Appendix D: Geotechnical Investigation Logs

- Borehole Logs: BH1 and BH2
- Hand Auger Logs: HA1 and HA2
- Scalar Logs: SC01 – SC09

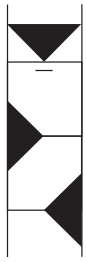
Tonkin+Taylor

Engineering log terminology

General

Soil and rock descriptions follow the "Guidelines for the field classification and description of soil and rock for engineering purposes" by the New Zealand Geotechnical Society (2005). Refer to this document for methods of field determination.

Water



Core recovery

Expressed as percentage of the length of the core run recovered.

Drilling method/casing

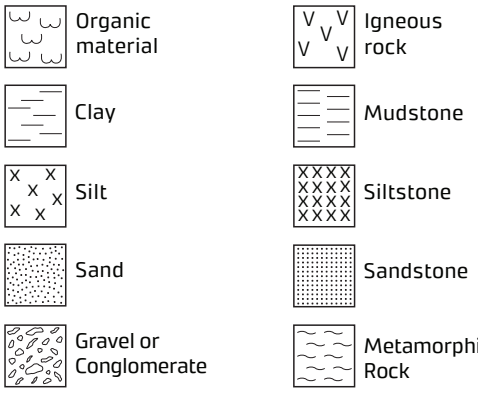
Common types:

OB	Open barrel
W	Wash
HQ3	HQ triple tube
PQ3	PQ triple tube
HSA	Hollow Stem Auger
WS	Window Sampler
HA	Hand Auger
HFS	High Frequency Sonic Drilling
LFS	Low Frequency Sonic Drilling

Graphic logs

The graphic log shows soil and rock types. The defect log indicates the location, orientation and abundance of defects of all types.

Typical material symbols:



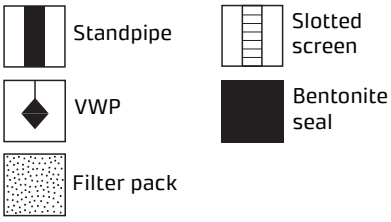
Tests

- **N=22:**SPT uncorrected blow count for 300 mm
- **75/12:**Undrained shear strength (peak /residual as measured by field vane.

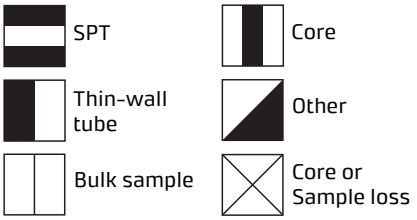
Laboratory test(s) carried out:

PMT	Pressuremeter test
LT	Lugeon test
LV	Laboratory vane
AL	Atterburg limits
UU	Undrained triaxial
PSD	Particle size distribution
c' Ø'	Effective stress
CONS	Consolidation
DS	Direct shear
COMP	Compaction
UCS	Unconfined compression
IS_{50}	Point load

Installation type



Sample type



Soil description

Moisture content

D	Dry, looks and feels dry
M	Moist, no free water on hand when remoulding
W	Wet, free water on hand when remoulding
S	Saturated, free water present on sample

Consistency/undrained shear strength

		S_u(kPa)
VS	Very soft	< 12
S	Soft	12 to 25
F	Firm	25 to 50
St	Stiff	50 to 100
VSt	Very stiff	100 to 200
H	Hard	> 200

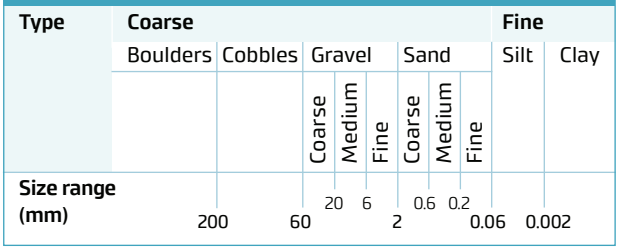
Density index

		SPT(N) - uncorrected
VL	Very loose	0 to 4
L	Loose	4 to 10
MD	Medium dense	10 to 30
D	Dense	30 to 50
VD	Very dense	> 50

Proportional terms definition (Coarse soils)

Fraction	**Term**	**% of soil mass**	**Example**
Major	(UPPER CASE)	Major constituent	GRAVEL
Subordinate	(lower case)	> 20	Sandy
Minor	with some... with minor...	12 - 20 5 - 12	with some sand with minor sand
	with trace of... (or slightly)...	< 5	with trace of sand (slightly sandy)

Grain size criteria



BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH1

SHEET: 1 OF 2

PROJECT: USP Towers, Fiji
JOB No.: 1002886.00
LOCATION: Site 1, USP Laucala, Suva, Fiji

CO-ORDINATES: 178.442286 (WGS84) -18.147331
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 29.97m
R.L. COLLAR:
DATUM:
SURVEY: Handheld GPS

DRILLED BY: Geotech Drilling Ltd
LOGGED BY: RLXB
CHECKED: CWM
START DATE: 27/07/2017
FINISH DATE: 27/07/2017
CONTRACTOR: Geotech Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	RQD (%)	Description & Additional Observations
Topsoil	0.0 m - Organic SILT with some clay and trace gravel; dark brown. Stiff, moist, moderate plasticity. Organics: silt and rootlets. Gravel: fine light brown, angular siltstone gravel.	HQTT	100		29	1		
	0.3 m - Highly to completely weathered, light brown, massive SILTSTONE. Very weak.	SPT	100	7/11 14 **N>=50**				
		HQTT	100		28	2		
	2.00m: Grades; extremely weak.	SPT	100	2/4 4/5 5/6 **N=20**				1.90 - 2.00m: J, 80° dip, St, R, dark brown stained surface
		HQTT	100					
	2.75 m - Moderately to highly weathered, light brown, massive SILTSTONE. Very weak.	SPT	100	7/11 11/15 14/10 **N>=50**	27	3		
		HQTT	100				0	3.25 - 3.30m: J, 50° dip, St, R, dark brown surface with Fe st. 3.30m: J, 10° dip, St, R 3.40 - 3.50m: J, 60° dip, Pl, Sm, Fe. St.
		SPT	100	17/12 13/13 18/6 for 40mm **N>=50**	26	4	48	*3.92 - 4.00m:* Recovered as GRAVEL - drill induced.
		HQTT	100					
		SPT	100	2/3 7/16 13/14 **N>=50**				
		HQTT	100		25	5	33	4.95m: J, 40° dip, Un, R, Fe. St.
Suva Marl	5.15 m - Moderately to highly weathered, light brown, massive MUDSTONE. Extremely weak to very weak.	SPT	100	5/8 10/10 9/12 **N=41**				
		HQTT	100				0	5.50 - 5.60m: J, 80° dip, Pl, Sm, Fe. St.
		SPT	100	6/7 7/6 8/7 **N=28**	24	6		
	6.2 - 6.3 m - CORE LOSS.	HQTT	66				66	
	6.3 m - Moderately to highly weathered, light brown, massive MUDSTONE. Extremely weak to very weak.	SPT	100	7/11 8/5 5/6 **N=24**	23	7		
		HQTT	100				86	
		SPT	100	14/12 7/5 5/5 **N=22**				
		HQTT	100		22	8	43	7.75m: J, 10° dip, St, R, Fe. St.
		SPT	100	4/3 4/5 7/7 **N=23**				
		HQTT	100				73	8.55m: J, 10° dip, St, Sm
		SPT	100	4/4 4/5 6/6 **N=21**	21	9		8.80m: J, 5° dip, Pl, R, Fe. St. 8.85 - 9.20m: J, 80° dip, Fe. St within SPT.
		HQTT	100				83	9.30m: DD, 5° dip
	9.1 m - Highly weathered, light brown, massive SILTSTONE. Extremely weak. (SILT with minor sand; light brown. Very stiff, moist, non plastic).							
	9.55 m - Moderately weathered, dark greenish grey, massive SILTSTONE. Extremely weak to very weak.	SPT	100	3/3 4/5 6/8 **N=23**	20	10		

Graphic Log: TS

Box 1, 0.0-3.5m

Box 2, 3.5-7.3m

COMMENTS: Target depth reached. Static water level measured on 8/8/2017 at 13.77 m bgl within open hole.

Hole Depth 20m

Scale 1:50

A-6-27

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH1

SHEET: 2 OF 2

PROJECT: USP Towers, Fiji
JOB No.: 1002886.00
LOCATION: Site 1, USP Laucala, Suva, Fiji

CO-ORDINATES: 178.442286 -18.147331 (WGS84)
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 29.97m
R.L. COLLAR:
DATUM:
SURVEY: Handheld GPS

DRILLED BY: Geotech Drilling Ltd
LOGGED BY: RLXB
CHECKED: CWM
START DATE: 27/07/2017
FINISH DATE: 27/07/2017
CONTRACTOR: Geotech Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
Suva Marl	10.0 m - Moderately weathered, dark greenish grey, massive SILTSTONE. Extremely weak to very weak.	UW SW MW HW CW	ES VS S MS HS VW EW	HQTT	100		19	11				100						
				SPT	100	5/6 5/6 7/7 N=25												
				HQTT	100							83	10.90m: DD, 5° dip					
				SPT	100	4/3 4/6 7/10 N=27												
				HQTT	100							100	11.60m: J, 10° dip, St, R					
	11.75 m - Moderately weathered, dark greenish grey, massive SILTSTONE. Very weak.			SPT	100	6/10 11/11 22/6 for 20mm N>=50	18	12										
				HQTT	100							71	12.30m: J, 10° dip, Pl, R, some broken gravel around joint. Fe. St.					
				SPT	100	6/8 10/11 14/14 N=49												
				HQTT	100		17	13				0	13.05 - 13.20m: J, 60° dip, Un, R, clean.					
				HQTT	100							100	13.90m: DD, 5° dip					
				HQTT		50 for 50mm N>=50		14					14.20m: J, 10° dip, St, R, Fe. St. and white discolouration.					
				HQTT	100		15					89						
				SPT	100	7/9 11/11 14/14 N>=50												
				HQTT	90		14	16				90						
	17.0 m - Slightly to moderately weathered, dark greenish grey massive SILTSTONE. Extremely weak to very weak. Widely spaced joints.			SPT	100	5/9 11/11 12/15 N=49	13	17										
				HQTT	100							71	17.45 - 17.55m: J, 60° dip, Pl, Sm					
							12	18					18.30m: J, 5° dip, St, R, Fe. St.					
				SPT	100	5/5 6/7 8/10 N=31												
	19.90m: Grades; light orangey brown.			HQTT	100		11	19				100						
	20m: END OF BOREHOLE						10											

08/08/2017: Static water level in open hole.

Box 3, 7.3-11.0m
Box 4, 11.0-14.4m
Box 5, 14.4-17.8m
Box 6, 17.8-20.0m

COMMENTS: Target depth reached. Static water level measured on 8/8/2017 at 13.77 m bgl within open hole.

Hole Depth 20m

Scale 1:50

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH2

SHEET: 1 OF 2

PROJECT: USP Towers, Fiji
JOB No.: 1002886.00
LOCATION: Site 2, USP Laucala, Suva, Fiji

CO-ORDINATES (WGS84): 178.443636, -18.147032
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 23.10m
R.L. COLLAR:
DATUM:
SURVEY: Handheld GPS

DRILLED BY: Geotech Drilling Ltd
LOGGED BY: RLXB
CHECKED: CWM
START DATE: 28/07/2017
FINISH DATE: 28/07/2017
CONTRACTOR: Geotech Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Depth (m)	RL (m)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	Graphic Log	Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
Topsoil	0.0 m - Organic SILT; dark brown. Very stiff, moist, low plasticity. Organics: silt, rootlets and decomposing wood fragments.																	
	0.45 m - SILT with minor sand; light yellowish brown. Hard, moist, non plastic. Sand: medium.	1	22			HQTT	100		TS									
						SPT	100	2/3 4/4 5/6 N=19										
		2	21			HQTT	100											
						SPT	100	2/2 3/4 5/7 N=19										
						HQTT	100											
	2.75 m - Highly weathered, dark grey, massive SILTSTONE. Extremely weak.	3	20			SPT	100	8/8 9/10 12/11 N=42					2.55m: J, 5° dip, Un, R, white discolouration. 2.65m: J, 5° dip, Un, R, white discolouration and Fe. St.					Box 1, 0.0-3.3m
	3.3 m - Moderately weathered, dark grey, massive SILTSTONE. Very weak.					HQTT	100						3.30 - 3.40m: J, 85° dip, Un, Sm, clean.					
						SPT	100	4/6 11/17 21 for 55mm N>=50										
		4	19			HQTT	100					76						
	4.15 m - Highly weathered, dark brown streaked light brown, massive SILTSTONE. Extremely weak.					SPT	100	9/10 8/5 8/9 N=30					4.05m: J, 5° dip, St, R, white discolouration. 4.15m: J, 5° dip, St, R, Fe. St.					
	4.7 - 4.9 m - CORE LOSS.					HQTT	33					33						
	4.9 m - Slightly to moderately weathered, dark grey, massive SILTSTONE. Very weak.	5	18			SPT	100	8/42 for 75mm N>=50										
Suva Marl	5.15 m - Slightly to moderately weathered, dark greenish grey, interbedded SILTSTONE and MUDSTONE. Very weak. Thinly interbedded at 0.1 m intervals with beds subhorizontal.					HQTT	100					0	5.20m: BF, 5° dip 5.25m: BF, 5° dip 5.40m: BF, 5° dip 5.45m: BF, 5° dip 5.60m: J, 10° dip, St, R 5.70m: J, 10° dip, St, R					
	5.75 - 5.85 m - CORE LOSS.					SPT	100	4/4 8/12 14 N>=50										
	5.75 m - Slightly to moderately weathered, dark greenish grey, massive MUDSTONE. Very weak.	6	17			HQTT	100					33						Box 2, 3.3-6.5m
						SPT	100	3/4 7/11 11/21 N>=50										
		7	16			HQTT	100					73						
	7.2 m - Moderately weathered, dark greenish grey, massive SILTSTONE. Extremely weak.					SPT	100	3/4 4/4 4/4 N=16										
	7.7 - 7.8 m - CORE LOSS.					HQTT	100					66						
	7.8 m - Moderately weathered, dark greenish grey, massive MUDSTONE. Extremely weak.	8	15			SPT	100	4/5 5/4 4/4 N=17										
						HQTT	100					100						
		9	14			SPT	100	3/3 2/4 5/7 N=18										
						HQTT	100					100						
						SPT	100	5/7 10/8 6/6 N=30										

COMMENTS: Target depth reached. Static water level measured on 8/8/2017 at 10.2 m bgl.

Hole Depth 20m

Scale 1:50

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH2

SHEET: 2 OF 2

PROJECT: USP Towers, Fiji
JOB No.: 1002886.00
LOCATION: Site 2, USP Laucala, Suva, Fiji

CO-ORDINATES: 178.443636 (WGS84) -18.147032
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 23.10m
R.L. COLLAR:
DATUM:
SURVEY: Handheld GPS

DRILLED BY: Geotech Drilling Ltd
LOGGED BY: RLXB
CHECKED: CWM
START DATE: 28/07/2017
FINISH DATE: 28/07/2017
CONTRACTOR: Geotech Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	ROCK DEFECTS: Fracture Spacing (mm)	ROCK DEFECTS: RQD (%)	ROCK DEFECTS: Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
Suva Marl	10.0 m - Moderately weathered, dark greenish grey, massive MUDSTONE. Extremely weak.			HQTT	100		13					100						
				SPT	100	2/3 4/4 5/7 **N=20**												
	10.7 - 10.8 m - CORE LOSS.			HQTT	66							40						
	10.8 m - Moderately weathered, dark grey, massive SILTSTONE. Extremely weak to very weak.			SPT	100	5/6 9/11 10/15 **N=45**	12	11										
				HQTT	100							0	11.45 - 11.75m: BF, 5° dip, multiple bedding fractures with core spin in places.					
				SPT	100	5/7 7/8 10/9 **N=34**	11	12										
				HQTT	100							100						
				SPT	100	6/8 8/10 11/9 **N=38**												
				HQTT	100		10	13				76	12.95 - 13.10m: J, 70° dip, Un, Sm, clean. 13.35m: J, 5° dip, St, R, white discolouration.					Box 4, 10.3-14.0m
				SPT	100	6/6 6/7 6/10 **N=29**	9	14										
	14.45 - 14.6 m - CORE LOSS.																	
	14.6 m - Moderately weathered, dark greenish grey, massive SILTSTONE. Extremely weak to very weak.			HQTT	100		8	15				85						
	15.5 m - Slightly weathered, dark grey, massive SILTSTONE. Very weak.			SPT	100	5/7 12/13 17/8 for 35mm **N>=50**							15.55m: J, 10° dip, Un, R, light green and grey discolouration.					
				HQTT	100		7	16				100						
				SPT	100	9/7 12/16 14/8 for 40mm **N>=50**	6	17										
				HQTT	100		5	18				64	18.40m: J, 5° dip, St, R, white discolouration.					Box 5, 14.0-17.8m
				SPT	100	6/7 5/5 6/8 **N=24**												
	18.95 - 19.15 m - CORE LOSS.						4	19										
	19.15 m - Slightly to moderately weathered, dark greenish grey, massive SILTSTONE. Extremely weak to very weak.			HQTT	100							57	19.15m: J, 75° dip, Un, Sm					Box 6, 17.8-20.0m
	20m: END OF BOREHOLE																	

Water Level: 8/08/2017: Static water level in open hole.

COMMENTS: Target depth reached. Static water level measured on 8/8/2017 at 10.2 m bgl.

Hole Depth 20m

Scale 1:50

Rev.: A

HAND AUGER LOG

HOLE Id: **HA1**

Hole Location: Site 1, USP Laucala, Suva, Fiji

SHEET: 1 OF 1

PROJECT: USP Towers, Fiji | LOCATION: The University of the South Pacific, Su | JOB No.: 1002886.00

CO-ORDINATES: 178.442277 WGS84 -18.147322

R.L.: 29.95m

DATUM:

DRILL TYPE: MLO

DRILL METHOD: HA

HOLE STARTED: 27/06/2017

HOLE FINISHED: 27/06/2017

DRILLED BY: T+T

LOGGED BY: MLO CHECKED: RLXB

GEOLOGICAL											ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/0mm) 2 4 6 8 10 12 14 16 18	TESTS	SAMPLES	RL (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	Description and Additional Observations
Topsoil								TS	M	VSt		0.0 m - SILT with some clay; dark brown. Very stiff, moist, moderate plasticity.
Suva Marl		100	HA		● UTP ● >202 kPa ● >202 kPa		0.5		D	H		0.2 m - SILT with trace clay; light brown. Hard, dry, non-plastic.
							29					0.87m: END OF BOREHOLE

COMMENTS: End of hole on refusal in hard ground. Borehole dry on completion. Shear strength measured using SV#1739 with a correction factor of 1.54.

Hole Depth 0.87m

Scale 1:5

Rev.: A

HAND AUGER LOG

HOLE Id: **HA2**

Hole Location: Site 1, USP Laucala, Suva, Fiji

SHEET: 1 OF 1

PROJECT: USP Towers, Fiji | LOCATION: The University of the South Pacific, Su | JOB No.: 1002886.00

CO-ORDINATES: 178.442361 WGS84 -18.147159

R.L.: 29.41m

DATUM:

DRILL TYPE: MLO

DRILL METHOD: HA

HOLE STARTED: 27/06/2017

HOLE FINISHED: 27/06/2017

DRILLED BY: T+T

LOGGED BY: MLO CHECKED: RLXB

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/0mm) 2 4 6 8 10 12 14 16 18	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION \ WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	Description and Additional Observations
Topsoil		100	HA						TS	M	VSt		0.0 m - SILT with some clay; dark brown. Very stiff, moist, moderate plasticity.
Suva Marl										D-M	H		0.2 m - SILT with trace clay; dark brown grading to light brown. Hard, dry to moist, low plasticity.
					UTP		29	0.5					0.3m: END OF BOREHOLE

COMMENTS: End of hole on refusal in hard ground. Borehole dry on completion. Shear strength measured using SV#1739 with a correction factor of 1.54.

Hole Depth 0.3m

Scale 1:5

Rev.: A

BH1_Box 1_0.0-3.45m.jpg

BH1_Box 2_3.45-7.25m.jpg

BH1_Box 3_7.25-11.0m.jpg

BH1_Box 4_11.0-14.4m.jpg

BH1_Box 5_14.4-17.75m.jpg

BH1_Box 6_17.75-20.0m.jpg

BH2_Box 1_0.0-3.3m.jpg

BH2_Box 2_3.3-6.5m.jpg

BH2_Box 3_6.5-10.25m.jpg

BH2_Box 4_10.25-14.0m.jpg

BH2_Box 5_14.0-17.8m.jpg

BH2_Box 6_17.8-20.0m.jpg

BH1_SPT_2.0-2.45m.jpg

BH1_SPT_3.5-3.92m.jpg

BH1_SPT_4.25-4.5m.jpg

BH1_SPT_5.0-5.45m.jpg

BH1_SPT_5.75-6.20m.jpg

BH1_SPT_6.5-6.95m.jpg

BH1_SPT_7.25-7.7m.jpg

BH1_SPT_8.0-8.45m.jpg

BH1_SPT_8.75-9.2m.jpg

BH1_SPT_9.5-9.95m.jpg

BH1_SPT_10.25-10.7m.jpg

BH1_SPT_11.0-11.45m.jpg

BH1_SPT_11.75-12.15m.jpg

BH1_SPT_12.5-12.95m.jpg

BH1_SPT_14.0-14.05m.jpg

BH1_SPT_15.5-15.95m.jpg

BH1_SPT_17.0-17.45m.jpg

BH1_SPT_18.5-18.95m.jpg

BH2_SPT_1.0-1.45m.jpg

BH2_SPT_2.0-2.45m.jpg

BH2_SPT_2.75-3.2m.jpg

BH2_SPT_3.5-3.86m.jpg

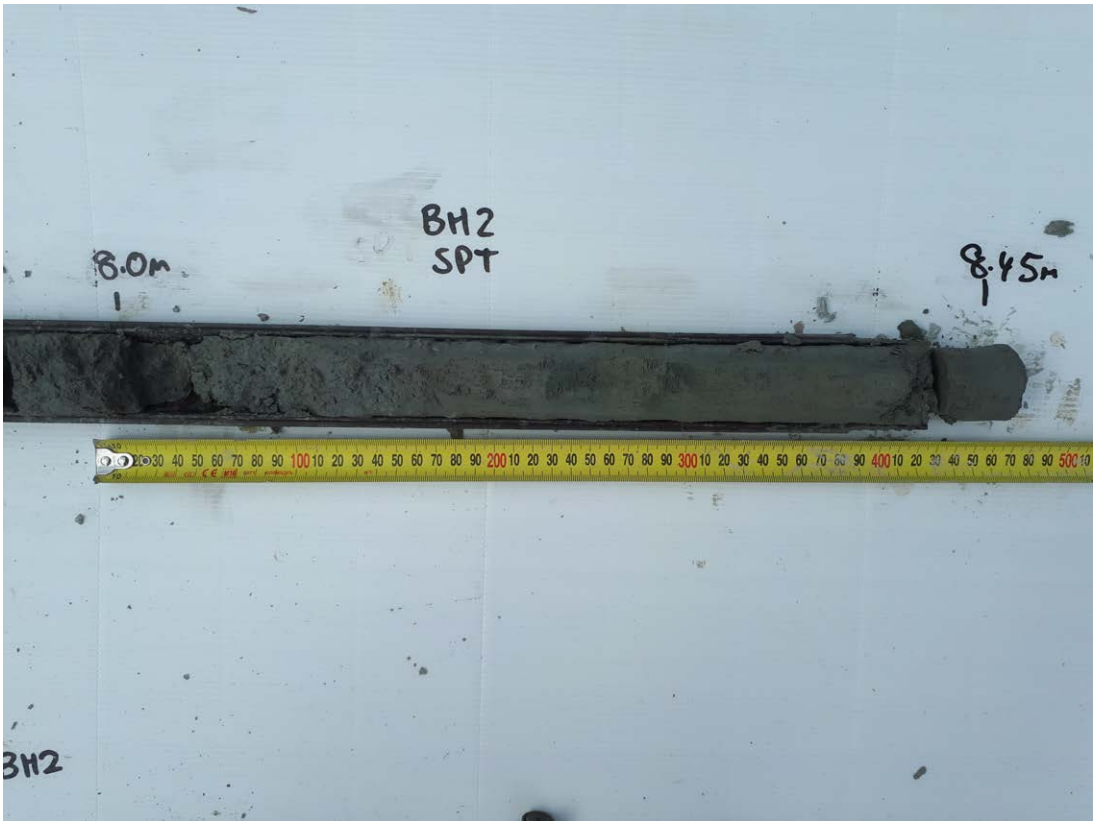
BH2_SPT_4.25-4.7m.jpg

BH2_SPT_5.0-5.15m.jpg

BH2_SPT_5.75-6.2m.jpg

BH2_SPT_6.5-6.95m.jpg

BH2_SPT_7.25-7.7m.jpg



BH2_SPT_8.0-8.45m.jpg

BH2_SPT_8.75-9.2m.jpg

BH2_SPT_9.5-9.95m.jpg

BH2_SPT_10.25-10.7m.jpg

BH2_SPT_11.0-11.45m.jpg

BH2_SPT_11.75-12.2m.jpg

BH2_SPT_12.5-12.95m.jpg

BH2_SPT_14.0-14.45m.jpg

BH2_SPT_15.5-15.91m.jpg

BH2_SPT_17.0-17.42m.jpg

BH2_SPT_18.5-18.95m.jpg

TONKIN & TAYLOR

SCALA PENETROMETER LOG

Job No: *1002886.0000*
Project: *USP FIJI*
Location: *HA1*
RL:

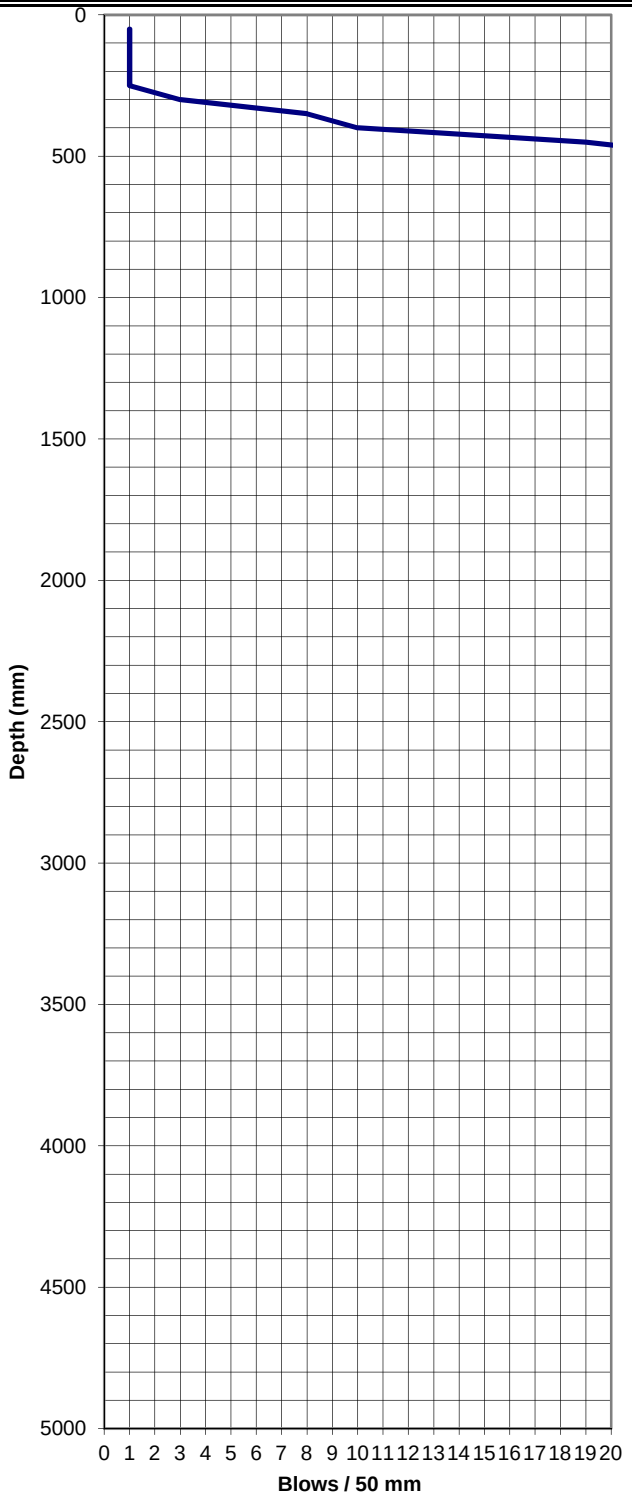
Date: *28/06/2017*
Operated by: *MLO*
Logged by: *MLO*
Checked by: *RLXB*

Test No. ***SC01***

Sheet **1 of *1***

mm Driven	No. of Blows
50	*1*
100	*1*
150	*1*
200	*1*
250	*1*
300	*3*
350	*8*
400	*10*
450	*19*
500	*24*
550	*37*
600	*30*
650	*25*
700	
750	
800	
850	
900	
950	
1000	
1050	
1100	
1150	
1200	
1250	
1300	
1350	
1400	
1450	
1500	
1550	
1600	
1650	
1700	
1750	
1800	
1850	
1900	
1950	
2000	
2050	
2100	
2150	
2200	
2250	
2300	
2350	
2400	
2450	
2500	

mm Driven	No. of Blows
2550	
2600	
2650	
2700	
2750	
2800	
2850	
2900	
2950	
3000	
3050	
3100	
3150	
3200	
3250	
3300	
3350	
3400	
3450	
3500	
3550	
3600	
3650	
3700	
3750	
3800	
3850	
3900	
3950	
4000	
4050	
4100	
4150	
4200	
4250	
4300	
4350	
4400	
4450	
4500	
4550	
4600	
4650	
4700	
4750	
4800	
4850	
4900	
4950	
5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

TONKIN & TAYLOR

SCALA PENETROMETER LOG

Job No: *1002886.0000*
Project: *USP FIJI*
Location: *HA1*
RL:

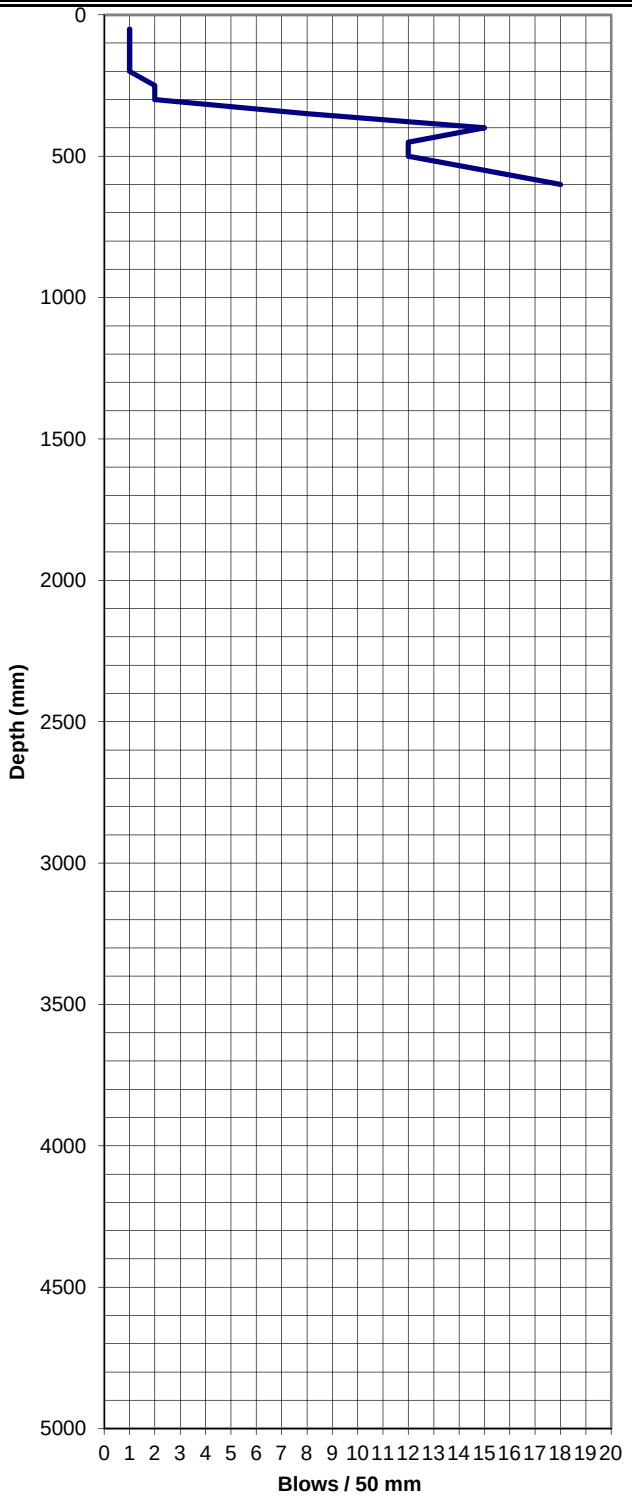
Date: *28/06/2017*
Operated by: *MLO*
Logged by: *MLO*
Checked by: *RLXB*

Test No. ***SC02***

Sheet **1 of *1***

mm Driven	No. of Blows
50	*1*
100	*1*
150	*1*
200	*1*
250	*2*
300	*2*
350	*8*
400	*15*
450	*12*
500	*12*
550	*15*
600	*18*
650	
700	
750	
800	
850	
900	
950	
1000	
1050	
1100	
1150	
1200	
1250	
1300	
1350	
1400	
1450	
1500	
1550	
1600	
1650	
1700	
1750	
1800	
1850	
1900	
1950	
2000	
2050	
2100	
2150	
2200	
2250	
2300	
2350	
2400	
2450	
2500	

mm Driven	No. of Blows
2550	
2600	
2650	
2700	
2750	
2800	
2850	
2900	
2950	
3000	
3050	
3100	
3150	
3200	
3250	
3300	
3350	
3400	
3450	
3500	
3550	
3600	
3650	
3700	
3750	
3800	
3850	
3900	
3950	
4000	
4050	
4100	
4150	
4200	
4250	
4300	
4350	
4400	
4450	
4500	
4550	
4600	
4650	
4700	
4750	
4800	
4850	
4900	
4950	
5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

TONKIN & TAYLOR

SCALA PENETROMETER LOG

Job No: *1002886.0000*
Project: *USP FIJI*
Location: *HA1*
RL:

Date: *28/06/2017*
Operated by: *MLO*
Logged by: *MLO*
Checked by: *RLXB*

Test No. ***SC03***

Sheet **1 of *1***

mm Driven	No. of Blows
50	*0*
100	*1*
150	*1*
200	*1*
250	*1*
300	*1*
350	*1*
400	*2*
450	*2*
500	*2*
550	*2*
600	*12*
650	*15*
700	*19*
750	
800	
850	
900	
950	
1000	
1050	
1100	
1150	
1200	
1250	
1300	
1350	
1400	
1450	
1500	
1550	
1600	
1650	
1700	
1750	
1800	
1850	
1900	
1950	
2000	
2050	
2100	
2150	
2200	
2250	
2300	
2350	
2400	
2450	
2500	

mm Driven	No. of Blows
2550	
2600	
2650	
2700	
2750	
2800	
2850	
2900	
2950	
3000	
3050	
3100	
3150	
3200	
3250	
3300	
3350	
3400	
3450	
3500	
3550	
3600	
3650	
3700	
3750	
3800	
3850	
3900	
3950	
4000	
4050	
4100	
4150	
4200	
4250	
4300	
4350	
4400	
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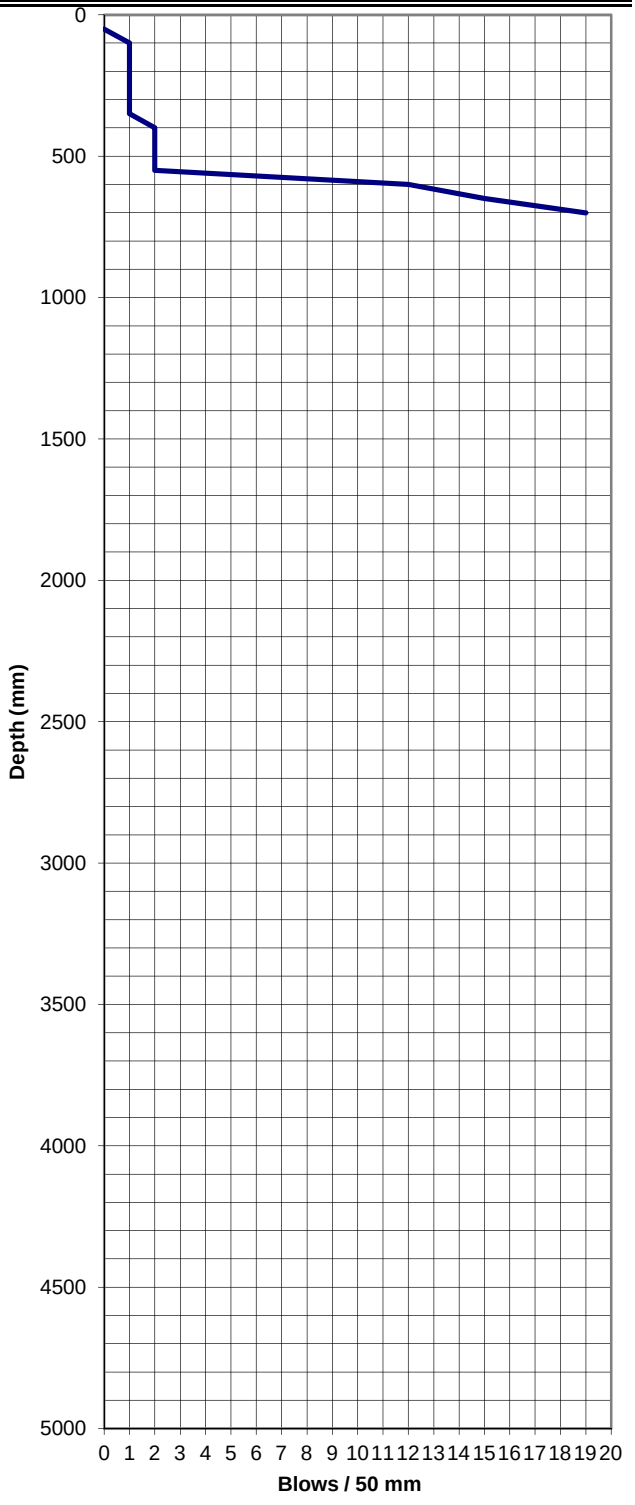
4550	
4600	
4650	
4700	
4750	
4800	
4850	
4900	
4950	
5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

TONKIN & TAYLOR

SCALA PENETROMETER LOG

Job No: *1002886.0000*
Project: *USP FIJI*
Location: *HA1*
RL:

Date: *28/06/2017*
Operated by: *MLO*
Logged by: *MLO*
Checked by: *RLXB*

Test No. ***SC04***
Sheet **1 of 1**

mm Driven	No. of Blows
50	
100	
150	
200	
250	*Augered to 500 mm*
300	
350	
400	
450	
500	
550	*6*
600	*9*
650	*15*
700	*10*
750	*16*
800	*14*
850	*15*
900	*14*
950	*24*
1000	*18*
1050	*24*
1100	*24*
1150	*26*
1200	*26*
1250	
1300	
1350	
1400	
1450	
1500	
1550	
1600	
1650	
1700	
1750	
1800	
1850	
1900	
1950	
2000	
2050	
2100	
2150	
2200	
2250	
2300	
2350	
2400	
2450	
2500	

mm Driven	No. of Blows
2550	
2600	
2650	
2700	
2750	
2800	
2850	
2900	
2950	
3000	
3050	
3100	
3150	
3200	
3250	
3300	
3350	
3400	
3450	
3500	
3550	
3600	
3650	
3700	
3750	
3800	
3850	
3900	
3950	
4000	
4050	
4100	
4150	
4200	
4250	
4300	
4350	
4400	
4450	
4500	
4550	
4600	
4650	
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4800	
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4900	
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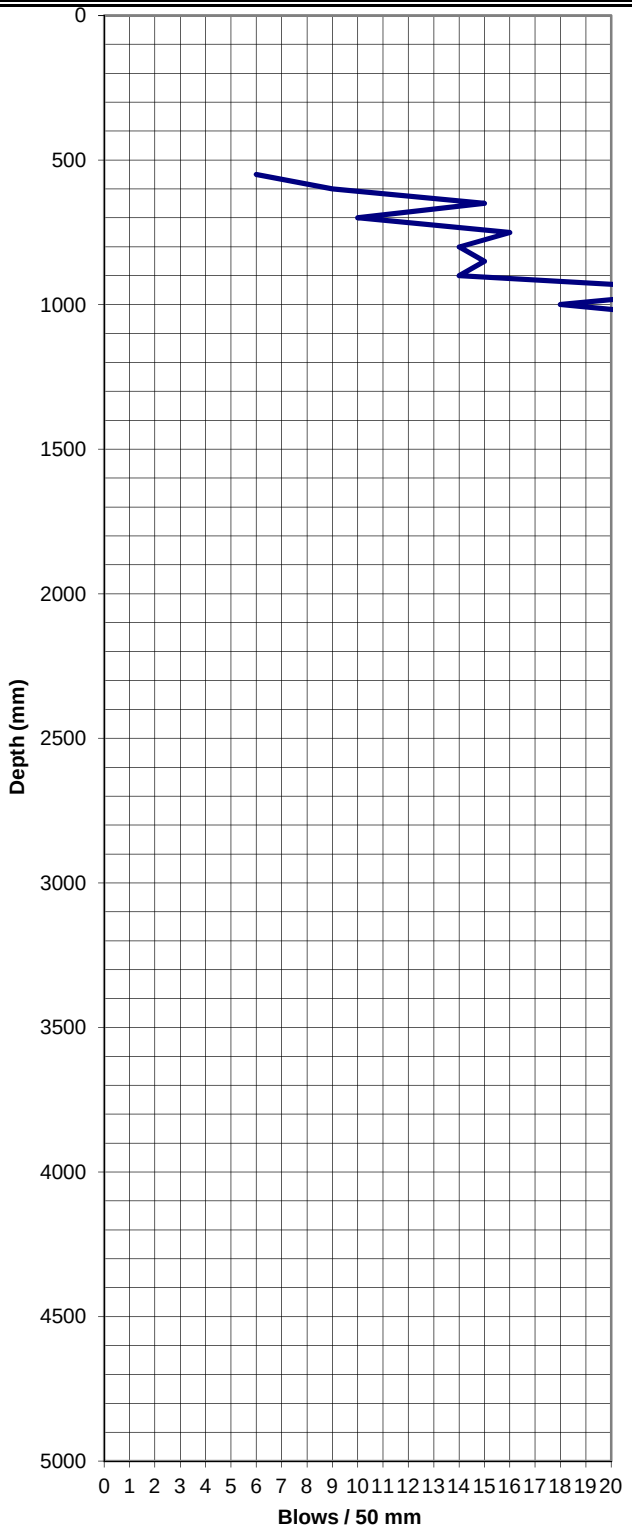
5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

TONKIN & TAYLOR

SCALA PENETROMETER LOG

Job No: *1002886.0000*
Project: *USP FIJI*
Location: *HA2*
RL:

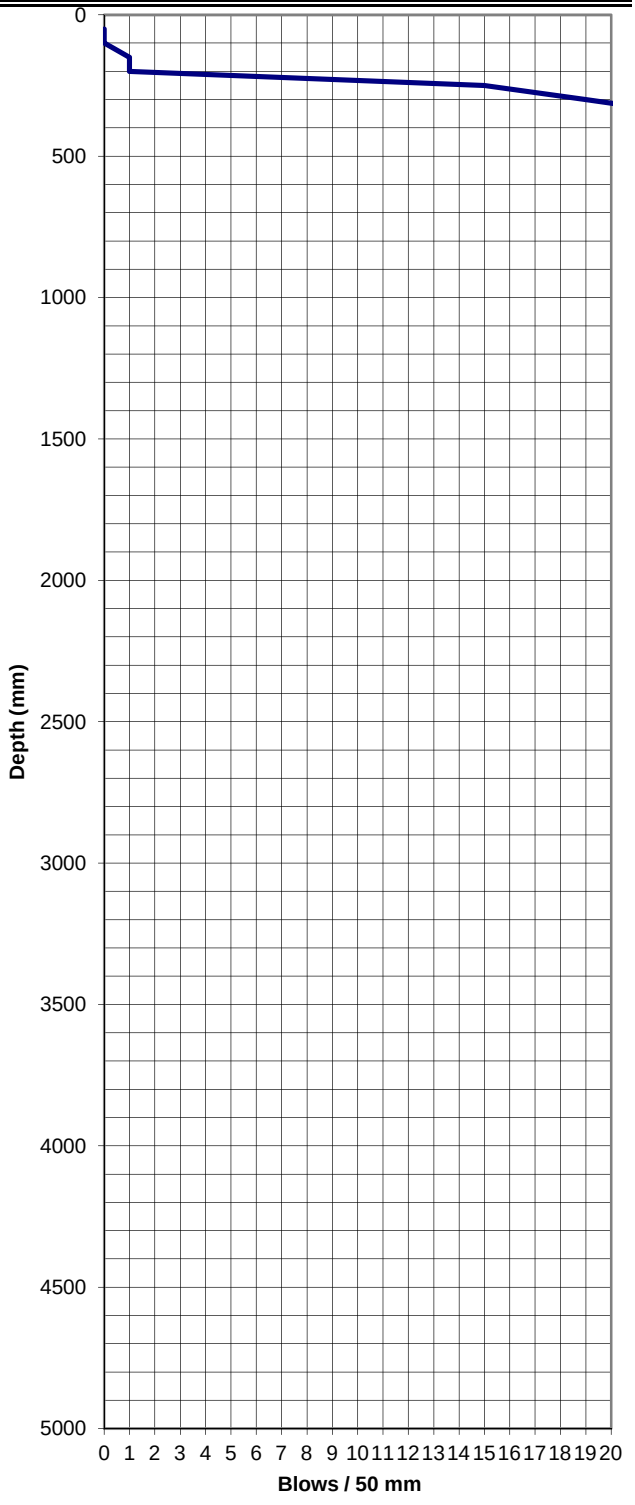
Date: *28/06/2017*
Operated by: *MLO*
Logged by: *MLO*
Checked by: *RLXB*

Test No. ***SC05***

Sheet **1 of *1***

mm Driven	No. of Blows
50	*0*
100	*0*
150	*1*
200	*1*
250	*15*
300	*19*
350	*23*
400	
450	
500	
550	
600	
650	
700	
750	
800	
850	
900	
950	
1000	
1050	
1100	
1150	
1200	
1250	
1300	
1350	
1400	
1450	
1500	
1550	
1600	
1650	
1700	
1750	
1800	
1850	
1900	
1950	
2000	
2050	
2100	
2150	
2200	
2250	
2300	
2350	
2400	
2450	
2500	

mm Driven	No. of Blows
2550	
2600	
2650	
2700	
2750	
2800	
2850	
2900	
2950	
3000	
3050	
3100	
3150	
3200	
3250	
3300	
3350	
3400	
3450	
3500	
3550	
3600	
3650	
3700	
3750	
3800	
3850	
3900	
3950	
4000	
4050	
4100	
4150	
4200	
4250	
4300	
4350	
4400	
4450	
4500	
4550	
4600	
4650	
4700	
4750	
4800	
4850	
4900	
4950	
5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

TONKIN & TAYLOR

SCALA PENETROMETER LOG

Job No: *1002886.0000*
Project: *USP FIJI*
Location: *HA2*
RL:

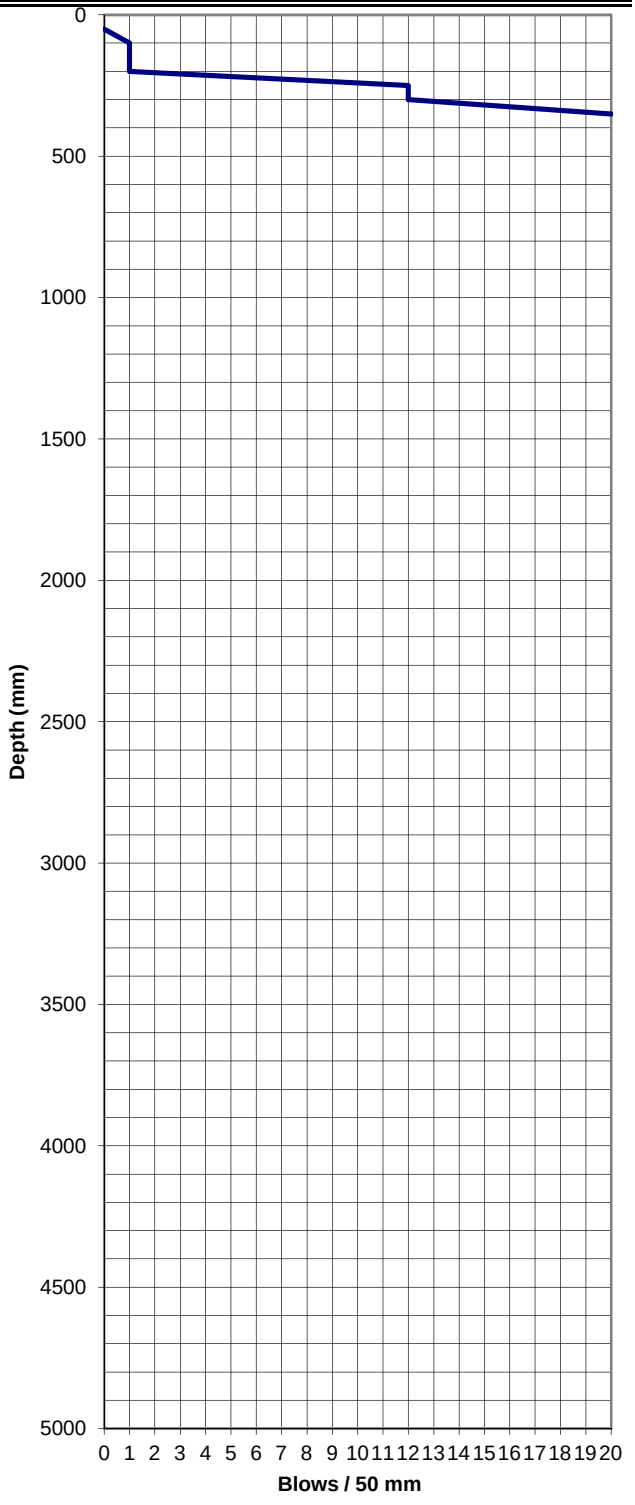
Date: *28/06/2017*
Operated by: *MLO*
Logged by: *MLO*
Checked by: *RLXB*

Test No. ***SC06***

Sheet **1 of *1***

mm Driven	No. of Blows
50	*0*
100	*1*
150	*1*
200	*1*
250	*12*
300	*12*
350	*20*
400	
450	
500	
550	
600	
650	
700	
750	
800	
850	
900	
950	
1000	
1050	
1100	
1150	
1200	
1250	
1300	
1350	
1400	
1450	
1500	
1550	
1600	
1650	
1700	
1750	
1800	
1850	
1900	
1950	
2000	
2050	
2100	
2150	
2200	
2250	
2300	
2350	
2400	
2450	
2500	

mm Driven	No. of Blows
2550	
2600	
2650	
2700	
2750	
2800	
2850	
2900	
2950	
3000	
3050	
3100	
3150	
3200	
3250	
3300	
3350	
3400	
3450	
3500	
3550	
3600	
3650	
3700	
3750	
3800	
3850	
3900	
3950	
4000	
4050	
4100	
4150	
4200	
4250	
4300	
4350	
4400	
4450	
4500	
4550	
4600	
4650	
4700	
4750	
4800	
4850	
4900	
4950	
5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

TONKIN & TAYLOR

SCALA PENETROMETER LOG

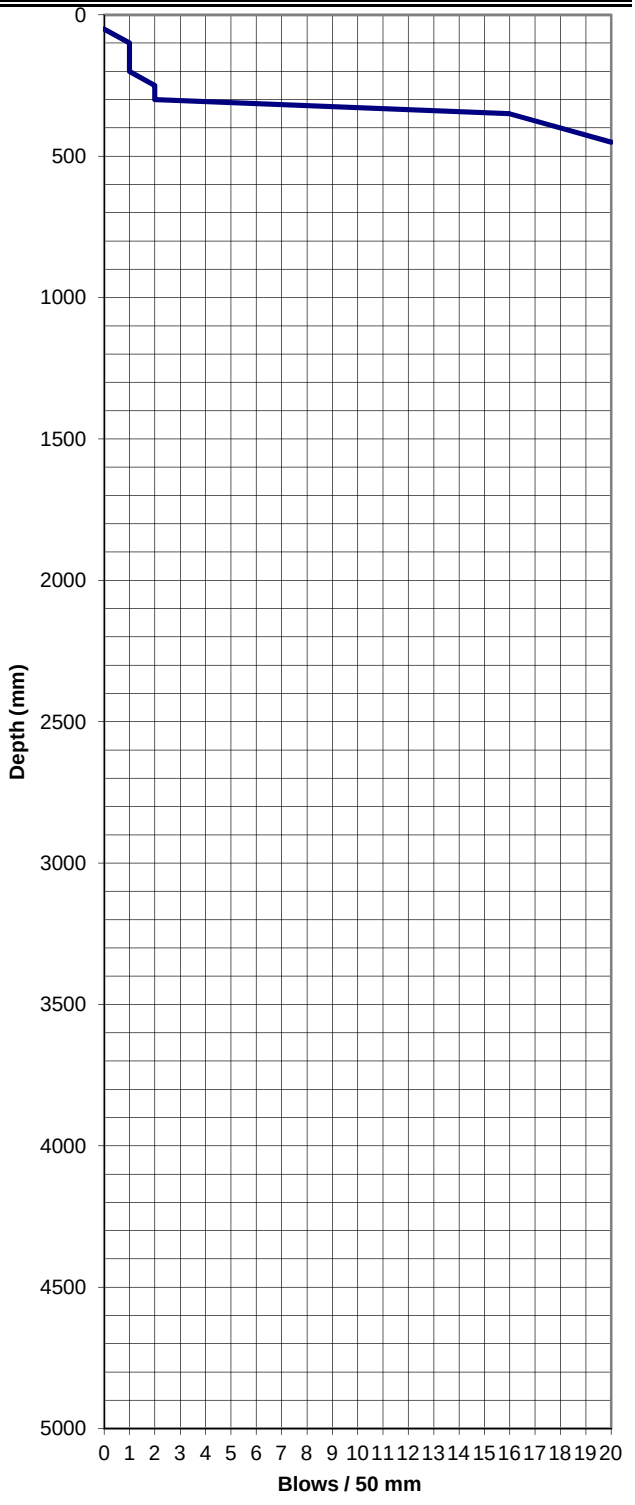
Job No: *1002886.0000*
Project: *USP FIJI*
Location: *HA2*
RL:

Date: *28/06/2017*
Operated by: *MLO*
Logged by: *MLO*
Checked by: *RLXB*

Test No. ***SC07***
Sheet **1 of *1***

mm Driven	No. of Blows
50	*0*
100	*1*
150	*1*
200	*1*
250	*2*
300	*2*
350	*16*
400	*18*
450	*20*
500	
550	
600	
650	
700	
750	
800	
850	
900	
950	
1000	
1050	
1100	
1150	
1200	
1250	
1300	
1350	
1400	
1450	
1500	
1550	
1600	
1650	
1700	
1750	
1800	
1850	
1900	
1950	
2000	
2050	
2100	
2150	
2200	
2250	
2300	
2350	
2400	
2450	
2500	

mm Driven	No. of Blows
2550	
2600	
2650	
2700	
2750	
2800	
2850	
2900	
2950	
3000	
3050	
3100	
3150	
3200	
3250	
3300	
3350	
3400	
3450	
3500	
3550	
3600	
3650	
3700	
3750	
3800	
3850	
3900	
3950	
4000	
4050	
4100	
4150	
4200	
4250	
4300	
4350	
4400	
4450	
4500	
4550	
4600	
4650	
4700	
4750	
4800	
4850	
4900	
4950	
5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

TONKIN & TAYLOR

SCALA PENETROMETER LOG

Job No: *1002886.0000*
Project: *USP FIJI*
Location: *HA2*
RL:

Date: *28/06/2017*
Operated by: *MLO*
Logged by: *MLO*
Checked by: *RLXB*

Test No. ***SC08***

Sheet **1 of *1***

mm Driven	No. of Blows
50	*0*
100	*3*
150	*3*
200	*2*
250	*2*
300	*2*
350	*3*
400	*1*
450	*2*
500	*2*
550	*11*
600	*20*
650	*25*
700	
750	
800	
850	
900	
950	
1000	
1050	
1100	
1150	
1200	
1250	
1300	
1350	
1400	
1450	
1500	
1550	
1600	
1650	
1700	
1750	
1800	
1850	
1900	
1950	
2000	
2050	
2100	
2150	
2200	
2250	
2300	
2350	
2400	
2450	
2500	

mm Driven	No. of Blows
2550	
2600	
2650	
2700	
2750	
2800	
2850	
2900	
2950	
3000	
3050	
3100	
3150	
3200	
3250	
3300	
3350	
3400	
3450	
3500	
3550	
3600	
3650	
3700	
3750	
3800	
3850	
3900	
3950	
4000	
4050	
4100	
4150	
4200	
4250	
4300	
4350	
4400	
4450	
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4550	
4600	
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4700	
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4800	
4850	
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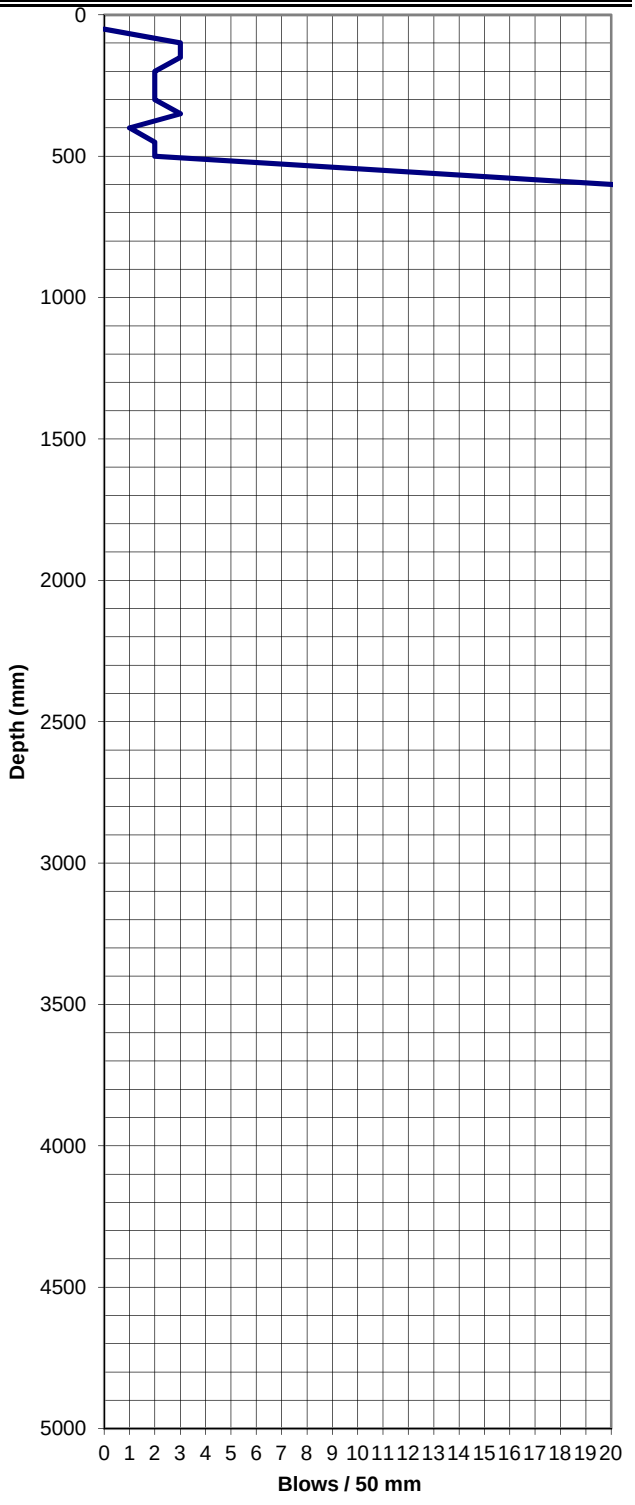
4950	
5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

TONKIN & TAYLOR

SCALA PENETROMETER LOG

Job No: *1002886.0000*
Project: *USP FIJI*
Location: *HA2*
RL:

Date: *28/06/2017*
Operated by: *MLO*
Logged by: *MLO*
Checked by: *RLXB*

Test No. ***SC09***
Sheet **1 of *1***

mm Driven	No. of Blows
50	*Augered to 250 mm*
100	
150	
200	
250	
300	*7*
350	*7*
400	*18*
450	*20*
500	*21*
550	*30*
600	
650	
700	
750	
800	
850	
900	
950	
1000	
1050	
1100	
1150	
1200	
1250	
1300	
1350	
1400	
1450	
1500	
1550	
1600	
1650	
1700	
1750	
1800	
1850	
1900	
1950	
2000	
2050	
2100	
2150	
2200	
2250	
2300	
2350	
2400	
2450	
2500	

mm Driven	No. of Blows
2550	
2600	
2650	
2700	
2750	
2800	
2850	
2900	
2950	
3000	
3050	
3100	
3150	
3200	
3250	
3300	
3350	
3400	
3450	
3500	
3550	
3600	
3650	
3700	
3750	
3800	
3850	
3900	
3950	
4000	
4050	
4100	
4150	
4200	
4250	
4300	
4350	
4400	
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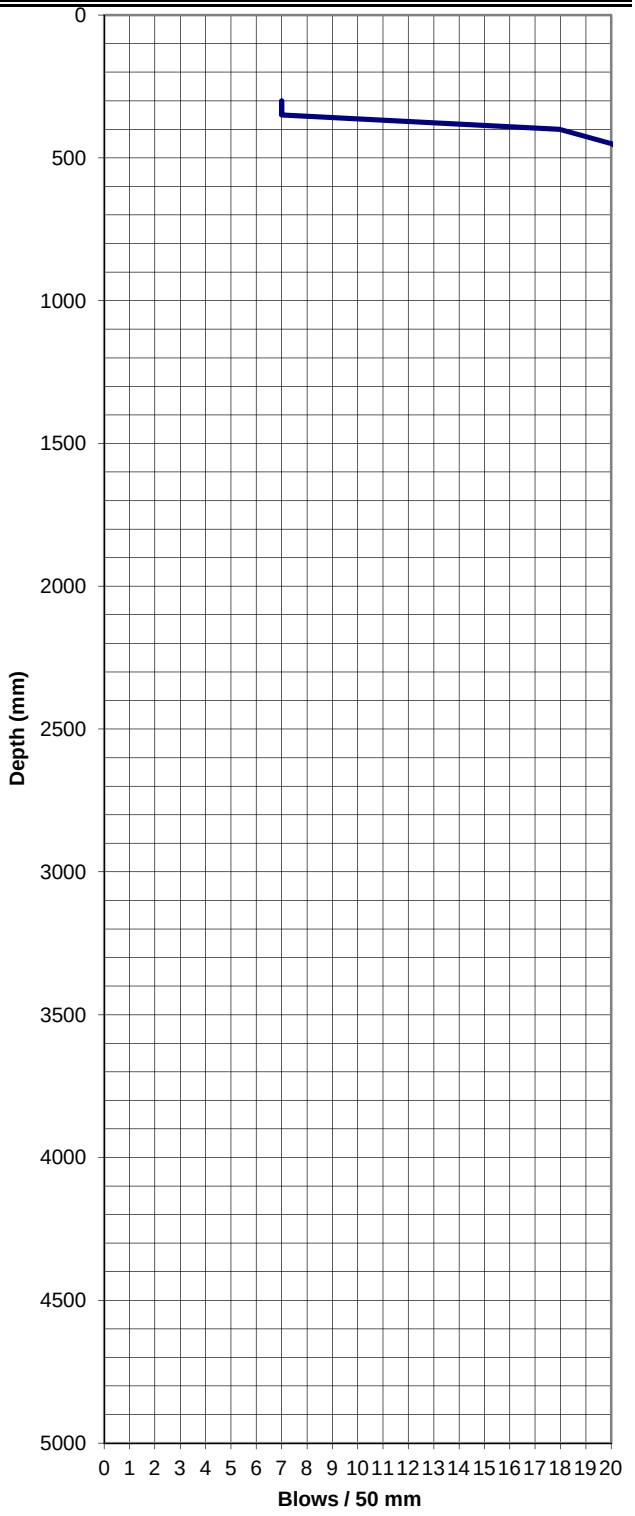
4800	
4850	
4900	
4950	
5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

Appendix E: Laboratory Test Results

- Water Content Test Results: BH1 and BH2 (13 Tests)
- Atterberg Limits Test Results: BH1 and BH2 (10 Tests)
- Solid Density Test Results: BH1 and BH2 (16 Tests)
- PSD and Hydrometer Test Results: BH1 and BH2 (14 Tests)
- Unconfined Compressive Strength Test Results: BH1 and BH2 (18 Test

GEOTECHNICS

Our Ref: 1004230.0000.0.0/Rep 1
Customer Ref: 1002886.0000
22 September 2017

Tonkin & Taylor
PO Box 5271, Wellesley Street, Auckland 1141

Attention: Mr Andy Pomfret

Dear Andy

USP Tower, Suva, Fiji

Laboratory Test Report

Samples from the above mentioned site have been tested as received and according to your instructions. Test results are included in this report.

Samples were destroyed during testing.

Please reproduce this report in full when transmitting to others or including in internal reports.

If we can be of any further assistance, feel free to get in touch. Contact details are provided at the bottom of this page.

GEOTECHNICS LTD

Report prepared by:

Sim Tirunahari
I am the author of this document
2017.09.22 09:39:59 +12'00'

.....

Sim Tirunahari
Soils Laboratory Manager

Authorised for Geotechnics by:

Vic O'Connor
I am approving this document
2017.09.22 10:32:03 +12'00'

.....

Vic O'Connor
Project Director
Approved Signatory

Report checked by:

Vic O'Connor
I have reviewed this document
2017.09.22 10:32:43 +12'00'

.....

Vic O'Connor
Managing Director
Approved Signatory

This document consists of 36 pages

22-Sep-17

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Auckland 1023, New Zealand
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w. www.geotechnics.co.nz

File: T:\Geotechnics Group\Projects\1004230\Working Material\Water Content Summary.xlsx

Site : USP Tower, Suva, Fiji

Your Job No.: **1002886**

Our Job No.: **1004230.0000.0.0**

Test Method Used: NZS 4402:1986 Test 2.1 Determination of the Water Content

TEST RESULTS

Water Content Test Results Summary:

Table 1:

BH No.:		1	1	1	1	1	1	1	1
Sample No.:		SPT	SPT	SPT	SPT	SPT	SPT	SPT	SPT
Depth	(m)	2.75-3.20	5.0-5.45	7.25-7.70	8.75-9.20	10.25-10.70	11.0-11.45	14.0-14.05	17.0-17.45
Water Content	%	63.3	70.9	75.7	85.1	75.6	75.1	58.1	67.8

Table 2:

BH No.:		2	2	2	2	2
Sample No.:		SPT	SPT	SPT	SPT	SPT
Depth	(m)	2.75-3.20	6.5-6.95	7.25-7.70	11.0-11.45	14.0-14.45
Water Content	%	66.1	74.1	73.8	66.9	68.9

Remarks :

The material used for testing was natural.

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File: T:Geotechnics Group\Projects\1004230\Working Material\Atterberg Limits Summary.xlsx

Your Job No.: **1002886**

Site : USP Tower, Suva, Fiji

Our Job No.: **1004230.0000.0.0**

Test Method Used: NZS 4402:1986 **Test 2.2 Determination of the Liquid Limit**

Test 2.3 Determination of the Plastic Limit

Test 2.4 Determination of the Plasticity Index

TEST RESULTS

Atterberg Limits Test Results Summary

Table 1:

BH No.:		**1**	**1**	**1**	**1**	**1**
Depth	(m)	**2.75-3.20**	**5.0-5.45**	**7.25-7.70**	**11.0-11.45**	**15.50-15.95**
Liquid Limit		**111**	**121**	**125**	**118**	**110**
Plastic Limit		**62**	**69**	**64**	**58**	**54**
Plasticity Index		**49**	**52**	**61**	**60**	**56**

Table 2:

BH No.:		**2**	**2**	**2**	**2**	**2**
Depth	(m)	**2.75-3.20**	**6.5-6.95**	**7.25-7.70**	**11.0-11.45**	**14.0-14.45**
Liquid Limit		**107**	**114**	**149**	**112**	**107**
Plastic Limit		**63**	**56**	**60**	**63**	**53**
Plasticity Index		**44**	**58**	**89**	**49**	**54**

Remarks : The material used for testing was natural, fraction passing a 0.425mm test sieve.

The test results are IANZ accredited.

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File: T:Geotechnics Group\Projects\1004230\Working Material\Solid density summary.xlsx

Your Ref No.: 1002886

Site : USP Tower, Suva, Fiji

Our Job No.: 1004230.0000.0.0

Test Method Used:NZS 4402:1986 Test 2.7.2 Determination of Solid Density of Soil Particles - Vacuum Method

SOLID DENSITY TEST RESULTS

Table 1: Solid Density

Borehole No.:		1	1	1	1	1	1	1	1
Sample ID.:		SPT	SPT	SPT	SPT	SPT	SPT	SPT	SPT
Depth	(m)	1.0-1.45	3.5-3.92	6.5-6.95	8.0-8.45	9.5-9.95	11.75-12.15	15.5-15.95	18.5-18.95
*Solid Density	(t/m^3)	2.85	2.74	2.80	2.82	2.80	2.79	2.78	2.80

Table 2: Solid Density

Borehole No.:		2	2	2	2	2	2	2	2
Sample ID.:		SPT	SPT	SPT	SPT	SPT	SPT	SPT	SPT
Depth	(m)	1.0-1.45	3.5-3.86	6.5-6.95	8.0-8.45	9.5-9.95	11.75-12.2	15.5-15.91	18.5-18.95
*Solid Density	(t/m^3)	2.83	2.65	2.66	2.80	2.79	2.80	2.80	2.84

Remarks : The material used for testing was natural, whole soil.

*As per the standard, two specimens are required to perform a solid density, but due to insufficient SPT sample mass obtained, it was performed on a single specimen as directed by the engineer. Therefore the test results are not IANZ accredited.

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Your Job No.: **1002886**

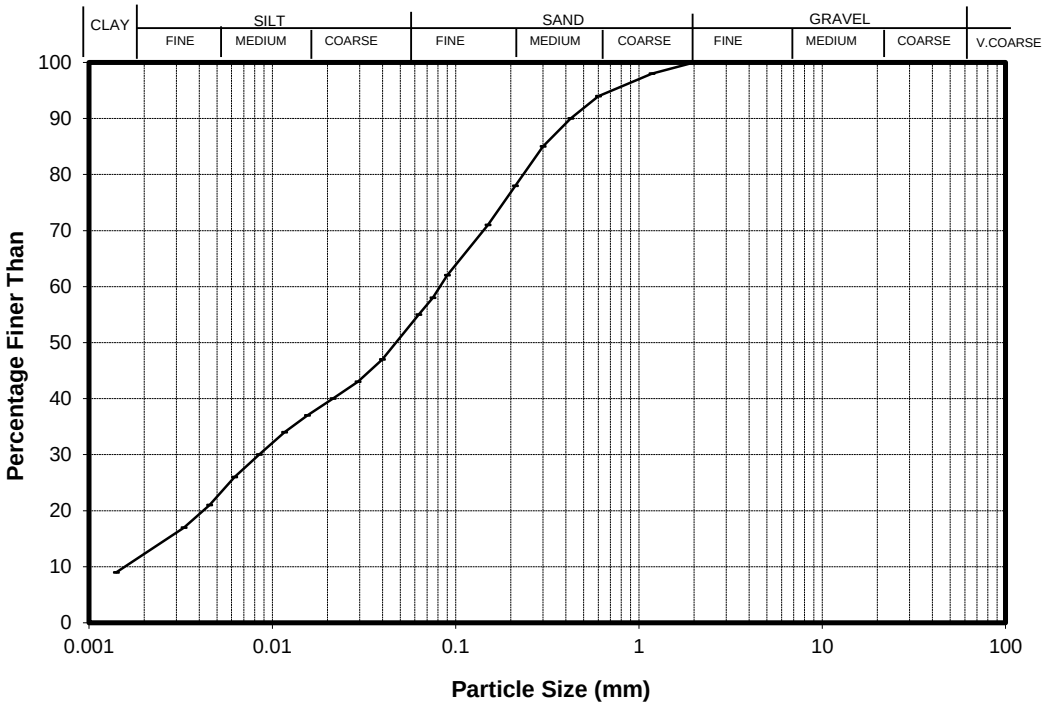
Site : **USP Tower, Suva, Fiji**

Our Job No.: **1004230.0000.0.0**

BH No.: **1** Sample No.: **SPT** Depth (m): **2.0-2.45**

Test Method Used : NZS 4402:1986 Test 2.8.1 Wet Sieve Test 2.8.4 Hydrometer

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing	Sieve (mm)	Total % Passing
26.5	---	0.425	90
19.0	---	0.300	85
13.2	---	0.212	78
9.50	---	0.150	71
6.70	---	0.090	62
4.75	---	0.075	58
3.35	100	0.063	55
2.00	100		
1.18	98		
0.600	94		

Equivalent Particle Diameter D (mm)	% of Particles Finer than D
0.0398	47
0.0293	43
0.0215	40
0.0156	37
0.0116	34
0.0085	30
0.0062	26
0.0045	21
0.0033	17
0.0014	9

Sample history : As received

Solid Density (Assumed): 2.85 t/m^3

Description : sandy SILT with minor clay, extremely weak, light brown, mottled black.

Remarks : The wet sieve sample was washed over 0.063mm test sieve, until the individual particles were clean. The material retained on 0.063mm test sieve was oven dried and dry sieved. The material passing 0.063mm test sieve was taken for hydrometer analysis.
The sieve data was combined with the hydrometer analysis to give a continuous curve.
Suspension pH 8.0
The test results are IANZ accredited but the sample description is not IANZ accredited.

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Your Job No.: **1002886**

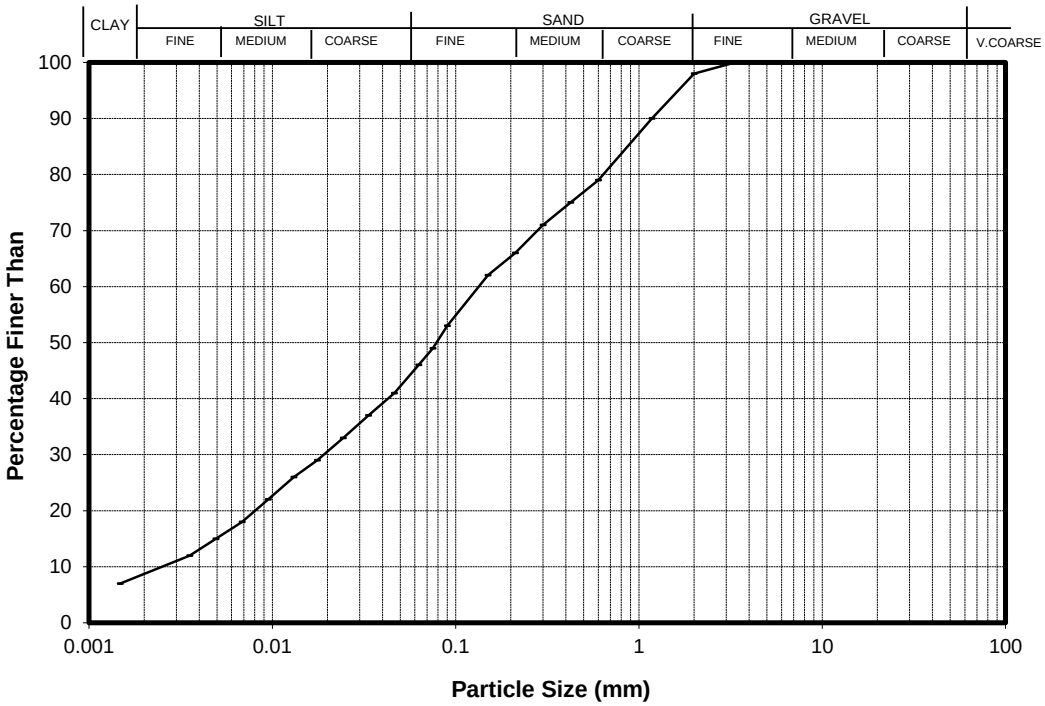
Site : **USP Tower, Suva, Fiji**

Our Job No.: **1004230.0000.0.0**

BH No.: **1** Sample No.: **SPT** Depth (m): **4.25-4.70**

Test Method Used : NZS 4402:1986 Test 2.8.1 Wet Sieve Test 2.8.4 Hydrometer

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing	Sieve (mm)	Total % Passing
26.5	---	0.425	75
19.0	---	0.300	71
13.2	---	0.212	66
9.50	---	0.150	62
6.70	---	0.090	53
4.75	100	0.075	49
3.35	100	0.063	46
2.00	98		
1.18	90		
0.600	79		

Equivalent Particle Diameter D (mm)	% of Particles Finer than D
0.0463	41
0.0335	37
0.0244	33
0.0176	29
0.0131	26
0.0095	22
0.0068	18
0.0049	15
0.0035	12
0.0015	7

Sample history : As received

Solid Density (Assumed): 2.75 t/m^3

Description : sandy SILT with minor clay and trace of fine gravel, very weak, light brown, mottled black.

Remarks : The wet sieve sample was washed over 0.063mm test sieve, until the individual particles were clean. The material retained on 0.063mm test sieve was oven dried and dry sieved. The material passing 0.063mm test sieve was taken for hydrometer analysis.
The sieve data was combined with the hydrometer analysis to give a continuous curve.
Suspension pH 8.0
The test results are IANZ accredited but the sample description is not IANZ accredited.

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Your Job No.: **1002886**

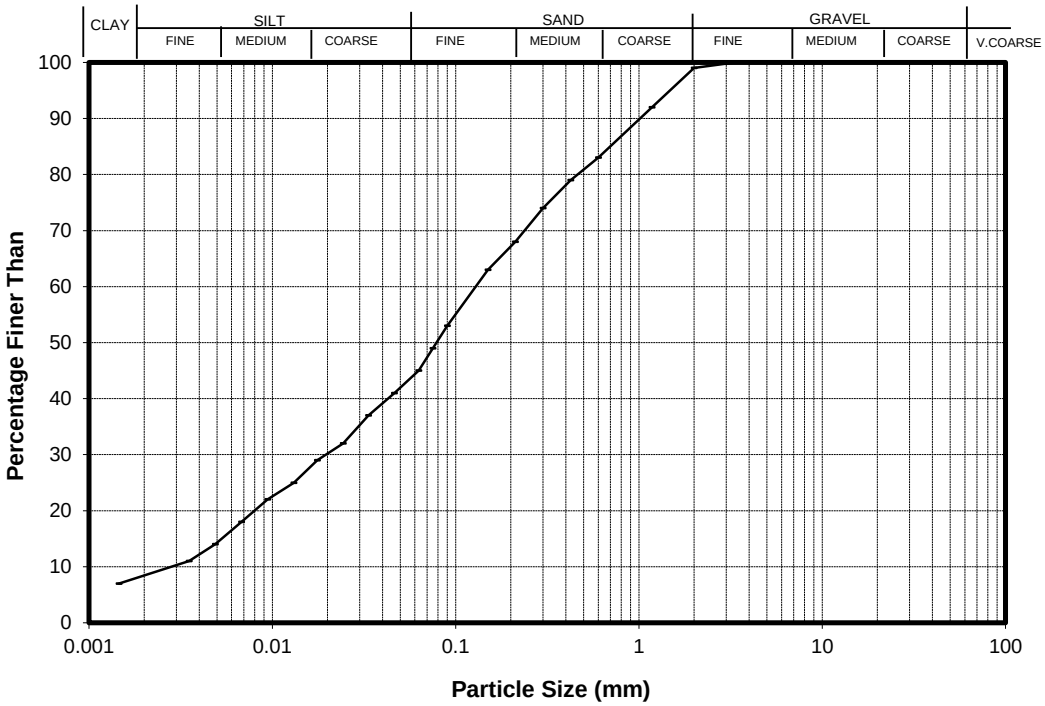
Site : **USP Tower, Suva, Fiji**

Our Job No.: **1004230.0000.0.0**

BH No.: **1** Sample No.: **SPT** Depth (m): **5.75-6.20**

Test Method Used : NZS 4402:1986 Test 2.8.1 Wet Sieve Test 2.8.4 Hydrometer

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing	Sieve (mm)	Total % Passing
26.5	---	0.425	79
19.0	---	0.300	74
13.2	---	0.212	68
9.50	---	0.150	63
6.70	---	0.090	53
4.75	100	0.075	49
3.35	100	0.063	45
2.00	99		
1.18	92		
0.600	83		

Equivalent Particle Diameter D (mm)	% of Particles Finer than D
0.0463	41
0.0335	37
0.0244	32
0.0176	29
0.0131	25
0.0094	22
0.0068	18
0.0049	14
0.0035	11
0.0015	7

Sample history : As received

Solid Density (Assumed): 2.80 t/m^3

Description : sandy SILT with minor clay and trace of fine gravel, extremely weak to very weak, light brown, mottled black.

Remarks : The wet sieve sample was washed over 0.063mm test sieve, until the individual particles were clean. The material retained on 0.063mm test sieve was oven dried and dry sieved. The material passing 0.063mm test sieve was taken for hydrometer analysis.
The sieve data was combined with the hydrometer analysis to give a continuous curve.
Suspension pH 8.0
The test results are IANZ accredited but the sample description is not IANZ accredited.

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Your Job No.: **1002886**

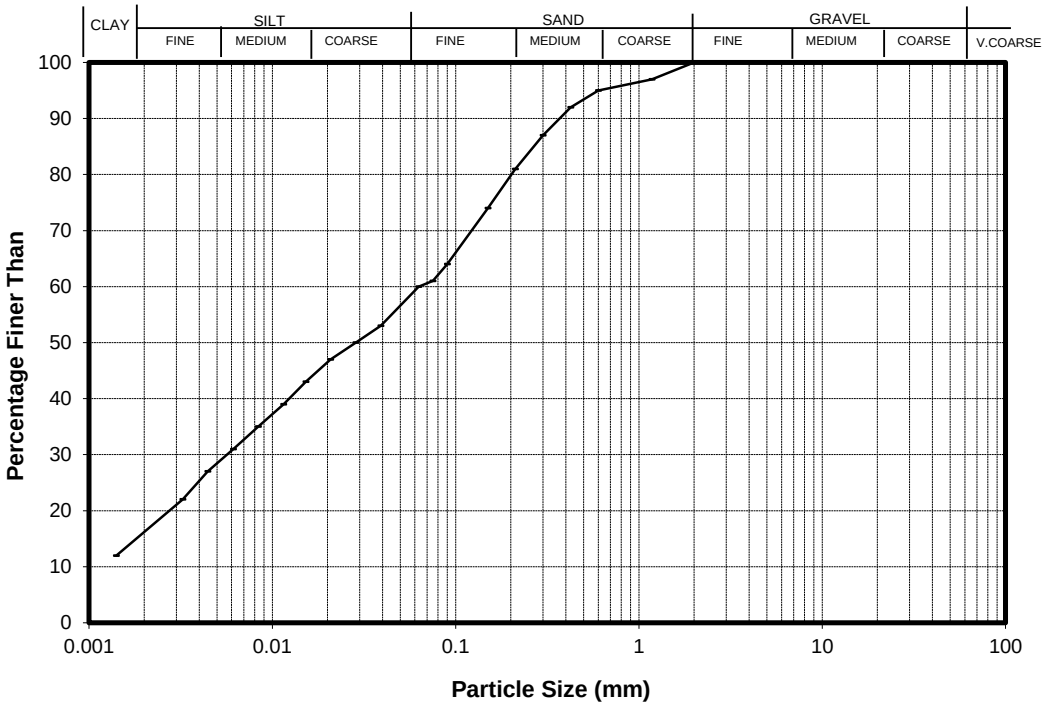
Site : **USP Tower, Suva, Fiji**

Our Job No.: **1004230.0000.0.0**

BH No.: **1** Sample No.: **SPT** Depth (m): **8.75-9.20**

Test Method Used : NZS 4402:1986 Test 2.8.1 Wet Sieve Test 2.8.4 Hydrometer

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing	Sieve (mm)	Total % Passing
26.5	---	0.425	92
19.0	---	0.300	87
13.2	---	0.212	81
9.50	---	0.150	74
6.70	---	0.090	64
4.75	---	0.075	61
3.35	100	0.063	60
2.00	100		
1.18	97		
0.600	95		

Equivalent Particle Diameter D (mm)	% of Particles Finer than D
0.0391	53
0.0285	50
0.0208	47
0.0152	43
0.0115	39
0.0084	35
0.0061	31
0.0044	27
0.0033	22
0.0014	12

Sample history : As received

Solid Density (Assumed): 2.80 t/m^3

Description : sandy SILT with some clay, extremely weak to very weak, light brown, mottled black.

Remarks : The wet sieve sample was washed over 0.063mm test sieve, until the individual particles were clean. The material retained on 0.063mm test sieve was oven dried and dry sieved. The material passing 0.063mm test sieve was taken for hydrometer analysis.
The sieve data was combined with the hydrometer analysis to give a continuous curve.
Suspension pH 8.0
The test results are IANZ accredited but the sample description is not IANZ accredited.

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Your Job No.: **1002886**

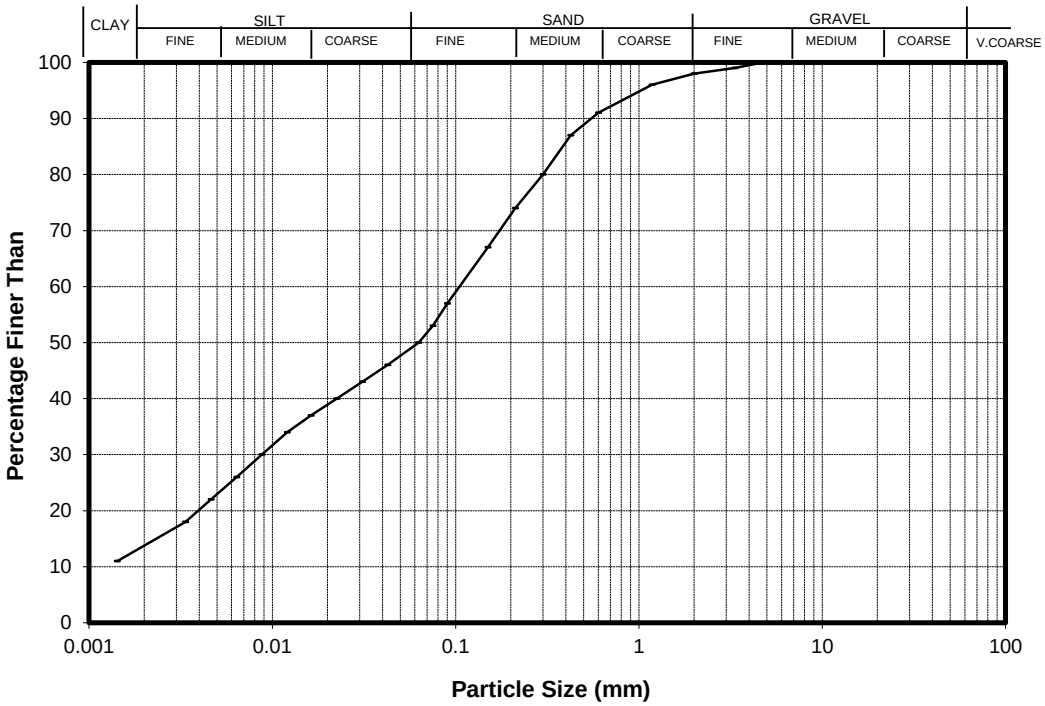
Site : **USP Tower, Suva, Fiji**

Our Job No.: **1004230.0000.0.0**

BH No.: **1** Sample No.: **SPT** Depth (m): **10.25-10.70**

Test Method Used : NZS 4402:1986 Test 2.8.1 Wet Sieve Test 2.8.4 Hydrometer

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing	Sieve (mm)	Total % Passing
26.5	---	0.425	87
19.0	---	0.300	80
13.2	---	0.212	74
9.50	---	0.150	67
6.70	---	0.090	57
4.75	100	0.075	53
3.35	99	0.063	50
2.00	98		
1.18	96		
0.600	91		

Equivalent Particle Diameter D (mm)	% of Particles Finer than D
0.0427	46
0.0310	43
0.0225	40
0.0163	37
0.0121	34
0.0088	30
0.0064	26
0.0046	22
0.0034	18
0.0014	11

Sample history : As received

Solid Density (Assumed): 2.80 t/m^3

Description : sandy SILT with some clay and trace of fine gravel, extremely weak to very weak, dark greenish grey, mottled black.

Remarks : The wet sieve sample was washed over 0.063mm test sieve, until the individual particles were clean. The material retained on 0.063mm test sieve was oven dried and dry sieved. The material passing 0.063mm test sieve was taken for hydrometer analysis.
The sieve data was combined with the hydrometer analysis to give a continuous curve.
Suspension pH 8.0
The test results are IANZ accredited but the sample description is not IANZ accredited.

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Your Job No.: **1002886**

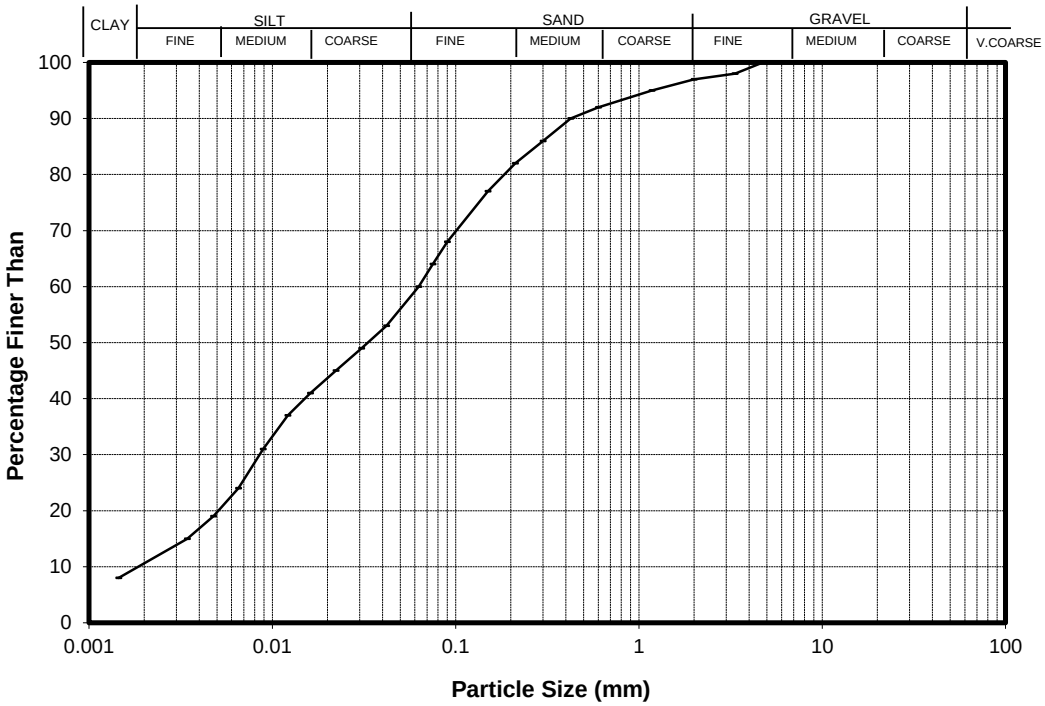
Site : **USP Tower, Suva, Fiji**

Our Job No.: **1004230.0000.0.0**

BH No.: **1** Sample No.: **SPT** Depth (m): **12.50-12.95**

Test Method Used : NZS 4402:1986 Test 2.8.1 Wet Sieve Test 2.8.4 Hydrometer

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing	Sieve (mm)	Total % Passing
26.5	---	0.425	90
19.0	---	0.300	86
13.2	---	0.212	82
9.50	---	0.150	77
6.70	---	0.090	68
4.75	100	0.075	64
3.35	98	0.063	60
2.00	97		
1.18	95		
0.600	92		

Equivalent Particle Diameter D (mm)	% of Particles Finer than D
0.0419	53
0.0307	49
0.0223	45
0.0161	41
0.0121	37
0.0089	31
0.0065	24
0.0048	19
0.0034	15
0.0014	8

Sample history : As received

Solid Density (Assumed): 2.80 t/m^3

Description : sandy SILT with minor clay and trace of fine gravel, very weak, dark greenish grey, mottled black.

Remarks : The wet sieve sample was washed over 0.063mm test sieve, until the individual particles were clean. The material retained on 0.063mm test sieve was oven dried and dry sieved. The material passing 0.063mm test sieve was taken for hydrometer analysis.
The sieve data was combined with the hydrometer analysis to give a continuous curve.
Suspension pH 8.0
The test results are IANZ accredited but the sample description is not IANZ accredited.

Entered by : JK Date : 22/09/2017 Checked by : ST Date : 22/09/2017

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Your Job No.: **1002886**

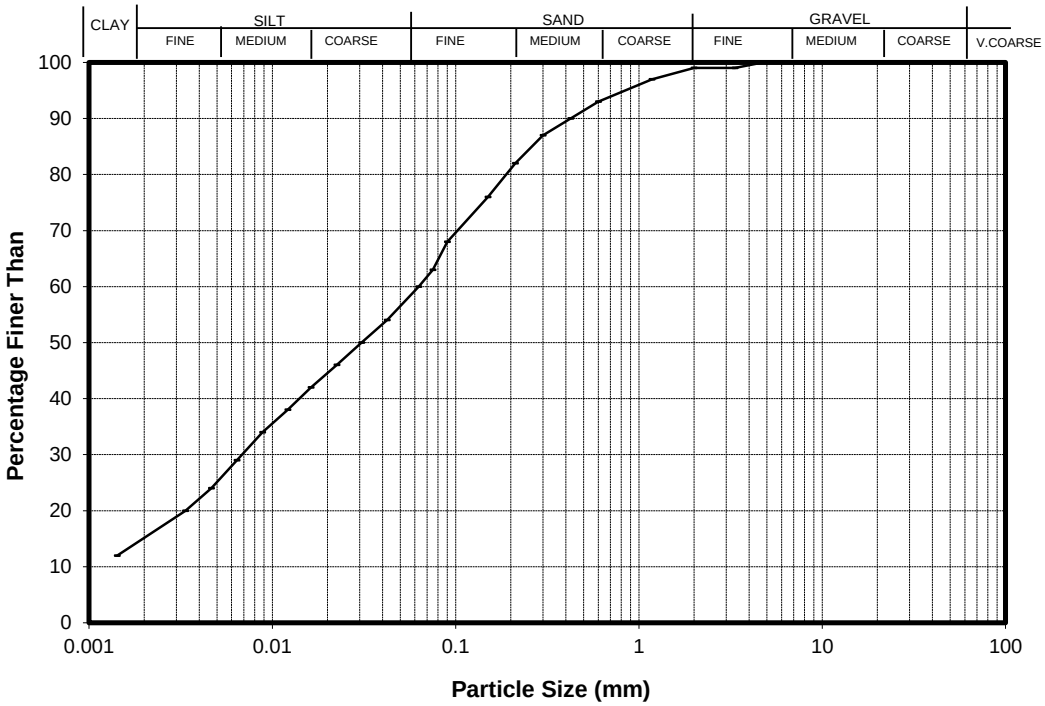
Site : **USP Tower, Suva, Fiji**

Our Job No.: **1004230.0000.0.0**

BH No.: **1** Sample No.: **SPT** Depth (m): **17.00-17.45**

Test Method Used : NZS 4402:1986 Test 2.8.1 Wet Sieve Test 2.8.4 Hydrometer

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing	Sieve (mm)	Total % Passing
26.5	---	0.425	90
19.0	---	0.300	87
13.2	---	0.212	82
9.50	---	0.150	76
6.70	---	0.090	68
4.75	100	0.075	63
3.35	99	0.063	60
2.00	99		
1.18	97		
0.600	93		

Equivalent Particle Diameter D (mm)	% of Particles Finer than D
0.0423	54
0.0307	50
0.0225	46
0.0163	42
0.0121	38
0.0088	34
0.0064	29
0.0047	24
0.0034	20
0.0014	12

Sample history : As received

Solid Density (Assumed): 2.80 t/m^3

Description : sandy SILT with some clay and trace of fine gravel, extremely weak to very weak, dark greenish grey, mottled black.

Remarks : The wet sieve sample was washed over 0.063mm test sieve, until the individual particles were clean. The material retained on 0.063mm test sieve was oven dried and dry sieved. The material passing 0.063mm test sieve was taken for hydrometer analysis.
The sieve data was combined with the hydrometer analysis to give a continuous curve.
Suspension pH 8.0
The test results are IANZ accredited but the sample description is not IANZ accredited.

Entered by : JK Date : 22/09/2017 Checked by : ST Date : 22/09/2017

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Your Job No.: **1002886**

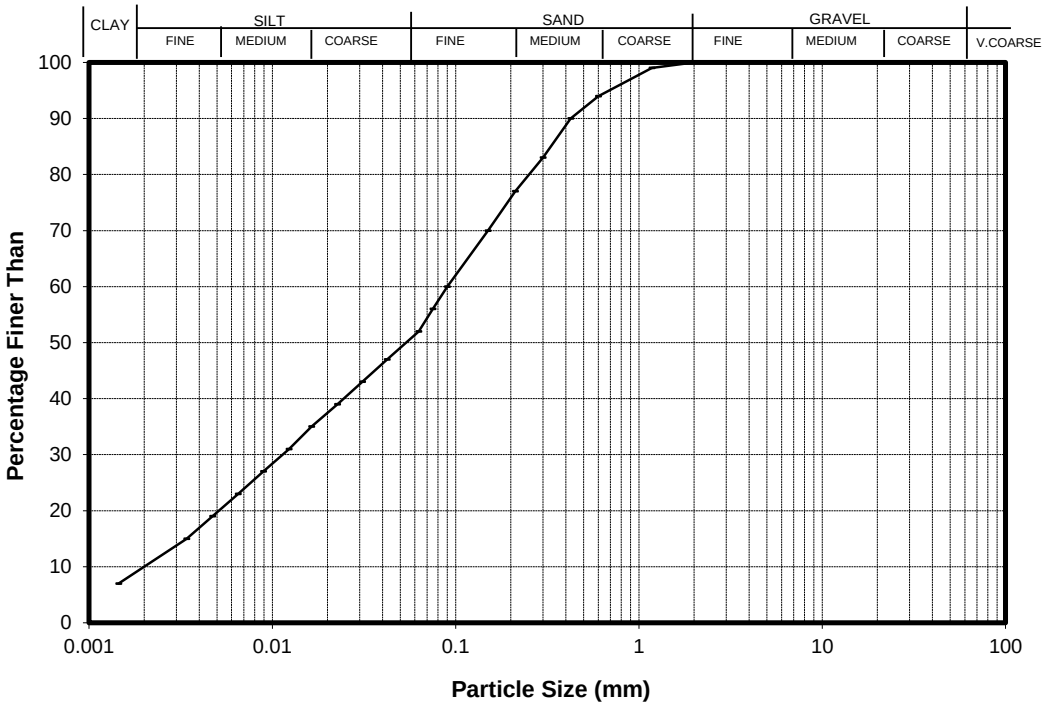
Site : **USP Tower, Suva, Fiji**

Our Job No.: **1004230.0000.0.0**

BH No.: **2** Sample No.: **SPT** Depth (m): **2.0-2.45**

Test Method Used : NZS 4402:1986 Test 2.8.1 Wet Sieve Test 2.8.4 Hydrometer

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing	Sieve (mm)	Total % Passing
26.5	---	0.425	90
19.0	---	0.300	83
13.2	---	0.212	77
9.50	---	0.150	70
6.70	---	0.090	60
4.75	100	0.075	56
3.35	100	0.063	52
2.00	100		
1.18	99		
0.600	94		

Equivalent Particle Diameter D (mm)	% of Particles Finer than D
0.0423	47
0.0310	43
0.0226	39
0.0164	35
0.0123	31
0.0090	27
0.0065	23
0.0047	19
0.0034	15
0.0014	7

Sample history : As received

Solid Density (Assumed): 2.80 t/m^3

Description : sandy SILT with minor clay, extremely weak, light greenish grey, mottled black.

Remarks : The wet sieve sample was washed over 0.063mm test sieve, until the individual particles were clean. The material retained on 0.063mm test sieve was oven dried and dry sieved. The material passing 0.063mm test sieve was taken for hydrometer analysis.
The sieve data was combined with the hydrometer analysis to give a continuous curve.
Suspension pH 8.0
The test results are IANZ accredited but the sample description is not IANZ accredited.

Entered by : JK Date : 22/09/2017 Checked by : ST Date : 22/09/2017

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Your Job No.: **1002886**

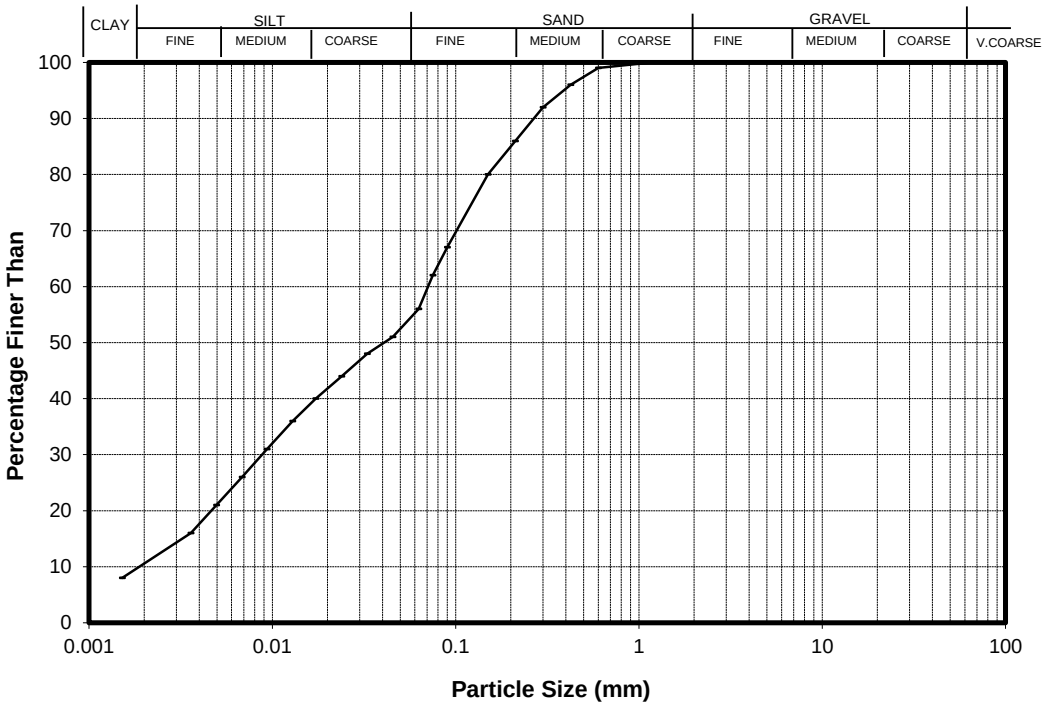
Site : **USP Tower, Suva, Fiji**

Our Job No.: **1004230.0000.0.0**

BH No.: **2** Sample No.: **SPT** Depth (m): **4.25-4.70**

Test Method Used : NZS 4402:1986 Test 2.8.1 Wet Sieve Test 2.8.4 Hydrometer

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing	Sieve (mm)	Total % Passing
26.5	---	0.425	96
19.0	---	0.300	92
13.2	---	0.212	86
9.50	---	0.150	80
6.70	---	0.090	67
4.75	100	0.075	62
3.35	100	0.063	56
2.00	100		
1.18	100		
0.600	99		

Equivalent Particle Diameter D (mm)	% of Particles Finer than D
0.0454	51
0.0329	48
0.0239	44
0.0173	40
0.0129	36
0.0094	31
0.0068	26
0.0050	21
0.0036	16
0.0015	8

Sample history : As received

Solid Density (Assumed): 2.65 t/m^3

Description : sandy SILT with minor clay, extremely weak, light greenish grey.

Remarks : The wet sieve sample was washed over 0.063mm test sieve, until the individual particles were clean. The material retained on 0.063mm test sieve was oven dried and dry sieved. The material passing 0.063mm test sieve was taken for hydrometer analysis.
The sieve data was combined with the hydrometer analysis to give a continuous curve.
Suspension pH 8.0
The test results are IANZ accredited but the sample description is not IANZ accredited.

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Your Job No.: **1002886**

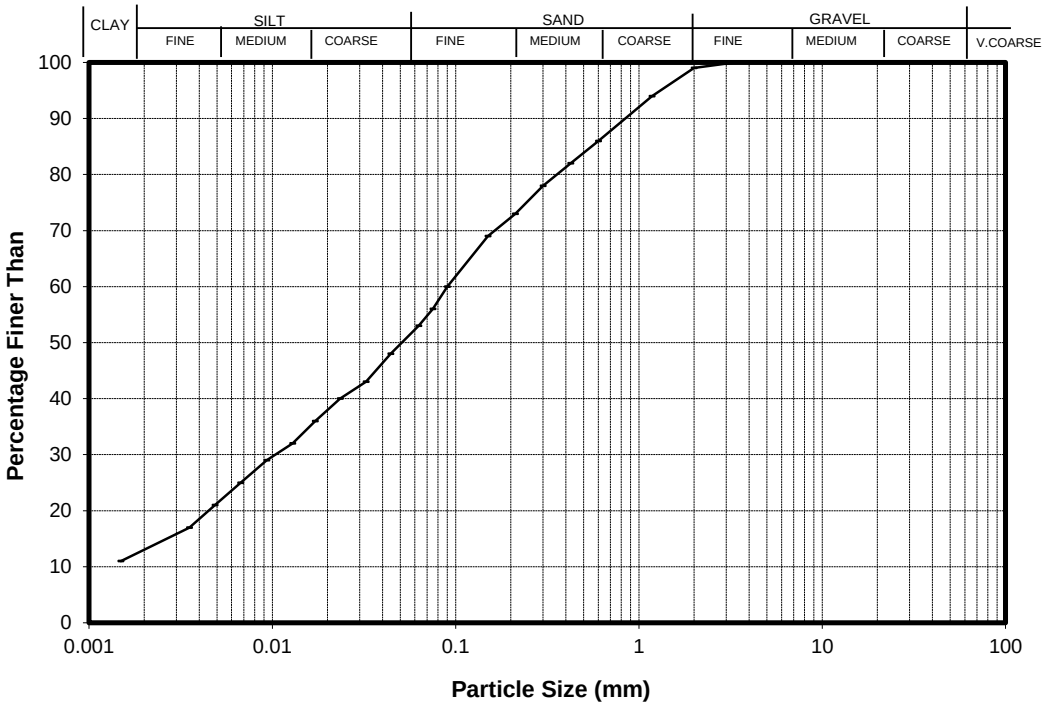
Site : **USP Tower, Suva, Fiji**

Our Job No.: **1004230.0000.0.0**

BH No.: **2** Sample No.: **SPT** Depth (m): **5.75-6.20**

Test Method Used : NZS 4402:1986 Test 2.8.1 Wet Sieve Test 2.8.4 Hydrometer

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing	Sieve (mm)	Total % Passing
26.5	---	0.425	82
19.0	---	0.300	78
13.2	---	0.212	73
9.50	---	0.150	69
6.70	---	0.090	60
4.75	100	0.075	56
3.35	100	0.063	53
2.00	99		
1.18	94		
0.600	86		

Equivalent Particle Diameter D (mm)	% of Particles Finer than D
0.0442	48
0.0324	43
0.0235	40
0.0171	36
0.0129	32
0.0093	29
0.0067	25
0.0049	21
0.0035	17
0.0015	11

Sample history : As received

Solid Density (Assumed): 2.65 t/m^3

Description : sandy SILT with some clay, very weak, dark greenish grey.

Remarks : The wet sieve sample was washed over 0.063mm test sieve, until the individual particles were clean. The material retained on 0.063mm test sieve was oven dried and dry sieved. The material passing 0.063mm test sieve was taken for hydrometer analysis.
The sieve data was combined with the hydrometer analysis to give a continuous curve.
Suspension pH 8.0
The test results are IANZ accredited but the sample description is not IANZ accredited.

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Your Job No.: **1002886**

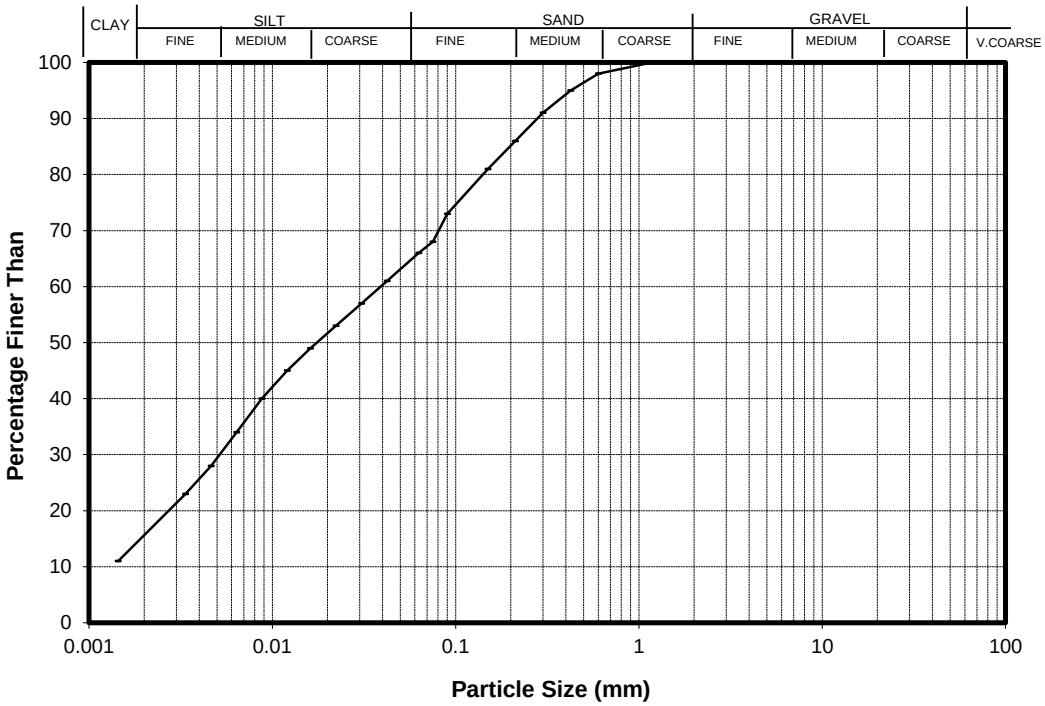
Site : **USP Tower, Suva, Fiji**

Our Job No.: **1004230.0000.0.0**

BH No.: **2** Sample No.: **SPT** Depth (m): **8.75-9.20**

Test Method Used : NZS 4402:1986 Test 2.8.1 Wet Sieve Test 2.8.4 Hydrometer

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing	Sieve (mm)	Total % Passing
26.5	---	0.425	95
19.0	---	0.300	91
13.2	---	0.212	86
9.50	---	0.150	81
6.70	---	0.090	73
4.75	---	0.075	68
3.35	---	0.063	66
2.00	100		
1.18	100		
0.600	98		

Equivalent Particle Diameter D (mm)	% of Particles Finer than D
0.0423	61
0.0307	57
0.0223	53
0.0161	49
0.0121	45
0.0088	40
0.0064	34
0.0046	28
0.0034	23
0.0014	11

Sample history : As received

Solid Density (Assumed): 2.80 t/m^3

Description : sandy SILT with some clay, extremely weak, dark greenish grey, mottled black.

Remarks : The wet sieve sample was washed over 0.063mm test sieve, until the individual particles were clean. The material retained on 0.063mm test sieve was oven dried and dry sieved. The material passing 0.063mm test sieve was taken for hydrometer analysis.
The sieve data was combined with the hydrometer analysis to give a continuous curve.
Suspension pH 8.0
The test results are IANZ accredited but the sample description is not IANZ accredited.

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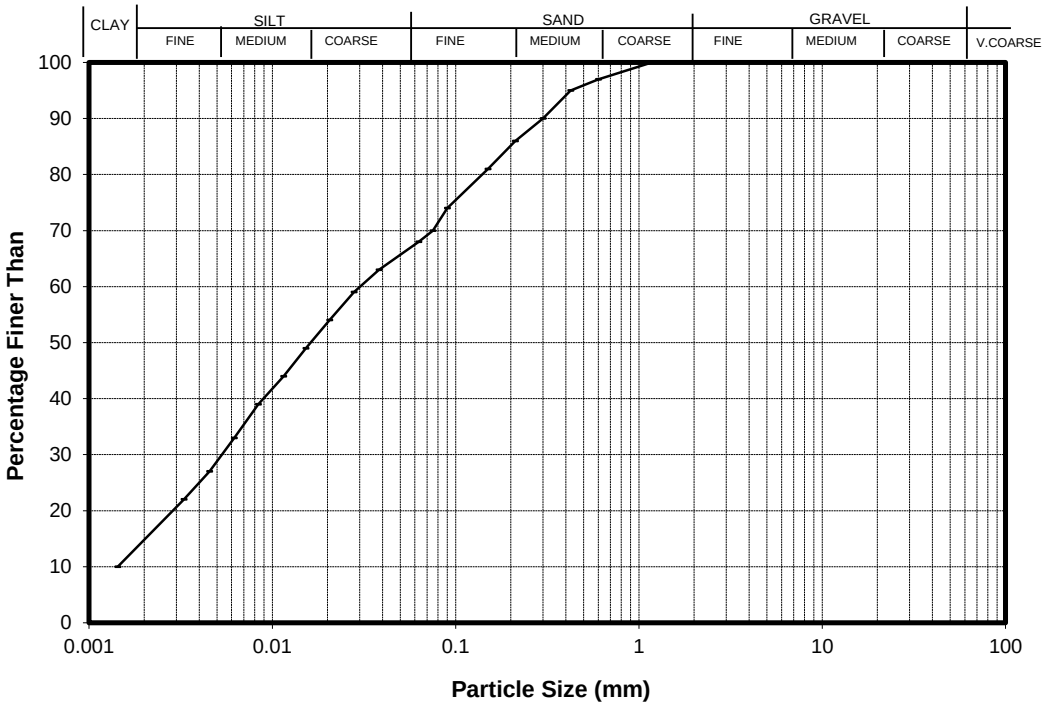
Your Job No.: **1002886**
Our Job No.: **1004230.0000.0.0**

Site : **USP Tower, Suva, Fiji**
BH No.: **2** Sample No.: **SPT** Depth (m): **10.25-10.70**

Test Method Used : NZS 4402:1986 Test 2.8.1 Wet Sieve Test 2.8.4 Hydrometer

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing	Sieve (mm)	Total % Passing
26.5	---	0.425	95
19.0	---	0.300	90
13.2	---	0.212	86
9.50	---	0.150	81
6.70	---	0.090	74
4.75	---	0.075	70
3.35	---	0.063	68
2.00	100		
1.18	100		
0.600	97		

Equivalent Particle Diameter D (mm)	% of Particles Finer than D
0.0382	63
0.0279	59
0.0206	54
0.0152	49
0.0115	44
0.0084	39
0.0062	33
0.0045	27
0.0033	22
0.0014	10

Sample history : As received
Solid Density (Assumed): 2.80 t/m^3
Description : sandy SILT with some clay, extremely weak, dark greenish grey, mottled black.

Remarks : The wet sieve sample was washed over 0.063mm test sieve, until the individual particles were clean. The material retained on 0.063mm test sieve was oven dried and dry sieved. The material passing 0.063mm test sieve was taken for hydrometer analysis.
The sieve data was combined with the hydrometer analysis to give a continuous curve.
Suspension pH 8.0
The test results are IANZ accredited but the sample description is not IANZ accredited.

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Your Job No.: **1002886**

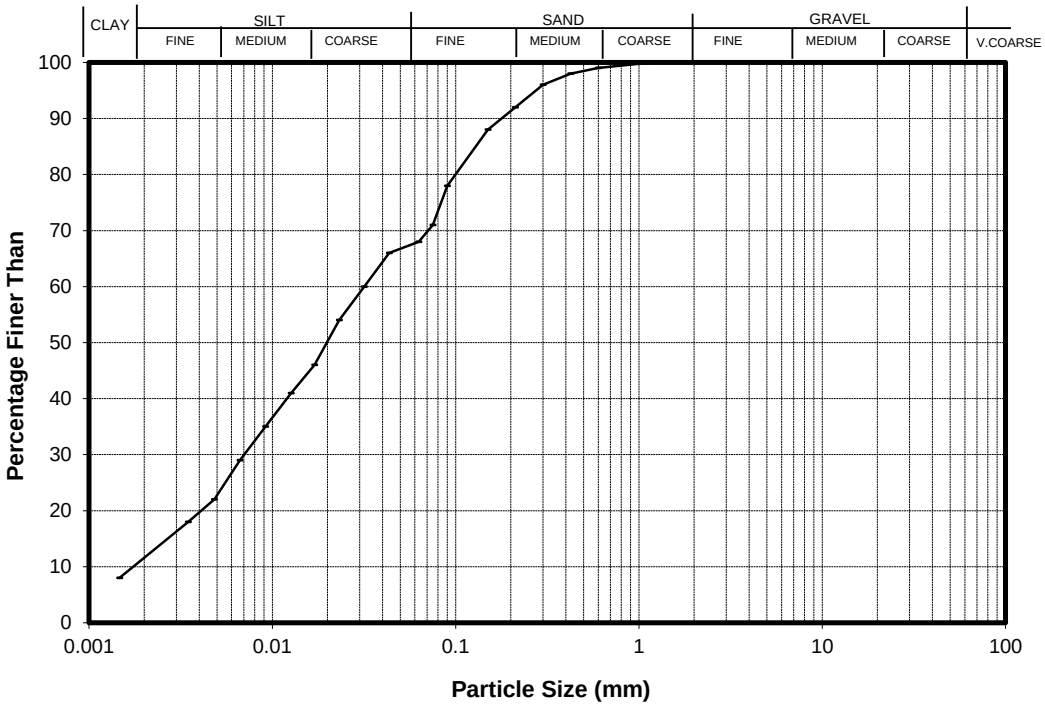
Site : **USP Tower, Suva, Fiji**

Our Job No.: **1004230.0000.0.0**

BH No.: **2** Sample No.: **SPT** Depth (m): **12.50-12.95**

Test Method Used : NZS 4402:1986 Test 2.8.1 Wet Sieve Test 2.8.4 Hydrometer

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing	Sieve (mm)	Total % Passing
26.5	---	0.425	98
19.0	---	0.300	96
13.2	---	0.212	92
9.50	---	0.150	88
6.70	---	0.090	78
4.75	---	0.075	71
3.35	---	0.063	68
2.00	100		
1.18	100		
0.600	99		

Equivalent Particle Diameter D (mm)	% of Particles Finer than D
0.0434	66
0.0318	60
0.0232	54
0.0170	46
0.0127	41
0.0092	35
0.0067	29
0.0048	22
0.0035	18
0.0015	8

Sample history : As received

Solid Density (Assumed): 2.80 t/m^3

Description : sandy SILT with minor clay, extremely weak to very weak, dark grey, mottled black.

Remarks : The wet sieve sample was washed over 0.063mm test sieve, until the individual particles were clean. The material retained on 0.063mm test sieve was oven dried and dry sieved. The material passing 0.063mm test sieve was taken for hydrometer analysis.
The sieve data was combined with the hydrometer analysis to give a continuous curve.
Suspension pH 8.0
The test results are IANZ accredited but the sample description is not IANZ accredited.

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Your Job No.: **1002886**

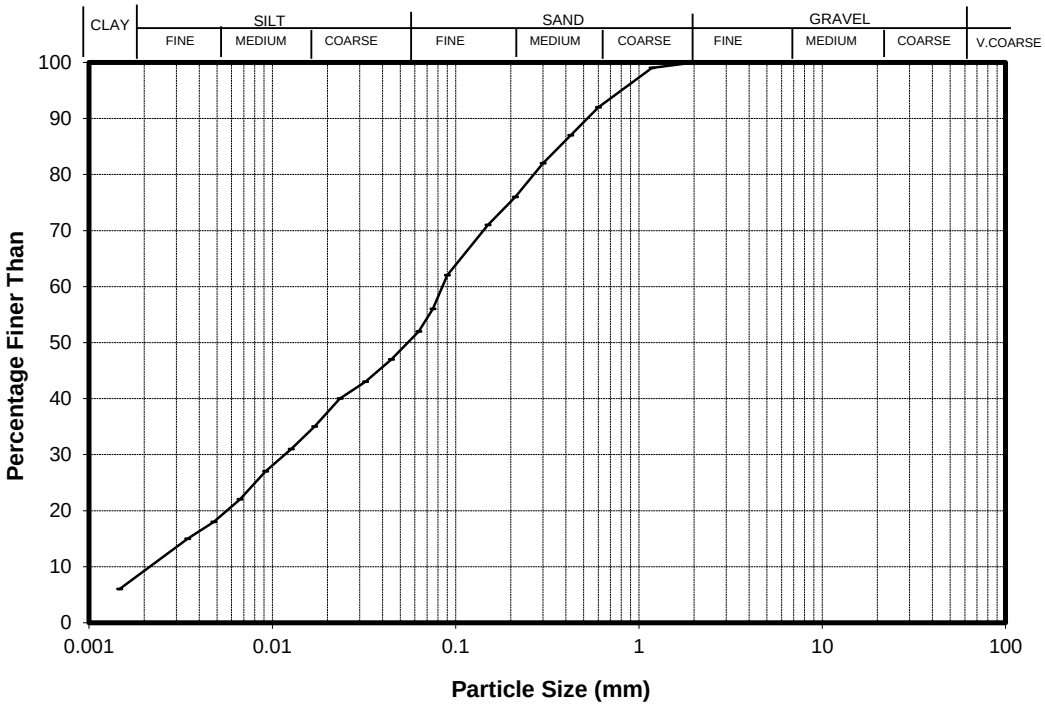
Site : **USP Tower, Suva, Fiji**

Our Job No.: **1004230.0000.0.0**

BH No.: **2** Sample No.: **SPT** Depth (m): **17.00-17.42**

Test Method Used : NZS 4402:1986 Test 2.8.1 Wet Sieve Test 2.8.4 Hydrometer

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing	Sieve (mm)	Total % Passing
26.5	---	0.425	87
19.0	---	0.300	82
13.2	---	0.212	76
9.50	---	0.150	71
6.70	---	0.090	62
4.75	---	0.075	56
3.35	100	0.063	52
2.00	100		
1.18	99		
0.600	92		

Equivalent Particle Diameter D (mm)	% of Particles Finer than D
0.0445	47
0.0323	43
0.0233	40
0.0170	35
0.0127	31
0.0092	27
0.0067	22
0.0048	18
0.0035	15
0.0015	6

Sample history : As received

Solid Density (Assumed): 2.80 t/m^3

Description : sandy SILT with minor clay, very weak, dark grey, mottled black.

Remarks : The wet sieve sample was washed over 0.063mm test sieve, until the individual particles were clean. The material retained on 0.063mm test sieve was oven dried and dry sieved. The material passing 0.063mm test sieve was taken for hydrometer analysis.
The sieve data was combined with the hydrometer analysis to give a continuous curve.
Suspension pH 8.0
The test results are IANZ accredited but the sample description is not IANZ accredited.

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Geotechnics Project ID	1004230.0000.0.0
Customer Project ID	1002886.0000

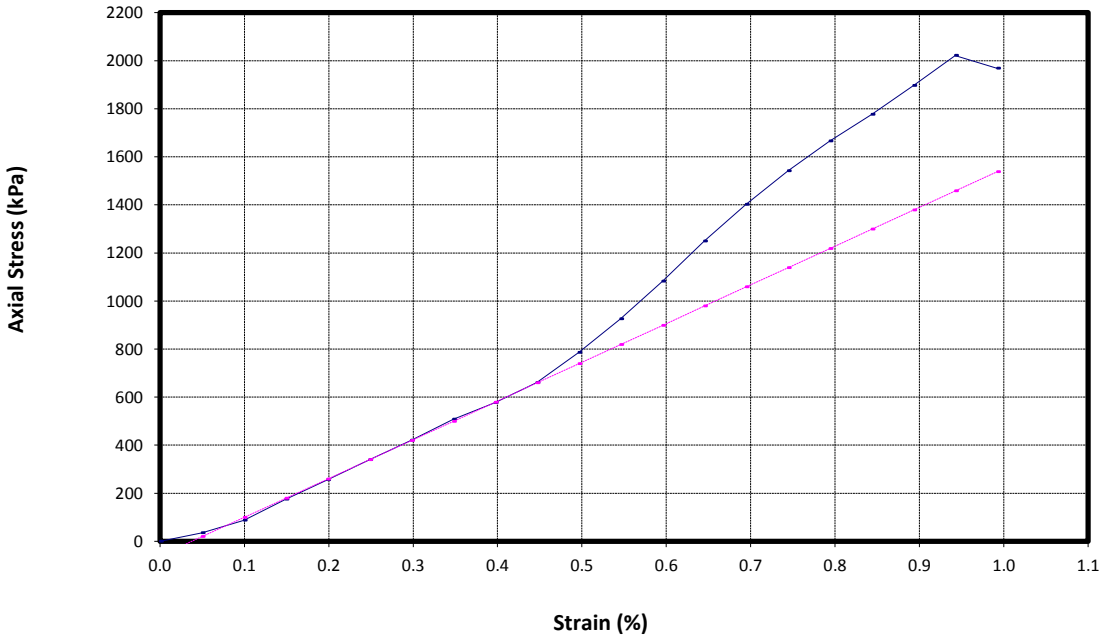
Determination of the unconfined compressive strength of cohesive soil - NZS 4402:1986 Test 6.3.1

Sample Details

Geotechnics Sample ID	-				
Site	USP Tower, Suva, Fiji				
BH No	BH1	Sample ID	--	Depth (m)	2.55-2.75m
Sample Description	Light brown, very weak, Suva Marl.				

Test Result

Unconfined Compressive Strength Test
Axial Stress vs Strain



Sample Parameters

Sample Height	(mm)	100.79	Bulk Density	(t/m³)	1.58
Sample Diameter	(mm)	60.21	Dry Density	(t/m³)	0.94
Test Height	(mm)	100.79	Water Content	(%)	69.1
Test H/D Ratio		1.67			

Failure Value

Axial Strain (%)	Unconfined Compressive Strength qu (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
0.94	2021	0.14	161

Mode of Failure Shear

Sample History Undisturbed core trimmed at natural water content.

Test Remarks

The sample height to diameter ratio is less than the required 2. The strength may be lower, due to the height to diameter ratio.

Unconfined Compressive Strength reported to the nearest 1 kPa and provided as indicative only.

Modulus of Elasticity value reported based on the straight line portion of the curve and provided as indicative only.

Sample description, UCS and modulus of elasticity value reported are not IANZ accredited.

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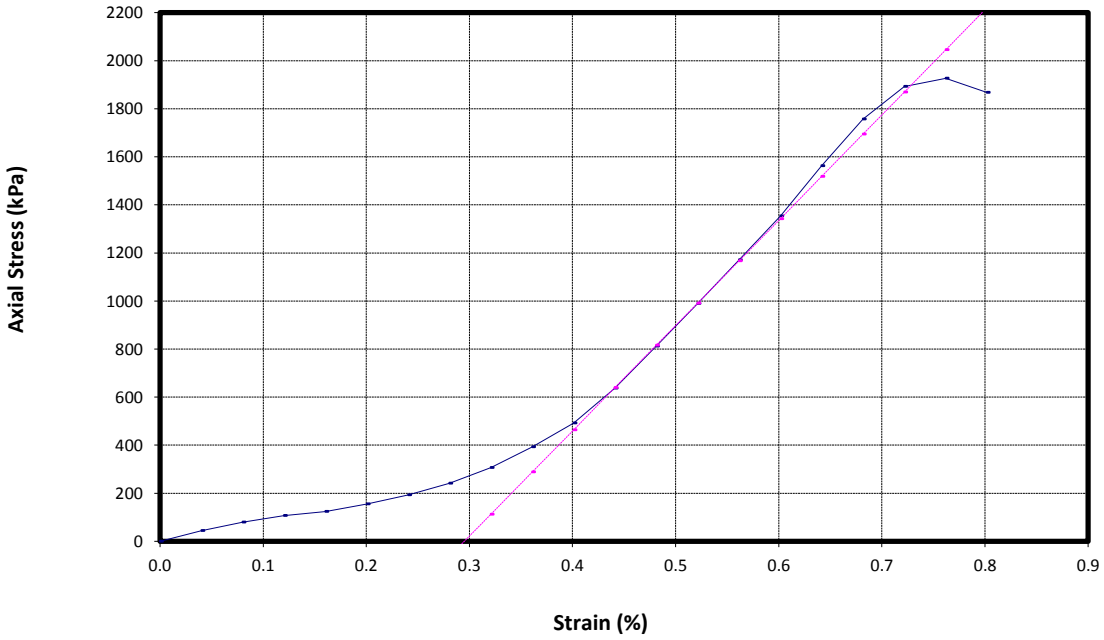
Determination of the unconfined compressive strength of cohesive soil - NZS 4402:1986 Test 6.3.1

Sample Details

Geotechnics Sample ID	-				
Site	USP Tower, Suva, Fiji				
BH No	BH1	Sample ID	--	Depth (m)	4.70-4.90m
Sample Description	Light brown, very weak, Suva Marl.				

Test Result

Unconfined Compressive Strength Test
Axial Stress vs Strain



Sample Parameters

Sample Height	(mm)	124.70	Bulk Density	(t/m³)	1.62
Sample Diameter	(mm)	60.71	Dry Density	(t/m³)	1.01
Test Height	(mm)	124.70	Water Content	(%)	60.3
Test H/D Ratio		2.05			

Failure Value

Axial Strain (%)	Unconfined Compressive Strength qu (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
0.76	1927	0.13	438

Mode of Failure Shear

Sample History Undisturbed core trimmed at natural water content.

Test Remarks

Unconfined Compressive Strength reported to the nearest 1 kPa and the test results are IANZ accredited.
Modulus of Elasticity value reported based on the straight line portion of the curve and provided as indicative only.
The sample description and modulus of elasticity value reported are not IANZ accredited.

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Customer Project ID 1002886.0000

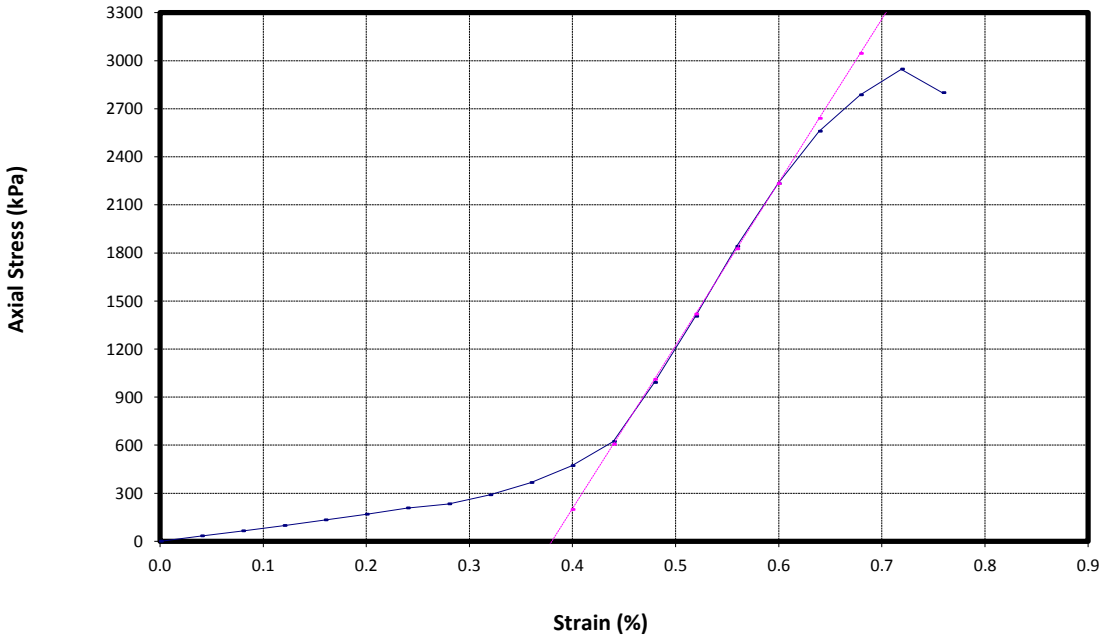
Determination of the unconfined compressive strength of cohesive soil - NZS 4402:1986 Test 6.3.1

Sample Details

Geotechnics Sample ID	-				
Site	USP Tower, Suva, Fiji				
BH No	BH1	Sample ID	--	Depth (m)	6.30-6.50m
Sample Description	Light brown, very weak, Suva Marl.				

Test Result

Unconfined Compressive Strength Test
Axial Stress vs Strain



Sample Parameters

Sample Height	(mm)	125.20	Bulk Density	(t/m³)	1.57
Sample Diameter	(mm)	59.54	Dry Density	(t/m³)	0.93
Test Height	(mm)	125.20	Water Content	(%)	68.6
Test H/D Ratio		2.10			

Failure Value

Axial Strain (%)	Unconfined Compressive Strength qu (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
0.72	2946	0.11	1019

Mode of Failure Shear

Sample History Undisturbed core trimmed at natural water content.

Test Remarks

Unconfined Compressive Strength reported to the nearest 1 kPa and the test results are IANZ accredited.
Modulus of Elasticity value reported based on the straight line portion of the curve and provided as indicative only.
Sample description and modulus of elasticity value reported are not IANZ accredited.

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Geotechnics Project ID	1004230.0000.0.0
Customer Project ID	1002886.0000

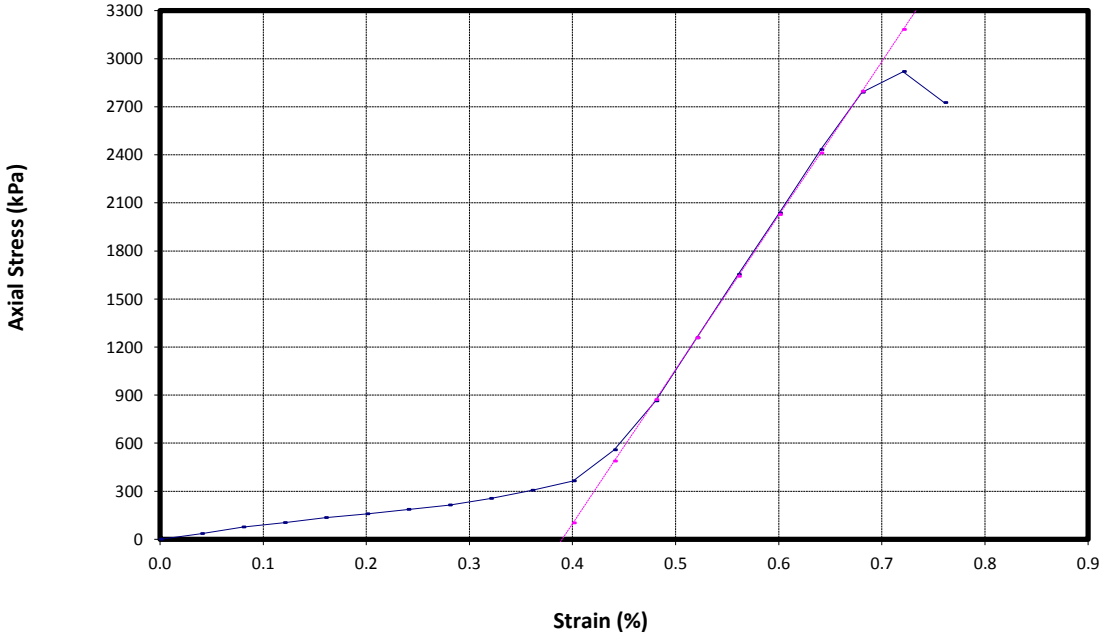
Determination of the unconfined compressive strength of cohesive soil - NZS 4402:1986 Test 6.3.1

Sample Details

Geotechnics Sample ID	-				
Site	USP Tower, Suva, Fiji				
BH No	BH1	Sample ID	--	Depth (m)	9.95-10.15m
Sample Description	Light greenish grey, very weak, Suva Marl.				

Test Result

Unconfined Compressive Strength Test
Axial Stress vs Strain



Sample Parameters

Sample Height	(mm)	124.90	Bulk Density	(t/m³)	1.56
Sample Diameter	(mm)	60.82	Dry Density	(t/m³)	0.91
Test Height	(mm)	124.90	Water Content	(%)	71.8
Test H/D Ratio		2.05			

Failure Value

Axial Strain (%)	Unconfined Compressive Strength qu (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
0.72	2918	0.16	961

Mode of Failure Shear

Sample History Undisturbed core trimmed at natural water content.

Test Remarks

Unconfined Compressive Strength reported to the nearest 1 kPa and the test results are IANZ accredited.
Modulus of Elasticity value reported based on the straight line portion of the curve and provided as indicative only.
Sample description and modulus of elasticity value reported are not IANZ accredited.

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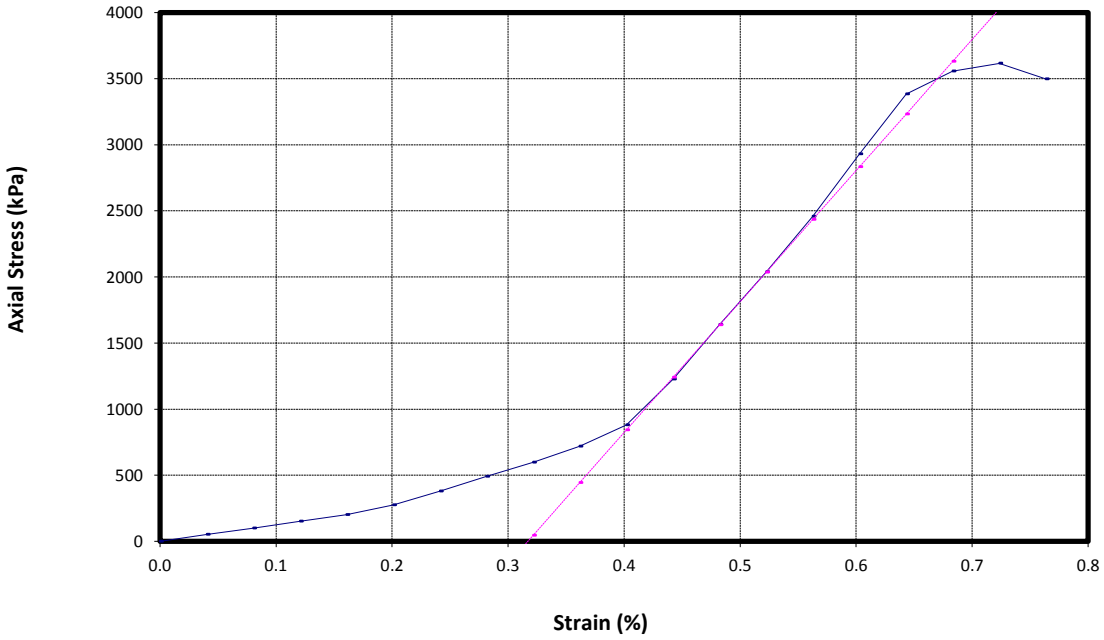
Determination of the unconfined compressive strength of cohesive soil - NZS 4402:1986 Test 6.3.1

Sample Details

Geotechnics Sample ID	-				
Site	USP Tower, Suva, Fiji				
BH No	BH1	Sample ID	--	Depth (m)	13.20-13.57m
Sample Description	Dark greenish grey, very weak, Suva Marl.				

Test Result

Unconfined Compressive Strength Test
Axial Stress vs Strain



Sample Parameters

Sample Height	(mm)	124.40	Bulk Density	(t/m³)	1.75
Sample Diameter	(mm)	60.13	Dry Density	(t/m³)	1.20
Test Height	(mm)	124.40	Water Content	(%)	46.0
Test H/D Ratio		2.07			

Failure Value

Axial Strain (%)	Unconfined Compressive Strength qu (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
0.72	3616	0.15	991

Mode of Failure Shear

Sample History Undisturbed core trimmed at natural water content.

Test Remarks

Unconfined Compressive Strength reported to the nearest 1 kPa and the test results are IANZ accredited.
Modulus of Elasticity value reported based on the straight line portion of the curve and provided as indicative only.
Sample description and modulus of elasticity value reported are not IANZ accredited.

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Customer Project ID	1002886.0000

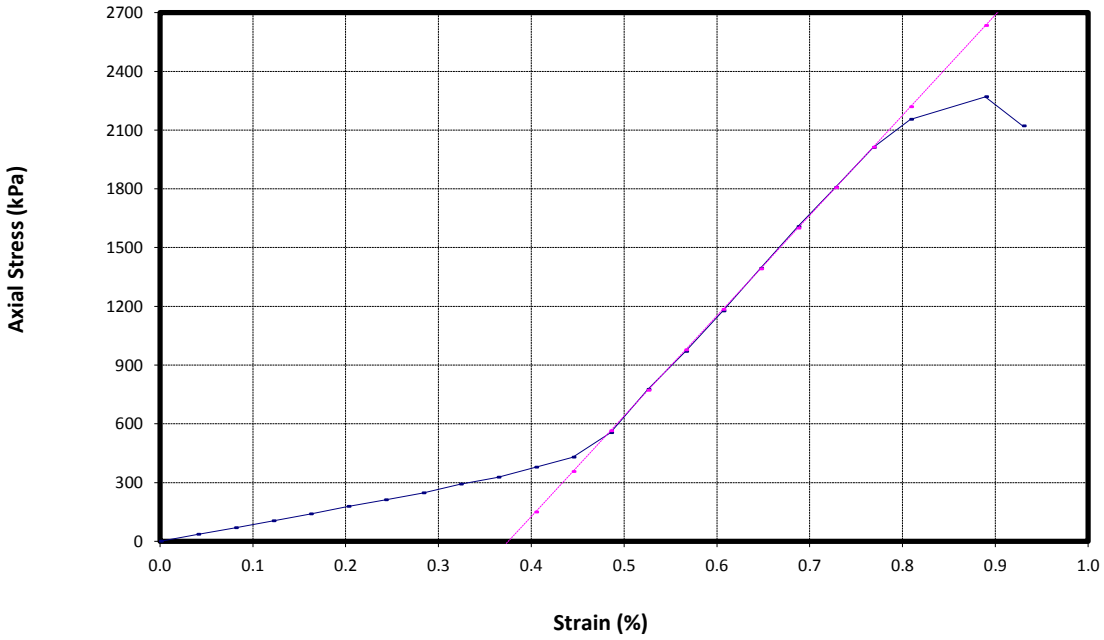
Determination of the unconfined compressive strength of cohesive soil - NZS 4402:1986 Test 6.3.1

Sample Details

Geotechnics Sample ID	-				
Site	USP Tower, Suva, Fiji				
BH No	BH1	Sample ID	--	Depth (m)	14.95-15.20m
Sample Description	Dark greenish grey, very weak, Suva Marl.				

Test Result

Unconfined Compressive Strength Test
Axial Stress vs Strain



Sample Parameters

Sample Height	(mm)	123.69	Bulk Density	(t/m³)	1.61
Sample Diameter	(mm)	60.49	Dry Density	(t/m³)	0.99
Test Height	(mm)	123.69	Water Content	(%)	61.6
Test H/D Ratio		2.05			

Failure Value

Axial Strain (%)	Unconfined Compressive Strength qu (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
0.89	2270	0.19	512

Mode of Failure Shear

Sample History Undisturbed core trimmed at natural water content.

Test Remarks

Unconfined Compressive Strength reported to the nearest 1 kPa and the test results are IANZ accredited.
Modulus of Elasticity value reported based on the straight line portion of the curve and provided as indicative only.
Sample description and modulus of elasticity value reported are not IANZ accredited.

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Geotechnics Project ID	1004230.0000.0.0
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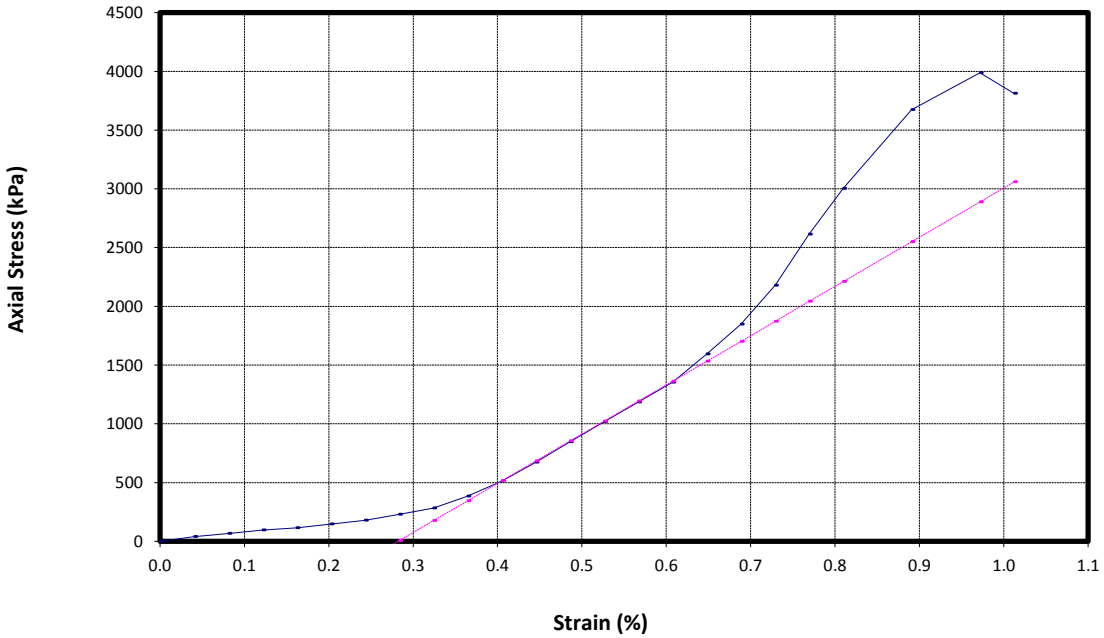
Determination of the unconfined compressive strength of cohesive soil - NZS 4402:1986 Test 6.3.1

Sample Details

Geotechnics Sample ID	-				
Site	USP Tower, Suva, Fiji				
BH No	BH1	Sample ID	--	Depth (m)	15.95-16.17m
Sample Description	Dark greenish grey, very weak, Suva Marl.				

Test Result

Unconfined Compressive Strength Test
Axial Stress vs Strain



Sample Parameters

Sample Height	(mm)	123.50	Bulk Density	(t/m³)	1.64
Sample Diameter	(mm)	60.17	Dry Density	(t/m³)	0.98
Test Height	(mm)	123.50	Water Content	(%)	66.9
Test H/D Ratio		2.05			

Failure Value

Axial Strain (%)	Unconfined Compressive Strength qu (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
0.97	3988	0.17	419

Mode of Failure Shear

Sample History Undisturbed core trimmed at natural water content.

Test Remarks

Unconfined Compressive Strength reported to the nearest 1 kPa and the test results are IANZ accredited.
Modulus of Elasticity value reported based on the straight line portion of the curve and provided as indicative only.
Sample description and modulus of elasticity value reported are not IANZ accredited.

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Geotechnics Project ID	1004230.0000.0.0
Customer Project ID	1002886.0000

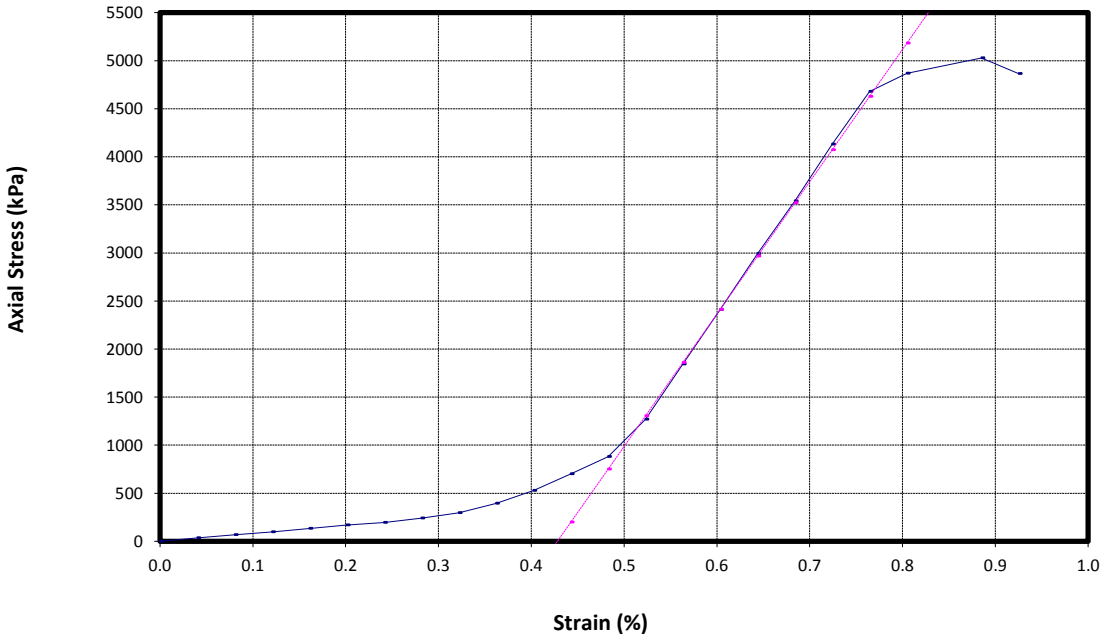
Determination of the unconfined compressive strength of cohesive soil - NZS 4402:1986 Test 6.3.1

Sample Details

Geotechnics Sample ID	-				
Site	USP Tower, Suva, Fiji				
BH No	BH1	Sample ID	--	Depth (m)	17.75-17.95m
Sample Description	Dark greenish grey, weak, Suva Marl.				

Test Result

Unconfined Compressive Strength Test
Axial Stress vs Strain



Sample Parameters

Sample Height	(mm)	124.30	Bulk Density	(t/m³)	1.68
Sample Diameter	(mm)	59.95	Dry Density	(t/m³)	1.08
Test Height	(mm)	124.30	Water Content	(%)	55.2
Test H/D Ratio		2.07			

Failure Value

Axial Strain (%)	Unconfined Compressive Strength qu (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
0.88	5028	0.13	1376

Mode of Failure Shear

Sample History Undisturbed core trimmed at natural water content.

Test Remarks

Unconfined Compressive Strength reported to the nearest 1 kPa and the test results are IANZ accredited.
Modulus of Elasticity value reported based on the straight line portion of the curve and provided as indicative only.
Sample description and modulus of elasticity value reported are not IANZ accredited.

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Geotechnics Project ID 1004230.0000.0.0
Customer Project ID 1002886.0000

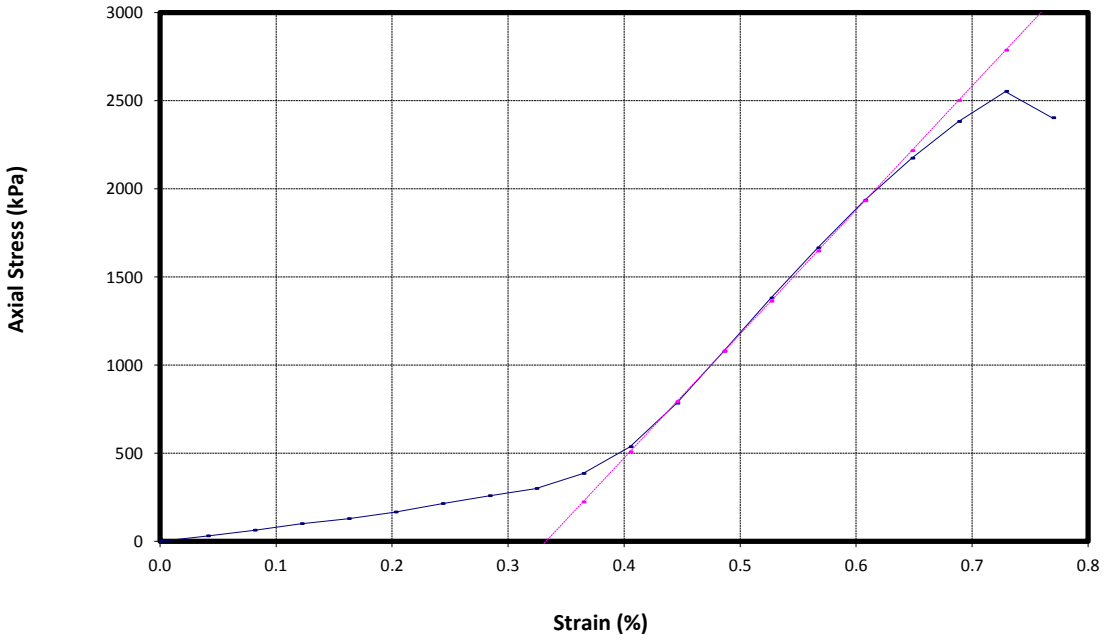
Determination of the unconfined compressive strength of cohesive soil - NZS 4402:1986 Test 6.3.1

Sample Details

Geotechnics Sample ID	-				
Site	USP Tower, Suva, Fiji				
BH No	BH1	Sample ID	--	Depth (m)	19.58-19.80m
Sample Description	Dark greenish grey, very weak, Suva Marl.				

Test Result

Unconfined Compressive Strength Test
Axial Stress vs Strain



Sample Parameters

Sample Height	(mm)	123.51	Bulk Density	(t/m³)	1.59
Sample Diameter	(mm)	60.75	Dry Density	(t/m³)	0.96
Test Height	(mm)	123.51	Water Content	(%)	65.2
Test H/D Ratio		2.03			

Failure Value

Axial Strain (%)	Unconfined Compressive Strength qu (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
0.73	2552	0.10	703

Mode of Failure Shear
Sample History Undisturbed core trimmed at natural water content.

Test Remarks

Unconfined Compressive Strength reported to the nearest 1 kPa and the test results are IANZ accredited.
Modulus of Elasticity value reported based on the straight line portion of the curve and provided as indicative only.
Sample description and modulus of elasticity value reported are not IANZ accredited.

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Geotechnics Project ID	1004230.0000.0.0
Customer Project ID	1002886.0000

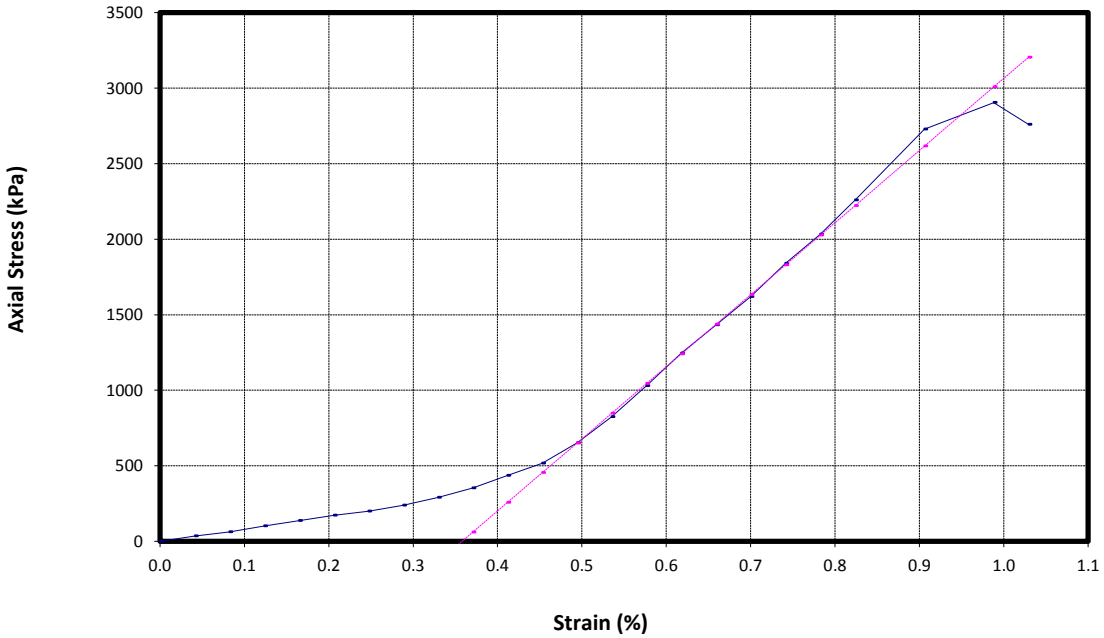
Determination of the unconfined compressive strength of cohesive soil - NZS 4402:1986 Test 6.3.1

Sample Details

Geotechnics Sample ID	-				
Site	USP Tower, Suva, Fiji				
BH No	BH2	Sample ID	--	Depth (m)	4.05-4.25m
Sample Description	Light brown, very weak, Suva Marl.				

Test Result

Unconfined Compressive Strength Test
Axial Stress vs Strain



Sample Parameters

Sample Height	(mm)	121.42	Bulk Density	(t/m³)	1.65
Sample Diameter	(mm)	60.24	Dry Density	(t/m³)	1.04
Test Height	(mm)	121.42	Water Content	(%)	58.9
Test H/D Ratio		2.02			

Failure Value

Axial Strain (%)	Unconfined Compressive Strength qu (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
0.99	2904	0.16	477

Mode of Failure Shear

Sample History Undisturbed core trimmed at natural water content.

Test Remarks

Unconfined Compressive Strength reported to the nearest 1 kPa and the test results are IANZ accredited.
Modulus of Elasticity value reported based on the straight line portion of the curve and provided as indicative only.
Sample description and modulus of elasticity value reported are not IANZ accredited.

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Geotechnics Project ID	1004230.0000.0.0
Customer Project ID	1002886.0000

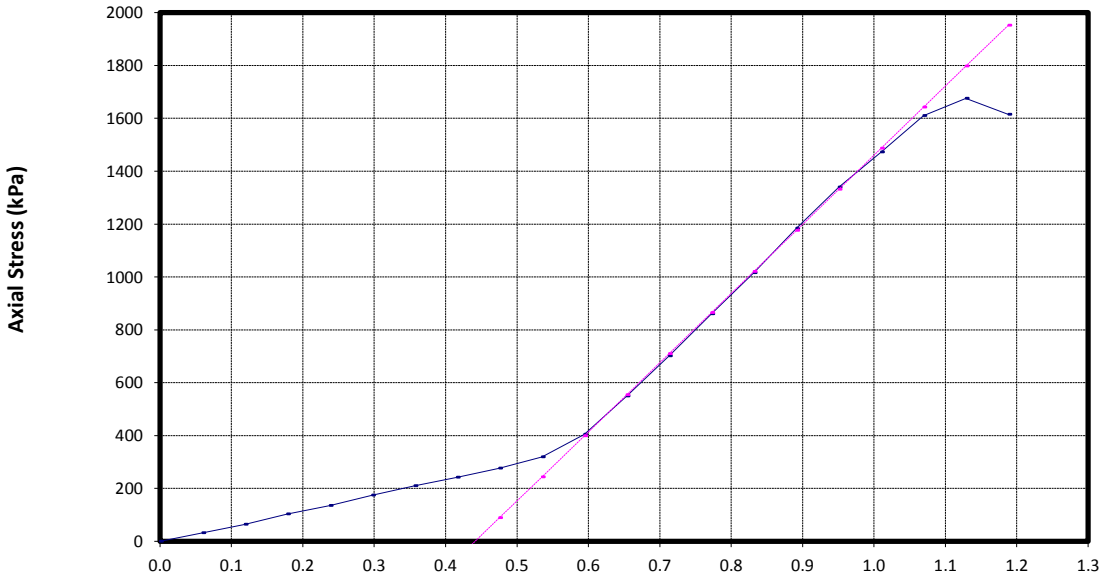
Determination of the unconfined compressive strength of cohesive soil - NZS 4402:1986 Test 6.3.1

Sample Details

Geotechnics Sample ID	-				
Site	USP Tower, Suva, Fiji				
BH No	BH2	Sample ID	--	Depth (m)	6.50-6.76m
Sample Description	Dark greenish grey, very weak, Suva Marl.				

Test Result

Unconfined Compressive Strength Test
Axial Stress vs Strain



Sample Parameters

Sample Height	(mm)	84.15	Bulk Density	(t/m³)	1.56
Sample Diameter	(mm)	59.74	Dry Density	(t/m³)	0.84
Test Height	(mm)	84.15	Water Content	(%)	84.1
Test H/D Ratio		1.41			

Failure Value

Axial Strain (%)	Unconfined Compressive Strength qu (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
1.13	1676	0.12	261

Mode of Failure Shear

Sample History Undisturbed core trimmed at natural water content.

Test Remarks

The sample height to diameter ratio is less than the required 2. The strength may be lower, due to the height to diameter ratio.

Unconfined Compressive Strength reported to the nearest 1 kPa and provided as indicative only.

Modulus of Elasticity value reported based on the straight line portion of the curve and provided as indicative only.

Sample description, UCS and modulus of elasticity value reported are not IANZ accredited.

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Customer Project ID	1002886.0000

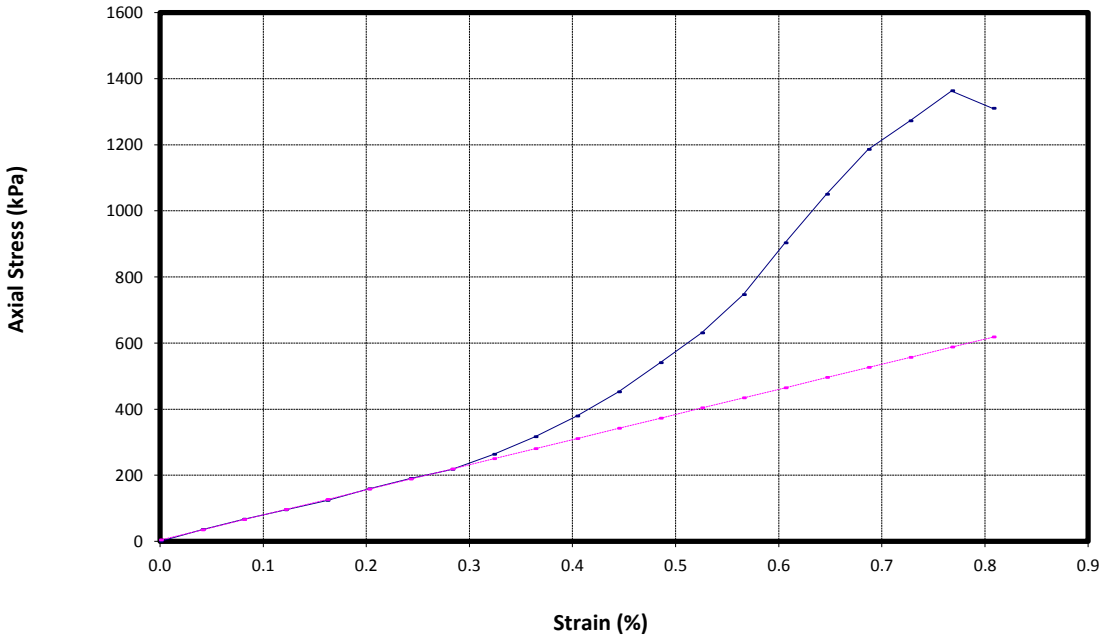
Determination of the unconfined compressive strength of cohesive soil - NZS 4402:1986 Test 6.3.1

Sample Details

Geotechnics Sample ID	-				
Site	USP Tower, Suva, Fiji				
BH No	BH2	Sample ID	--	Depth (m)	8.50-8.75m
Sample Description	Dark greenish grey, very weak, Suva Marl.				

Test Result

Unconfined Compressive Strength Test
Axial Stress vs Strain



Sample Parameters

Sample Height	(mm)	123.81	Bulk Density	(t/m³)	1.56
Sample Diameter	(mm)	60.14	Dry Density	(t/m³)	0.91
Test Height	(mm)	123.81	Water Content	(%)	71.7
Test H/D Ratio		2.06			

Failure Value

Axial Strain (%)	Unconfined Compressive Strength qu (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
0.77	1363	0.12	76

Mode of Failure Shear

Sample History Undisturbed core trimmed at natural water content.

Test Remarks

Unconfined Compressive Strength reported to the nearest 1 kPa and the test results are IANZ accredited.
Modulus of Elasticity value reported based on the straight line portion of the curve and provided as indicative only.
Sample description and modulus of elasticity value reported are not IANZ accredited.

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Geotechnics Project ID	1004230.0000.0.0
Customer Project ID	1002886.0000

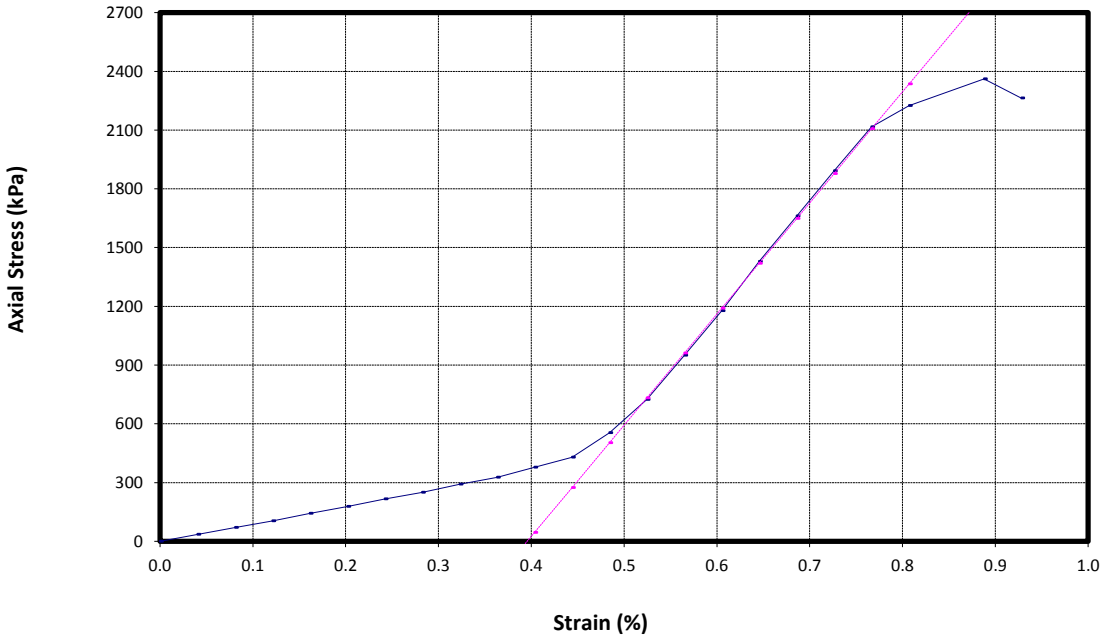
Determination of the unconfined compressive strength of cohesive soil - NZS 4402:1986 Test 6.3.1

Sample Details

Geotechnics Sample ID	-				
Site	USP Tower, Suva, Fiji				
BH No	BH2	Sample ID	--	Depth (m)	13.74-14.0m
Sample Description	Dark greenish grey, very weak, Suva Marl.				

Test Result

Unconfined Compressive Strength Test
Axial Stress vs Strain



Sample Parameters

Sample Height	(mm)	123.92	Bulk Density	(t/m³)	1.58
Sample Diameter	(mm)	60.46	Dry Density	(t/m³)	0.93
Test Height	(mm)	123.92	Water Content	(%)	69.0
Test H/D Ratio		2.05			

Failure Value

Axial Strain (%)	Unconfined Compressive Strength qu (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
0.89	2361	0.14	568

Mode of Failure Shear

Sample History Undisturbed core trimmed at natural water content.

Test Remarks

Unconfined Compressive Strength reported to the nearest 1 kPa and the test results are IANZ accredited.
Modulus of Elasticity value reported based on the straight line portion of the curve and provided as indicative only.
Sample description and modulus of elasticity value reported are not IANZ accredited.

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Geotechnics Project ID	1004230.0000.0.0
Customer Project ID	1002886.0000

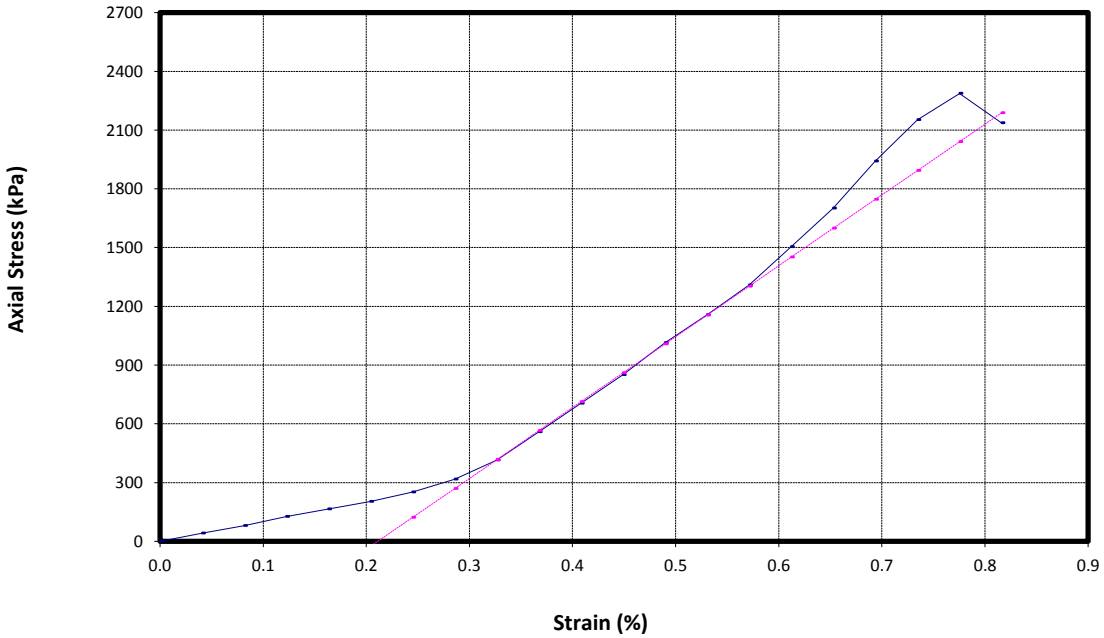
Determination of the unconfined compressive strength of cohesive soil - NZS 4402:1986 Test 6.3.1

Sample Details

Geotechnics Sample ID	-				
Site	USP Tower, Suva, Fiji				
BH No	BH2	Sample ID	--	Depth (m)	14.60-14.80m
Sample Description	Dark greenish grey, very weak, Suva Marl.				

Test Result

Unconfined Compressive Strength Test
Axial Stress vs Strain



Sample Parameters

Sample Height	(mm)	122.55	Bulk Density	(t/m³)	1.62
Sample Diameter	(mm)	60.30	Dry Density	(t/m³)	1.00
Test Height	(mm)	122.55	Water Content	(%)	62.4
Test H/D Ratio		2.03			

Failure Value

Axial Strain (%)	Unconfined Compressive Strength qu (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
0.78	2287	0.16	362

Mode of Failure Shear

Sample History Undisturbed core trimmed at natural water content.

Test Remarks

Unconfined Compressive Strength reported to the nearest 1 kPa and the test results are IANZ accredited.
Modulus of Elasticity value reported based on the straight line portion of the curve and provided as indicative only.
Sample description and modulus of elasticity value reported are not IANZ accredited.

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Customer Project ID	1002886.0000

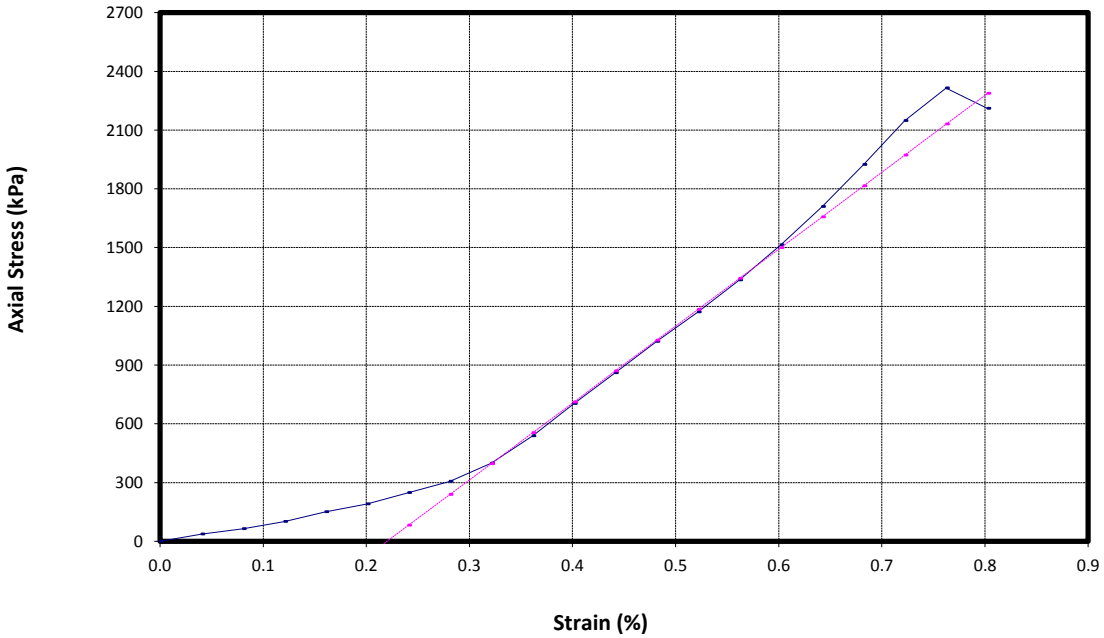
Determination of the unconfined compressive strength of cohesive soil - NZS 4402:1986 Test 6.3.1

Sample Details

Geotechnics Sample ID	-				
Site	USP Tower, Suva, Fiji				
BH No	BH2	Sample ID	--	Depth (m)	16.20-16.50m
Sample Description	Dark greenish grey, very weak, Suva Marl.				

Test Result

Unconfined Compressive Strength Test
Axial Stress vs Strain



Sample Parameters

Sample Height	(mm)	124.62	Bulk Density	(t/m³)	1.62
Sample Diameter	(mm)	59.48	Dry Density	(t/m³)	1.00
Test Height	(mm)	124.62	Water Content	(%)	61.8
Test H/D Ratio		2.10			

Failure Value

Axial Strain (%)	Unconfined Compressive Strength qu (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
0.76	2315	0.16	393

Mode of Failure Shear

Sample History Undisturbed core trimmed at natural water content.

Test Remarks

Unconfined Compressive Strength reported to the nearest 1 kPa and the test results are IANZ accredited.
Modulus of Elasticity value reported based on the straight line portion of the curve and provided as indicative only.
Sample description and modulus of elasticity value reported are not IANZ accredited.

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Geotechnics Project ID	1004230.0000.0.0
Customer Project ID	1002886.0000

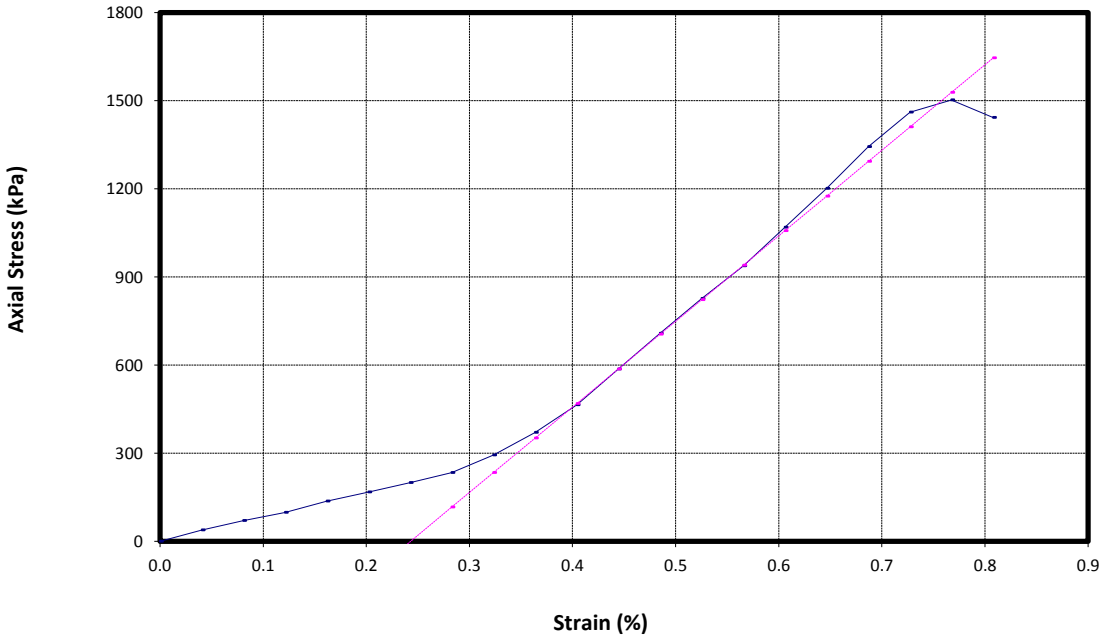
Determination of the unconfined compressive strength of cohesive soil - NZS 4402:1986 Test 6.3.1

Sample Details

Geotechnics Sample ID	-				
Site	USP Tower, Suva, Fiji				
BH No	BH2	Sample ID	--	Depth (m)	17.58-17.80m
Sample Description	Dark greenish grey, very weak, Suva Marl.				

Test Result

Unconfined Compressive Strength Test
Axial Stress vs Strain



Sample Parameters

Sample Height	(mm)	123.77	Bulk Density	(t/m³)	1.62
Sample Diameter	(mm)	60.28	Dry Density	(t/m³)	0.98
Test Height	(mm)	123.77	Water Content	(%)	65.2
Test H/D Ratio		2.05			

Failure Value

Axial Strain (%)	Unconfined Compressive Strength qu (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
0.77	1502	0.14	291

Mode of Failure Shear

Sample History Undisturbed core trimmed at natural water content.

Test Remarks

Unconfined Compressive Strength reported to the nearest 1 kPa and the test results are IANZ accredited.
Modulus of Elasticity value reported based on the straight line portion of the curve and provided as indicative only.
Sample description and modulus of elasticity value reported are not IANZ accredited.

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Geotechnics Project ID	1004230.0000.0.0
Customer Project ID	1002886.0000

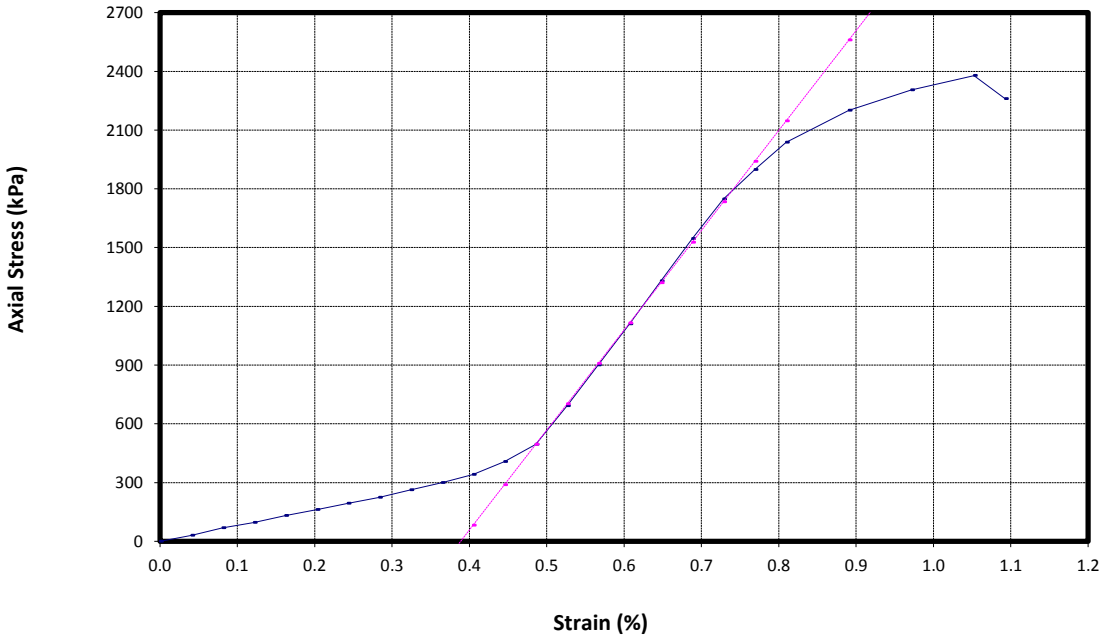
Determination of the unconfined compressive strength of cohesive soil - NZS 4402:1986 Test 6.3.1

Sample Details

Geotechnics Sample ID	-				
Site	USP Tower, Suva, Fiji				
BH No	BH2	Sample ID	--	Depth (m)	17.95-18.25m
Sample Description	Dark greenish grey, very weak, Suva Marl.				

Test Result

Unconfined Compressive Strength Test
Axial Stress vs Strain



Sample Parameters

Sample Height	(mm)	123.55	Bulk Density	(t/m³)	1.59
Sample Diameter	(mm)	60.68	Dry Density	(t/m³)	0.96
Test Height	(mm)	123.55	Water Content	(%)	66.0
Test H/D Ratio		2.04			

Failure Value

Axial Strain (%)	Unconfined Compressive Strength qu (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
1.05	2378	0.15	510

Mode of Failure Shear

Sample History Undisturbed core trimmed at natural water content.

Test Remarks

Unconfined Compressive Strength reported to the nearest 1 kPa and the test results are IANZ accredited.
Modulus of Elasticity value reported based on the straight line portion of the curve and provided as indicative only.
Sample description and modulus of elasticity value reported are not IANZ accredited.

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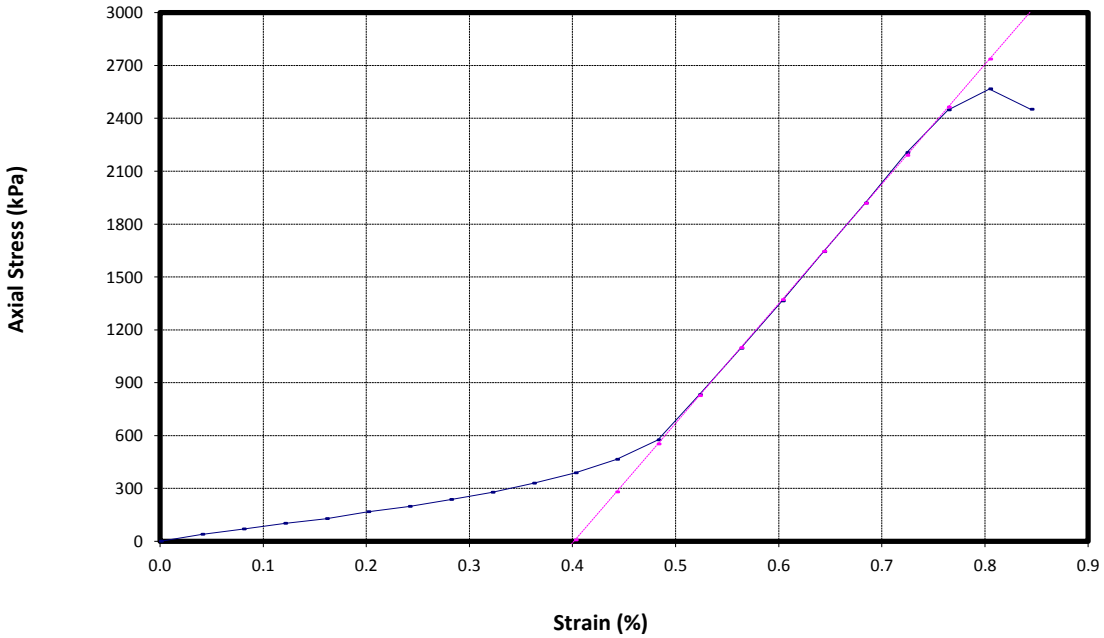
Sample Details

Geotechnics Sample ID	-				
Site	USP Tower, Suva, Fiji				
BH No	BH2	Sample ID	--	Depth (m)	19.44-19.88m
Sample Description	Dark greenish grey, very weak, Suva Marl.				

Test Result

Unconfined Compressive Strength Test
Axial Stress vs Strain



Sample Parameters

Sample Height	(mm)	124.34	Bulk Density	(t/m³)	1.62
Sample Diameter	(mm)	60.47	Dry Density	(t/m³)	1.00
Test Height	(mm)	124.34	Water Content	(%)	62.7
Test H/D Ratio		2.06			

Failure Value

Axial Strain (%)	Unconfined Compressive Strength qu (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
0.80	2566	0.15	678

Mode of Failure Shear

Sample History Undisturbed core trimmed at natural water content.

Test Remarks

Unconfined Compressive Strength reported to the nearest 1 kPa and the test results are IANZ accredited.
Modulus of Elasticity value reported based on the straight line portion of the curve and provided as indicative only.
Sample description and modulus of elasticity value reported are not IANZ accredited.

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Appendix 7 Soft Component (Technical Assistance) Plan

Preparatory Study
for
The Project for Enhancement of USPNet Communication System
in
The Republic of Fiji

Draft of Soft Component (Technical Assistance) Plan

August 2017

Yachiyo Engineering Co., Ltd.

1. Background of Planning Soft Components

The University of the South Pacific ("USP") was established in 1968 using funds from the governments of various nations in the Pacific region. The main campus is located in Suva, the capital of Fiji. As of 2017, the University is jointly operated by 12 member nations and regions: (1) Cook Islands, (2) Fiji, (3) Kiribati, (4) Nauru, (5) Niue, (6) Samoa, (7) Solomon Islands, (8) Tokelau, (9) Tonga, (10) Tuvalu, (11) Vanuatu, and (12) Marshall Islands. One foundation of education at USP is Distance Learning provided through a satellite communication network known as "USPNet." Distance Learning is held at campuses and centers in each of the 12 member nations and regions. Support from Japan, New Zealand ("NZ") and Australia was used to establish USPNet in 2000, and presently the Information Technology Services ("ITS") operates and maintains the network. When USPNet was launched in 2000, it comprised only a C Band satellite communication network. Presently, USPNet comprises a Ku Band satellite communication network and an optical fiber communication network as well as a C Band satellite communication network, each of which branch off and connect to the respective campuses and centers ("Remote Stations").

The C Band network connects 15 remote stations ("Remotes") including the hub station ("HUB") installed at the USP main campus in Fiji; the Ku Band network connects 10 Remotes including HUB (Figure 1).

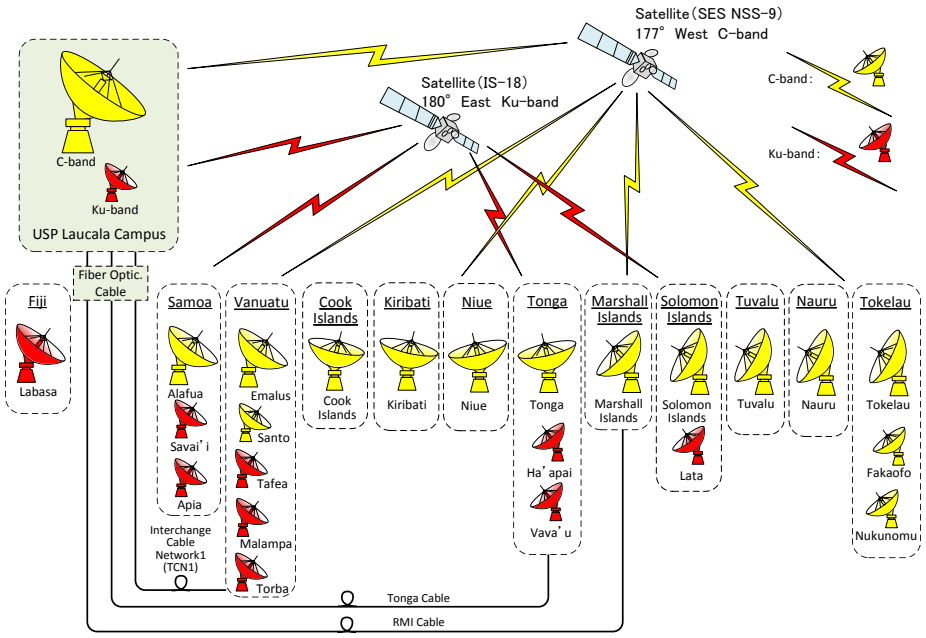

Figure 1: Existing USPNet

The C Band network operates on a frequency bandwidth of 15 MHz and primarily connects campuses; the Ku Band operates on a frequency bandwidth of 5 MHz and primarily connects centers.

Under this plan, HUB of USPNet, which went into operation in 2000 and have deteriorated significantly, will be updated (replaced). In the course of implementing this plan, efforts will be made to improve communication stability and streamline communication traffic by consolidating the existing C and Ku Band networks into a single Ku Band satellite communication network. Specifically, new HUB facilities for a Ku Band that uses a new communication satellite (JCSAT-2B) will be installed at the USP main campus to create a separate satellite communication network from the present network that operates from both the C and Ku Band networks. Each Remote will be connected to the new HUB of this JCSAT-2B Ku Band in succession as Remote equipment is

updated (repaired) using funds from NZ, a project scheduled for implementation over the same period.

Finally, once all Remote equipment within USPNet is updated (repaired) and connected to the new HUB, the functions of the presently operating C and Ku Band satellite communication networks will be suspended (Figure 2).

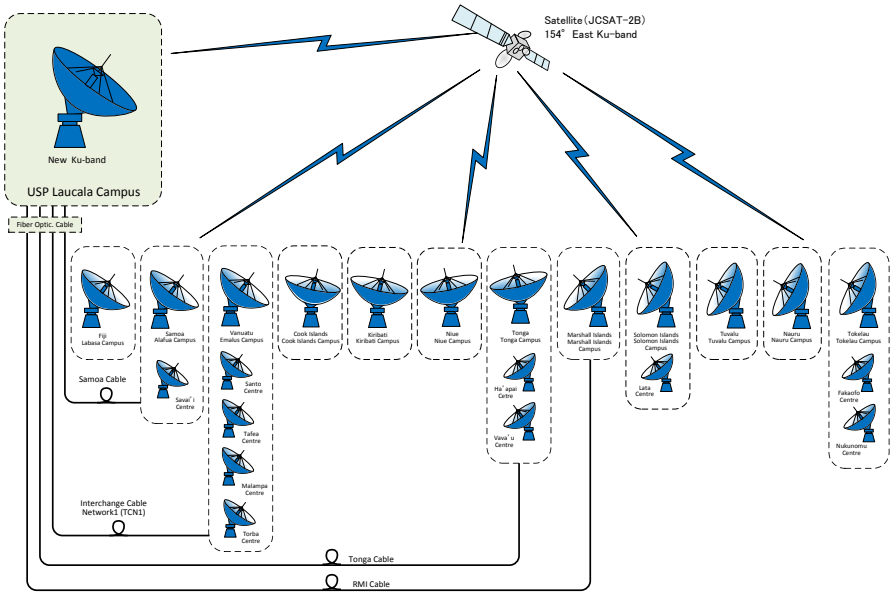

Figure 2: New USPNet Structure (Ku Band)

The primary objectives of this plan for soft components are the acquisition of **Transition/Daily Operation Technology**, which includes technology for connecting (transitioning) to the new HUB as well as daily inspections, data gathering, operation and problem analysis and other daily operation technology for new station systems; and **Satellite Communication Link Use/Application Technology**, which is technology for using and applying the new Ku Band Satellite Communication System in operation at all 23 stations.

Transition/Daily Operation Technology comprises transition technology, which is technology for transitioning from the presently operating C and Ku Band satellite networks to the new Ku Band satellite network, and daily operation technology, which includes technology for detecting signs of problems in everyday operation, and technology for providing instruction to Remote Station operations staff members and beginners.

"Transition technology" refers to technology that HUB requires to obtain approval from a satellite operator to transmit regular radio waves to Remotes, as well as the technology required to connect to the new HUB in the Remotes after obtaining that approval. Specifically, transition technology includes the emission of test radio waves (radio waves with smaller transmission power than regular radio waves) from HUB and instructions to adjust radio waves during satellite operator confirmation, and confirmation tests of present services (contents, etc.) for Remotes provided by HUB, suspension of services from old systems and the like during connection to the new HUB of the Remotes.

"Daily operation technology" refers to technology that uses daily inspections, data gathering, and operation and problem analysis to detect signs of problems with new HUB whose new communication equipment comprises an overlapping (redundant) structure of active and backup systems; technology for providing instruction to Remotes operations staff members and beginners; and the like. Note that the present system is insufficient for preventing problems through daily inspections and data gathering due to the insufficient antenna tracking functions, which have

malfunctioned.

Satellite Communication Link Use/Application Technology includes technology for optimal traffic control in response to the access conditions of campuses and centers with regard to the consolidated 20-MHz satellite link of the C and Ku Band system (optimal control technology for inbound circuit traffic) and the like.

Acquiring these technologies should enable the establishment of a system capable of providing highly consistent and reliable operation and maintenance.

Note that the technology for operating and maintaining equipment to be procured under this plan will be imparted through a technology transfer that consists of initial operation instruction provided by the suppliers of the equipment, and operating instructions regarding maintenance inspections and the like.

2. Soft Component Objectives

USP has assigned roughly 30 employees to the ITS at Laucala Campus to operate and maintain USPNet. Instruction regarding **Transition/Daily Operation Technology** and **Satellite Communication Link Use/Application Technology** will be systematically provided to the six ITS employees responsible for satellite communication work, and the objective is to improve their capacity to operate and maintain the satellite communication facilities of the new USPNet so that the upgraded equipment operates in a highly consistent, reliable manner over a long period of time.

Note that imparting **Transition/Daily Operation Technology** to the operations staff members assigned to Remotes should enhance their capacity to operate and maintain the satellite communication facilities throughout the new USPNet. In addition, imparting **Transition/Daily Operation Technology** to employees assigned to the ITS should improve their understanding of the new USPNet. These efforts work toward another objective, which is to create the capacity to train Remotes operations staff members and ITS employees other than the employees responsible for satellite communication work.

3. Soft Component Outcomes

The implementation of these soft components will produce the following outcomes with regard to **Transition/Daily Operation Technology** and **Satellite Communication Link Use/Application Technology**.

Transition/Daily Operation Technology

USP (ITS) will use the technology acquired through classroom study and practical training to create the following written procedures and manuals regarding Transition/Daily Operation Technology.

For Transition Operation Technology:

- Manual for HUB/Remotes satellite transition
- Written procedures for tests for HUB/Remotes satellite transition

For Daily Operation Technology:

- Written procedures for daily inspections and periodic inspections for satellite communication systems
- Operation and maintenance manual for satellite communication systems

- Optimal operation manual for active and backup systems
  *Operation manual for active equipment/backup equipment, which are the structural elements of the new HUB
- Manual for restoring operations when there are problems with equipment
- Manual for preventing disasters/restoring operations
- Instruction manual for Remotes operations staff members and beginners

Satellite Communication Link Use/Application Technology

USP (ITS) will use the technology acquired through classroom study to create the following written standards and manuals regarding Satellite **Communication Link** Use/Application Technology.

- Written standards for traffic control on satellite link
- Manual for traffic control on satellite link
- Optimal operation manual for inbound in frequency band
- Optimal operation manual for outbound
- Instruction manual for Remotes operations staff members and beginners

4. Methods for Confirming the Level of Outcome Achievement

Field	Outcome	Outcome Confirmation Method
Transition/Daily Operation Technology	Manual for HUB/Remotes satellite transition	Confirm the completeness of the manual by performing work according to the manual, and confirm the straightforwardness of the manual by implementing a questionnaire (ask the trainees to evaluate on a scale of 1-5). The outcomes are confirmed when trainee scores average 4 or higher; if the trainees identify points for improvement (revision), give them the experience of using the PDCA cycle to revise and improve the points on their own.
	Written procedures for tests for HUB/Remotes satellite transition	Follow the written procedures and perform a simulation of tests regarding the configured satellite transition situations. Use evaluation sheets to confirm proper transitions. The outcomes are confirmed when the score is a perfect 100%; if the trainees identify points for improvement (revision), give them the experience of using the PDCA cycle to revise and improve the points on their own.
	Written procedures for daily inspections and periodic inspections for satellite communication systems	Confirm the accuracy of the written procedures by following them to conduct practical training for daily inspections and periodic inspections.
	Operation and maintenance manual for satellite communication systems	Confirm the accuracy of the procedures by following the manual to conduct practical training for operation and maintenance.
	Optimal operation manual for active and backup systems	Confirm the accuracy of the procedures by following the manual to conduct practical training for optimal operation.
	Manual for restoring operations when there are problems with equipment	Confirm the accuracy of the procedures by following the manual to conduct practical training for responding to problems with equipment.
	Manual for preventing disasters/restoring operations	Confirm the accuracy of the procedures by following the manual to conduct practical training for preventing

		disasters and restoring operations.
	Instruction manual for Remotes operations staff members and beginners	Follow the manual and provide instruction to ITS employees other than the employees responsible for satellite communication, and implement a questionnaire (ask the employees to evaluate on a scale of 1-5) to check their understanding. The outcomes are confirmed when trainee scores average 4 or higher; if the trainees identify points for improvement (revision), give them the experience of using the PDCA cycle to revise and improve the points on their own.
Satellite Communication Link Use/Application Technology	Standards for traffic control on satellite link	Follow the control procedures and conduct a simulation of issues regarding traffic control standards, and use an evaluation sheet to confirm proper control. The outcomes are confirmed when the score is a perfect 100%; if the trainees identify points for improvement (revision), give them the experience of using the PDCA cycle to revise and improve the points on their own.
	Manual for traffic control on satellite link	Follow the manual and conduct a simulation of issues regarding traffic control on satellite link, and use an evaluation sheet to confirm proper control. The outcomes are confirmed when the score is a perfect 100%; if the trainees identify points for improvement (revision), give them the experience of using the PDCA cycle to revise and improve the points on their own.
	Optimal operation manual for inbound in frequency band	Follow the manual and conduct a simulation of issues regarding inbound control in frequency band, and use an evaluation sheet to confirm proper operation. The outcomes are confirmed when the score is a perfect 100%; if the trainees identify points for improvement (revision), give them the experience of using the PDCA cycle to revise and improve the points on their own.
	Optimal operation manual for outbound	Follow the manual and conduct a simulation of issues regarding outbound control, and use an evaluation sheet to confirm proper operation. The outcomes are confirmed when the score is a perfect 100%; if the trainees identify points for improvement (revision), give them the experience of using the PDCA cycle to revise and improve the points on their own.
	Instruction manual for Remotes operations staff members and beginners	Follow the manual and provide instruction to ITS employees other than the employees responsible for satellite communication, and implement a questionnaire (ask the employees to evaluate on a scale of 1-5) to check their understanding. The outcomes are confirmed when trainee scores average 4 or higher; if the trainees identify points for improvement (revision), give them the experience of using the PDCA cycle to revise and improve the points on their own.

5. Target Trainees

Target trainees under this plan for soft components are the six members of the ITS responsible for satellite communication. Three of the six trainees should come from a group of mid-level employees with ample experience with satellite communication work, and the other three should come from a group of beginners with little experience with satellite communication work.

The three trainees from the beginner's group are the target for training in the **Transition/Daily Operation Technology** field described previously, and the three trainees from the mid-level employee's group are the target for the training in the **Satellite Communication Link Use/Application Technology** field.

The soft component input plan described later calls for both groups to progress through the training simultaneously and in parallel. The reasoning behind this lies in the establishment of several opportunities throughout the training for the groups to come together to discuss the training in the hope of promoting mutual cooperation during daily operations as well as when responding to emergencies. Another aim of the simultaneous training is to encourage employees to help themselves, as beginners improve their skills and aim for mid-level positions, and mid-level employees improve their skills and aim for top-level positions.

6. Soft Component Activities (Input Plan)

Field/Target	Training Content/Preparation in Japan	Output	Implementation Resources (Numbers of Employees/M/M)
Step 1	**Preparation in Japan** (Create educational materials/questionnaire)		
Transition/Daily Operation Technology	Create the educational materials to be used in Step 2: (1) Educational materials for HUB/Remotes satellite transition (2) Educational materials for tests for HUB/Remotes satellite transition (3) Educational materials for daily/periodic inspections for satellite communication systems (4) Educational materials for operation and maintenance of satellite communication systems (5) Educational materials for optimal operation of active and backup systems (6) Educational materials for restoring operations when there are problems with equipment (7) Educational materials for preventing disasters/restoring operations (8) Questionnaire for trainees	・Instructional materials/questionnaire	■Japanese instructor: 0.5 M/M x 1 instructor (0.5 M/M)
Satellite Communication Link Use/Application Technology	Create the educational materials to be used in Step 2: (1) Educational materials for standards for traffic control on satellite link (2) Educational materials for traffic control on satellite link (3) Educational materials for optimal operation of inbound in frequency band (4) Educational materials for optimal operation of outbound (5) Questionnaire for trainees	・Instructional materials/questionnaire	■Japanese instructor: 0.5 M/M x 1 instructor (0.5 M/M)

Step 2-1	**First On-Site Instruction** (Orientation, interviews, lectures about transition technology)		
Both Target trainees: USP ITS Beginners/mid-level employees	▫ Discuss technical training content and implementation schedule ▫ Interview each trainee ▫ Prepare to create educational materials ▫ Provide instruction on satellite transition procedures and points to remember, etc.	・ Draft of written training plan	■Japanese instructors: 0.17 M/M x 2 instructors (0.34 M/M)
Step 2-2	**First On-Site Instruction** (Lectures, evaluations)		
Transition/Daily Operation Technology Target trainees: USP ITS Beginners	(1) Implement HUB/Remotes satellite transition ・ Satellite communication system configuration ・ Communication/modulation methods ・ Satellite communication system performance ・ Design of Link Budget and system evaluation ・ Satellite transition procedure ・ Satellite transition plans	・ Manual for HUB/Remotes satellite transition	■Japanese instructor: 0.77 M/M x 1 instructor (0.77 M/M)
	(2) Procedures for tests for HUB/Remotes satellite transition ・ Testing procedures for Satellite Access Tests ・ Service level function test ・ Entry into Network	・ Written procedures for tests for HUB/Remotes satellite transition	
	(3) Procedures for daily/periodic inspections for satellite communication systems (HUB/Remotes) ・ Inspection data gathering ・ Data and problem analysis	・ Written procedures for daily/periodic inspections for satellite communication systems	
	(4) Operation and maintenance of satellite communication systems ・ Satellite communication network launch/shutdown procedures ・ Satellite communication network operation records ・ Satellite communication network operation statistics	・ Operation and maintenance manual for satellite communication systems	
	(5) Optimal operation of a redundant systems in HUB ・ Interchangeable operation of active and backup systems ・ Periodic performance tests of testbed systems and backup systems ・ Test data evaluation/analysis	・ Optimal operation manual for redundant systems in HUB	
	(6) Restoring operations when there are problems with equipment ・ Malfunctioning equipment switchover to backup equipment ・ Test procedures ・ Restoration procedures	・ Manual for restoring operations when there are problems with equipment	
	(7) Preventing disasters/restoring operations ・ Prevention mode standards ・ Operation mode transition procedures ・ Operation mode restoration procedures	・ Manual for preventing disasters/restoring operations	

Satellite Communication Link Use/Application Technology Target trainees: USP ITS Mid-level employees	(1) Standards for traffic control on satellite link ・ Traffic load factors ・ Traffic control factors ・ Establish traffic control philosophy	・ Standards for traffic control on satellite link	■Japanese instructor: 0.77 M/M x 1 instructor (0.77 M/M)
	(2) Traffic control on satellite link ・ Traffic measurement ・ Traffic analysis ・ Traffic monitoring ・ IP platform traffic measurement ・ IP platform traffic analysis ・ Outbound control ・ Outbound monitoring ・ Inbound traffic control ・ Inbound traffic monitoring	・ Manual for traffic control on satellite link	
	(3) Optimal operation of inbound in frequency band ・ Optimal allocation of inbound links ・ Inbound links rain attenuation control ・ Network connectivity ・ Network efficiency ・ VLAN and service streamlining	・ Optimal operation manual for inbound in frequency band	
	(4) Optimal operation of outbound ・ QoS ・ ACM control ・ Outbound rain attenuation ・ Outbound transmission power control ・ Link Availability ・ Link Availability by decreasing antenna diameters ・ Total bit rate variation factors ・ Total bit rate/frequency band streamlining	・ Optimal operation manual for outbound	
Step 3	**Second On-Site Instruction** (Lectures, practical training, evaluations)		
Both Target trainees: USP ITS Beginners/mid-level employees	(1) Improving the capacity to instruct and train Remotes operations staff members and beginners ・ Plan classes (Content/instructor responsibilities/schedule) ・ Create educational materials for classes (Basics of satellite communication, overviews of Next-Generation USPNet, Transition/Daily Operation Technology, Satellite Communication Link Use/Application Technology)	・ Instruction manual for Remotes operations staff members and beginners	■Japanese instructors: 0.77 M/M x 2 instructors (1.5 M/M)

Details of activity schedules are as follows:

Step 1 Preparation in Japan (Create educational materials/questionnaire)

Date	Day	Transition/Daily Operation Technology	Satellite Communication Link Use/Application Technology
1	Mon	Prepare educational materials for HUB/Remotes satellite transition	Prepare educational materials for standards for traffic control on satellite link
2	Tue	Prepare educational materials for tests for HUB/Remotes satellite transition	Same as above

3	Wed	Prepare educational materials for daily/periodic inspections for satellite communication systems	Prepare educational materials for traffic control on satellite link
4	Thu	Prepare educational materials for operation and maintenance of satellite communication systems	Same as above
5	Fri	Prepare educational materials for optimal operation of redundant systems in HUB	Same as above
6	Mon	Prepare educational materials for restoring operations when there are problems with equipment	Prepare educational materials for optimal operation of inbound in frequency band
7	Tue	Prepare educational materials for preventing disasters/restoring operations	Same as above
8	Wed	Prepare questions/questionnaire	Prepare questions/questionnaire
9	Thu	Translate into English	Translate into English
10	Fri	Check/revise content, etc.	Check/revise content, etc.

Step 2-1 First On-Site Instruction (Orientation, interviews, lectures about transition technology)

Date	**Day**	Orientation, interviews, general lectures about transition technology (Target: Beginners/mid-level employees)
1	Sat	Depart from Japan
2	Sun	Arrive in Suva
3	Mon	Workshop orientation, participant interviews, discuss technical training content/schedules/questionnaire, etc.
4	Tue	Provide instruction on satellite transition procedures and points to remember, etc. (General lectures to beginners/mid-level employees)
5	Wed	

Step 2-2 First On-Site Instruction (Lectures, evaluations)

Date	**Day**	**Transition/Daily Operation Technology (Target: Beginners)**	**Satellite Communication Link ~~Circuit~~ Use/Application Technology**
6	Thu	(1) HUB/Remotes satellite transition technology ・Satellite communication system configuration, communication/modulation methods	(1) Standards for traffic control on satellite link ・Traffic load factors
7	Fri	・Satellite communication system performance ・Design of Link Budget and system evaluation	・Traffic control factors ・Traffic control philosophy
8	Sat	Document organization	
9	Sun	Same as above	
10	Mon	・Devising satellite transition procedure ・Devising Satellite transition plans	(2) Traffic control on satellite link ・Traffic measurement/analysis/monitoring
11	Tue	(2) Procedures for tests for HUB/Remotes satellite transition ・Testing procedures for Satellite Access Tests	・IP platform traffic measurement/analysis ・Outbound control/monitoring
12	Wed	・Service level function test ・Entry into Network	・Inbound traffic control ・Inbound traffic monitoring
13	Thu	(3) Procedures for daily/periodic inspections for satellite communication systems ・Inspection data gathering, data and problem analysis	(3) Optimal operation of inbound in frequency band ・Optimal allocation of inbound links ~~circuits~~
14	Fri	(4) Operation and maintenance of satellite communication systems ・Satellite communication network launch/shutdown procedures	・Inbound links rain attenuation control ・Network connectivity
15	Sat	Document organization	
16	Sun	Same as above	
17	Mon	・Satellite communication network operation records ・Satellite communication network operation statistics	・Network efficiency ・VLAN and service streamlining
18	Tue	(5) Optimal operation of redundant systems in HUB	(4) Optimal operation of outbound ・QoS, ACM control

Date	Day	Transition/Daily Operation Technology (Target: Beginners)	Satellite Communication Link ~~Circuit~~ Use/Application Technology
		・Interchangeable operation of active and backup systems	
19	Wed	・Periodic performance tests of testbed systems and backup systems ・Test data evaluation/analysis	・Outbound rain attenuation ・Outbound transmission power control
20	Thu	(6) Restoring operations when there are problems with equipment ・Malfunctioning equipment switchover to backup equipment, test/restoration procedures	・Link Availability ・Link Availability by decreasing antenna diameters
21	Fri	(7) Preventing disasters/restoring operations ・Prevention mode standards, operation mode transition/restoration procedures	・Total bit rate variation factors ・Total bit rate/ frequency band streamlining
22	Sat	Document organization	
23	Sun	Same as above	
24	Mon	Evaluation of various manuals/written procedures, review of training, Q&A/discussion	
25	Tue	Write reports	
26	Wed	Report the results of training to USP ITS Director /JICA Fiji Office	
27	Thu	Depart from Suva	
28	Fri	Arrive in Japan	

Step 3　Second On-Site Instruction (Lectures, practical training, evaluations)

Date	Day	Transition/Daily Operation Technology (Target: Beginners)	Satellite Communication Link Use/Application Technology (Target: Mid-level employees)
1	Sat	Depart from Japan	
2	Sun	Arrive in Suva	
3	Mon	Consider/discuss class content/instructor responsibilities/schedules/questionnaire	
4	Tue	Provide instruction for creating educational materials for Remotes operations staff members and beginners HUB/Remotes satellite transition ・General satellite communication technology ・Overviews of Next-Generation USPNet ・Satellite transition technology	Provide instruction for creating educational materials for Remotes operations staff members and beginners Satellite Communication Link Use/Application Technology ・Overviews of standards for Traffic control on satellite link ・Overviews of traffic control philosophy ・Overviews of Traffic control on satellite link
5	Wed		
6	Thu		
7	Fri	Procedures for tests for hub station/Remote Station satellite transition ・Procedures for tests to be conducted after transition	・Overviews of inbound traffic control
8	Sat	Document organization	
9	Sun	Same as above	
10	Mon	Procedures for tests for HUB/Remotes satellite transition ・Procedures for tests to be conducted after transition	Satellite Communication Link Use/Application Technology ・Overviews of optimal operation of inbound in frequency band
11	Tue	・Procedures for daily/periodic inspections for all equipment introduced	・Overviews of Remotes access traffic
12	Wed	・Operation and maintenance for all equipment introduced	・Overviews of inbound links rain attenuation control
13	Thu	・Restoring operations when there are problems with equipment	・Overviews of optimal operation of outbound
14	Fri	・Preventing disasters/restoring operations	・Outbound rain attenuation control
15	Sat	Document organization	
16	Sun	Same as above	
17	Mon	*Trial Training (ITS employees: For beginners), questionnaire aggregation/analysis	
18	Tue	Review training content and hold discussions with trainees	

Date	Day	Transition/Daily Operation Technology (Target: Beginners)	Satellite Communication Link Use/Application Technology (Target: Mid-level employees)
19	Wed	Write reports	
20	Thu		
21	Fri	Report the results of training to USP ITS Director, organize issues and offer recommendations, report to the JICA Fiji Office	
22	Sat	Depart from Suva	
23	Sun	Arrive in Japan	

Note: In Trial Training, trainees will use the educational materials prepared in the lecture in Step 3 (educational materials for Remotes operations staff members and beginners) to provide actual instruction (training) to beginners.

7. Methods for Procuring Implementation Resources for Soft Components

As explained in the first section on background, efforts will be made to improve the communication stability of USPNet and streamline its communication links by consolidating the existing C and Ku Band satellite communication systems into a single Ku Band system. This plan only calls for the installation of HUB, but USP (ITS) must lead transition efforts (changing from C Band to Ku Band) at Remotes in line with the progress of upgrades to Remote equipment funded by NZ, an undertaking scheduled over the same period.

To enable the long-term and consistent use of the upgraded equipment, it is vital to acquire daily system inspections, data gathering and analysis methods that lead to the prevention of problems (detecting signs the problems will occur), and to ensure the efficient use of the new system comprised of an overlapping (redundant) structure of active and backup systems, thereby preventing the interruption of lecture streaming and other services caused by problems that cause system shutdowns.

In addition, Satellite Communication Link Use/Application Technology and other technology for optimal traffic control in response to the access conditions of campuses and centers is vital toward ensuring the effective use of the consolidated satellite links of the C and Ku Band system with frequency band of 20 MHz.

As for implementation resources, we believe a direct support model comprised of consultants who are deeply familiar with satellite communication systems, the use of equipment, and communication satellites, and who fully understand the USPNet operation method and upgrade plans for Remotes, is appropriate.

Japan has a wealth of experience in the use of communication satellites, and is a world leader in the operation of large-scale systems as well as satellite communication network transition and operation technology.

In pursuit of the acquisition of **Transition/Daily Operation Technology** and **Satellite Communication Link Use/Application Technology**, which are the objectives of these soft components, we believe it is appropriate to appoint to the position of instructor Japanese consultants who are familiar with satellite communication system maintenance technology, large-scale system operation technology, transition and operation technology and the like, and who have intimate knowledge of the status of USPNet operation and the network structure as well as experience providing operations support and planning maintenance for Japanese manufacturers and the like.

In the course of providing direct support, the appointed Japanese consultants (instructors) will not use local resources. However, the cooperation of USP (ITS) is vital toward promoting the smooth implementation of soft components; therefore, we will have USP (ITS) appoint a manager responsible for gathering trainees.

8. Soft Component Implementation Process

The table below shows the implementation process of the soft components under this plan. Once preparation work in Japan (Step 1) is complete, the first on-site instruction (Step 2) will be

implemented during the period in which the equipment is installed on-site, and once the equipment is put into operation, instruction as to how to create the required manuals and written procedures will be provided. In addition, the second on-site instruction (Step 3) will be implemented after the installation of equipment is complete.

The target trainees of **Transition/Daily Operation Technology** are beginners on the USP/ITS staff, and the target trainees of **Satellite Communication Link Use/Application Technology** are mid-level employees of the USP/ITS staff. Opportunities for the mid-level employee's group and the beginner's group to come together for discussions during the training will be provided in the hope of promoting mutual cooperation during daily operations as well as when responding to emergencies, and encouraging employees to help themselves as beginners improve their skills and aim for mid-level positions and mid-level employees improve their skills and aim for top-level positions. Therefore, the soft component input plan describes the implementation of training such that both groups progress through it simultaneously and in parallel as both possible and imperative.

Soft Component Implementation Schedule

Year	2019									2020		
Month	4	5	6	7	8	9	10	11	12	1	2	3
Equipment installation work (Including initial operation instruction and operating instructions)												
Transition/Daily Operation Technology												
Satellite Communication Link Use/Application Technology												

: Work in Japan (Step 1)
: First On-Site Instruction (Step 2)
: Second On-Site Instruction (Step 3)

9. Soft Component Output

As explained in the third section on soft component outcomes.

10. Soft Component Initial Cost Estimation

The table below shows the initial cost estimation of the soft components under this plan. (There are no costs of local sub-contracting.)

Expense Item	Total (x 1,000 JPY)
1. Direct labor cost	4,004
2. Direct costs	3,124
3. Indirect costs	8,328
Total:	**15,456**

6. Partner Country Obligations

The partner country is required to implement the following items in regard to the implementation of soft components.

(1) Cooperate toward soft component implementation

- Appoint people in charge of the soft component implementation described previously, and select participants.
- Provide educational materials and venues for the soft component implementation described previously.

(2) Establish a management system

- Ensure that USP (ITS)–namely, the employees who implement the soft components described previously–appropriately manages and analyzes data. In addition, establish a system that facilitates the long-term succession of acquired content.

(3) Conduct periodic and daily inspections

- In an effort to improve operation technology, use and pass down the manuals, written procedures and other materials created as outputs.

  Strive to review manuals and written procedures at appropriate times, and to revise them when necessary. Specifically, employ the PDCA cycle to ensure that manuals and written procedures are constantly kept in an appropriate state.

(4) Secure a budget

Make efforts to secure a budget sufficient for continuously bearing the expenses described previously.

End of document

Appendix 8 Field Report

PREPARATORY SURVEY (FOR BASIC DESIGN)
ON
THE PROJECT
FOR
ENHANCEMENT OF USPNet COMMUNICATION SYSTEM
IN
THE REPUBLIC OF FIJI

FIELD REPORT

July 3, 2017

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1. Introduction

This Field Report is to establish mutual understandings among JICA Project Team (hereinafter referred to as "the Team") for the project for the Enhancement of USPNet Communication System in the Republic of Fiji (hereinafter referred to as "the Project") and the Fijian side such as The University of the South Pacific (hereinafter referred as "USP") and relevant organizations of the Government of Fiji on the technical and engineering aspects for the Project. This has been also prepared by the Team based on the results of the field survey and discussions with the Fijian side.

Through the filed survey, the Team confirmed the present condition of the existing satellite communication system in USPNet. Though some of the equipment for satellite communication system had been replaced to new one by USP's own efforts, most of the main equipment are currently well over its life span period of 10 years.

The Project aims to enhance the function of distance learning network in updating the aging satellite communication system (Antenna, Radio Frequency Systems, iDirect Baseband System, New Hub Station Building and etc.) in USPNet, thereby contribute to provide stable network communication to USP's member countries. Both the Fijian and the Japanese sides have recognized to proceed the plan of the equipment component, specifications and undertakings by the both sides under the Project as described in this report.

It is also noted that all the information as described in this report will be decided after further studies in Japan with JICA, the Team and relevant organizations of the Government of Japan. JICA will submit the draft final report, which describes the final component of the Project, to the Fijian side in February 2018 as stated in the Minutes of Discussions (M/D) signed by both parties on June 23, 2017.

2. Present Situation of the Project

2-1 Present situation of USPNet (Earth Station)

The USPNet that was established in 2000 with the support of Government of Japan, New Zealand and Austrailia is a dedicated satellite communication network equipment that uses VSATs (Very Small Aperture Terminal) to connect USP Centres in member countries to USP Laucala Campus. Though USPNet had offered satellite based flexible distance learning system through C-Band systems as of 2000, C-Band, Ku-Band system and Optical Fiber Cable have been combined to USPNet as of 2017.

During the field survey, the Team had confirmed USP about the present situation of the Earth Station of USPNet as shown in Figure 2-1-1.

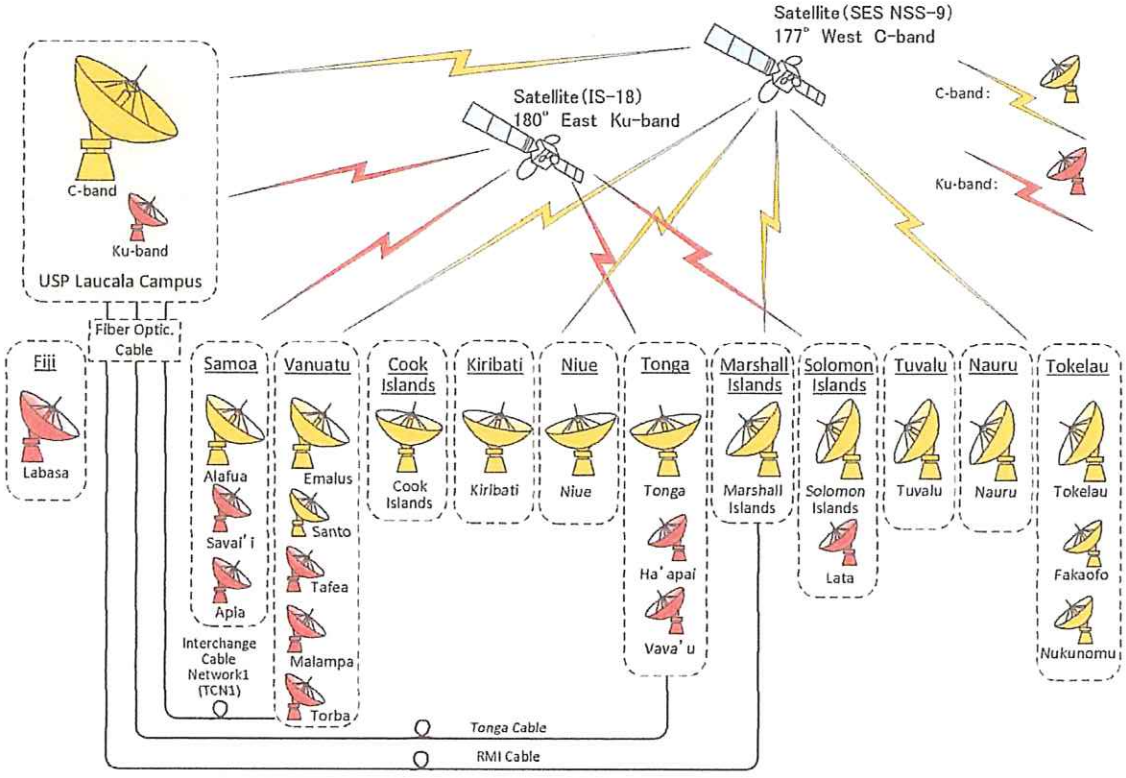


Figure 2-1-1 Outline of the USPNet

Table 2-1-1 indicates the latest connection for campuses and centres in USP and the commencement year of operation at each site. As shown in Table 2-1-1, more than 15 years have passed since the commencement of operation in some stations including C-Band HUB station in Laucala Campus and most of the equipment in those stations are currently well over its life span period of 10 years.

Table 2-1-1 Earth Station of USPNet

No.	Campus	Centre	Country	City	Earth Station Type	Band	Tx Earth Station ID	High Power Amplifier (Optical Cable)	Commencement of Operation (Year)	Antenna Diameter
1	Laucala	– – –	Fiji	Suva	HUB	C	FJI-SUV-004	80W	2000	7.6 m
2						Ku	SVA+16G5	40W	2011	4.5 m
3						Optical Fiber Cable to Vanuatu		(TCN1)	2016	– – –
4						Optical Fiber Cable to Tonga		(Tonga Cable)	2014	– – –
5						Optical Fiber Cable to Marshall Is.		(RMI Cable)	2016	– – –
6						Optical Fiber Cable to Samoa		(Samoa Cable)	2017.12	– – –
7	Labasa	– – –		Labasa	Remote	Ku	FJLAB+1.8	3W	2011	1.8 m
						Through Local ISP				
8		Savusavu		Savusavu	Remote	Through Local ISP				
9	Lautoka			Lautoka	Remote	Through Local ISP				
10	Alafua	– – –	Samoa	Apia	Remote	C	SMO-API-004	5 W	2000	6.3 m
						Ku	API+1.8	3 W	2013	1.8 m
11						Optical Fiber Cable to Fiji		(Samoa Cable)	2017.12	– – –
12		Savai'i		Savai'i	Remote	Ku	SAV+1.8	3 W	2011	1.8 m
13	Emalus	– – –	Vanuatu	Port Vila	Remote	C	VUT-PTV-002	5 W	2000	4.5 m
14						Optical Fiber Cable to Fiji		(TCN1)	2016	– – –
15		Santo		Santo	Remote	C	VUT-PTV-009	5 W	2006	3.8 m
16		Tafea		Tafea	Remote	Ku	TAN+1.8	3 W	2011	1.8 m
17		Malampa		Malampa	Remote	Ku	MAL+1.8	3 W	2011	1.8 m
18		Torba		Torba	Remote	Ku	TOR+1.8	3 W	2011	1.8 m
19	Cook Is.	– – –	Cook Is.	Rarotonga	Remote	C	CKH-RAR-001	5 W	2000	4.5 m
20	Kiribati	– – –	Kiribati	Tarawa	Remote	C	KIR-TAR-002	5 W	2000	4.5 m
21	Niue	– – –	Niue	Alofi	Remote	C	NIU-ALO-002	5 W	2000	4.5 m
22	Tonga	– – –	Tonga	Nuku'alofa	Remote	C	TON-NUK-002	5 W	2000	4.5 m
23						Optical Fiber Cable to Fiji		(Tonga Cable)	2014	– – –
24		Ha'apai		Ha'apai	Remote	Ku	HAP+1.8	3 W	2011	1.8 m
25		Vava'u		Vava'u	Remote	Ku	VAV+1.8	3 W	2011	1.8 m
26	Marshall Is.	– – –	Marshall Is.	Maluro	Remote	C	MHL-MJO-003	5 W	2000	4.5 m
27						Optical Fiber Cable to Fiji		(RMI Cable)	2016	– – –
28	Solomon Is.	– – –	Solomon Is.	Honiara	Remote	C	SLM-HON-003	5 W	2000	4.5 m
29		Gizo		Gizo	Remote	Through Local ISP				
30		Lata		Lata	Remote	Ku	LAT+1.8	3 W	2011	1.8m
31	Tuvalu	– – –	Tuvalu	Funafuti	Remote	C	TUV-FUN-002	5 W	2000	4.5 m
32	Nauru	– – –	Nauru	Yaren	Remote	C	NRU-YAR-002	5 W	2000	4.5 m
33	Tokelau	– – –	Tokelau	Atafu	Remote	C	TKL-ATA-001	5 W	2000	4.5 m
34		Fakaofo		Fakaofo	Remote	C	TKL-Fakaofo	5 W	2015	4.5 m
35		Nukunonu		Nukunonu	Remote	C	TKL-Nukunonu	5 W	2015	4.5 m

2-2 Present situation of USPNet (Space segment)

Two (2) satellites have been utilized in space segment for USPNet till now. NSS-9 is for C-Band communication and IS-18 for Ku-Band communication as shown in Table 2-2-1.

NSS-9 (177-W) as C-Band which was launched on February 12th, 2009 and Intelsat-18 (180-E) as Ku-Band which was launched on October 6th, 2011 have been used as the satellite for USPNet.

Table 2-2-1 Satellite for USPNet

No.	Satellite	Operation Campany	Band	Position	Year of Operation
1	SES NSS-9	SES AMERICOM-NEW SKIES	C	177° West	2009
2	IS-18	SATBEAMS	Ku	180° East	2011

2-3 Site condition

There is the USP Laucala Campus in Suva approximately 2.4km to the east of the center of the city, and the total area is 175 acres (0.708km^2). The New HUB Station for USPNet will be located in about 200m away from ICT centre. The antenna diameter will be 7.6m and the building size will be 5m x 10m.

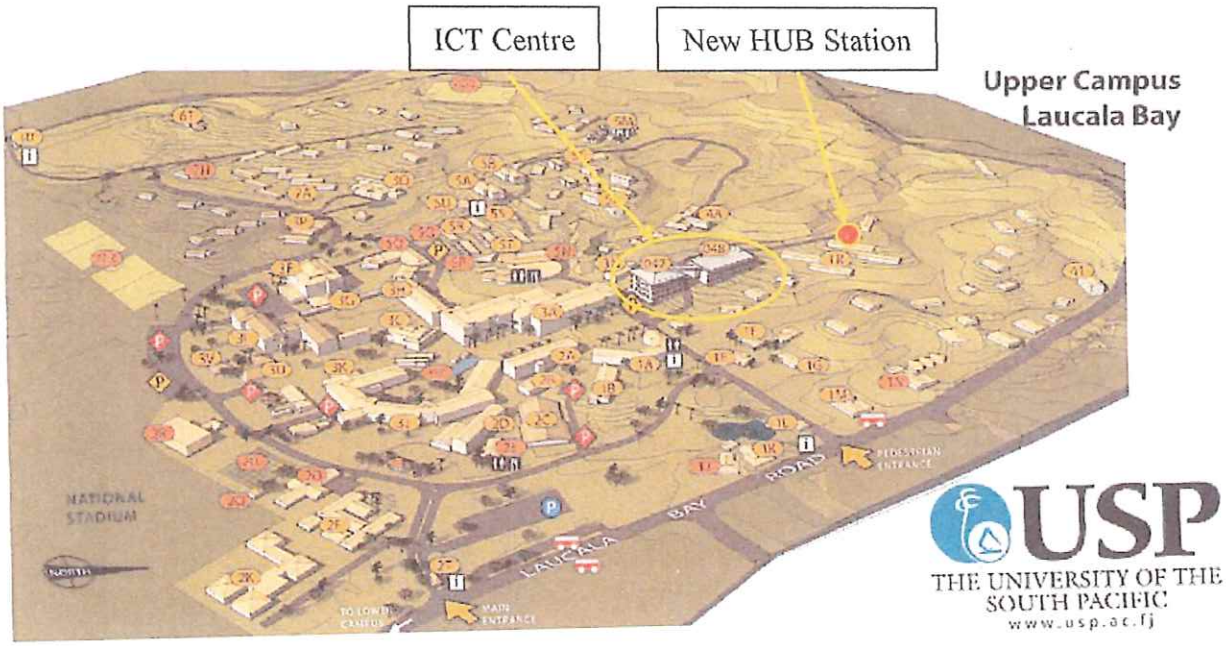


Figure 2-3-1 Map of USP Laucala Campus

2-4 Others (Rehabilitation of existing C-Band antenna)

As mentioned in the Minutes of Discussions on the Preparatory Survey for the Project for the Enhancement of USPNet Communication System concluded on June 23, 2017, the rehabilitation of existing C-Band antenna will be taken care by the New Zealand's grant contribution recently officially committed to USP.

Through the technical discussion with USP, the Team have carefully studied the present situation as shown in 3-4. Ku-Band system is proposed for the Project component as new antenna and Radio Frequency (RF) System.

3. Basic Design Concept

3-1 Climatic Conditions (Source: Fiji Meteorological Service)

(1) Altitude of the Site

- HUB Station Building and Parabolic Antenna: 32 meters (above sea level)

(2) Temperature

Table 3-1-1 Maximum and Minimum Temperature in 2016 at Suva

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Max. Temperature (℃)	33.7	35.0	34.3	30.6	30.5	30.2	28.9	29.4	32.5	30.3	33.9	32.8
Min. Temperature (℃)	23.4	22.1	23.7	21.6	19.0	19.7	18.1	18.0	19.4	19.1	21.9	22.3

- Max. Temperature of the year 2016: 35.0 ℃ (Feb. 14)
- Min. Temperature of the year 2016: 18.0 ℃ (Aug. 20)

(3) Humidity:

Table 3-1-2 Maximum and Minimum Humidity in 2016 at Suva

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Max. Humidity (%)	100.0	100.0	99.0	100.0	100.0	98.0	98.0	100.0	99.0	100.0	100.0	100.0
Min. Humidity (%)	57.0	54.0	52.0	62.0	58.0	55.0	49.0	52.0	39.0	56.0	54.0	53.0

- Max. Humidity of the year 2016: 100 %
- Min. Humidity of the year 2016: 39 % (Sep. 26)

(4) Wind speed:

Table 3-1-3 Maximum Wind Speed in 2016 at Suva

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Max. Wind speed (m/s)	17.0	31.4	11.3	15.4	13.4	12.9	12.9	10.8	11.3	18.5	11.8	22.1

- Max. Wind speed of the year 2016: 31.4 m/s (Feb. 20)

(5) Seasons

- Cyclone season: November to April

(6) Precipitation

Table 3-1-4 Precipitation in 2016 at Suva

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Total Precipitation (mm)	143.5	332.5	85.0	345.5	157.0	40.0	76.5	414.5	52.5	311.5	110.5	774.5
Day Max. precipitation (mm)	31.5	176.5	21.5	81.5	57.5	17.5	16.5	106.0	33.5	105.5	47.0	214.0
10min. Max. Precipitation (mm)	8.5	16.0	5.0	9.0	10.0	2.0	2.5	7.5	4.5	7.5	12.5	19.5

- Max. Precipitation per month of the year 2016: 414.5 mm (Aug.)
- Min. Precipitation per month of the year 2016: 40.0 mm (Jun.)

(7) Number of Rainy Days

- Average of Number of Rainy Days per month: 19.9 days 1961-1990
- Average of Max. Number of Rainy Days per month: 23 days (Jan. & Mar.)1961-1990

(8) Thunderbolt (Suva area)

Table 3-1 5 Number of Thunderbolt in 2016 at Suva area

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Thunderbolt-Near (time)	420	3,780	558	0	0	0	0	0	0	0	3,480	18,372
Thunderbolt-Far (time)	756	9,456	2,442	498	0	0	0	162	0	846	15,798	24,054

- Number of Thunderbolt in 2016: 80,622 times
- Max. number of Thunderbolt per month in 2016: 42,426 times (Dec.)
- Min. number of Thunderbolt per month in 2016: 0 time (May-Jul. & Sep.)

3-2 Applicable Design Standards

Table 3-2-1 Applicable Design Standards

No.	Name of Standards	Application
(a)	International Electrotechnical Commission (IEC)	Main functions of electrical goods in general
(b)	International Standardization Organization (ISO)	Performance of industrial products in general
(c)	Japanese Industrial Standards (JIS)	Industrial products in general
(d)	Japanese Electrotechnical Commission (JEC)	Electrical goods in general
(e)	The Standard of Japan Electrical Manufacturer's Association (JEM)	Same as above
(f)	Japan Electric Association Code (JEAC)	Same as above
(g)	Japan Cable Maker's Association Standard (JCS)	Electrical wires and cable
(h)	Electrical Industrial Association of Japan (EIAJ)	Electrical goods in general
(i)	International Telecommunication Union (ITU)	Electrical goods in general
(j)	Society of Motion Picture and Television Engineers (SMPTE)	Broadcasting equipment in general
(k)	Other related Japanese and International standards such as AES/EBU (Audio Engineering Society/ European Broadcast Union)	Industrial products in general
(l)	International Civil Aviation Organization (ICAO)	Antenna Mast
(m)	Electronic Industries Alliance of the U.S.A (EIA)	Same as above
(n)	Japanese building code and standards	Building design

No.	Name of Standards	Application
(O)	National Building Code FIJI	Building design
(P)	Standards Document Aerodromes Civil Aviation Authority of Fiji	Tower design
(Q)	The European Telecommunications Standards Institute (ETSI)	Globally-applicable standards for Information and Communications Technologies (ICT), including fixed, mobile, radio, converged, broadcast and Internet technologies.
(R)	Digital Video Broadcasting (DVB)	Global standards for Digital Video Broadcasting

3-3 Other Issue for Design

AC Power Supply: 3 phase -3 wire 240 V, 50 Hz

3-4 Satellite

(1) NSS-9 and Intelsat-18 which are used as the satellites for USPNet currently

As for the user's Campus and Centre of USPNet, 12 Campuses and 3 Centre are connected to NSS-9 for C-Band. 3 Campuses and 9 Centres are connected to Intelsat-18 for Ku. In generally, the service life of the satellites are 15 years or more. Therefore, NSS-9 will be used till 2024 or longer and Intelsat-18 will be used till 2026 or longer.

(2) JCSAT-2B

JCSAT-2B (154-E) has been launched on May 6, 2016 as the latest satellite which covers the south pacific region using Pacific Beam of it. The life time of JCSAT-2B is 15 years or more and remaining life will be 14 years. The life time is the longest among three satellites which covers south pacific region.

As the characteristics, JCSAT-2B has the 57MHz x 16 transponders which have 150 W output power. Because of this higher transponder output and wide bandwidth, it is expected that high link availability and expandability of applied bandwidth as shown in Attachment-1: Comparison of Satellite Overview.

(3) Comparison of link availability among the 3 satellites

The same size of an antenna for HUB Station is selected to compare with the current C-Band Antenna for HUB Station, then the comparison of link availability among satellites was carried out. Ku-Band of JSAT-2B realizes over 99.9 for both inbound (from Remotes to HUB) and outbound (from HUB to Remotes) as shown in Attachment-2: Comparison of Link Availability.

(4) Proposed satellite and frequency band

Through the above consideration, the Team proposed the latest JCSAT-2B Ku-Band as a candidate satellite for USPNet.

By selecting JCSAT-2B Ku-Band, USPNet can use the integrated into one satellite from the current dual satellites of NSS-9 for C-Band and Intelsat-18 for Ku-Band. As a result, the operation cost of the satellite for USPNet will be reduced.

And for the future possibility, USPNet will be able to extend its user from campuses, centers, sub-centers and households level. Students who live in small islands can study in their home by using small dishes to connect USPNet. It can't be use small dish for C-Band antenna but it can be used the antenna which diameter of dish is smaller than 1.8m for Ku-Band under the appropriate link availability. It will be the future challenge of the "Next Generation USPNet".

4. Equipment Plan

The Team proposed the Ku-Band Network System and the System Block Diagram plan of the New HUB Station in Laucala Campus based on Ku-Band. Figure 4-1-1 indicates the USPNet Ku-Band Network System and Figure 4-1-2 indicates Ku-Band HUB Station System Block Diagram (Plan). As the suitable satellite for the new USPNet, JCSAT-2B is proposed as mentioned in 3-4 (4). It was launched in 2016, and is covered the south pacific region widely.

The tentative equipment plan (hereinafter referred to as "the Equipment") is shown in Table 4-1-1. The preparations of the detailed equipment specification will be done by the Team in Japan with a draft schedule and project cost estimation. And they will be reported by the draft final report.

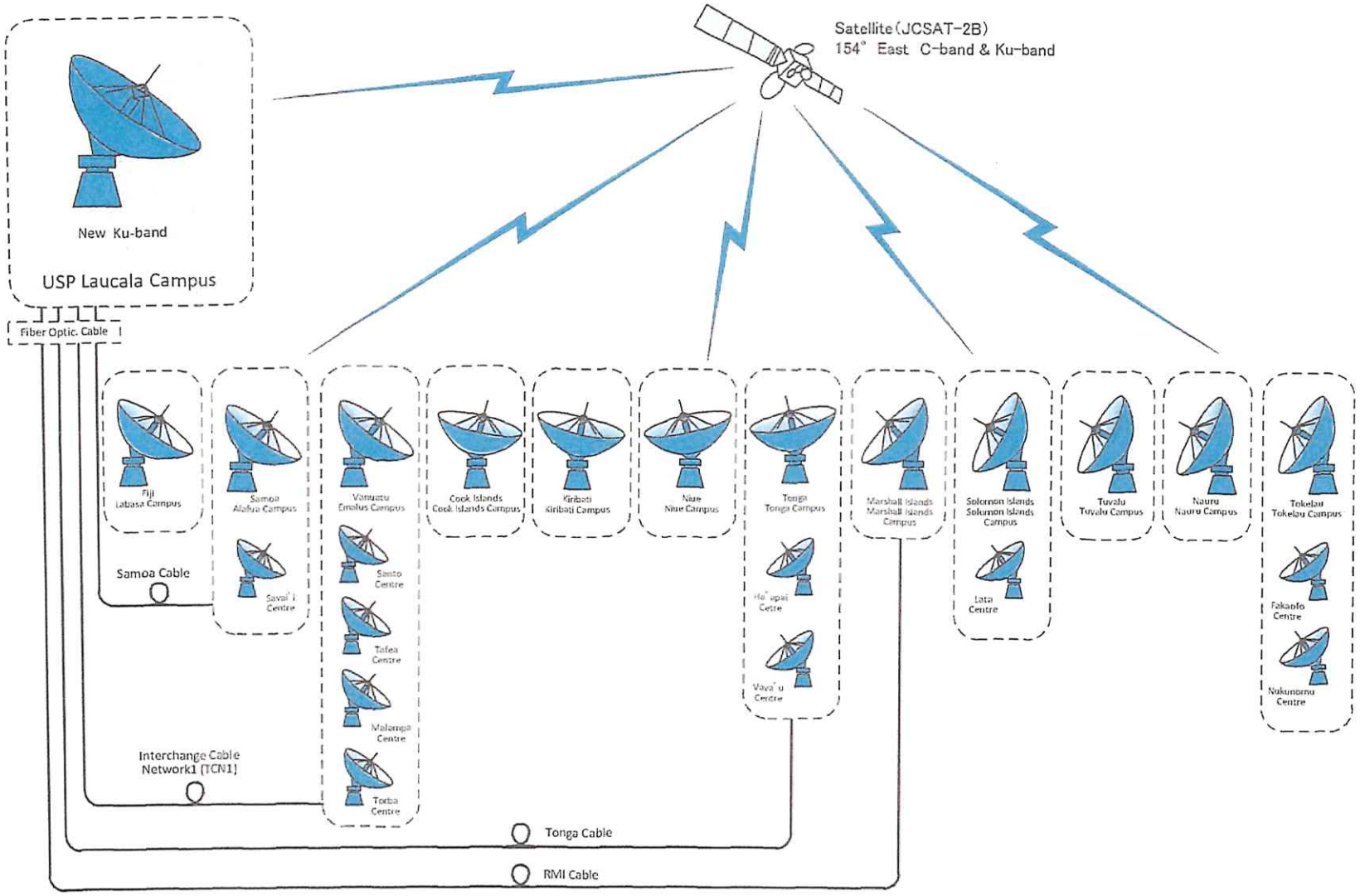


Figure 4-1-1 USPNet Ku-Band Network System (Plan)

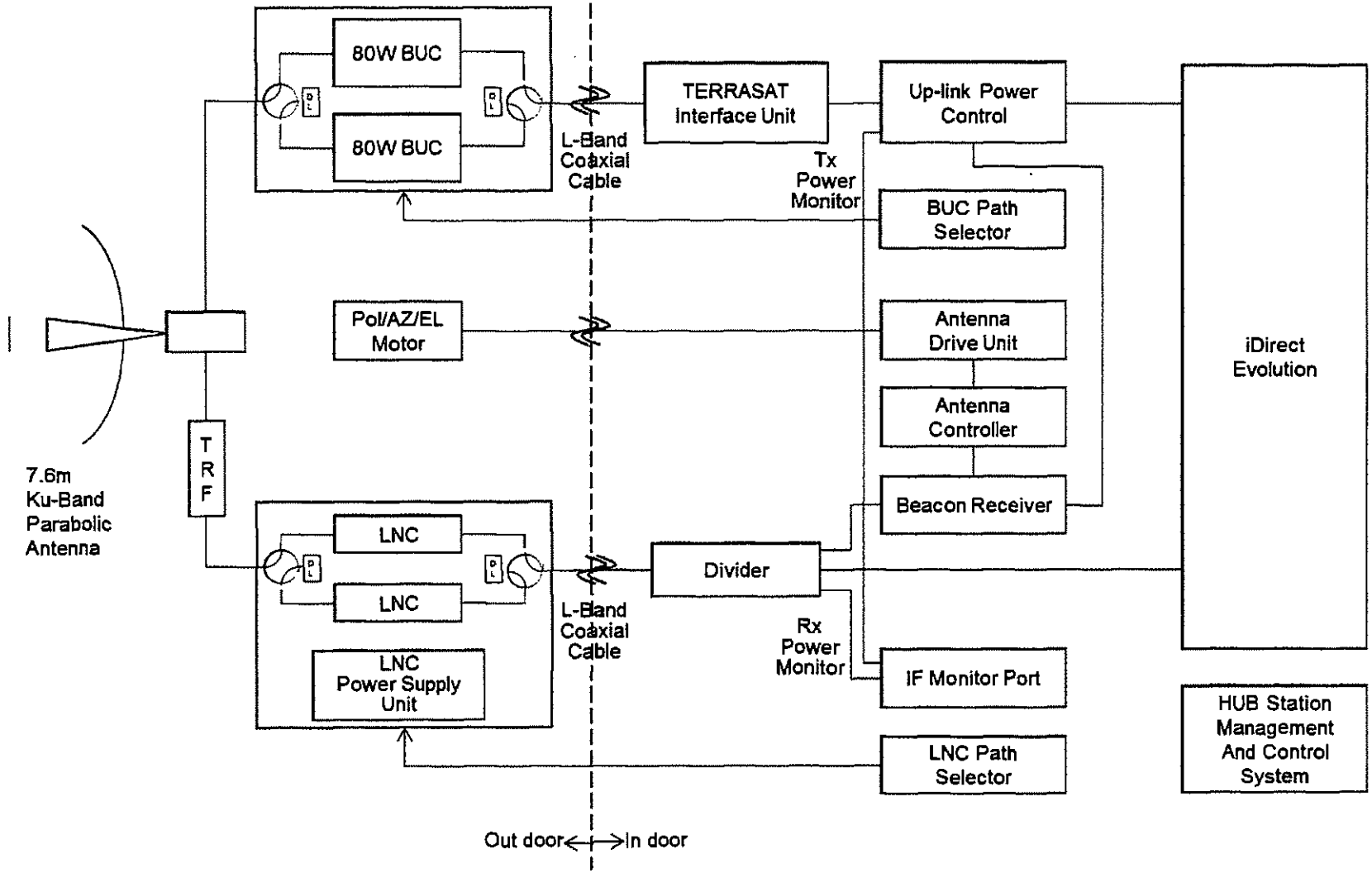


Figure 4-1-2 Ku-Band HUB Station System Block Diagram (Plan)

4-1 List of the Planned Equipment Component

Table 4-1-1 Equipment List

No.	Description	Q'ty
1.	7.6m Ku-Band Auto Tracking Parabolic Antenna System	1 lot
1.1	7.6m Ku-Band Parabolic Antenna with motorized POL, AZ and EL	1 set
1.2	Antenna Control System	1 set
1.2.1	Beacon Receiver	1 set
1.2.2	Antenna Controller	1 set
1.2.3	Antenna Drive Unit	1 set
2.	1:1 Redundant LNC System with Power Supply Unit	1 lot
2.1	1:1 Redundant LNC System	1 set
2.2	LNC Cold Standby	1 set
2.3	Power Supply Unit	1 set
3.	1:1 Redundant BUC System	1 lot
3.1	1:1 Redundant BUC System	1 set
3.2	Interface Unit	1 set
3.3	BUC Path Selector	1 set
3.4	Uplink Power Control	1 set
4.	iDirect Evolution	1 lot
4.1	Series 15100 Universal Satellite Hub	1 set
4.2	XLC-11 Line Cards	4 set
4.3	XLC-M Line Cards	6 set
5.	HUB Station Management And Control System	1 lot
6.	UPS	1 set
7.	Lightning Protection Unit	1 lot
8.	Maintenance Equipment and Tools	1 lot
9.	Spare Parts	1 lot

4-2 Key Specifications of the Equipment

4-2-1 7.6 m Ku-Band Auto Tracking Parabolic Antenna System

- Frequency Tx: 14.000 – 14.500 GHz
- Frequency Rx: 12.250 – 12.750 GHz
- Mount: Az/El
- Polarization: Linear (Horizontal and Vertical)

4-2-2 1:1 Redundant LNC System with power supply unit

(1) LNC

- Input Frequency: 12.250 ~ 12.750 GHz
- Output Frequency: 0.950 ~ 1.450 GHz

- Gain: 55 dB
- Noise Temperature: 100 K (Typical)

(2) Redundancy

- Structure: 1:1 Redundancy

4-2-3 1:1 Redundant BUC System

(1) BUC

- Input Frequency: 0.950 ~ 1.450 GHz
- Output Frequency: 14.000 ~ 14.500 GHz
- Input VSWR: 1.5:1 max (50 ohm)
- Input Connector: Type N female (50 ohm)
- Output VSWR: 1.5:1 max
- Output Wave Guide: WR-75

(2) Redundancy

- Structure: 1:1 Redundancy

4-2-4 iDirect Evolution

- To be determined

4-2-5 HUB Station Management and Control System

- To be determined

4-2-6 UPS

- To be determined

4-2-7 Lightning Protection Unit

- To be determined

4-2-8 Maintenance Equipment and Tools

- To be determined

4-2-9 Spare Parts

(1) LNC

- Cold Standby Unit: 1 unit

(2) BUC

- Cold Standby Unit : 1 unit

4-3 New HUB Station Building

(1) Story

- One (1) story building

(2) Floor area

Telecommunication Equipment Room	30 m^2
Maintenance Room	20 m^2
Total	50 m^2

(3) Building service

- Indoor Lighting and Outlet for all Rooms
- Air Conditioning System

5. Results of the Skyline Measurements

The Team have measured a Skyline at 2 points where are the candidate locations of "7.6m Ku-Band Auto Tracking Parabolic Antenna" of the Project in USP Laucala Campus. The detail of the Skyline Measurements are shown as follows:

(1) Measurement Points: See Figure 5-1-1

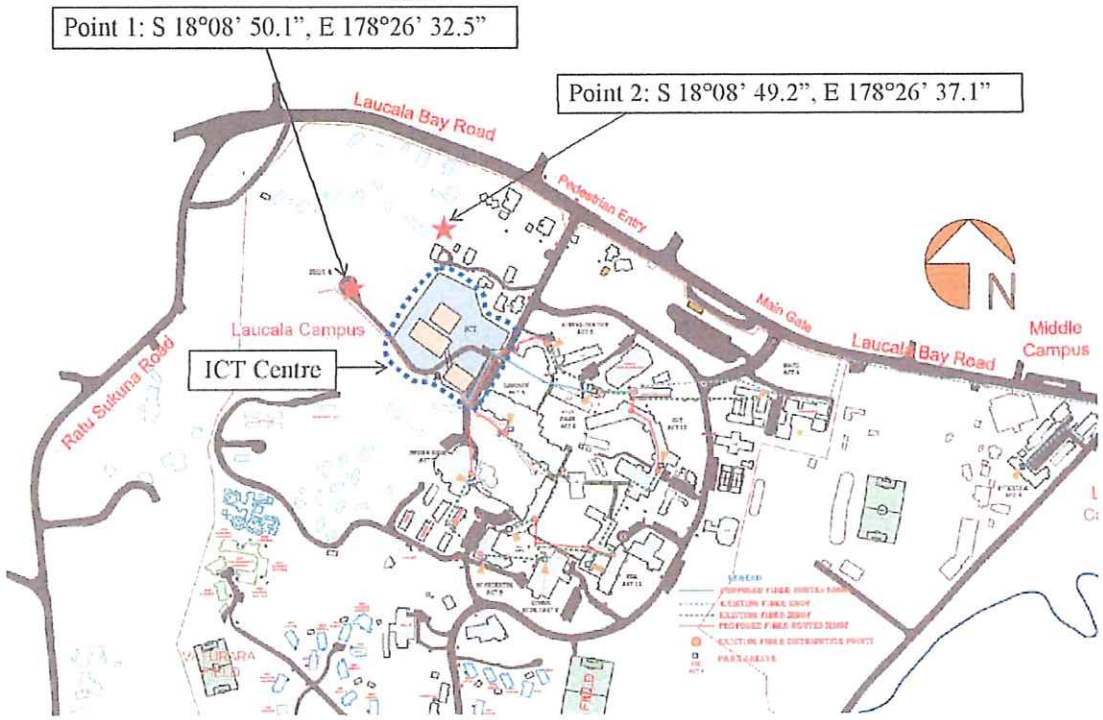


Figure 5-1-1 Measurement Points of the Skyline

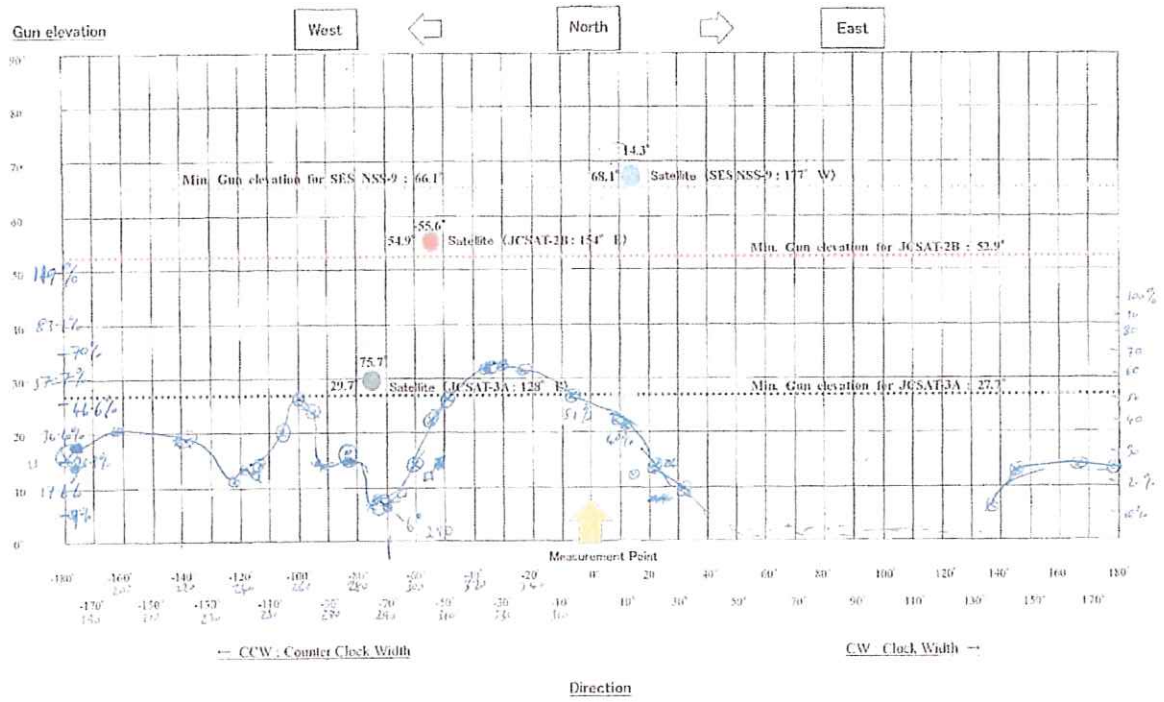
(2) Measurement date: June 27, 2017

(3) Target satellite: SES NSS-9 (177° West), JCSAT-2B (154° East) and JCSAT-3A (128° East)

(4) Result:

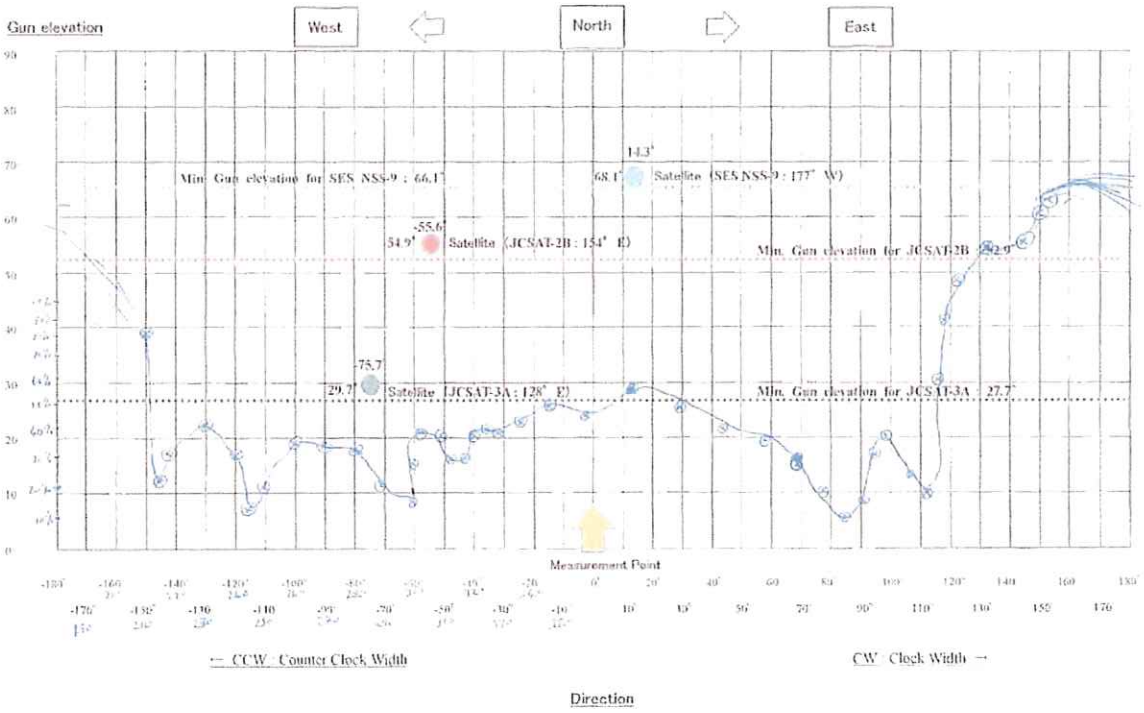
As a shown in Figure 5-1-2 and Figure 5-1-3, there are no obstacle on the line between the satellites (SES NSS-9 and JCSAT-2B) and both locations (Point 1 and Point 2). Regarding to JCSAT-3A, since the gun elevation is smaller than the other satellites, it is expected that the growth of some trees will be obstacle for the line between the satellite and Point 2. The situation between JCSAT-3A and Point 1 seems to be better than Point 1.

As the consideration above, the Team proposed the Point 1 (S 18°08' 50.1", E 178°26' 32.5") as a location for the New Parabolic Antenna.



Point 1: S 18°08' 50.1", E 178°26' 32.5"

Figure 5-1-2 Skyline from Point 1



Point 2: S 18°08' 49.2", E 178°26' 37.1"

Figure 5-1-3 Skyline from Point 2

6. Topographic Survey and Soil Exploration

The Team measured Topographic Survey and Soil Exploration under the following conditions at Point 1 as mentioned in Chapter 5.

1) Topographic Survey Point and Soil Exploration point

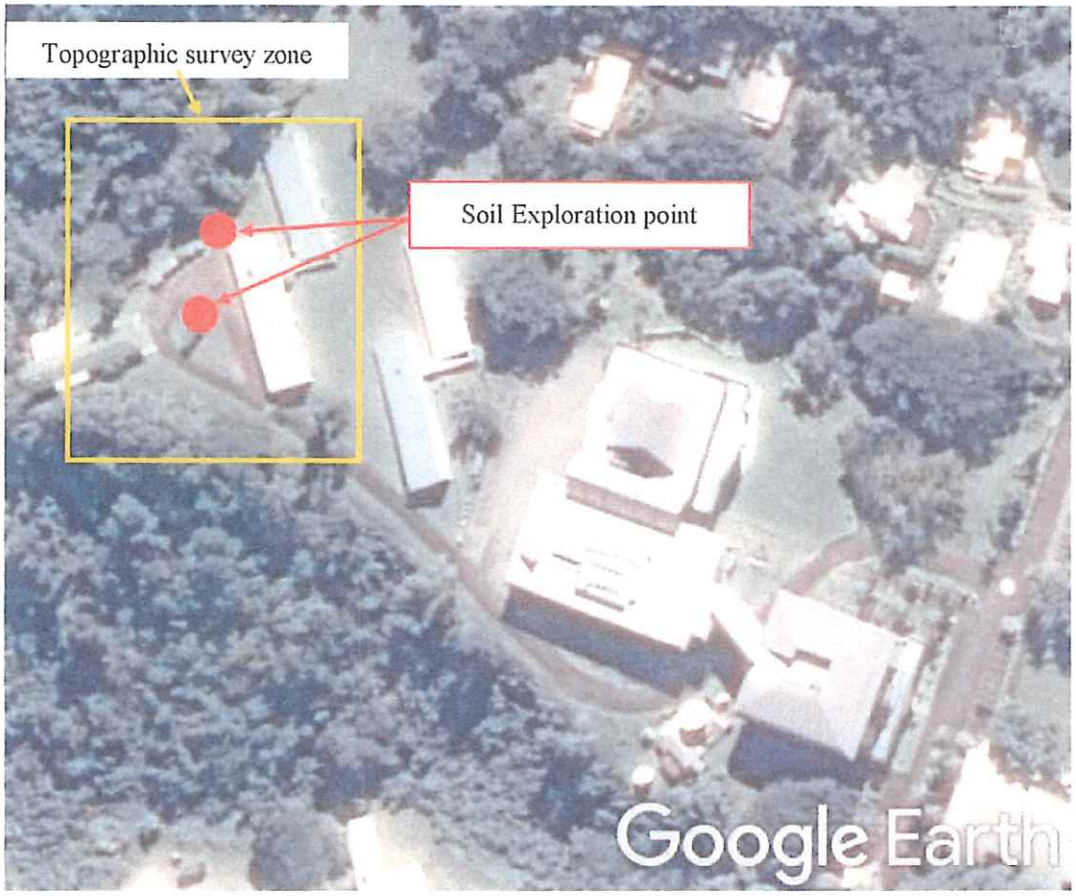


Figure 6-1-1 Site Location

2) Topographical Survey

Existing ground levels profile survey at 5m interval for each direction (longitudinal and transversal). The Representative depends on site situation. Existing ground levels profile survey will be carried out for the contour line. The contour line will be shown each 0.2m height in the survey drawing.
The site locations as shown in Figure 6-1-1

3) Soil Exploration

The Soil Exploration will be executed with specific quantities as shown in Table 6-1-1.

Table 6-1-1 Soil Exploration Items

Items	Quantity	Remarks
The Standard Penetration Test	2 places	20 m depth (from GL)
Soil Investigation		
Density of soil particles	20 samples/ each items	10 samples/place (2m span from GL) Total 20 samples
Water content of soils		
Particle size distribution of soils		
Liquid limit and Plastic limit of soils		
Bulk density of soils		
Unconfined compression test		
Triaxial compression test		

GL: Ground level

*If can't penetrate till 20m, test is finished.

7. The Work and Cost Demarcation of the Project

7-1 Principle

The work demarcation between the Japanese side and the Fijian side (USP and relevant organizations of the Government of the Republic of Fiji) shall be as shown below.

Table 7-1-1 Work demarcation between the both governments

(1) Before the Tender

No.	Undertakings	To be covered by		Notes
		Japan	Fiji (USP)	
1	To open Bank Account (Banking Arrangement (B/A))		●	To complete within 1 month after G/A
2	To bear the following commissions to a bank in Japan for the banking services based upon the Banking Arrangement (B/A) for the Consultant			
	(1) Advising commission of Authorization to Pay (A/P) for the Consulting Service Agreement		●	
	(2) Payment commission		●	
3	To approve EIA and secure the budget for implementation, if necessary.		●	To complete within 1 month after the signing of the G/A
4	To obtain the confirmation letter of permissions from the owners of the Project site(s) of the Equipment		●	To complete before the implementation of the Project.
5	To obtain the permission to use frequencies for the New HUB Station, if necessary.		●	To complete before the implementation of the Project.
6	Securing of lands for installation of equipment (hereinafter referred to as "the Project site(s)"), bush clearing and removal of obstacles in the Project site(s) (ground/underground)		●	To complete before the Tender Notice.
7	Construction of Access road to the Project site(s), if necessary		●	
8	To submit Project Monitoring Report (with the result of Detail Design)		●	

Remark: ● denote the side responsible for the work

(2) During the Project Implementation

No.	Undertakings	To be covered by		Notes
		Japan	Fiji (USP)	
A	**Common**			
1	To accord Japanese nationals and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●	
2	To bear the following commissions to a bank in Japan for the banking services based upon the Banking Arrangement (B/A)			
	(1) Advising commission of Authorization to Pay (A/P) for the contract between the Supplier and the Buyer		●	
	(2) Payment commission		●	
3	To assure the security for personnel in the Project site(s), when necessary		●	

No.	Undertakings	To be covered by		Notes
		Japan	Fiji (USP)	
4	Procurement of the Equipment	●		"The Equipment" is defined as the equipment and materials to be provided by the Japanese side under the Project.
5	To secure the following storages, facilities, sites, yard, etc.; (1) Storages for the Equipment in USP (2) Temporary offices for the Consultant and the Supplier (3) Material storing yard (4) Temporary construction yard (5) Waste disposal around the Project site(s)		●	
6	To ensure that custom duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the Products and/or the Services be exempted, such as, (1) Import Duties, (2) Value Added Tax (VAT), (3) Others, if any		●	The detail of the custom duties, the internal taxes and the other fiscal levies are under confirmation by Ministry of Economy and Ministry of Education.
7	Transportation of the Equipment, customs procedures and tax procedures			
	(1) Marine/air transportation to a port of disembarkation in Suva	●		
	(2) Secure the storage for the Equipment in Suva		●	
	(3) Procedures for tax exemption and customs clearance at the port of disembarkation and to assist the Supplier(s) with internal transportation therein		●	
	(4) Internal transportation from the port of disembarkation to the storage of Suva	●		
8	To obtain the confirmation letter for (1) Permission of the Installation Work at the Project site(s) (2) Permission to enter the Project site(s)		●	
9	To ensure the required power supply for the equipment		●	
10	Relocation of the existing power distribution lines (overhead/underground) in the Project site(s), if necessary		●	
11	Installation of the Equipment, Adjustment and Testing	●		
12	Providing facilities for the distribution of electricity, water supply, drainage and incidental facilities to the New HUB Station Building			
	(1) Electricity			
	1) The distributing line for AC 240V (3phase, 3wire) to the New HUB Station Building		●	
	2) The drop wiring and internal wiring within the Project Sites	●		
	3) The main circuit breaker and transformer	●		
	4) Standby Generator (Outdoor Type) for New HUB Station Building		●	
	(2) Water Supply			
	The city water distribution main to the New HUB Station Building		●	
	(3) Drainage			
	The drainage system (for toilet sewer, ordinary waste, storm drainage and others) within the New HUB Station Building		●	
	(4) General furniture		●	
13	Provision of security to the Equipment during the implementation of the Installation Work	●		

No.	Undertakings	To be covered by		Notes
		Japan	Fiji (USP)	
14	Construction of the gate(s) and fence(s) in and around the Project site(s)		●	
15	Provision of trainings for Initial operation and maintenance of the Equipment	●		
16	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●	
17	To submit Project Monitoring Report			
	1) After each work under the contract(s) such as shipping, hand over, installation and operational training		●	Within one month after completion of each work
	2) After completion of the works		●	Within one month after signing of Certificate of Completion for the works under contract(s)
18	To submit a report concerning completion of the Project		●	Within six month after completion of Project

Remark: ● denote the side responsible for the work

(3) After the Project

No.	Undertakings	To be covered by		Notes
		Japan	Fiji (USP)	
1	To provide security to the Equipment after the handing over of the Equipment		●	
2	To establish proper operation and maintenance structure including routine check/periodic inspection and cleaning.		●	
3	Allocation of necessary staff and budget for the operation and maintenance of the Equipment, including the periodical maintenance work after the completion of the Project		●	

Remark: ● denote the side responsible for the work

7-2 Tax Exemption Procedure

To confirm the Tax Exemption Procedure, the flow chart regarding the procedure (Attachment-3) had been submitted by the Team to Ministry of Economy and Ministry of Education. It has been under confirmation by both Ministries. The Fijian side shall undertake arrangement necessary for the exemption of the Equipment without delaying.

8. Budget Estimation of the Undertakings by the Fijian side (USP)

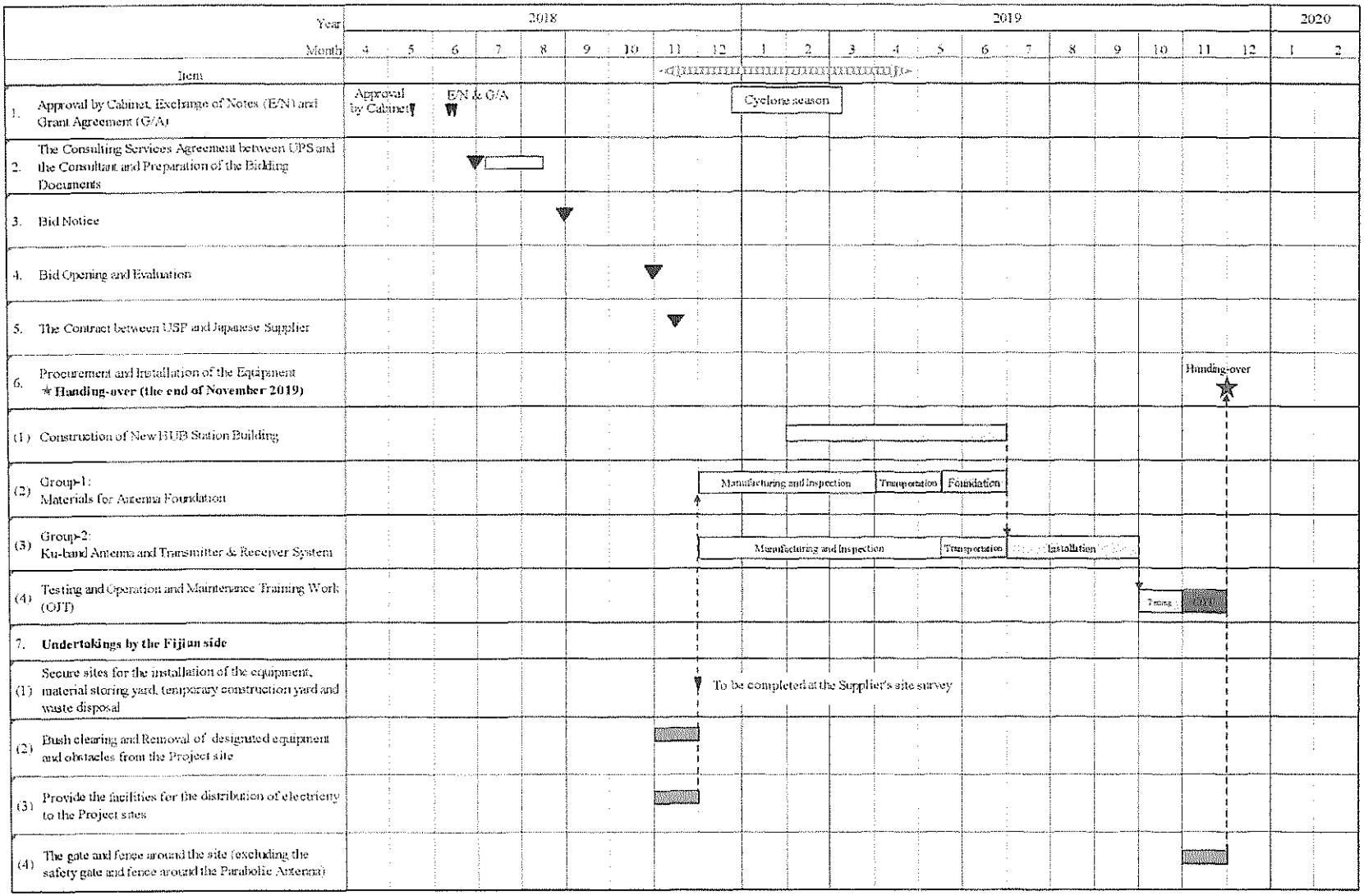
For the undertakings to be done by the Fijian side (USP and relevant organizations of the Republic of Fiji) as shown in Chapter 7 above, The Team estimated the budget necessary for the undertakings to be secured by the Fijian side as follows:

Table 8-1-1 Budget Estimation of the Undertakings by the Fijian side

Item	Estimated Cost (FJD)	Remarks
(1) Miscellaneous Fee	100,000	Refer to 6-1 (2) B2 Connection for Electrical Distribution Line, Water Supply and Drainage pipe etc. of Existing system in USP.
(2) Stand by Generator (Outdoor type) for New HUB Station Building	200,000	Refer to 6-1 (2) B2 For Satellite Telecommunication Equipment
(3) Construction of the gate and fence(s) around the Project site	20,000	Refer to 6-1 (2) B3 For the new Antenna (Number of Gate: 1, Length of Fence: Aprox. 40m Number of Pillar: 16pillars)
Total amount:	**320,000**	

* Bank commission 0.1% of the Project Budget on Fiji bank account shall be needed.

9. Implementation Schedule of the Project (Tentative)



10. Operation and Maintenance, Soft Component and Financial Plans for USP

10-1 Budget Estimation of Operation and Maintenance

In order to operate USPNet properly by USP, it is necessary to carry out proper operation and maintenance for the Equipment. USP has operated USPNet since 2000 and it will continue ahead. It seems that the operation cost will not change significantly between before the Project and after the Project. Therefore, the Team had considered the specific maintenance cost of the Project. The Team estimated budget to be secured by the Fijian side necessary for proper maintenance of the facilities after the completion of the Project as shown in Table 10-1-1 Maintenance Cost of the Equipment.

Table 10-1-1 Maintenance Cost of the Equipment

Item	Unit Price(FJD)	Q'ty	Amount(FJD)
Spare Parts (Unit)			
LNC	18,000	1	18,000
BUC	85,000	1	85,000
Consumable Material (Lot)			
Paint for maintenance work (per year)	2,000	1	2,000
Grease for maintenance work (per year)	2,000	1	2,000

Source: USP

Painting for Antenna (pole, dish, etc.) and greasing up the mechanical part of the Antenna will be necessary as periodical maintenance work every year. Then it will cost 4,000 FJD per year.

Spare Parts as LNC and BUC will replace when it will be broken. The cost for LNC is 18,000 FJD and for BUC is 85,000 FJD per unit, however it won't cost USP every year.

Table 10-1-2 ITS Recurrent Financial Report Unit:thousand FJD

Item	2012	2013	2014	2015	2016
Total Operating Expense	6,834	7,041	8,862	11,349	10,152
1) Personnel Charge	2,726	2,972	3,409	3,449	3,681
2) Non Personnel Charge	4,108	4,069	5,453	7,900	6,471
-Internet Lease Line Charges	221	783	779	1,211	1,414
-Satellite Lease	1,741	1,817	1,849	3,520	2,427
-Telephone & Faxes Charges	14	267	281	750	637
-Service Contracts (Other)	233	239	273	246	219
-Other (include Maintenance Cost)	1,899	963	2,271	2,173	1,774

Source: USP

The ITS Recurrent Financial Report 2012 to 2016 is shown in Table 10-1-2. In accordance with the report, the average of Total Operating Expense for ITS (Department incharge of USPNet) is Approx. 9 million FJD. This amount is including Personnel Charge and Non personnel charge (Internet Lease Line change, Satellite Least charge, etc.). Maintenance cost is included category "Other" of Non Personnel Charge and the average of "Other" cost is Approx. 1.8 million FJD in last five years (2012 to 2016).

The total maintenance cost for Spare Parts and Consumable material for the Equipment will be Maximum 107,000 FJD and it will be less than 6 % of the average of the "Other" cost per year.

10-2 Soft Component

When the commencement of operation of USPNet in 2000, two dedicated staffs were assigned to look after the operation and maintenance for the satellite HUB Station in Laucala Campus and necessary soft component was conducted. However, two of them had left USP in 2005. The current one dedicated staff responsible for the HUB Station had received the operation and maintenance training from them for a half year.

At this moment three staffs within ITS will be called upon to assist the current staff for satellite HUB Station when an emergency occurs. It is, therefore, in high relevance to carefully plan the soft component for the Project considering redundancy of the equipment/network and emergency response like cyclones and to execute this plan accordingly.

Additionally, it is confirmed that for the next ten-fifteen years of new USPNet operation at USP, a long standing, robust and resilient structure of operation and maintenance in ITS is widely required among all the users of USPNet inUSP.

This Soft Component will be conducted to ITS HUB Station staffs right after the installation of the HUB Station by the Consultant members aiming at the following two outcomes:

- Reviewing the current routine maintenance schedule, to renew this through the technical transfer of hands-on and knowledge with regards to resilient and emergency responsive operation and management of USPNet.
- Reviewing the current technical operator maintenance training program, to renew this program based on above mentioned technical transfer and to make the training materials. This training materials will be utilized at the time of the Technical Operator Maintenance Work Shop which will be conducted by those recipients of the Soft Component with necessary guidance by the Consultant. Timing-wise it will be held on the last week of this Soft Component.

10-3 Financial Plan for USP

Table 10-3-1 shows the statement of income and expenditure for USP in this five years. Based on the table below, the total amount of Government Contributions and Student Tuition Fees have accounted for more than 50 % of total income in each year. Since the number of students has been on increase recent years, the Student Tuition Fees is expected increasing as well.

As mentioned in 10-1, the maintenance cost for the Equipment will be maximum 107,000 FJD and the amount is less than 0.1 % of the total income in each year from 2012 to 2017.

Accordingly, it is expected that USP will ensure the budget for maintenance of the Project equipment in future as well.

Table 10-3-1 Statement of Comprehensive Income and Expenditure in 2011 to 2017(Plan)

unit: US$

item	2011	2012	2013	2014	2015	2016	2017 (Plan)
Income							
Government Contributions	47,946,462	47,946,462	47,946,462	49,564,724	49,515,848	38,420,176	38,420,000
Student Tuition Fees	35,438,939	37,378,606	39,265,387	43,915,290	53,977,487	66,079,842	73,253,000
Development Assistance	30,875,771	45,846,831	51,082,889	51,335,296	50,392,932	52,575,183	46,687,000
Trading Activities	14,413,270	16,703,776	18,454,145	18,935,422	17,753,015	17,208,354	17,206,000
Consultancy Income	2,913,492	2,185,499	1,534,327	1,661,700	3,134,101	2,422,647	1,559,000
Other Incomes	5,556,190	6,464,092	8,993,349	9,811,425	7,547,211	8,370,665	13,130,000
Release of Deferred Revenue	5,318,040	7,225,441	4,633,316	4,833,963	5,065,946	5,146,007	5,210,000
Interest Income	1,263,842	683,627	759,819	759,948	661,172	709,091	700,000
Write Up in Value of Inventories	-	-	-	415,317	215,104	-	-
Realized Exchange Gain	-	-	670,570	-	485,424	8,830	-
Unrealized Exchange Gain	432,008	97,319	-	-	11,848	812,968	-
Total Income	**144,158,014**	**164,531,653**	**173,340,264**	**181,233,085**	**188,760,088**	**191,753,763**	**196,165,000**
Expenditure (▲minus)							
Staff Costs	62,399,251	67,431,614	78,511,110	82,195,130	82,634,439	82,489,804	83,540,000
Operating Costs	62,016,571	80,014,069	84,393,953	79,102,507	81,652,162	85,182,150	91,707,000
Depreciation & Amortization	6,679,938	9,275,121	9,436,990	11,277,418	11,617,441	12,466,640	13,317,000
Movement in Impairment Provision	3,955,320	▲1,180,149	1,134,304	1,929,042	4,380,285	1,646,103	1,497,000
Write Down in Value of Inventories	110,893	119,069	479,420	-	-	82,157	-
Realized Exchange Loss	1,429,254	858,660	-	424,902	-	-	-
Unrealized Exchange Loss	-	-	420,738	480,621	-	-	-
Loss on Disposal of Assets	-	2,154	8,355	13,116	-	-	-
Write Off of Project Debts			-	630,290	41,490	-	-
Total Expenditure	**136,591,227**	**156,520,538**	**174,384,870**	**176,053,026**	**180,110,713**	**181,866,854**	**190,255,000**
Surplus for the year	7,566,787	8,011,115	▲1,044,606	5,180,059	8,434,271	9,886,909	

11. Benefit of the Project

The Team and USP confirmed the benefit of the Project which is to be achieved after two (2) years from the completion of the Project in 2019, as follows.

For all earth station, not only the HUB Station in Laucala Campus but also all remote stations;

- To increase the Signal Receiving Level and Transmitting Level and make them stable at high signal level,
- To increase Link Availability

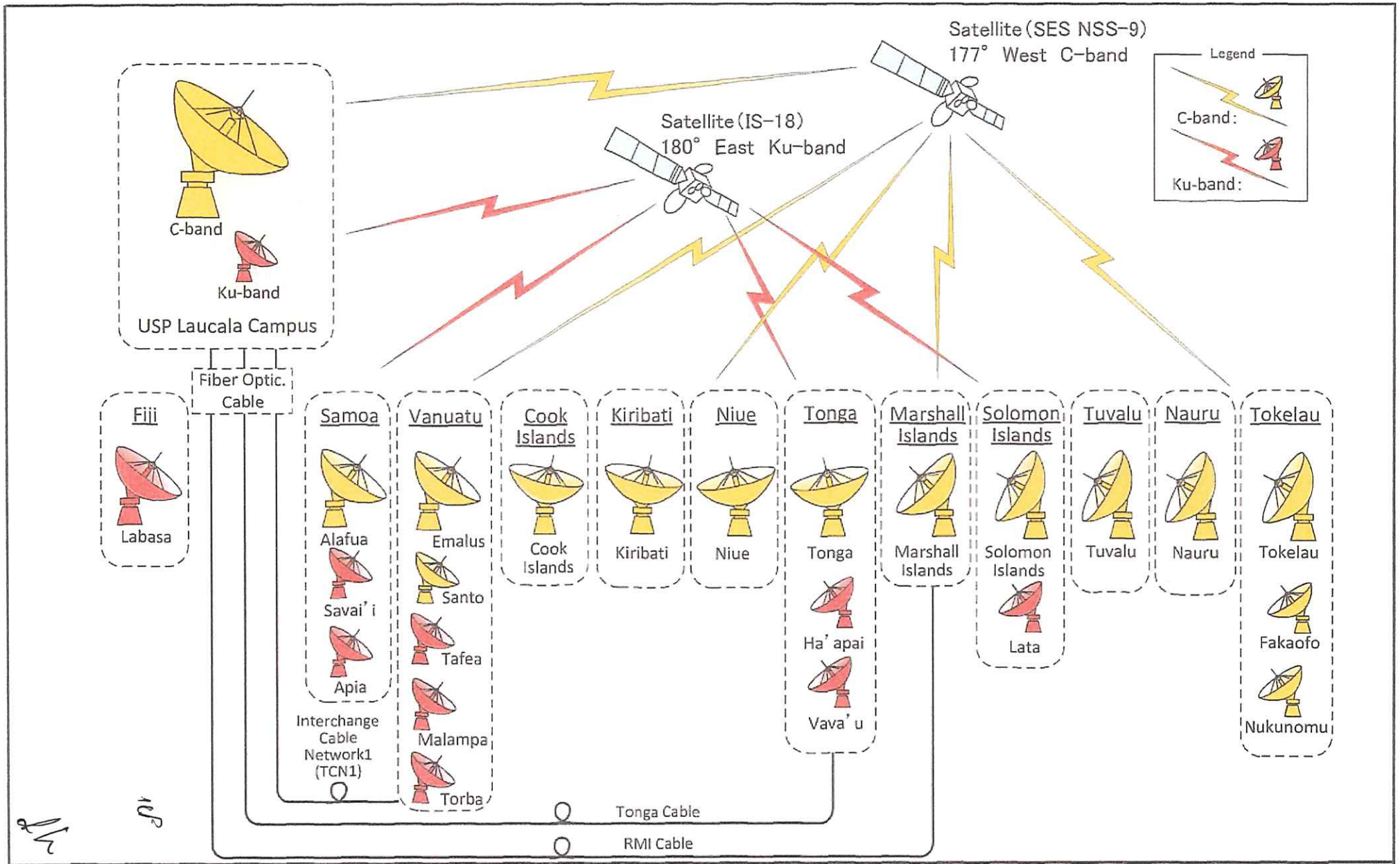
As a result of those improvements, USPNet will be able to provide more stable communication to users.

12. Drawings for Basic Design

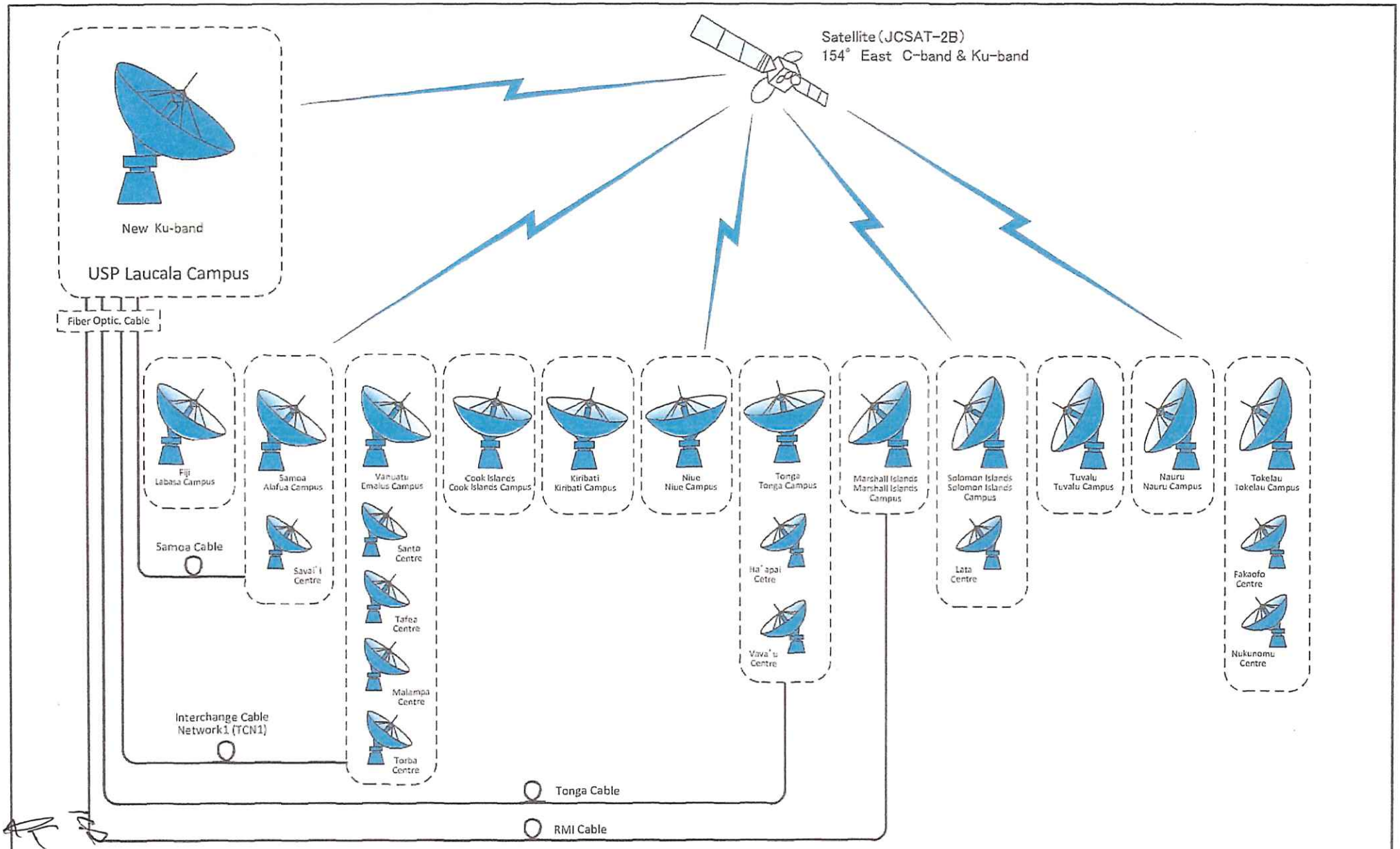
Dwg. No.	Title
S-01	Site Allocation of USP Laucala Campus
D-01	C-Band & Ku-Band Network System of USPNet (Existing)
D-02	Block Diagram of Existing HUB Station for USPNet
D-03	Ku-Band Network System of USPNet (Plan)

(End)

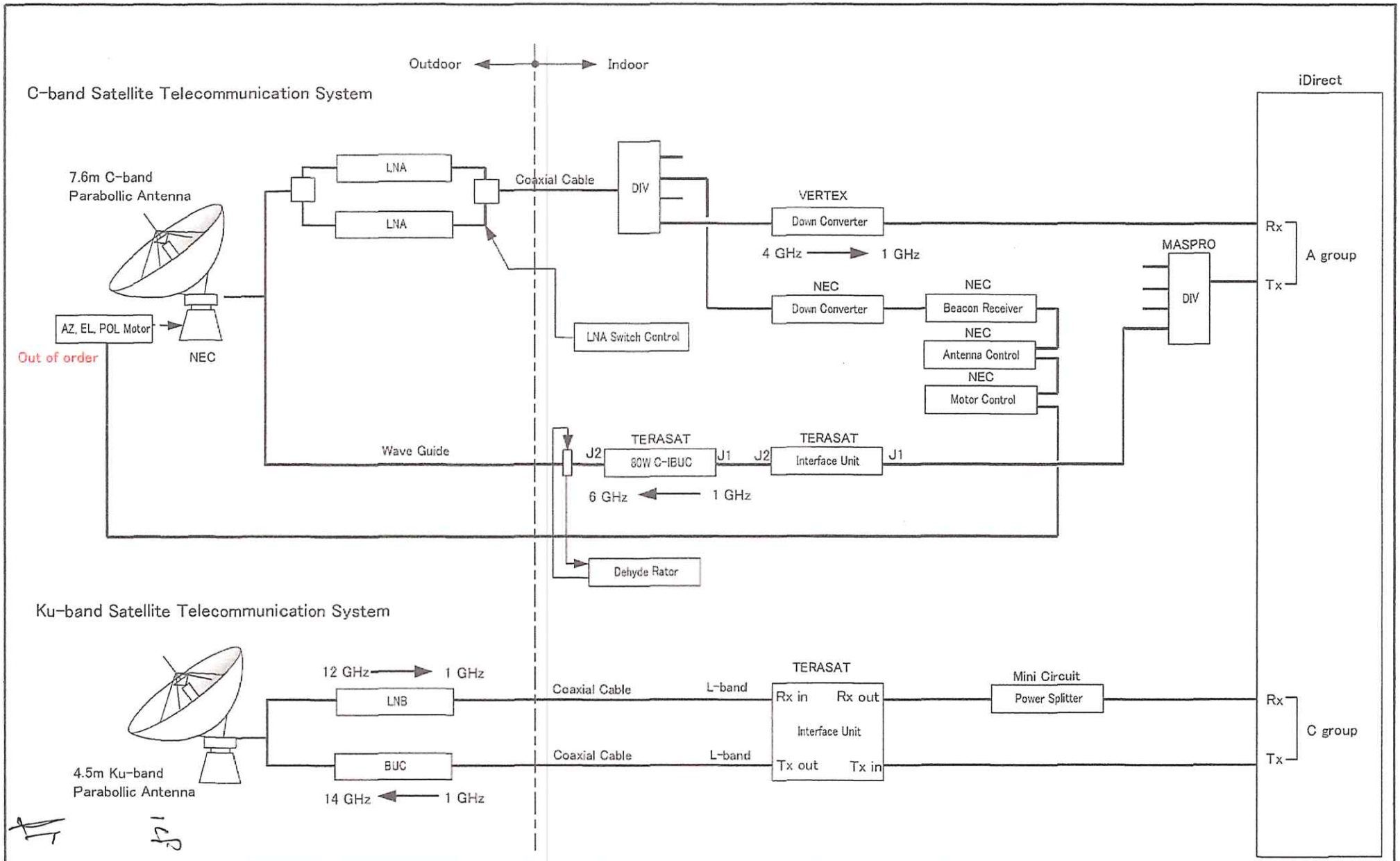
PROJECT NAME	EXECUTING ORGANIZATION	TITLE	SCALE	DATE	DESIGNED	CHECKED	APPROVED	DWG No.
The Project for Enhancement of USPNet Communication System in the Republic of Fiji	The University of the South Pacific	Site Allocation of USP Laucala Campus	—	June 28, 2017	T. YAMASHITA	Y. IKEDA	K. TANAKA	S-01
				YACHIYO ENGINEERING CO., LTD. TOKYO, JAPAN				



PROJECT NAME	EXECUTING ORGANIZATION	TITLE	SCALE	DATE	DESIGNED	CHECKED	APPROVED	DWG No.
The Project for Enhancement of USPNet Communication System in the Republic of Fiji	The University of the South Pacific	USPNet C-Band & Ku-Band Network System (Existing)	—	June 28, 2017	T. YAMASHITA	Y. IKEDA	K. TANAKA	D-01
				YACHIYO ENGINEERING CO., LTD. TOKYO, JAPAN				



PROJECT NAME	EXECUTING ORGANIZATION	TITLE	SCALE	DATE	DESIGNED	CHECKED	APPROVED	DWG No.
The Project for Enhancement of USPNet Communication System in the Republic of Fiji	The University of the South Pacific	USPNet Ku-Band Network System (Plan)	—	June 28, 2017	T. YAMASHITA	Y. IKEDA	K. TANAKA	D-03
				YACHIYO ENGINEERING CO., LTD. TOKYO, JAPAN				



PROJECT NAME	EXECUTING ORGANIZATION	TITLE	SCALE	DATE	DESIGNED	CHECKED	APPROVED	DWG No.
The Project for Enhancement of USPNet Communication System in the Republic of Fiji	The University of the South Pacific	Block Diagram of Existing HUB Station for USPNet	—	June 28, 2017	T. YAMASHITA	Y. IKEDA	K. TANAKA	D-02
				YACHIYO ENGINEERING CO., LTD. TOKYO, JAPAN				

Attachment-1

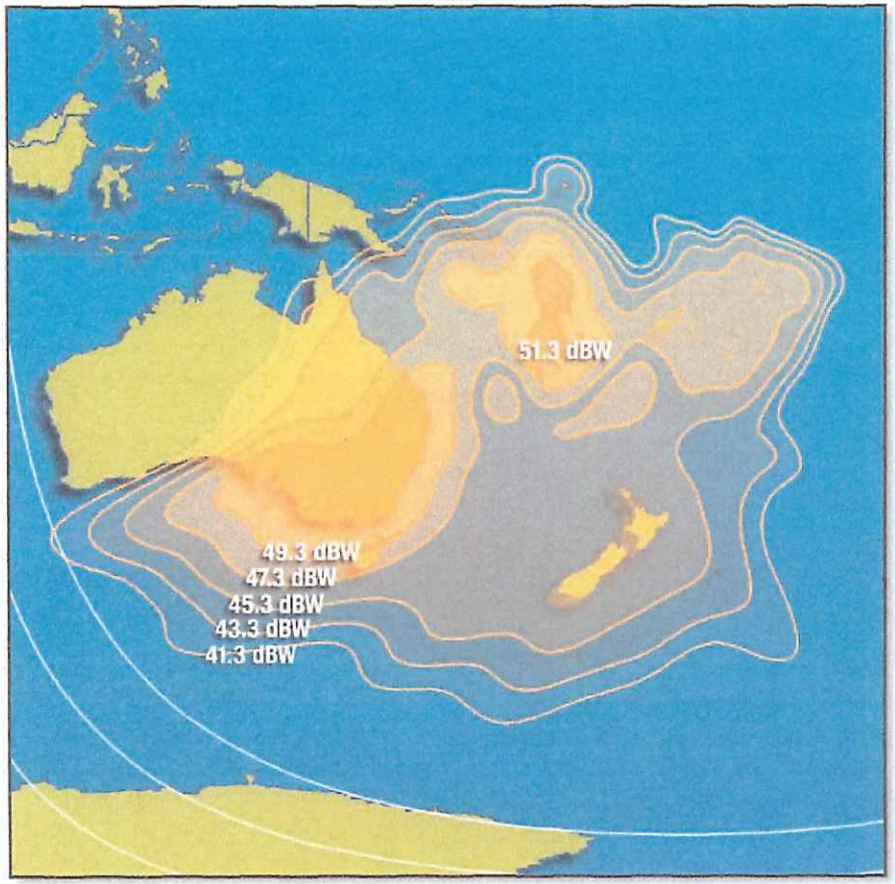
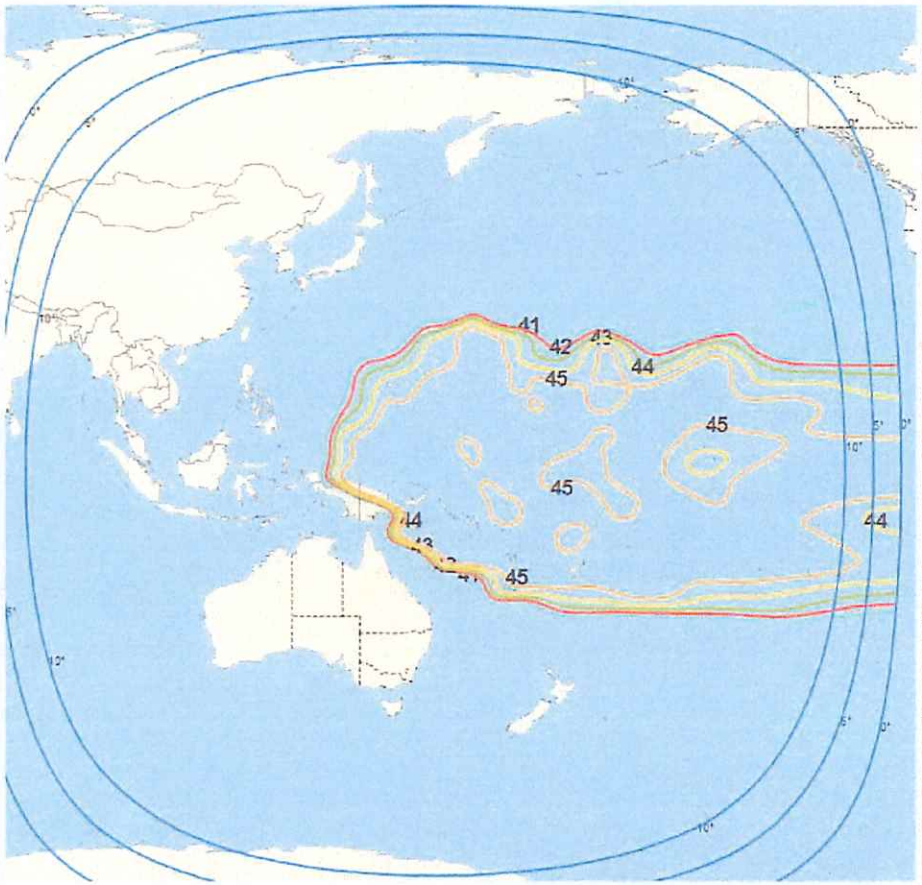
Comparison of Satellite Overview

	Intelsat IS-18	SES NSS-9	JSAT JCSAT-2B	
Launch Date	October 6, 2011	February 12, 2009	May 6, 2016	
Orbital Location	180° E	177° W	154° E	
Launch Vehicle	Zenit 3SL	Ariane 5 ECA	Falcon 9 (SpaceX)	
Satellite Bus	GEOStar-2 (OSC)	GEOStar-2 (OSC)	SSL1300 (Space Systems Loral)	
Coverage Area	Eastern Asia, The Pacific, Western US, Eastern Australia	Australia, Indonesia, the Philippines, Japan, China, Korea, Pacific Region	Japan, Asia, Oceania, Russia, Pacific Region	
Service Life	15 years + (until 2026 or longer)	15 years + (until 2024 or longer)	15 years + (until 2031 or longer)	
Frequency Bands	**Ku-Band**	**C-Band**	**Ku-Band**	**C-Band**
	Uplink 14.00 – 14.50 GHz Downlink 10.95 – 11.70 GHz 12.25 – 12.75 GHz	Uplink 5.850-6.425GHz Downlink 3.625-4.200GHz	Uplink 14.000 - 14.500 GHz Downlink 12.250 - 12.750 GHz 11.450 - 11.700 GHz	Uplink 5.850 - 6.425 GHz Downlink 3.625 - 4.200 GHz
HPA Output	-	-	150W	100W
Transponders	36MHz x 12	44 transponders	57MHz x 16	108MHz x 6 72MHz x 4 56MHz x 15 51MHz x 1
Frequency Translation	-	-	1748 MHz 2557MHz	2225 MHz
Polarization	Linear	Circular	Linear (Horizontal and Vertical)	

A-1-1

A-8-35

Ku-Band Coverage Comparison

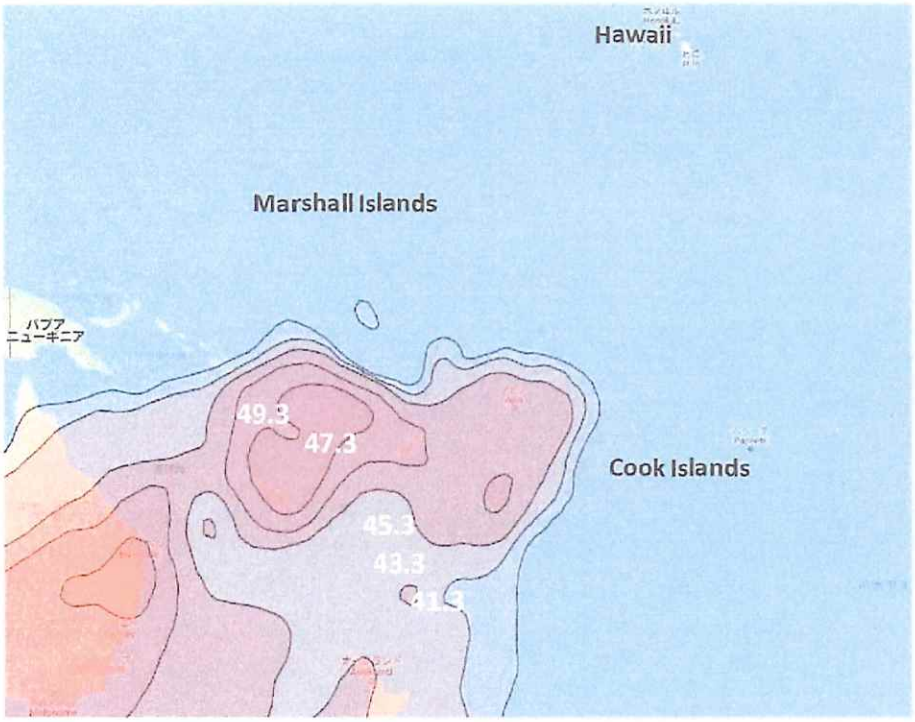
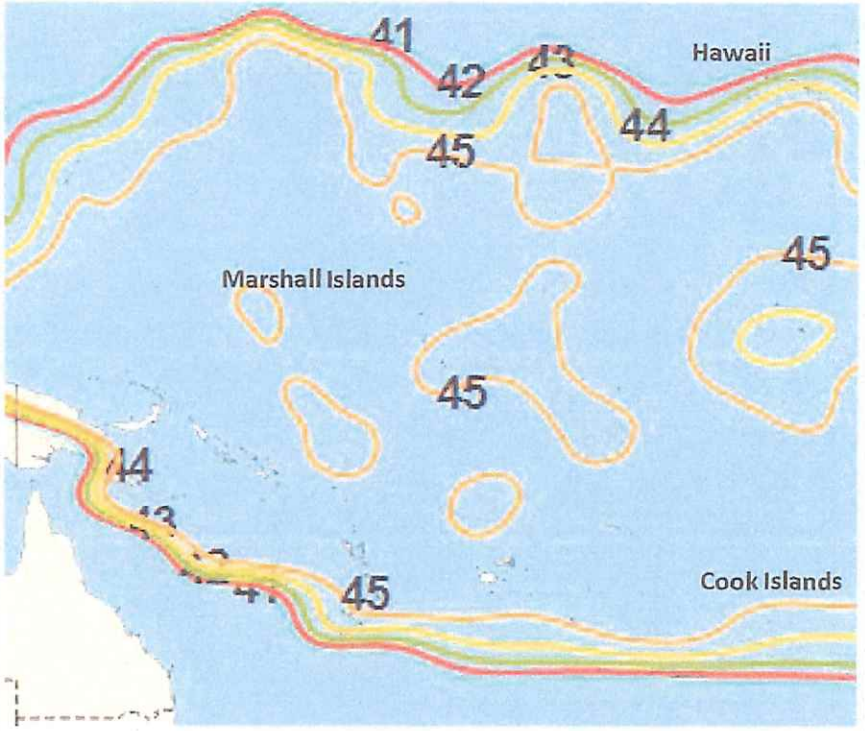
Intelsat IS-18 @180° E	JCSAT 2B @154° E
South Pacific Beam Footprint	Pacific Beam Footprint
	

Source: http://www.intelsat.com/

A-1-2

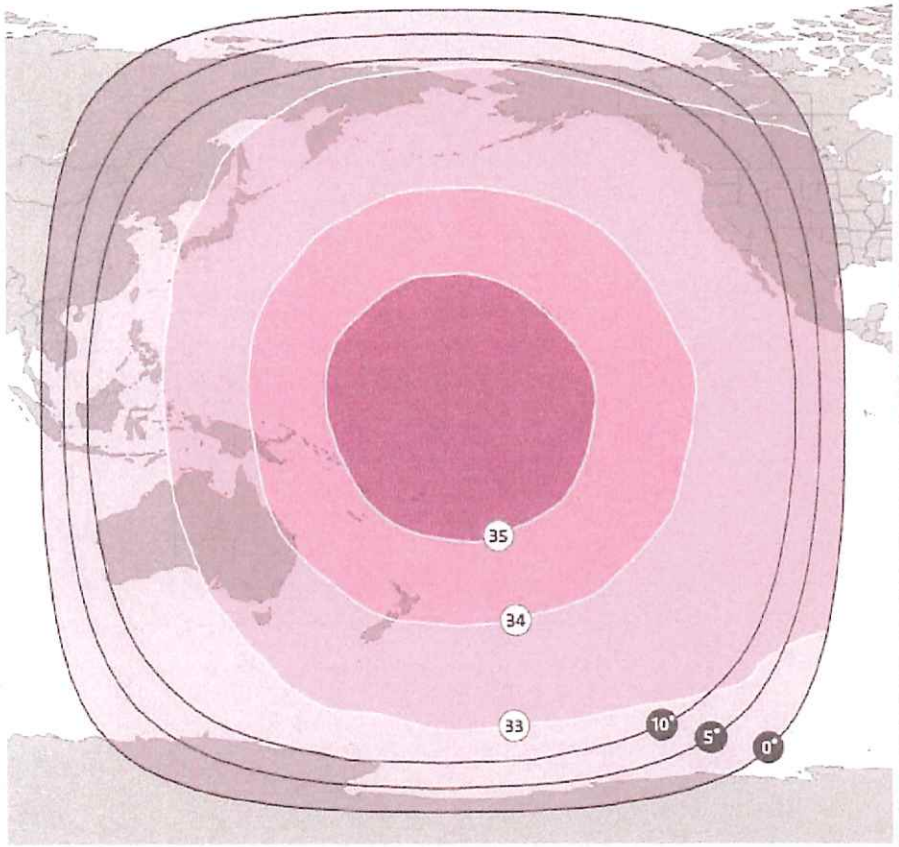
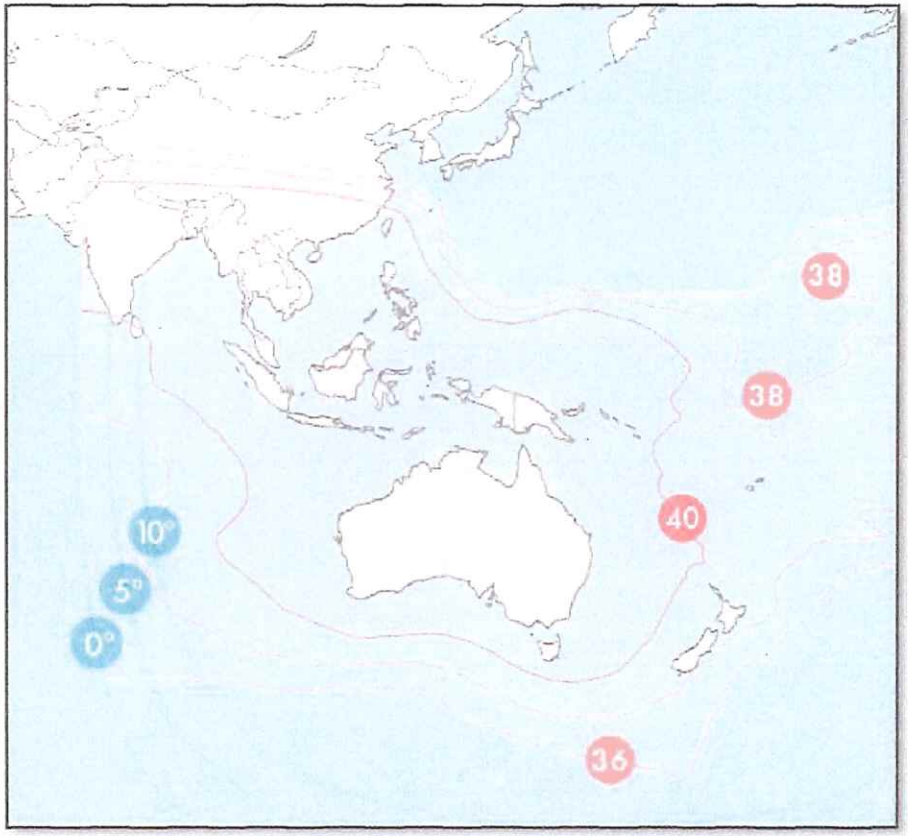
A-8-36

Ku-Band Coverage Comparison

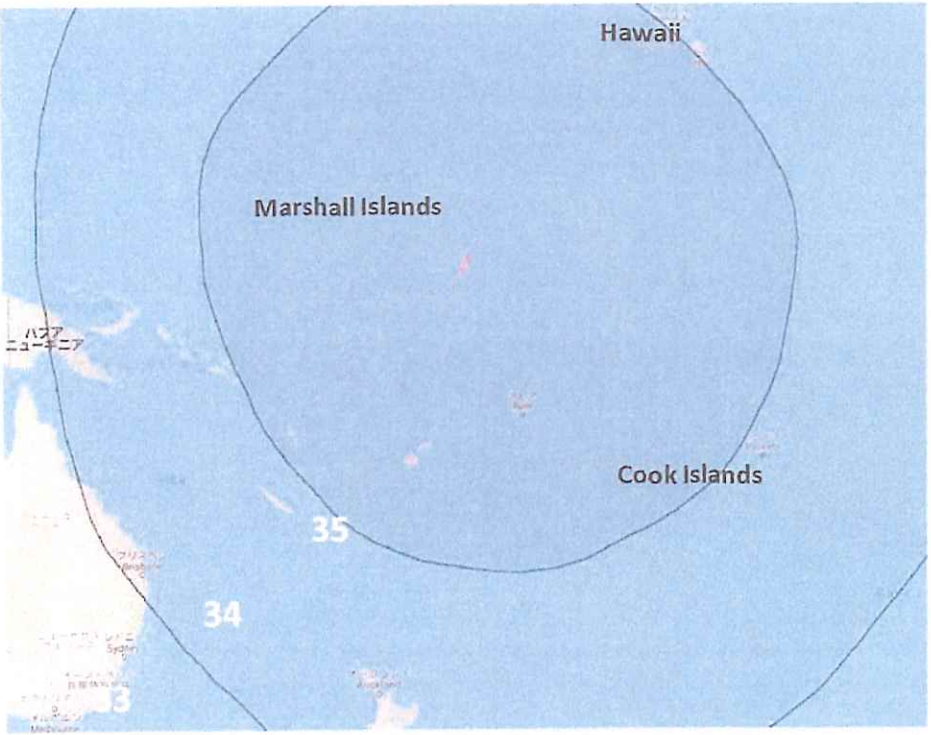
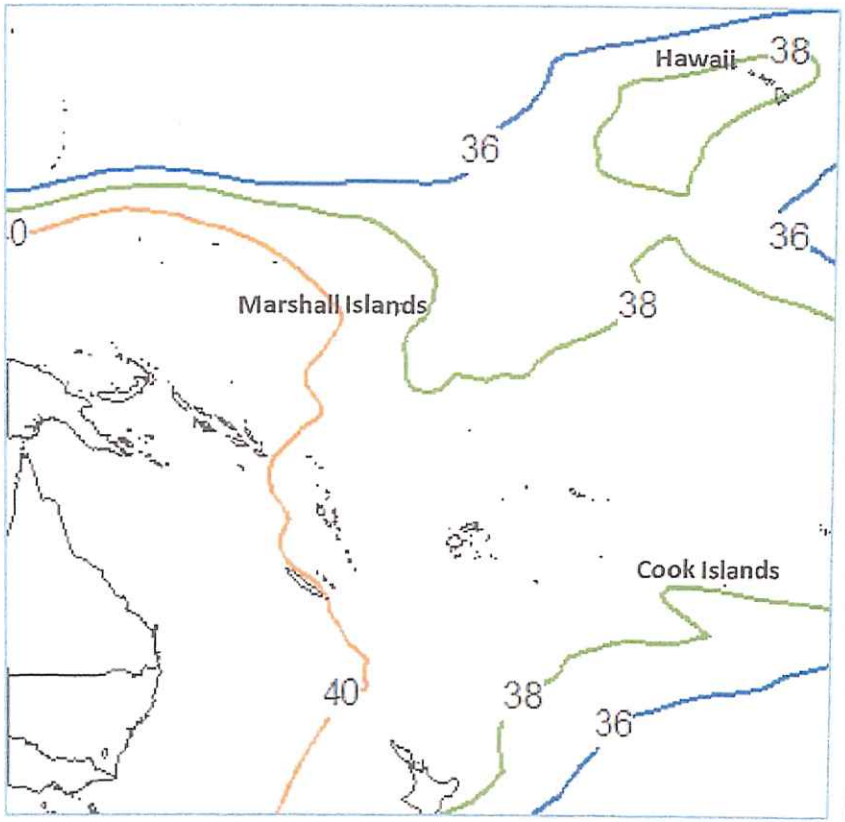
Intelsat IS-18 @180° E	JCSAT 2B @154° E
South Pacific Beam Footprint	Pacific Beam Footprint
	

Source: https://satbeams.com/

C-Band Coverage Comparison

NSS-9 @177° W	JCSAT 2B @154° E
Global Beam Footprint	South Beam Footprint
 Source: https://www.ses.com/	

C-Band Coverage Comparison

NSS-9 @177° W	JCSAT 2B @154° E
Global Beam Footprint	South Beam Footprint
	
Source: https://satbeams.com/	

Satellites over The Pacific

Company	Satellite	Orbital Location	Frequency Band	Polarization	Launch Date
SKY Perfect JSAT	JCSAT-2B	154° E	C-Band, Ku-Band	Linear	May 2016
Intelsat	IS-18	180° E	C-Band	Circular	October 2011
			Ku-Band	Linear	
	IS-19	166° E	C-Band	Linear	June 2012
SES	NSS-9	177° W	C-Band	Circular	February 2009
ABS	ABS-6	159° E	C-Band, Ku-Band	Linear	September 1999
Eutelsat	Eutelsat-172B/172A	172° E	C-Band, Ku-Band	Linear	June 2017
APT Satellite	Apstar-9	142° E	C-Band, Ku-Band	Linear	October 2015

Attachment-2

Comparison of Link Availability

Outbound : Site which is lounding points of Submarine cable : Maximum Link Availability : Minimum Link Availability

Uplink Site		Suva, Fiji													
Antenna Diameter		7.6m													
Downlink Site		Rarotonga Cook Islands	Tarawa Kiribati	Majuro Marshall Islands	Alofi Niue	Yaren Nauru	Honiara Solomon Islands	Apia Samoa	Atafu Tokelau	Nuku`Alofa Tonga	Funafuti Tuvalu	Port Vila Vanuatu	Santo Vanuatu	Fakaofo Tokelau	Nukunonu Tokelau
Antenna Diameter		4.5	4.5	4.5	4.5	4.5	4.5	6.3	4.5	4.5	4.5	4.5	3.8	4.5	4.5
Link Availability	[%]														
NSS-9	C-Band	99.986	99.996	99.992	99.989	99.995	99.994	99.998	99.992	99.995	99.996	99.994	99.978	99.993	99.993
JCSAT-2B	Ku-Band	99.930	99.940	99.950	99.960	99.960	99.960	99.970	99.930	99.950	99.940	99.960	99.950	99.940	99.930
JCSAT-2B	C-Band	99.980	99.995	99.993	99.985	99.997	99.998	99.998	99.994	99.995	99.995	99.996	99.994	99.995	99.995

Inbound

Uplink Site		Rarotonga Cook Islands	Tarawa Kiribati	Majuro Marshall Islands	Alofi Niue	Yaren Nauru	Honiara Solomon Islands	Apia Samoa	Atafu Tokelau	Nuku`Alofa Tonga	Funafuti Tuvalu	Port Vila Vanuatu	Santo Vanuatu	Fakaofo Tokelau	Nukunonu Tokelau
Antenna Diameter		4.5	4.5	4.5	4.5	4.5	4.5	6.3	4.5	4.5	4.5	4.5	3.8	4.5	4.5
Downlink Site		Suva, Fiji													
Antenna Diameter		7.6m													
Link Availability	[%]														
NSS-9	C-Band	99.979	99.979	99.979	99.979	99.979	99.979	99.979	99.979	99.979	99.979	99.979	99.979	99.979	99.979
JCSAT-2B	Ku-Band	99.910	99.910	99.910	99.930	99.900	99.910	99.930	99.920	99.950	99.910	99.950	99.940	99.910	99.910
JCSAT-2B	C-Band	99.986	99.990	99.988	99.988	99.992	99.991	99.988	99.988	99.993	99.988	99.993	99.992	99.986	99.986

A-2-1
A-8-41

JCSAT-2B Link Budget Result
Ku-band Pacific Beam, Outroute (after optimazation)

CED-B-17-094
13-June-2017

Earth Station Information		Outroute													
Uplink Site		Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva
Antenna Diameter	m	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Downlink Site		RAROTONGA	Tarawa	Majuro	Alofi	Yaren	HONIARA	Apia	Atafu	NUKU' ALOFA	Funafuti	PORT VILA	Santo	Fakaofo	Nukunonu
Antenna Diameter	m	4.5	4.5	4.5	4.5	4.5	4.5	6.3	4.5	4.5	4.5	4.5	3.8	4.5	4.5
TPC	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Carrier Information															
Information Rate	Mbps	17.190	17.190	17.190	17.190	17.190	17.190	17.190	17.190	17.190	17.190	17.190	17.190	17.190	17.190
Modulation		QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK
FEC Type		LDPC	LDPC	LDPC	LDPC	LDPC	LDPC	LDPC	LDPC	LDPC	LDPC	LDPC	LDPC	LDPC	LDPC
FEC Rate		3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
Symbol Rate	Msps	12.367	12.367	12.367	12.367	12.367	12.367	12.367	12.367	12.367	12.367	12.367	12.367	12.367	12.367
Allocated BW	MHz	14.850	14.850	14.850	14.850	14.850	14.850	14.850	14.850	14.850	14.850	14.850	14.850	14.850	14.850
Power Equivalent BW	MHz	14.840	14.840	14.840	14.840	14.840	14.840	14.840	14.840	14.840	14.840	14.840	14.840	14.840	14.840
Link Budget															
Uplink															
Required EIRP	dBW	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3
- Transmit power	dBW	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
	W	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6
- Feeder loss *1	dB	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
- Ant. Gain *1	dBi	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8
Uplink path loss	dB	-206.9	-206.9	-206.9	-206.9	-206.9	-206.9	-206.9	-206.9	-206.9	-206.9	-206.9	-206.9	-206.9	-206.9
Satellite G/T	dB/K	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Bandwidth	dBHz	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9
Boltzmann Const.	dBW/Hz·K	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6
C/Nup (thermal)	dB	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1
Downlink															
Satellite EIRP	dBW	44.6	45.4	46.1	47.1	46.9	46.8	47.2	44.9	45.2	45.4	46.2	47.2	45.3	45.2
Output backoff	dB	(-) 8.8	(-) 8.8	(-) 8.8	(-) 8.8	(-) 8.8	(-) 8.8	(-) 8.8	(-) 8.8	(-) 8.8	(-) 8.8	(-) 8.8	(-) 8.8	(-) 8.8	(-) 8.8
Downlink path loss	dB	-205.5	-205.0	-205.0	-205.3	-204.9	-204.9	-205.2	-205.2	-205.3	-205.1	-205.0	-205.0	-205.2	-205.2
Rcv. Ant. G/T *1	dB/K	29.2	29.2	29.2	29.2	29.2	29.2	32.2	29.2	29.2	29.2	29.2	27.6	29.2	29.2
Bandwidth	dBHz	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9	(-) 70.9
Boltzmann Const.	dBW/Hz·K	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6
C/Ndown (thermal)	dB	17.0	18.4	19.1	19.7	20.0	19.8	22.9	17.6	17.9	18.2	18.2	18.7	18.1	17.9
Total															
C/Ntotal (thermal)	dB	14.9	15.7	16.1	16.4	16.5	16.4	17.6	15.3	15.5	15.6	16.1	15.9	15.5	15.5
C/I	dB	14.3	14.3	14.3	14.3	14.3	14.3	14.4	14.3	14.3	14.3	14.3	14.3	14.3	14.3
Total C/(N+I)	dB	11.6	12.0	12.1	12.2	12.3	12.2	12.7	11.8	11.8	11.9	12.1	12.0	11.9	11.8
Required C/(N+I) *2	dB	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Total C/(N+I) Margin	dB	7.3	7.8	7.8	7.9	7.9	7.9	8.4	7.4	7.5	7.6	7.8	7.7	7.5	7.5
Link Availability *3	%	99.93	99.94	99.95	99.96	99.96	99.96	99.97	99.93	99.95	99.94	99.96	99.95	99.94	99.93

<NOTE>
Satellite performances are subject to change
*1 The above calculation is based on the Earth station specification with our assumptive parameters.
*2 These parameters are based on Guaranteed E_b/N_0 of iDirect satellite modem
*3 These parameters are based on ITU-R P.618-9 and its related documents.

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SKY Perfect JSAT Corporation

JCSAT-2B Link Budget Result
C-band South Beam, Outroute (after optimization)

CED-B-17-094
13-June-2017

Earth Station Information		Outroute													
Uplink Site		Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva
Antenna Diameter	m	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Downlink Site		RAROTONGA	Tarawa	Majuro	Aloft	Yaren	HONIARA	Apia	Atafu	NUKU' ALOFA	Funafuti	PORT VILA	Santo	Fakaofo	Nukunonu
Antenna Diameter	m	4.5	4.5	4.5	4.5	4.5	4.5	6.3	4.5	4.5	4.5	4.5	3.8	4.5	4.5
Carrier Information															
Information Rate	Mbps	17.190	17.190	17.190	17.190	17.190	17.190	17.190	17.190	17.190	17.190	17.190	17.190	17.190	17.190
Modulation		8PSK	8PSK	8PSK	8PSK	8PSK	8PSK	8PSK	8PSK	8PSK	8PSK	8PSK	8PSK	8PSK	8PSK
FEC Type		LDPC	LDPC	LDPC	LDPC	LDPC	LDPC	LDPC	LDPC	LDPC	LDPC	LDPC	LDPC	LDPC	LDPC
FEC Rate		3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
Symbol Rate	Msps	8.304	8.304	8.304	8.304	8.304	8.304	8.304	8.304	8.304	8.304	8.304	8.304	8.304	8.304
Allocated BW	MHz	9.140	9.140	9.140	9.140	9.140	9.140	9.140	9.140	9.140	9.140	9.140	9.140	9.140	9.140
Power Equivalent BW	MHz	10.249	10.249	10.249	10.249	10.249	10.249	10.249	10.249	10.249	10.249	10.249	10.249	10.249	10.249
Link Budget															
Uplink															
Required EIRP	dBW	65.2	65.2	65.2	65.2	65.2	65.2	65.2	65.2	65.2	65.2	65.2	65.2	65.2	65.2
- Transmit power	dBW	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6
	W	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0
- Feeder loss *1	dB	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
- Ant. Gain *1	dBi	51.6	51.6	51.6	51.6	51.6	51.6	51.6	51.6	51.6	51.6	51.6	51.6	51.6	51.6
Uplink path loss	dB	-199.6	-199.6	-199.6	-199.6	-199.6	-199.6	-199.6	-199.6	-199.6	-199.6	-199.6	-199.6	-199.6	-199.6
Satellite G/T	dB/K	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2
Bandwidth	dBHz	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2
Boltzmann Const.	dBW/Hz-K	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6
C/Nup (thermal)	dB	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7
Downlink															
Satellite EIRP	dBW	37.8	38.6	38.8	38.2	40.2	41.4	39.2	39.5	38.8	38.8	39.4	39.6	39.7	39.7
Output backoff	dB	(-) 10.9	(-) 10.9	(-) 10.9	(-) 10.9	(-) 10.9	(-) 10.9	(-) 10.9	(-) 10.9	(-) 10.9	(-) 10.9	(-) 10.9	(-) 10.9	(-) 10.9	(-) 10.9
Downlink path loss	dB	-196.0	-195.5	-195.5	-195.8	-195.4	-195.4	-195.8	-195.7	-195.8	-195.6	-195.5	-195.5	-195.7	-195.7
Rcv. Ant. G/T *1	dB/K	23.2	24.7	23.6	23.2	24.7	24.7	27.1	23.2	24.7	24.7	24.7	23.3	23.8	23.6
Bandwidth	dBHz	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2	(-) 69.2
Boltzmann Const.	dBW/Hz-K	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6
C/Ndown (thermal)	dB	13.4	16.2	15.4	14.0	17.9	19.1	19.0	15.4	16.2	16.1	16.9	15.8	16.0	16.0
Total															
C/Ntotal (thermal)	dB	12.3	14.3	13.7	12.6	15.3	15.9	15.8	13.7	14.3	14.2	14.7	14.0	14.1	14.1
C/I	dB	14.0	14.0	13.9	13.8	14.1	14.1	14.1	14.1	14.0	14.1	14.0	13.9	14.1	14.1
Total C/(N+I)	dB	10.1	11.1	10.8	10.2	11.6	11.9	11.9	10.9	11.1	11.1	11.4	10.9	11.1	11.1
Required C/(N+I) *2	dB	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Total C/(N+I) Margin	dB	1.6	2.7	2.3	1.8	3.2	3.4	3.4	2.4	2.7	2.7	2.9	2.5	2.6	2.6
Link Availability *3	%	99.980	99.995	99.993	99.985	99.997	99.998	99.998	99.994	99.995	99.995	99.996	99.994	99.995	99.995

<NOTE>
Satellite performances are subject to change.
*1 The above calculation is based on the Earth station specification with our assumptive parameters
*2 These parameters are based on Guaranteed E_b/N_0 of iDirect satellite modem
*3 These parameters are based on ITU-R P.618-9 and its related documents

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SKY Perfect JSAT Corporation

JCSAT-2B Link Budget Result
Ku-band Pacific Beam, Inroute (after optimization)

CED-B-17-094
13-June-2017

Earth Station Information		Inroute													
Uplink Site		RAROTONGA	Tarawa	Majuro	Alofi	Yaren	HONIARA	Apia	Atafu	NUKU' ALOFA	Funafuti	PORT VILA	Santo	Fakaofo	Nukunonu
Antenna Diameter	m	4.5	4.5	4.5	4.5	4.5	4.5	6.3	4.5	4.5	4.5	4.5	3.8	4.5	4.5
Downlink Site		Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva
Antenna Diameter	m	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
TPC	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carrier Information															
Information Rate	Mbps	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.250
Modulation		QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK
FEC Type		2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B
FEC Rate		1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Symbol Rate	Msps	2.500	2.500	2.500	2.500	2.500	2.500	2.500	2.500	2.500	2.500	2.500	2.500	2.500	2.500
Allocated BW	MHz	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000
Power Equivalent BW	MHz	2.242	3.000	3.000	3.000	3.000	3.000	3.000	3.000	2.796	3.000	3.000	2.963	3.000	3.000
Link Budget															
Uplink															
Required EIRP	dBW	63.0	61.7	60.8	61.9	60.7	61.9	62.3	61.9	63.0	61.9	61.5	61.5	62.2	62.2
- Transmit power	dBW	9.5	8.2	7.3	8.4	7.2	8.5	5.9	8.4	9.5	8.5	8.0	9.5	8.7	8.7
	W	8.9	6.6	5.4	6.9	5.3	7.0	3.9	7.0	8.9	7.0	6.4	8.9	7.4	7.4
- Feeder loss *1	dB	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8
- Ant. Gain *1	dBi	54.3	54.3	54.3	54.3	54.3	54.3	57.2	54.3	54.3	54.3	54.3	52.8	54.3	54.3
Uplink path loss	dB	-207.3	-206.7	-206.7	-207.1	-206.7	-206.7	-207.0	-207.0	-207.0	-206.8	-206.8	-206.7	-207.0	-207.0
Satellite G/T	dB/K	-2.3	-0.4	0.6	-0.2	0.6	-0.7	-0.7	-0.4	-1.7	-0.5	-0.1	-0.2	-0.6	-0.6
Bandwidth	dBHz	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0
Boltzmann Const.	dBW/Hz-K	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6
C/Nup (thermal)	dB	17.9	19.1	19.1	19.1	19.1	19.1	19.1	19.1	18.8	19.1	19.1	19.1	19.1	19.1
Downlink															
Satellite EIRP	dBW	45.7	45.7	45.7	45.7	45.7	45.7	45.7	45.7	45.7	45.7	45.7	45.7	45.7	45.7
Output backoff	dB	(-) 17.1	(-) 15.8	(-) 15.8	(-) 15.8	(-) 15.8	(-) 15.8	(-) 15.8	(-) 15.8	(-) 16.1	(-) 15.8	(-) 15.8	(-) 15.8	(-) 15.8	(-) 15.8
Downlink path loss	dB	-205.1	-205.1	-205.1	-205.1	-205.1	-205.1	-205.1	-205.1	-205.1	-205.1	-205.1	-205.1	-205.1	-205.1
Rcv. Ant. G/T *1	dB/K	33.8	33.8	33.8	33.8	33.8	33.8	33.8	33.8	33.8	33.8	33.8	33.8	33.8	33.8
Bandwidth	dBHz	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0	(-) 64.0
Boltzmann Const.	dBW/Hz-K	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6
C/Ndown (thermal)	dB	21.8	23.0	23.0	23.0	23.0	23.0	23.0	23.0	22.7	23.0	23.0	23.0	23.0	23.0
Total															
C/N total (thermal)	dB	16.4	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.3	17.6	17.6	17.6	17.6	17.6
C/I	dB	13.7	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.3	14.4	14.4	14.4	14.4	14.4
Total C/(N+I)	dB	11.9	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.5	12.7	12.7	12.7	12.7	12.7
Required C/(N+I) *2	dB	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Total C/(N+I) Margin	dB	9.7	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.3	10.5	10.5	10.5	10.5	10.5
Link Availability *3	%	99.91	99.91	99.91	99.93	99.90	99.91	99.93	99.92	99.95	99.91	99.95	99.94	99.91	99.91

<NOTE>
Satellite performances are subject to change
*1 : The above calculation is based on the Earth station specification with our assumptive parameters
*2 These parameters are based on Guaranteed E_b/N_0 of iDirect satellite modem
*3 : These parameters are based on ITU-R P 618-9 and its related documents

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SKY Perfect JSAT Corporation

JCSAT-2B Link Budget Result
C-band South Beam, Inroute (after optimization)

Earth Station Information		Inroute													
Uplink Site		RAROTONGA	Tarawa	Majuro	Aloft	Yaren	HONIARA	Apia	Atafu	NUKU' ALOFA	Funafuti	PORT VILA	Santo	Fakaofo	Nukunonu
Antenna Diameter	m	4.5	4.5	4.5	4.5	4.5	4.5	6.3	4.5	4.5	4.5	4.5	3.8	4.5	4.5
Downlink Site		Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva	Suva
Antenna Diameter	m	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Carrier Information															
Information Rate	Mbps	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.250
Modulation		8PSK	8PSK	8PSK	8PSK	8PSK	8PSK	8PSK	8PSK	8PSK	8PSK	8PSK	8PSK	8PSK	8PSK
FEC Type		2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B	2D16S-170B
FEC Rate		2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3
Symbol Rate	Msps	1.302	1.302	1.302	1.302	1.302	1.302	1.302	1.302	1.302	1.302	1.302	1.302	1.302	1.302
Allocated BW	MHz	1.570	1.570	1.570	1.570	1.570	1.570	1.570	1.570	1.570	1.570	1.570	1.570	1.570	1.570
Power Equivalent BW	MHz	0.948	0.948	0.948	0.948	0.948	0.948	0.948	0.948	0.948	0.948	0.948	0.948	0.948	0.948
Link Budget															
Uplink															
Required EIRP	dBW	54.5	54.8	55.2	53.8	54.6	52.3	54.3	54.4	55.2	52.0	54.1	53.2	54.4	54.4
- Transmit power	dBW	8.3	8.6	9.0	7.6	8.4	6.1	5.2	8.2	9.0	5.8	7.9	8.5	8.2	8.2
	W	6.8	7.3	8.0	5.8	6.9	4.1	3.3	6.6	7.9	3.8	6.2	7.1	6.6	6.6
- Feeder loss *1	dB	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8
- Ant. Gain *1	dBi	47.0	47.0	47.0	47.0	47.0	47.0	49.9	47.0	47.0	47.0	47.0	45.5	47.0	47.0
Uplink path loss	dB	-200.0	-199.4	-199.4	-199.8	-199.4	-199.4	-199.7	-199.6	-199.7	-199.5	-199.5	-199.4	-199.7	-199.7
Satellite G/T	dB/K	-5.5	-6.3	-6.8	-5.0	-6.2	-3.9	-5.6	-5.7	-6.4	-3.4	-5.6	-4.8	-5.7	-5.7
Bandwidth	dBHz	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1
Boltzmann Const.	dBW/Hz-K	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6
C/Nup (thermal)	dB	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4
Downlink															
Satellite EIRP	dBW	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9
Output backoff	dB	(-) 21.2	(-) 21.2	(-) 21.2	(-) 21.2	(-) 21.2	(-) 21.2	(-) 21.2	(-) 21.2	(-) 21.2	(-) 21.2	(-) 21.2	(-) 21.2	(-) 21.2	(-) 21.2
Downlink path loss	dB	-195.7	-195.7	-195.7	-195.7	-195.7	-195.7	-195.7	-195.7	-195.7	-195.7	-195.7	-195.7	-195.7	-195.7
Rcv. Ant. G/T *1	dB/K	29.6	29.6	29.6	29.6	29.6	29.6	29.6	29.6	29.6	29.6	29.6	29.6	29.6	29.6
Bandwidth	dBHz	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1	(-) 61.1
Boltzmann Const.	dBW/Hz-K	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6
C/Ndown (thermal)	dB	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9
Total															
C/Ntotal (thermal)	dB	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5
C/I	dB	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
Total C/(N+I)	dB	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6
Required C/(N+I) *2	dB	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Total C/(N+I) Margin	dB	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Link Availability *3	%	99.986	99.990	99.986	99.988	99.992	99.991	99.988	99.988	99.993	99.988	99.993	99.992	99.988	99.986

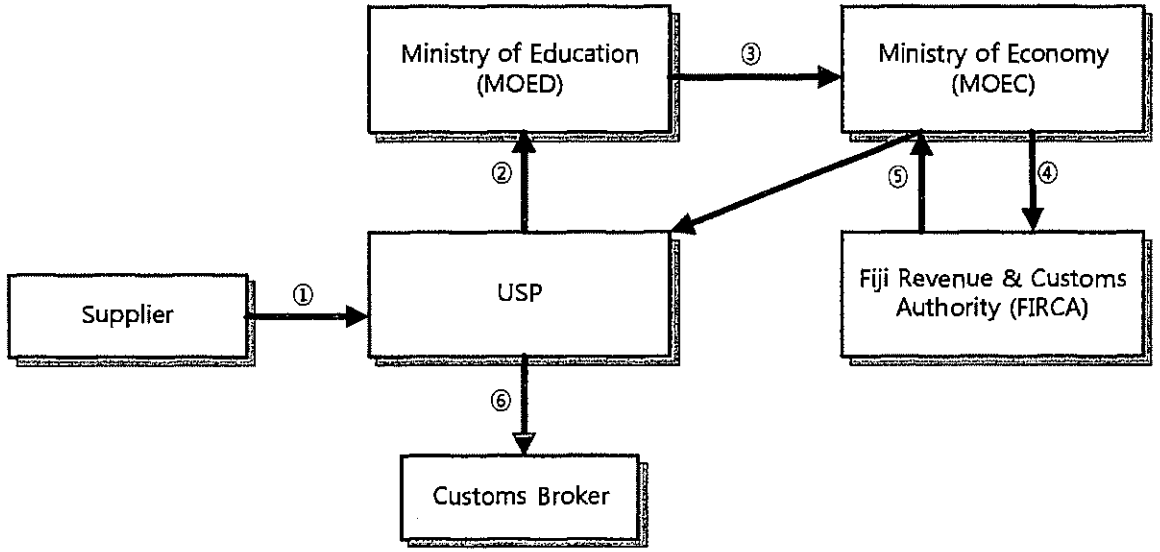
<NOTE>
Satellite performances are subject to change.
*1 The above calculation is based on the Earth station specification with our assumptive parameters
*2 These parameters are based on Guaranteed E_b/N_0 of iDirect satellite modem
*3 These parameters are based on ITU-R P.618-9 and its related documents

A-2-5
A-8-45

Attachment-3

Tax Exemption Procedures

<Import Duties>
<Consumption Tax for Import Materials>



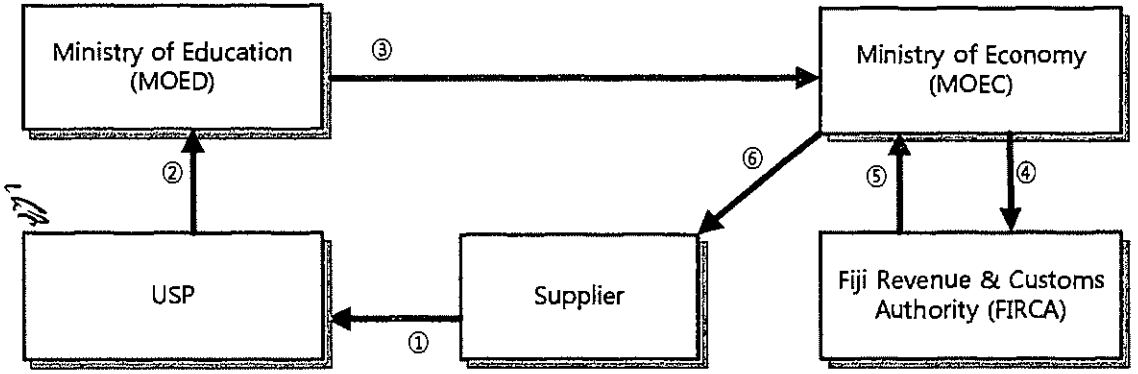
① The Supplier shall send an application for Tax Exemption with following documents to USP;
- Bill of Lading
- Commercial Invoice
- Packing List

② USP will send the application to MOED
③ MOED will review and send the application to MOEC
④ MOEC will review and send the application to FIRCA
⑤ FIRCA will review the application and approve the exemption. Then FIRCA will send Tax Exemption Letter to USP via MOEC
⑥ After USP obtains the approval, USP requests to proceed a custom clearance with Tax Exemption to Custom Broker

A-3-1
A-8-46

VAT Refunding Procedures

<VAT for the Equipment and construction materials procured in Fiji>



① The Supplier shall send the Invoice of the Equipment/construction materials which has been described VAT amount to USP
② USP will send the document to MOED
③ MOED will review and send the document to MOEC
④ MOEC will review and send the document to FIRCA
⑤ FIRCA will review the document and approve to refund the VAT. and inform MOEC of it.
⑥ After MOEC obtains the approval, MOEC will refund the VAT to the Supplier

Appendix 9 Comparison between Existing C-band / Ku-band Antenna System and New Ku-band Antenna System

Comparison between Existing C-band/Ku-band Antenna System and New Ku-band Antenna System

Preparatory Survey Team for the Outline Design of the Project for the Enhancement of USPNet Communication System

No.	Item	Existing C-band and Ku-band system		New Ku-band system
1	Running Cost (Satellite Fee)	C-band:	This part is closed due to confidentiality.	1,512,000 FJD (- 213,800 FJD)
		Ku-band:		
		Total	1,725,800 FJD	
2	Bandwidth	C-band:	15 MHz	20 MHz
		Ku-band:	5 MHz	
3	Reliability/Rain Fade	C-band:	○ 99.98 ~ 99.99 % (NSS-9)	○ 99.72 ~ 99.97 %* (JCSAT-2B)
		Ku-band:	△ 73.39 ~ 99.74 % (IS-18)	
4	Antenna Diameter in Remote Station	C-band:	4.5 m (Campus) ~ 1.8 m (Center)	4.5 m (Campus) ~ 1.0 m (Home)
		Ku-band:		
5	Flexibility/Selectable Satellite	C-band:	NSS-9 JCSAT-2B (C)	JCSAT-2B (Ku) IS-18
		Ku-band:	IS-18 JCSAT-2B (Ku)	
6	System Design	Dual Satellite System		Single Satellite System

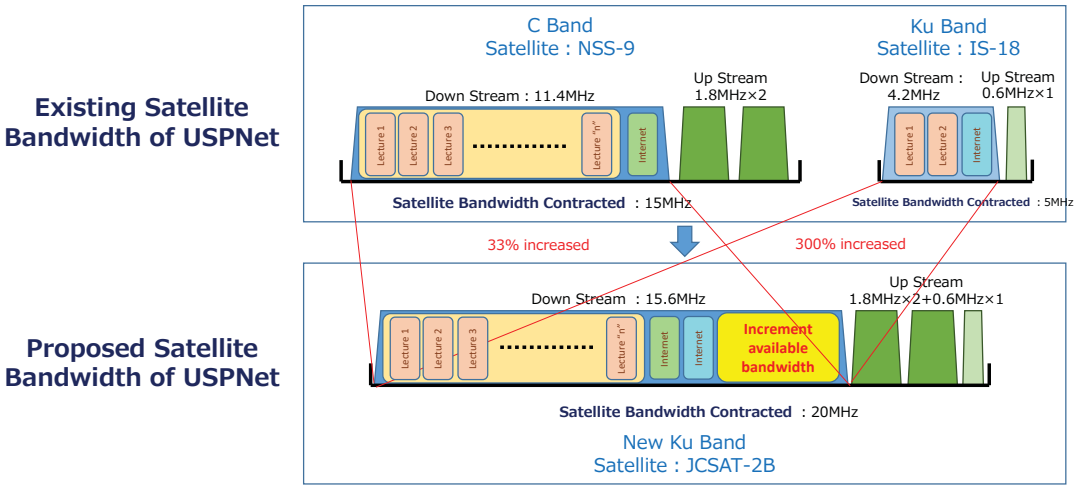
* In case 1.8 m (Center) of Antenna Diameter in Remote Station

1. Reduction of maintenance and operation cost

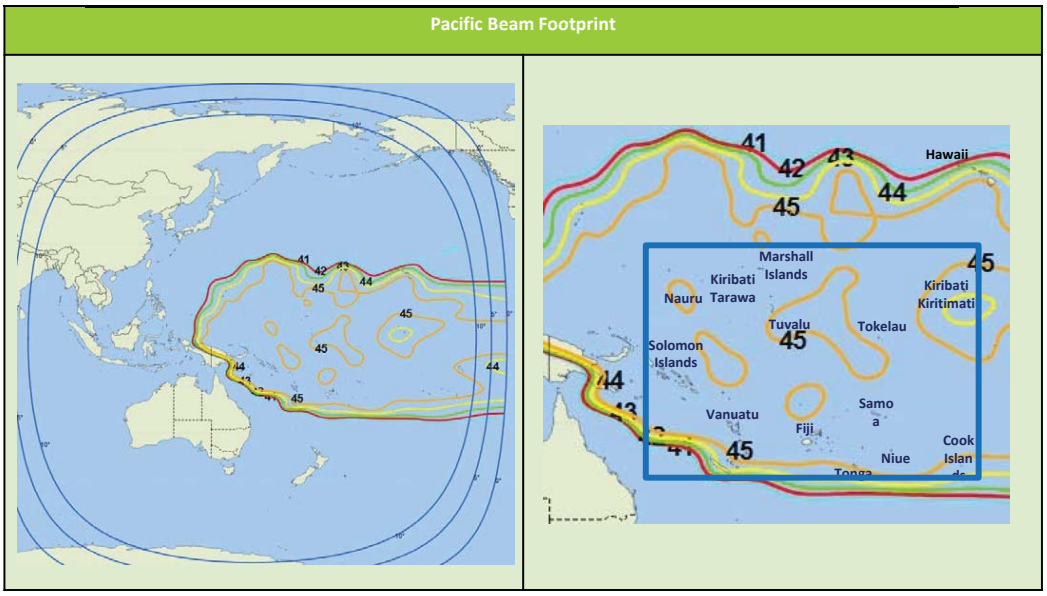
Currently USP has TWO contracts with different satellite operaters. If the system will be unified into ONE contract (Ku-band), the cost will be decreased. Cost for maintenance parts and satellite fee of HUB station are also reduction.

2. Expanded distance learning contents

Bandwidth of the C-band is 15MHz in USPNet. By expanding it to 20MHz, USPNet will be possible to increase available bandwidth.



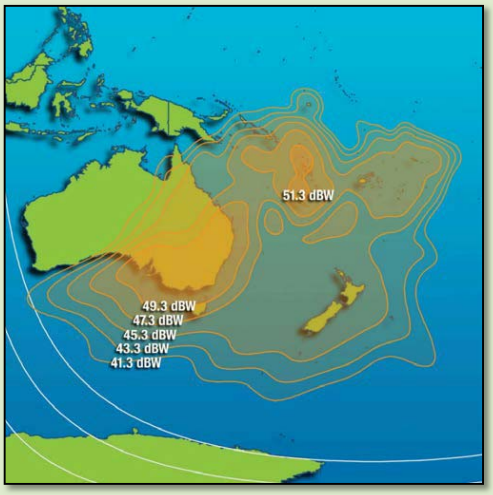
JCSAT 2B @154 E New Ku-Band Coverage

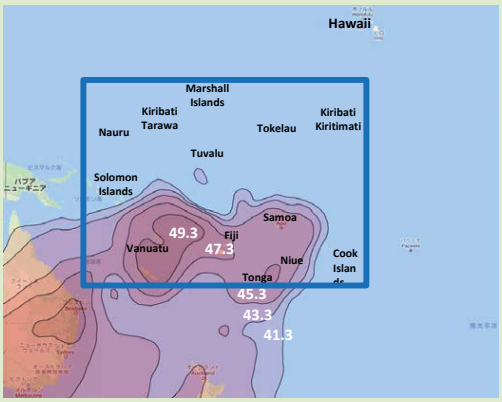


Source: http://www.jsat.net/

Intelsat IS-18 @180 E　Existing Ku-Band Coverage

South Pacific Beam Footprint





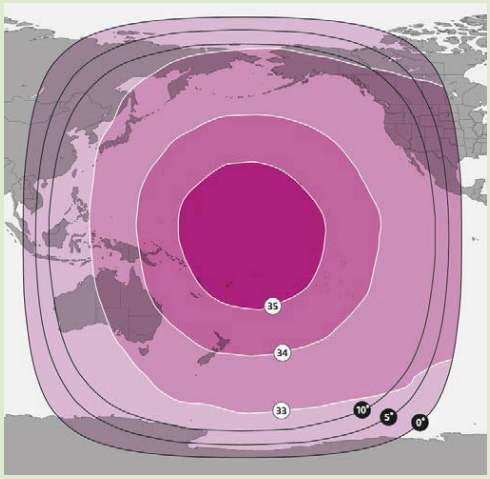
Source: https://satbeams.com/

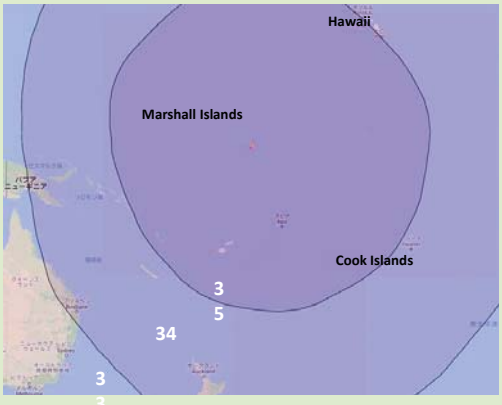
Source: http://www.intelsat.com/

*IS-18 (Ku-band) is not able to cover some member countries of USP. Therefore, link availability of some Center is low.

NSS-9 @177 W　C-Band Coverage

Global Beam Footprint





Source: https://satbeams.com/

Source: https://www.ses.com/