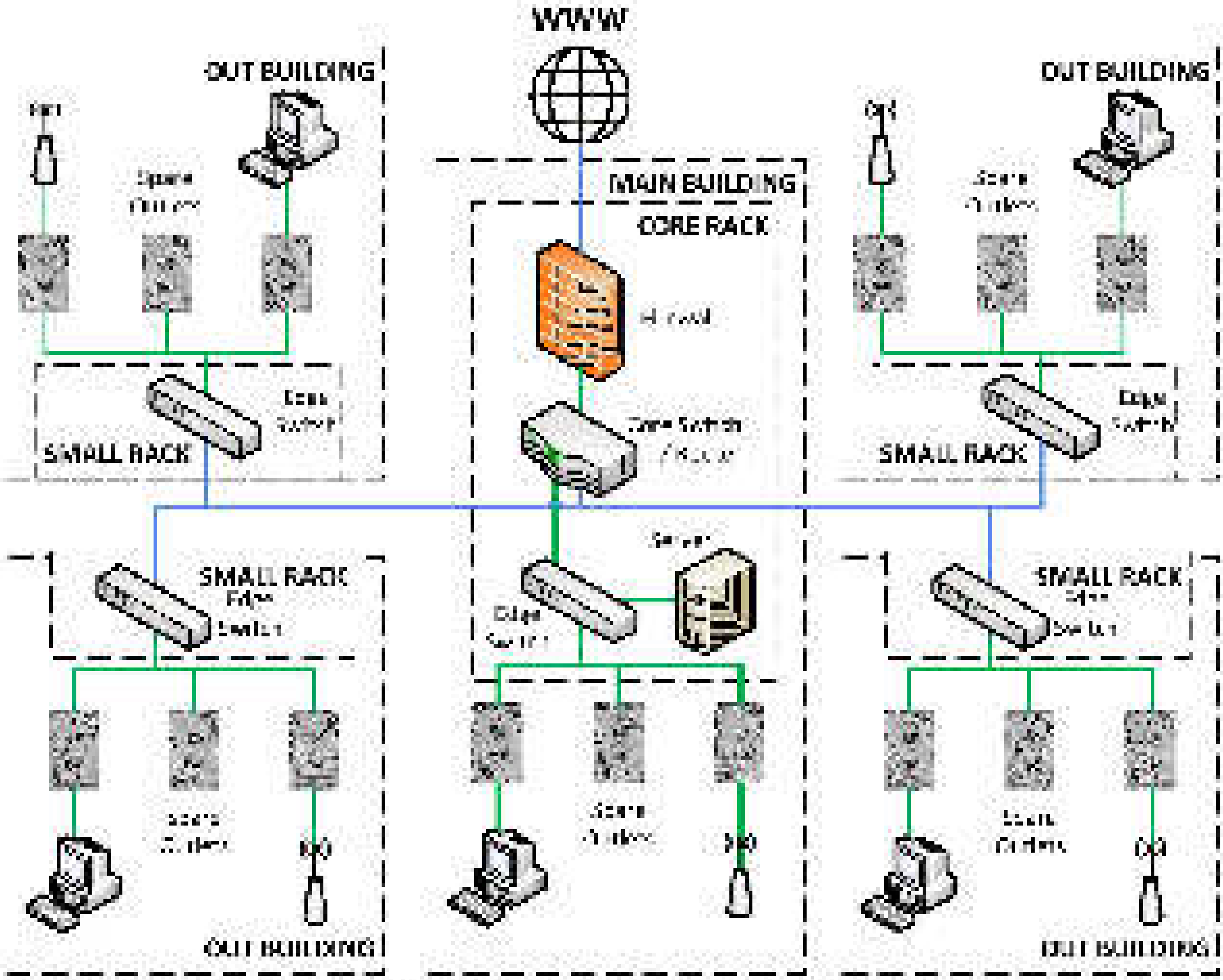
The future cell phone tower installation by Our Telekom, will give students and staff reliable access to cellular network for calls data and messaging.

Appendix A

Proposed Telecommunications Network Layout

Appendix B

Proposed Telecommunications Network Concept Design



Note Main Building is the USP Administration Building and Out Buildings include all other buildings on the USP site.

Proposed Telecommunications Network Concept Design

Beca