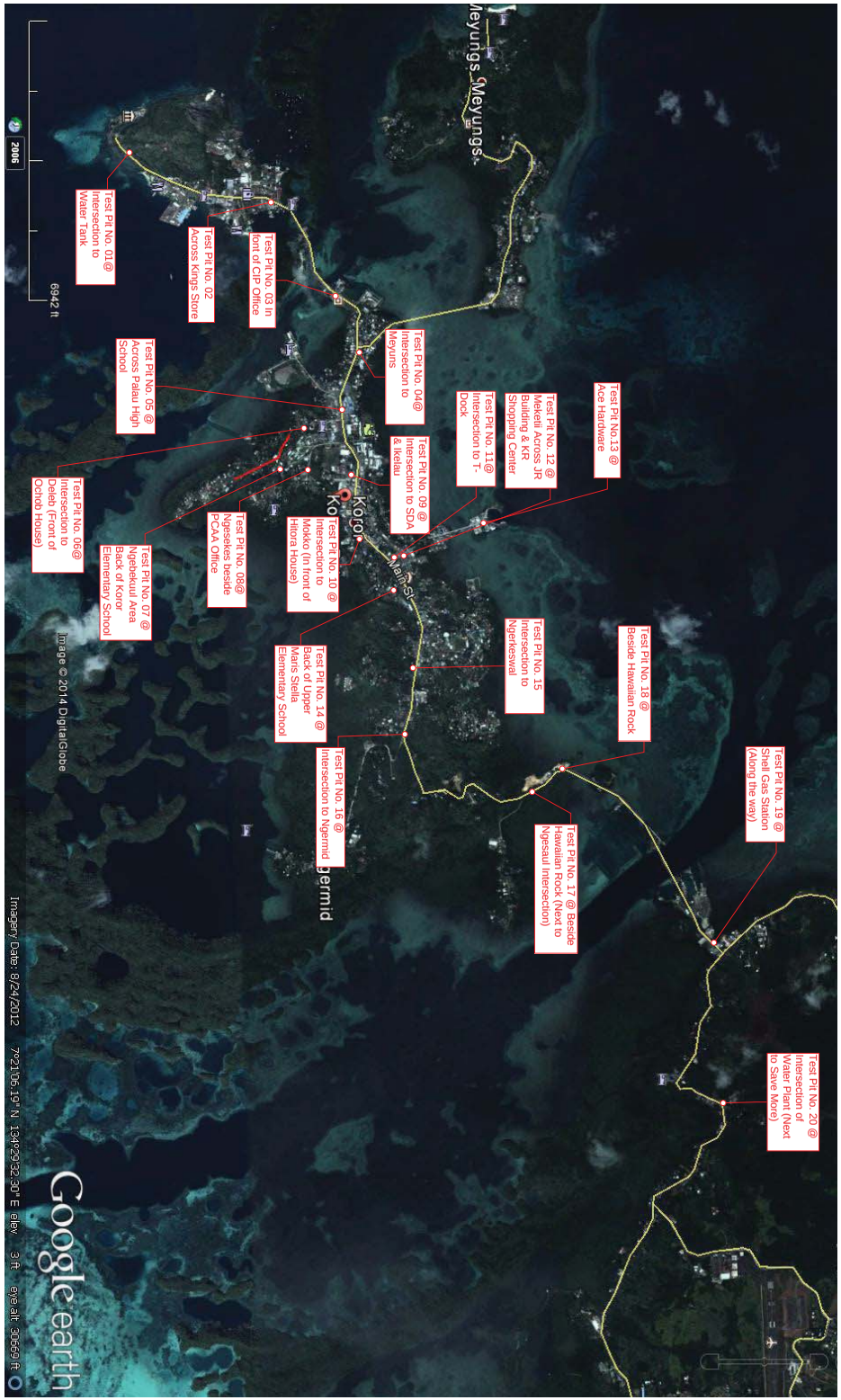
資料-9

自然条件調査（試掘調査）結果

（現地再委託）



資料-9-1

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www.construction.surangel.com

Category : Soil Condiction

Date: October 23,2014

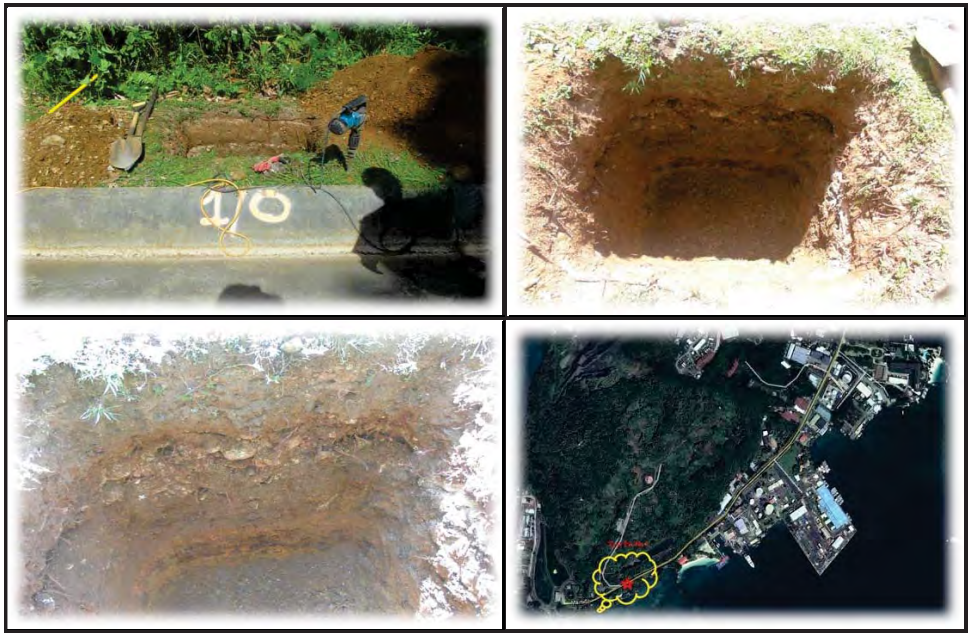
Location: Intersection to Malakal Water Tank

Sampler: Ebil Gailliard

Weather: Clear (Fair)

Sampling Method: Manual Excavation

Location/ Area	Test Pit No.	Type Of Soil	Thickness / Layer	Remarks
Intersection to Malakal	1	Topsoil	45 cm	
Tank		Coral	15 cm	
Malakal, Koror		Clay	60 cm	



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Category : Soil Condition

Date: October 23,2014

Location: Across Kings Store

Sampler: Ebil Gailliard

Weather: Clear (Fair)

Sampling Method: Manual Excavation

Location/ Area	Test Pit No.	Type Of Soil	Thickness / Layer	Remarks
Across Kings Store	2	Basecourse	15 cm	
Malakal, Koror		Clay	105 cm	

資料-9-2

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Category : Soil Condition

Date: October 22,2014

Location: Infront of CIP Office

Sampler: Ebil Gailliard

Weather: Clear (Fair)

Sampling Method: Manual Excavation

Location/ Area	Test Pit No.	Type Of Soil	Thickness / Layer	Remarks
Infront of CIP Office	3	Coral	120 cm	
Malakal, Koror				

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Category : Soil Condition

Date: October 22,2014

Location: Inter. to Meyuns Infront of Rainbow Mart

Sampler: Ebil Gailliard

Weather: Clear (Fair)

Sampling Method: Manual Excavation

Location/ Area	Test Pit No.	Type Of Soil	Thickness / Layer	Remarks
Infron of Rainbow Mart	4	Basecourse	100 cm	
Malakal, Koror		Coral	10 cm	
		Clay	10 cm	

資料-9-3

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Category : Soil Condition

Date: October 22,2014

Location: Infront of H.E Store

Sampler: Ebil Gailliard

Weather: Clear (Fair)

Sampling Method: Manual Excavation

Location/ Area	Test Pit No.	Type Of Soil	Thickness / Layer	Remarks
Infront of H.E Store	5	Basecourse	40 cm	
Malakal, Koror		Clay	80 cm	

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Category : Soil Condition

Date: October 22,2014

Location: Infront of Ochob House

Sampler: Ebil Gailliard

Weather: Clear (Fair)

Sampling Method: Manual Excavation

Location/ Area	Test Pit No.	Type Of Soil	Thickness / Layer	Remarks
Infront of Ochob House	6	Top soil	4 cm	
Ngerbeched, Koror		Basecourse	6 cm	
		Coral	40 cm	
		Clay	70 cm	

資料-9-4




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Category : Soil Condition

Date: October 21,2014

Location: Ngebekuu Area

Sampler: Ebil Gailliard

Weather: Clear (Fair)

Sampling Method: Manual Excavation

Location/ Area	Test Pit No.	Type Of Soil	Thickness / Layer	Remarks
Ngebekuu Area	7	Coral	35 cm	
Ngerbeched, Koror		Clay	95 cm	




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Category : Soil Condition

Date: October 21,2014

Location: Ngesekes Area

Sampler: Ebil Gailliard

Weather: Clear (Fair)

Sampling Method: Manual Excavation

Location/ Area	Test Pit No.	Type Of Soil	Thickness / Layer	Remarks
Ngesekes Area	8	Top Soil	10 cm	
Ngerbeched, Koror		Coral	30 cm	
		Clay	80 cm	

資料-9-5




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Category : Soil Condition

Date: October 22,2014

Location: Intersection @ SDA Elemetary School

Sampler: Ebil Gailliard

Weather: Clear (Fair)

Sampling Method: Manual Excavation

Location/ Area	Test Pit No.	Type Of Soil	Thickness / Layer	Remarks
Inter. Of SDA	9	Clay	120 cm	**All Clay**
Ngerbeched, Koror				



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Category : Soil Condition

Date: October 20,2014

Location: Infront of Hitor House

Sampler: Ebil Gailliard

Weather: Clear (Fair)

Sampling Method: Manual Excavation

Location/ Area	Test Pit No.	Type Of Soil	Thickness / Layer	Remarks
Infront of Hitora House	10	Clay	120 cm	***All Clay***
Ikelau, Koror				

資料-6-6




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Category : Soil Investigation

Date: October 21,2014

Location: Intersection @ Neco building going to T-Dock

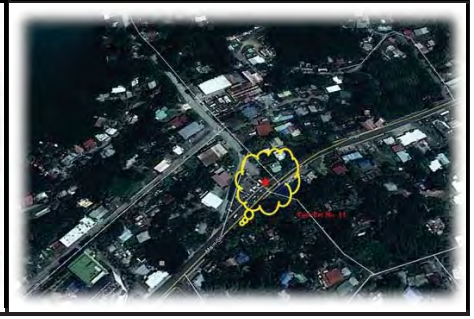
Sampler: Ebil Gailliard

Weather: Clear (Fair)

Sampling Method: Manual Excavation

Location/ Area	Test Pit No.	Type Of Soil	Thickness / Layer	Remarks
NECO Building	11	Basecourse	100 cm	
Ikelau, Koror		Clay	10 cm	
		Coral	10 cm	



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Category : Soil Condition

Date: October 20,2014

Location: Across Jr Building & KR Shopping Center

Sampler: Ebil Gailliard

Weather: Clear (Fair)

Sampling Method: Manual Excavation

Location/ Area	Test Pit No.	Type Of Soil	Thickness / Layer	Remarks
Across JR & KR Building	12	Bascourse	15 cm	
Ikelau, Koror		Coral	10 cm	
		Clay	95 cm	

資料-9-7

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Category : Soil Condition

Date: October 20,2014

Location: Across Ace Hardware

Sampler: Ebil Gailliard

Weather: Clear (Fair)

Sampling Method: Manual Excavation

Location/ Area	Test Pit No.	Type Of Soil	Thickness / Layer	Remarks
Across Ace Hardware	13	Basecourse	35 cm	
Ikelau, Koror		Coral	85 cm	

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Category : Soil Condition

Date: October 19,2014

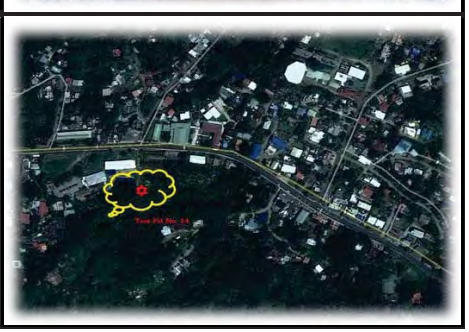
Location: Back at the upper Maris Stella school

Sampler: Ebil Gailliard

Weather: Clear (Fair)

Sampling Method: Manual Excavation

Location/ Area	Test Pit No.	Type Of Soil	Thickness / Layer	Remarks
Upper Maris Stella	14	Coral	20 cm	
Idid, Koror		Clay	100 cm	



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Category : Soil Condition

Date: October 19,2014

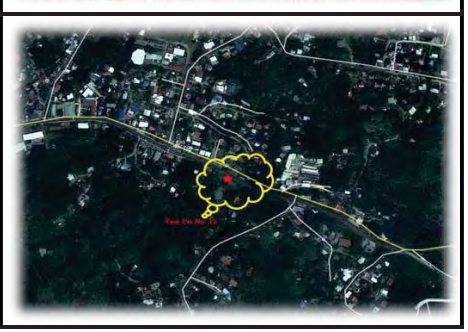
Location: Intersection of Ngekesewaul

Sampler: Ebil Gailliard

Weather: Clear (Fair)

Sampling Method: Manual Excavation

Location/ Area	Test Pit No.	Type Of Soil	Thickness / Layer	Remarks
Inter. of Ngekesewaul	15	Basecuorse	10 cm	
Ngerkeswaul, Koror		Clay	110 cm	



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Category : Soil Condition

Date: October 17,2014

Location: Intersection of Ngermid

Sampler: Ebil Gailliard

Weather: Clear (Fair)

Sampling Method: Manual Excavation

Location/ Area	Test Pit No.	Type Of Soil	Thickness / Layer	Remarks
Intersection of Ngermid	16	Basecourse	10 cm	
Ngerkeswaul, Koror		Rock	90 cm	
		Clay	20 cm	

資料9-9

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Category : Soil Condition

Date: October 17,2014

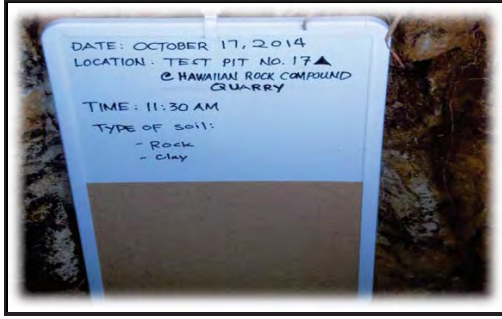
Location: Along Hawaiian Rock Quarry

Sampler: Ebil Gailliard

Weather: Clear (Fair)

Sampling Method: Manual Excavation

Location/ Area	Test Pit No.	Type Of Soil	Thickness / Layer	Remarks
Hawaiian Rock Quarry	17	Rock	100 cm	
Ngesaul, Koror		Clay	20 cm	



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Category : Soil Condition

Date: October 16,2014

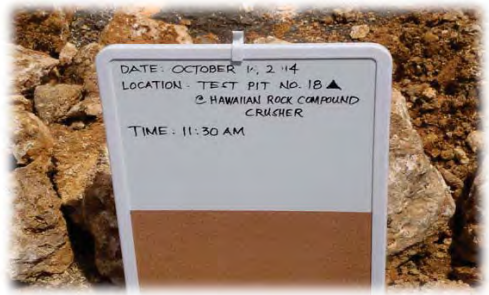
Location: Along Hawaiian Rock Quarry

Sampler: Ebil Gailliard

Weather: Clear (Fair)

Sampling Method: Manual Excavation

Location/ Area	Test Pit No.	Type Of Soil	Thickness / Layer	Remarks
Hawaiian Rock Quarry	18	Coral	15 cm	
Ngesaul,Koror		Rocks	105 cm	



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Category : Soil Condition

Date: October 23,2014

Location: Along Shell Gas Station

Sampler: Ebil Gailliard

Weather: Clear (Fair)

Sampling Method: Manual Excavation

Location/ Area	Test Pit No.	Type Of Soil	Thickness / Layer	Remarks
Shell Gas Station	19	Basecourse	120 cm	
Airai				

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Category : Soil Condition

Date: October 23,2014

Location: Intersection to water plant

Sampler: Ebil Gailliard

Weather: Clear (Fair)

Sampling Method: Manual Excavation

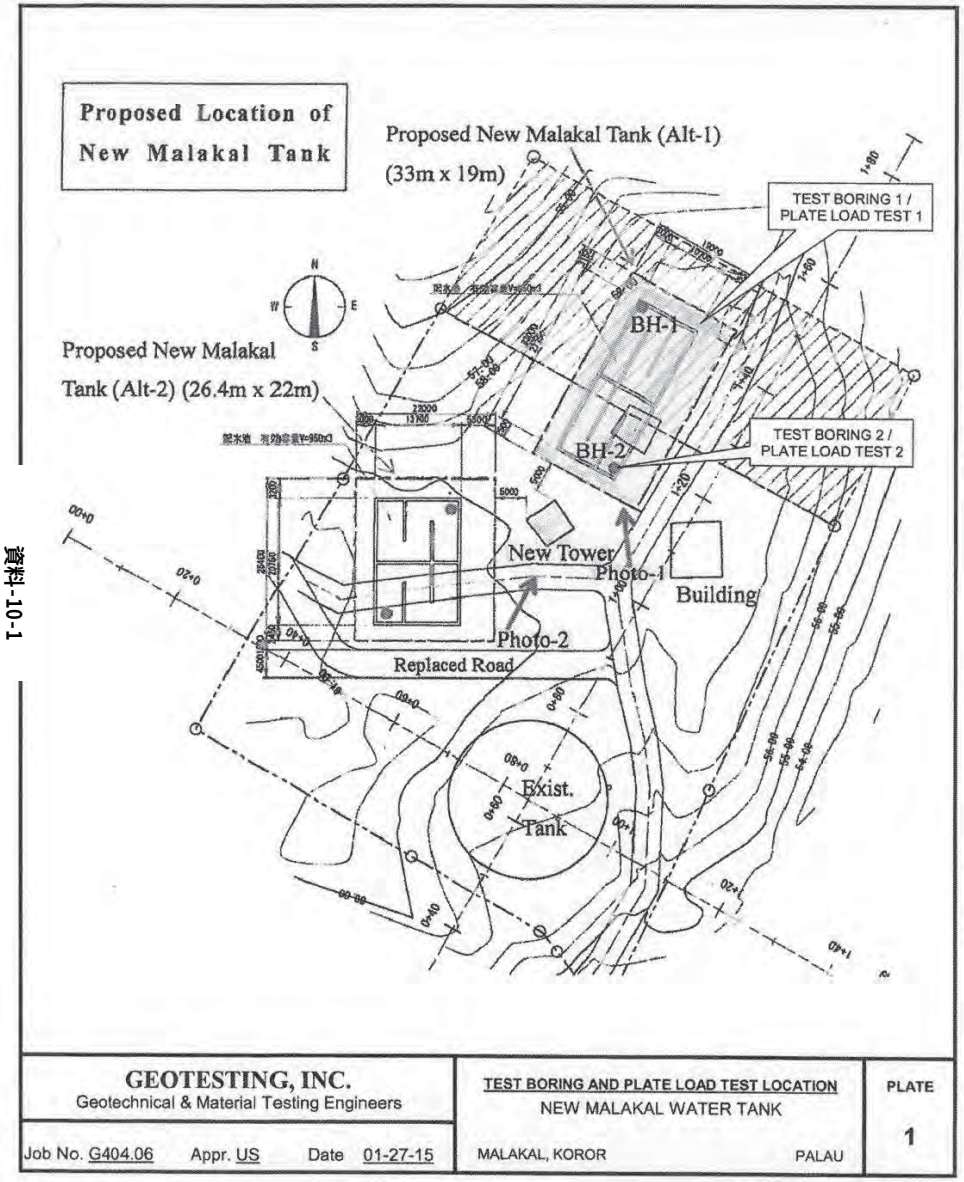
Location/ Area	Test Pit No.	Type Of Soil	Thickness / Layer	Remarks
Inter. to water plant	20 a	Coral	60 m	Stopped do to Concrete Pipe
Ngesaul,Koror				**Relocation of Test Pit**
	20 b	Basecourse	15 cm	Final Test Pit Location
		Coral	105 cm	

資料-9-11

資料-10

自然条件調査（地盤調査）結果

（現地再委託）



GEOTESTING, INC. Geotechnical & Material Testing Engineers	TEST BORING AND PLATE LOAD TEST LOCATION NEW MALAKAL WATER TANK	PLATE
Job No. G404.06 Appr. US Date 01-27-15	MALAKAL, KOROR PALAU	1

資料-10-1

PROJECT: NEW MALAKAL WATER TANK
Malakal, Koror, Palau

RESULTS OF PLATE LOAD TESTS

Plate Load Test No.	Yield Point load,		½ Yield Point load,		Settlement,
	psi	psf	psi	psf	Inches
PLT-1	36	5184	18	2592	0.080
PLT-2	35.5	5112	17.8	2563	0.175

資料-10-2

LOG OF TEST BORING 1

Notes:
Relatively Undisturbed Sample
Disturbed/Bulk Sample
SPT = Standard Penetration Test based on 140 lb (63.5 kg) hammer free falling 30 in (76 cm.)/blow

DATE December 18, 2014
EQUIPMENT Mikun Drilling Rig
ELEVATION --

DEPTH (FT.)	DEPTH (M.)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (min/ft)	SPT (Blows/ft.)*	MOISTURE CONTENT, %	DRY DENSITY, lbs./cu.ft.	LABORATORY TESTS
0	0	MOTTLED RED-BLACK-YELLOW-BROWN-GREY CLAYEY SILT (MH) - stiff, moist							
	1					8	68.1	56	
5									
	2	medium at 7'				4	63.9	59	-200=92% LL= 56; PI= 3 Consol Gs=2.731
10	3								
		stiff at 12'				14	62.0	62	
15	4								
	5	(Refusal, no recovery, very hard, possibly encountered basalt				20/0"			
		(No free water encountered)							
		Note: Terminated at 16'-8", the drill rig cannot penetrate further down.							

GEOTESTING, INC.
Geotechnical & Material Testing Engineers

LOG OF TEST BORING 1
NEW MALAKAL WATER TANK
KOROR, PALAU

PLATE 2

Job No. G404.06 Date 12/23/14

LOG OF TEST BORING 2

Notes:
Relatively Undisturbed Sample
Disturbed/Bulk Sample
SPT = Standard Penetration Test based on 140 lb (63.5 kg) hammer free falling 30 in (76 cm.)/blow

DATE December 18, 2014
EQUIPMENT Mikun Drilling Rig
ELEVATION --

DEPTH (FT.)	DEPTH (M.)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (min/ft)	SPT (Blows/ft.)*	MOISTURE CONTENT, %	DRY DENSITY, lbs./cu.ft.	LABORATORY TESTS
0	0	BROWN CLAYEY SILT (MH) - soft, moist, with grass on surface							
	1					29	50.9	66	Tx 1144 (175)
5									
	2	MOTTLED YELLOWISH BROWN-BROWN-BLACK DEEPLY WEATHERED TUFFACEOUS SILTSTONE - moderately hard				33	46.4	71	UC 3247
10	3	(No free water encountered)							
		Refusal, no recovery, hammer bounced during SPT sampling. Performed SPT at 10' after the drill rate was 1" over minutes.							
		Attempted to drill from 10' but drill rate was zero penetration over 4 minutes. Terminated the test boring at 10', the drill rig cannot drill further down.							

GEOTESTING, INC.
Geotechnical & Material Testing Engineers

LOG OF TEST BORING 2
NEW MALAKAL WATER TANK
KOROR, PALAU

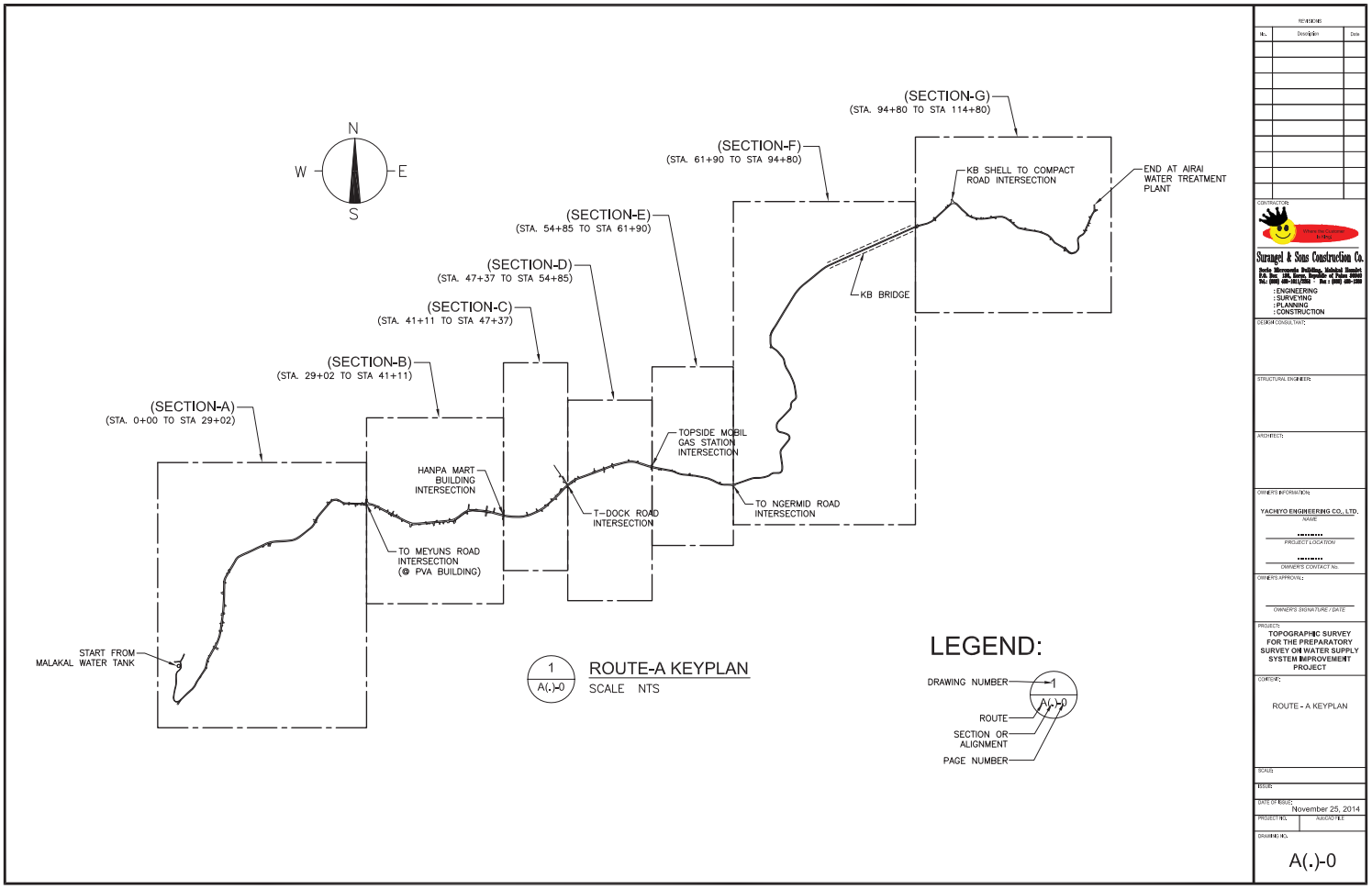
PLATE 3

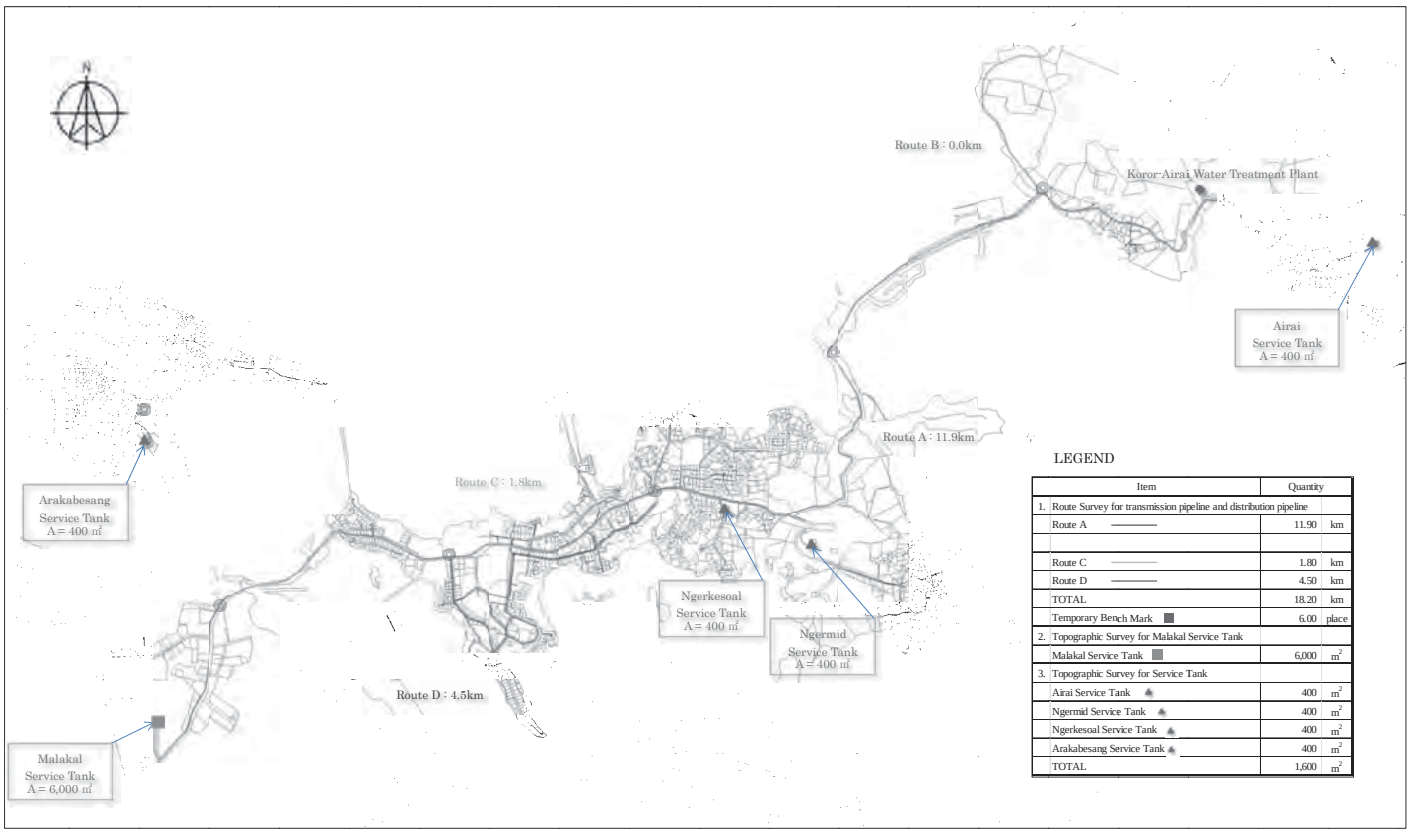
Job No. G404.06 Date 12/23/14

資料-11

自然条件調査（地形測量）結果

（現地再委託）





Item	Quantity	
1. Route Survey for transmission pipeline and distribution pipeline		
Route A	11.90	km
Route C	1.80	km
Route D	4.50	km
TOTAL	18.20	km
Temporary Bench Mark	6.00	place
2. Topographic Survey for Malakal Service Tank		
Malakal Service Tank	6,000	m^2
3. Topographic Survey for Service Tank		
Airai Service Tank	400	m^2
Ngermid Service Tank	400	m^2
Ngerkesoal Service Tank	400	m^2
Arakabesang Service Tank	400	m^2
TOTAL	1,600	m^2

Location Map for Route and Topographic Survey

資料-12

自然条件調査

（既存管路の漏水状況調査）結果

（国内再委託）

1. 調査目的

本業務委託は、パラオ共和国コロール地区の水道施設で幹線道路及びその隣接道路の地下に埋設され、老朽化している主配水管である石綿コンクリート管の漏水状況を把握することを目的に行った。

2. 調査概要

（1）	委託業務名	パラオ国上水道改善計画準備調査に係る漏水調査	
（2）	現地調査期間	自平成　２６年　　９月　２８日 至平成　２６年　１０月　１１日	
（3）	委託業務場所	コロール地区	
（4）	調査数量	①作業計画	１３ ㎞
		②現場下見調査	１３ ㎞
		③戸別音聴調査	１９６戸
		④路面音聴調査	１３ ㎞

3. 調査内容

（1）作業計画

配管図に基づき、机上にて調査が円滑にできるように作業手順及び工程等を検討した。

（2）現場下見調査

準備した図面と現地を照合し、調査の妨げとなる施設を事前に把握した。

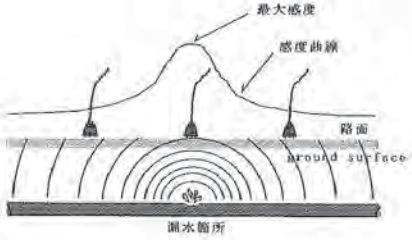
（3）戸別音聴調査

各使用者の水道メータ・止水栓などの給水装置や配水管に付属する仕切弁や消火栓などを音聴棒で直接聴音することにより、付近での漏水発生箇所より伝播されてくる漏水疑似音および、目視できる漏水を捕捉。

（4）路面音聴調査

配水管上・給水管上に対し漏水探知器を使用し、路面からの異常音を探知する。発見した漏水位置は道路上にマークすると同時にＧＰＳで位置測定を行い漏水位置報告書に記入した。

（5）
調査報告書
漏水
作成



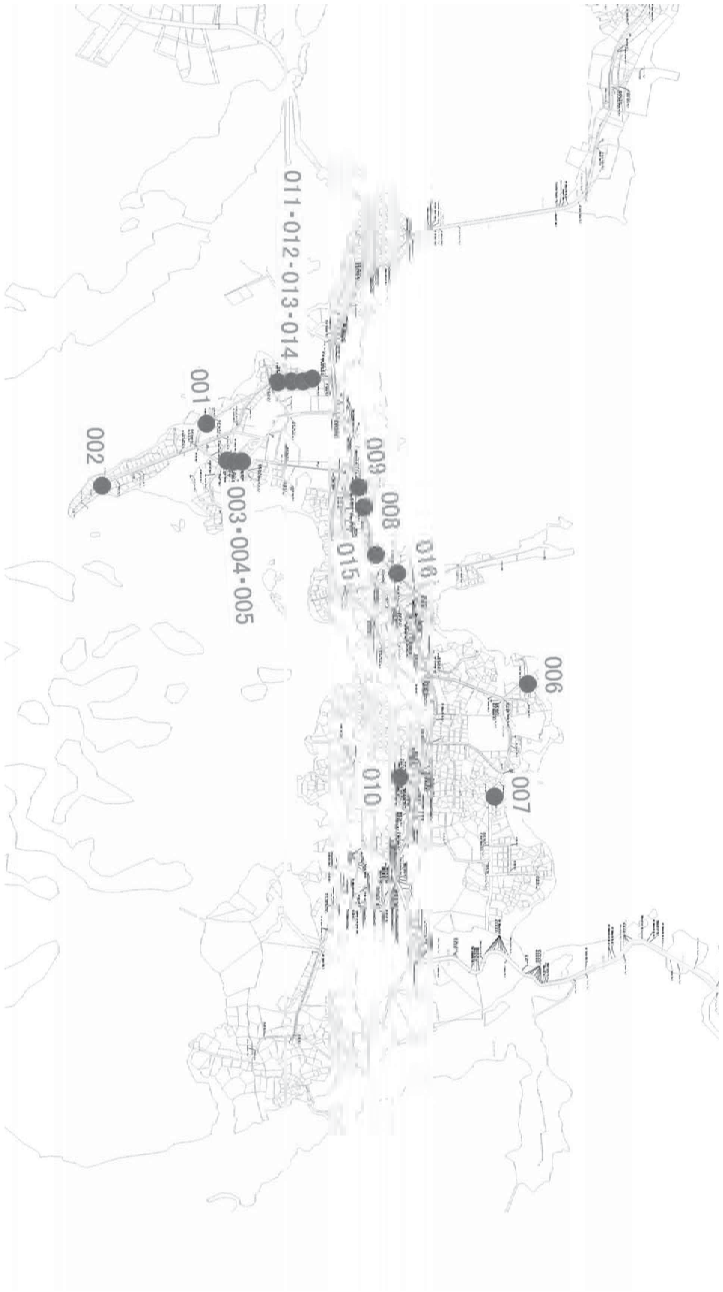
4. 漏水発見結果

① 漏水発見件数　16 件
② 推定漏水量　9.78 m3／h

漏水箇所一覧表

漏水番号	漏水種別	管種	口径 (mm)	推定漏水量 (m3/h)	漏水状況 公道	漏水状況 宅地	備考
001	分水栓	PVC	25	1.00	○		
002	分水栓	PVC	50	0.60	○		
003	配水管上	ACP	200	0.06	○		
004	配水管上	ACP	200	0.06	○		
sonota	配水管上	ACP	200	0.06	○		
006	消火栓	ACP	100	0.30		○	
007	配水管上	ACP	200	2.00	○		
008	分水栓	PVC	13	0.30	○		
009	配水管上	ACP	200	0.10	○		
010	給水管上	PVC	13	0.10		○	
011	配水管上	ACP	200	3.00	○		
012	配水管上	ACP	200	0.60	○		
013	配水管上	ACP	200	0.60	○		
014	配水管上	ACP	200	0.60	○		
015	配水管上	ACP	200	0.10	○		
016	配水管上	ACP	200	0.30	○		
小　計				9.78	14	2	

5. 漏水調査位置図



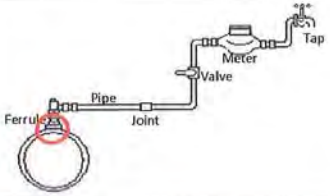
資料-12-3

Leakage Record Sheet

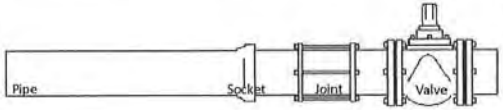
Leak. No 001

Date of survey:	30-Sep-14	Street	
House No,		GPS	N : 07° 20' 09.7" E : 134° 28' 25.6"
Main Pipe	1. CIP, 2. DCIP, 3. PVC, **4. ACP**, 5. Others	**Location**	1. Pipe, 2. Joint･Socket, 3. Ferrle , 4. Valve, 5. Meter, 6. Tap, 7. Reservoir Tank, 8. Others,
Diameter	200 mm	**Condition**	1. Hole, **2. Crack**, 3. Packing, 4. Loose Connection, 5. Over Flow, 6. Unknown, 7. Others ( )
Service Pipe	1. PEP, **2. PVC**, 3. GP, 4. Others ( )	**Cause**	1. Corrosion, **2.** Deterioration (Aging), 3. Traffic Load, 4. Wrong Construction, 5. Less Adhesive, 6. Pressure Fluctuation, 7. Defective Valve , 8. Destruction, 9. Other Construction, 10. Unknown, 11. Others( )
Diameter	25 mm		
Depth	cm	**Surface**	**1.**Asphalt, 2.Concrete, 3.Gravel, 4.Grass, 5.Soil, 6.Others
Leakage Size	1. Large, **2. Middium**, 3. Small, 4. Drops, Estimated volume (1.0 m3/h)	Detected Method	1. Patrol, 2. Customer Informing, 3. Acoustic, **4.** Pinpoint,

Leak Point



Hole/Crack Size:(cm)



Location Map

Photo

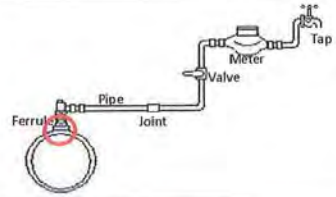
Remarks:

Leakage Record Sheet

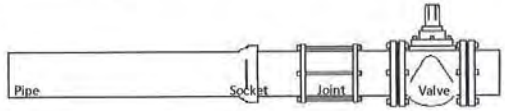
Leak. No 002

Date of survey:	30-Sep-14	Street	
House No,		GPS	N : 07° 19' 50.6" E : 134° 28' 38.6"
Main Pipe	1. CIP, 2. DCIP, 3. PVC, **4. ACP**, 5. Others	**Location**	1. Pipe, 2. Joint･Socket, 3. Ferrle , 4. Valve, 5. Meter, 6. Tap, 7. Reservoir Tank, 8. Others,
Diameter	200 mm	**Condition**	1. Hole, **2.** Crack, 3. Packing, 4. Loose Connection, 5. Over Flow, 6. Unknown, 7. Others ( )
Service Pipe	1. PEP, **2. PVC**, 3. GP, 4. Others ( )	**Cause**	1. Corrosion, **2.** Deterioration (Aging), 3. Traffic Load, 4. Wrong Construction, 5. Less Adhesive, 6. Pressure Fluctuation, 7. Defective Valve , 8. Destruction, 9. Other Construction, 10. Unknown, 11. Others( )
Diameter	50 mm		
Depth	cm	**Surface**	**1.**Asphalt, 2.Concrete, 3.Gravel, 4.Grass, 5.Soil, 6.Others
Leakage Size	1. Large, **2.** Middium, 3. Small, 4. Drops, Estimated volume (0.6 m3/h)	Detected Method	1. Patrol, 2. Customer Informing, 3. Acoustic, **4.** Pinpoint,

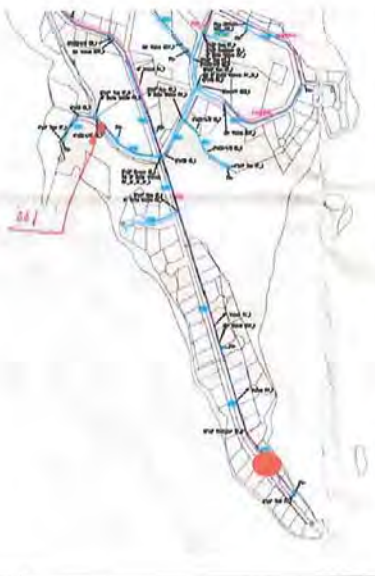
Leak Point



Hole/Crack Size:(cm)



Location Map



Photo

Remarks:

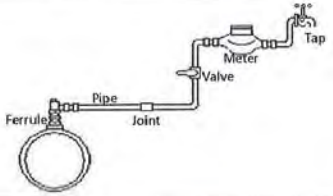
資料-12-4

Leakage Record Sheet

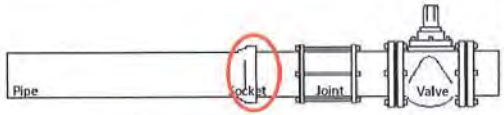
Leak. No 003

Date of survey:	1-Oct-14	Street	
House No,		GPS	N : 07° 20' 13.6" E : 134° 28' 32.9"
Main Pipe	1. CIP, 2. DCIP, 3. PVC, **4. ACP**, 5. Others	**Location**	1. Pipe, **2. Joint・Socket**, 3. Ferrle , 4. Valve, 5. Meter, 6. Tap, 7. Reservoir Tank, 8. Others,
Diameter	200 mm	**Condition**	1. Hole, 2. Crack, **3. Packing**, 4. Loose Connection, 5. Over Flow, 6. Unknown, 7. Others ( )
Service Pipe	1. PEP, 2. PVC, 3. GP, 4. Others ( )	**Cause**	1. Corrosion, **2. Deterioration (Aging)**, 3. Traffic Load, 4. Wrong Construction, 5. Less Adhesive, 6. Pressure Fluctuation, 7. Defective Valve , 8. Destruction, 9. Other Construction, 10. Unknown, 11. Others( )
Diameter	50 mm		
Depth	cm	**Surface**	**1.Asphalt**, 2.Concrete, 3.Gravel, 4.Grass, 5.Soil, 6.Others
Leakage Size	1. Large, 2. Middium, **3. Small**, 4. Drops, Estimated volume (0.06 m3/h)	Detected Method	1. Patrol, 2. Customer Informing, 3. Acoustic, **4. Pinpoint**,

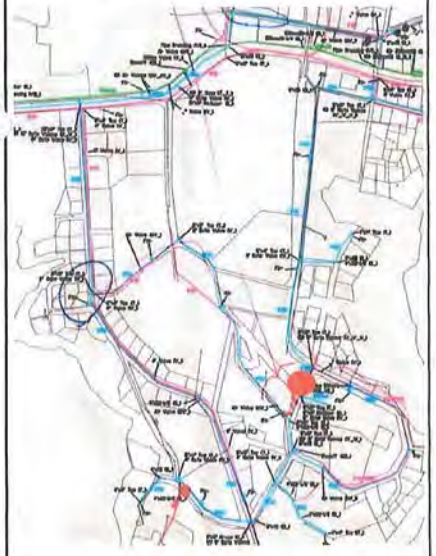
Leak Point



Hole/Crack Size:(cm)



Location Map



Photo

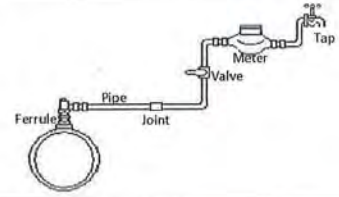
Remarks: Please confirm the boring investigation.

Leakage Record Sheet

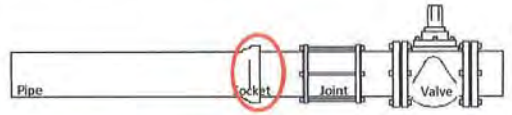
Leak. No 004

Date of survey:	1-Oct-14	Street	
House No,		GPS	N : 07° 20' 13.9" E : 134° 28' 32.9"
Main Pipe	1. CIP, 2. DCIP, 3. PVC, **4. ACP**, 5. Others	**Location**	1. Pipe, **2. Joint・Socket**, 3. Ferrle , 4. Valve, 5. Meter, 6. Tap, 7. Reservoir Tank, 8. Others,
Diameter	200 mm	**Condition**	1. Hole, 2. Crack, **3. Packing**, 4. Loose Connection, 5. Over Flow, 6. Unknown, 7. Others ( )
Service Pipe	1. PEP, 2. PVC, 3. GP, 4. Others ( )	**Cause**	1. Corrosion, **2. Deterioration (Aging)**, 3. Traffic Load, 4. Wrong Construction, 5. Less Adhesive, 6. Pressure Fluctuation, 7. Defective Valve , 8. Destruction, 9. Other Construction, 10. Unknown, 11. Others( )
Diameter	mm		
Depth	cm	**Surface**	**1.Asphalt**, 2.Concrete, 3.Gravel, 4.Grass, 5.Soil, 6.Others
Leakage Size	1. Large, 2. Middium, **3. Small**, 4. Drops, Estimated volume (0.06 m3/h)	Detected Method	1. Patrol, 2. Customer Informing, 3. Acoustic, **4. Pinpoint**,

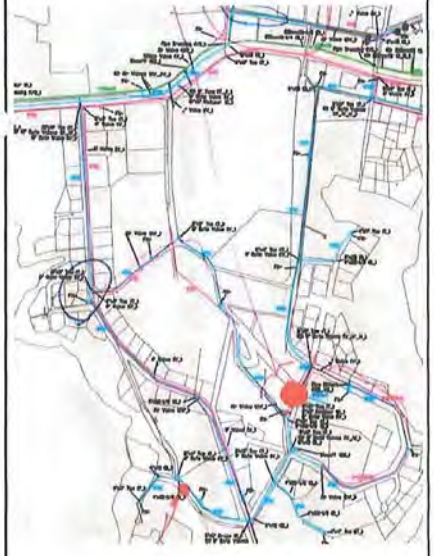
Leak Point



Hole/Crack Size:(cm)



Location Map



Photo

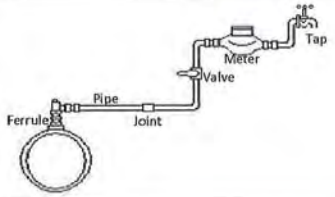
Remarks: Please confirm the boring investigation.

Leakage Record Sheet

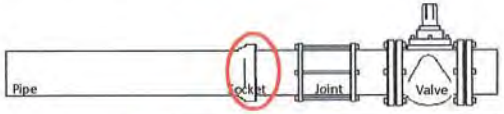
Leak. No 005

Date of survey:	1-Oct-14	Street	
House No,		GPS	N : 07° 20' 14.0" E : 134° 28' 32.9"
Main Pipe	1. CIP, 2. DCIP, 3. PVC, **4. ACP**, 5. Others	**Location**	1. Pipe, **2. Joint・Socket**, 3. Ferrle , 4. Valve, 5. Meter, 6. Tap, 7. Reservoir Tank, 8. Others,
Diameter	200 mm	**Condition**	1. Hole, 2. Crack, **3. Packing**, 4. Loose Connection, 5. Over Flow, 6. Unknown, 7. Others ( )
Service Pipe	1. PEP, 2. PVC, 3. GP, 4. Others ( )	**Cause**	1. Corrosion, **2. Deterioration (Aging)**, 3. Traffic Load, 4. Wrong Construction, 5. Less Adhesive, 6. Pressure Fluctuation, 7. Defective Valve , 8. Destruction, 9. Other Construction, 10. Unknown, 11. Others( )
Diameter	mm		
Depth	cm	**Surface**	**1.Asphalt**, 2.Concrete, 3.Gravel, 4.Grass, 5.Soil, 6.Others
Leakage Size	1. Large, 2. Middium, **3. Small**, 4. Drops, Estimated volume (0.06 m3/h)	Detected Method	1. Patrol, 2. Customer Informing, 3. Acoustic, **4. Pinpoint**,

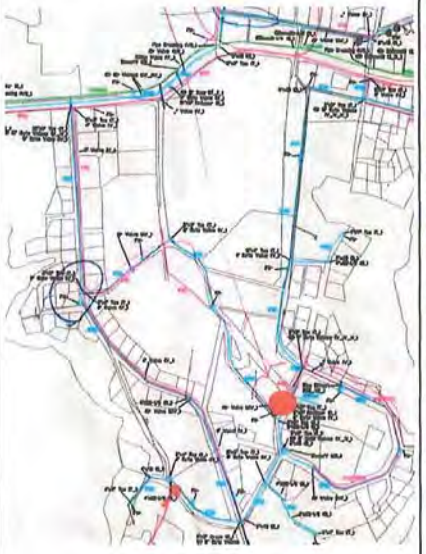
Leak Point



Hole/Crack Size:(cm)



Location Map



Photo

Remarks: Please confirm the boring investigation.

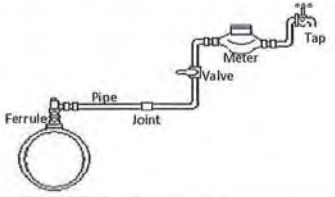
資料-12-5

Leakage Record Sheet

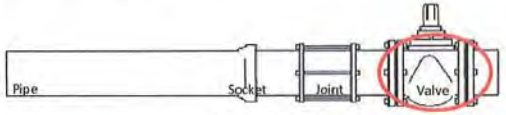
Leak. No 006

Date of survey:	2-Oct-14	Street	
House No,		GPS	N : 07° 21' 00.5" E : 134° 29' 08.0"
Main Pipe	1. CIP, 2. DCIP, 3. PVC, **4. ACP**, 5. Others	**Location**	1. Pipe, 2. Joint・Socket, 3. Ferrle , 4. Valve, 5. Meter, 6. Tap, 7. Reservoir Tank, 8. Others,
Diameter	100 mm	**Condition**	1. Hole, 2. Crack, 3. Packing, **4. Loose Connection**, 5. Over Flow, 6. Unknown, 7. Others ( )
Service Pipe	1. PEP, 2. PVC, 3. GP, 4. Others ( )	**Cause**	1. Corrosion, **2. Deterioration (Aging)**, 3. Traffic Load, 4. Wrong Construction, 5. Less Adhesive, 6. Pressure Fluctuation, 7. Defective Valve , 8. Destruction, 9. Other Construction, 10. Unknown, 11. Others( )
Diameter	mm		
Depth	cm	**Surface**	1.Asphalt, **2.Concrete**, 3.Gravel, 4.Grass, 5.Soil, 6.Others
Leakage Size	1. Large, 2. Middium, **3. Small**, 4. Drops, Estimated volume (0.3 m3/h)	Detected Method	1. Patrol, 2. Customer Informing, 3. Acoustic, **4. Pinpoint**,

Leak Point



Hole/Crack Size:(cm)



Location Map

Photo

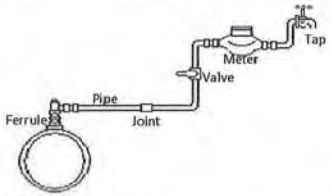
Remarks:

Leakage Record Sheet

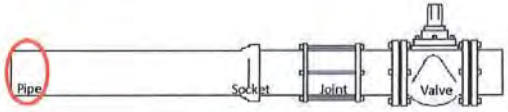
Leak. No 007

Date of survey:	3-Oct-14	Street	
House No,		GPS	N : 07° 20' 54.1" E : 134° 29' 26.5"
Main Pipe	1. CIP, 2. DCIP, 3. PVC, 4. ACP, 5. Others	**Location**	1. Pipe, 2. Joint･Socket, 3. Ferrle , 4. Valve, 5. Meter, 6. Tap, 7. Reservoir Tank, 8. Others,
Diameter	200 mm	**Condition**	1. Hole, 2. Crack, 3. Packing, 4. Loose Connection, 5. Over Flow, 6. Unknown, 7. Others ( )
Service Pipe	1. PEP, 2. PVC, 3. GP, 4. Others ( )	**Cause**	1. Corrosion, 2. Deterioration (Aging), 3. Traffic Load, 4. Wrong Construction, 5. Less Adhesive, 6. Pressure Fluctuation, 7. Defective Valve , 8. Destruction, 9. Other Construction, 10. Unknown, 11. Others( )
Diameter	mm		
Depth	cm	**Surface**	1.Asphalt, 2.Concrete, 3.Gravel, 4.Grass, 5.Soil, 6.Others
Leakage Size	1. Large, 2. Middium, 3. Small, 4. Drops, Estimated volume (2.0 m3/h)	Detected Method	1. Patrol, 2. Customer Informing, 3. Acoustic, 4. Pinpoint,

Leak Point



Hole/Crack Size:(cm)



Location Map

Photo

Remarks:

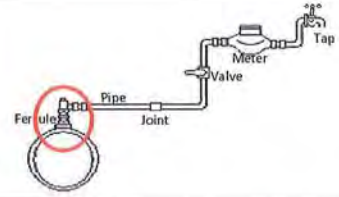
資料-12-6

Leakage Record Sheet

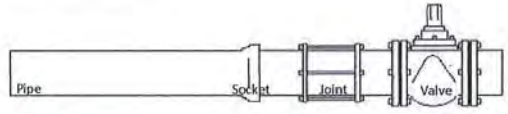
Leak. No 008

Date of survey:	6-Oct-14	Street	
House No,		GPS	N : 07° 20' 34.2" E : 134° 28' 38.9"
Main Pipe	1. CIP, 2. DCIP, 3. PVC, 4. ACP, 5. Others	**Location**	1. Pipe, 2. Joint･Socket, 3. Ferrle , 4. Valve, 5. Meter, 6. Tap, 7. Reservoir Tank, 8. Others,
Diameter	200 mm	**Condition**	1. Hole, 2. Crack, 3. Packing, 4. Loose Connection, 5. Over Flow, 6. Unknown, 7. Others ( )
Service Pipe	1. PEP, 2. PVC, 3. GP, 4. Others ( )	**Cause**	1. Corrosion, 2. Deterioration (Aging), 3. Traffic Load, 4. Wrong Construction, 5. Less Adhesive, 6. Pressure Fluctuation, 7. Defective Valve , 8. Destruction, 9. Other Construction, 10. Unknown, 11. Others( )
Diameter	mm		
Depth	cm	**Surface**	1.Asphalt, 2.Concrete, 3.Gravel, 4.Grass, 5.Soil, 6.Others
Leakage Size	1. Large, 2. Middium, 3. Small, 4. Drops, Estimated volume (0.3 m3/h)	Detected Method	1. Patrol, 2. Customer Informing, 3. Acoustic, 4. Pinpoint,

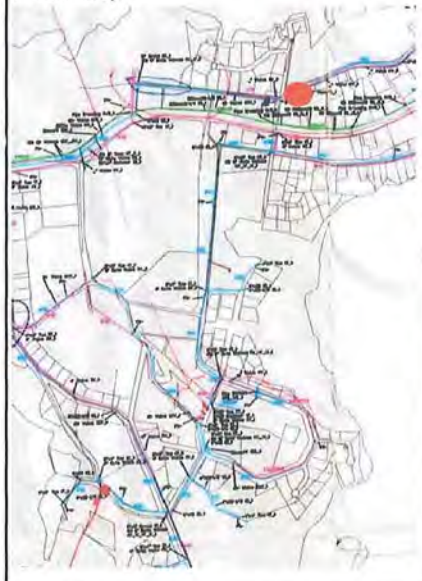
Leak Point



Hole/Crack Size:(cm)



Location Map



Photo

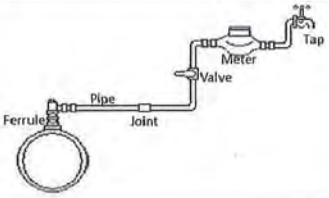
Remarks:

Leakage Record Sheet

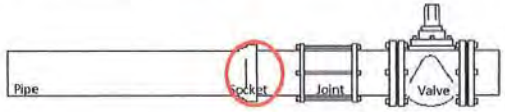
Leak. No 009

Date of survey:	6-Oct-14	Street	
House No,		GPS	N : 07° 20' 33.6" E : 134° 28' 37.6"
Main Pipe	1. CIP, 2. DCIP, 3. PVC, 4. ACP, 5. Others	**Location**	1. Pipe, 2. Joint・Socket, 3. Ferrle, 4. Valve, 5. Meter, 6. Tap, 7. Reservoir Tank, 8. Others,
Diameter	200 mm	**Condition**	1. Hole, 2. Crack, 3. Packing, 4. Loose Connection, 5. Over Flow, 6. Unknown, 7. Others ( )
Service Pipe	1. PEP, 2. PVC, 3. GP, 4. Others ( )	**Cause**	1. Corrosion, 2. Deterioration (Aging), 3. Traffic Load, 4. Wrong Construction, 5. Less Adhesive, 6. Pressure Fluctuation, 7. Defective Valve, 8. Destruction, 9. Other Construction, 10. Unknown, 11. Others( )
Diameter	mm		
Depth	cm	**Surface**	1.Asphalt, 2.Concrete, 3.Gravel, 4.Grass, 5.Soil, 6.Others
Leakage Size	1. Large, 2. Middium, 3. Small, 4. Drops, Estimated volume (0.1 m3/h)	Detected Method	1. Patrol, 2. Customer Informing, 3. Acoustic, 4. Pinpoint,

Leak Point



Hole/Crack Size:(cm)



Location Map

Photo

Remarks:

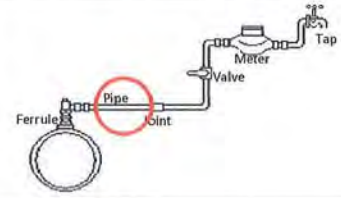
資料-12-7

Leakage Record Sheet

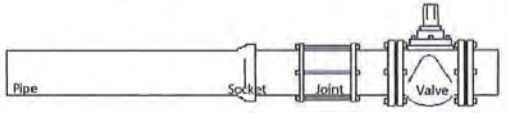
Leak. No 010

Date of survey:	6-Oct-14	Street	
House No,		GPS	N : 07° 20' 34.0" E : 134° 28' 38.0"
Main Pipe	1. CIP, 2. DCIP, 3. PVC, 4. ACP, 5. Others	**Location**	1. Pipe, 2. Joint・Socket, 3. Ferrle, 4. Valve, 5. Meter, 6. Tap, 7. Reservoir Tank, 8. Others,
Diameter	mm	**Condition**	1. Hole, 2. Crack, 3. Packing, 4. Loose Connection, 5. Over Flow, 6. Unknown, 7. Others ( )
Service Pipe	1. PEP, 2. PVC, 3. GP, 4. Others ( )	**Cause**	1. Corrosion, 2. Deterioration (Aging), 3. Traffic Load, 4. Wrong Construction, 5. Less Adhesive, 6. Pressure Fluctuation, 7. Defective Valve, 8. Destruction, 9. Other Construction, 10. Unknown, 11. Others( )
Diameter	13 mm		
Depth	cm	**Surface**	1.Asphalt, 2.Concrete, 3.Gravel, 4.Grass, 5.Soil, 6.Others
Leakage Size	1. Large, 2. Middium, 3. Small, 4. Drops, Estimated volume (0.1 m3/h)	Detected Method	1. Patrol, 2. Customer Informing, 3. Acoustic, 4. Pinpoint,

Leak Point



Hole/Crack Size:(cm)



Location Map

Photo

Remarks:

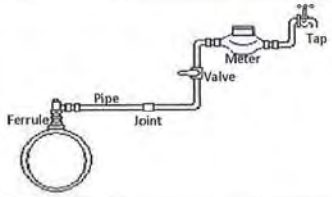
資料-12-8

Leakage Record Sheet

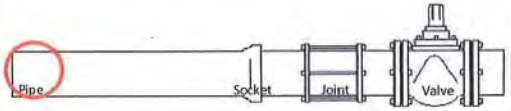
Leak. No 011

Date of survey:	8-Oct-14	Street	
House No,		GPS	N : 07° 20' 41.2" E : 134° 29' 23.9"
Main Pipe	1. CIP, 2. DCIP, 3. PVC, 4. ACP, 5. Others	**Location**	1. Pipe, 2. Joint･Socket, 3. Ferrle, 4. Valve, 5. Meter, 6. Tap, 7. Reservoir Tank, 8. Others,
Diameter	200 mm	**Condition**	1. Hole, 2. Crack, 3. Packing, 4. Loose Connection, 5. Over Flow, 6. Unknown, 7. Others ( )
Service Pipe	1. PEP, 2. PVC, 3. GP, 4. Others ( )	**Cause**	1. Corrosion, 2. Deterioration (Aging), 3. Traffic Load, 4. Wrong Construction, 5. Less Adhesive, 6. Pressure Fluctuation, 7. Defective Valve, 8. Destruction, 9. Other Construction, 10. Unknown, 11. Others( )
Diameter	mm		
Depth	cm	**Surface**	1.Asphalt, 2.Concrete, 3.Gravel, 4.Grass, 5.Soil, 6.Others
Leakage Size	1. Large, 2. Middium, 3. Small, 4. Drops, Estimated volume (3.0 m3/h)	Detected Method	1. Patrol, 2. Customer Informing, 3. Acoustic, 4. Pinpoint,

Leak Point



Hole/Crack Size:(cm)



Location Map

Photo

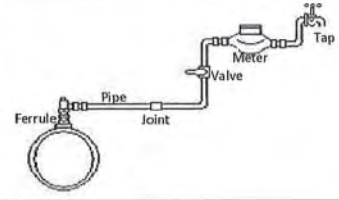
Remarks:

Leakage Record Sheet

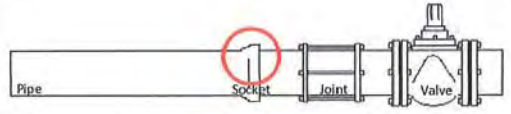
Leak. No 012

Date of survey:	9-Oct-14	Street	
House No,		GPS	N : 07° 20' 20.8" E : 134° 28' 20.0"
Main Pipe	1. CIP, 2. DCIP, 3. PVC, 4. ACP, 5. Others	**Location**	1. Pipe, 2. Joint･Socket, 3. Ferrle, 4. Valve, 5. Meter, 6. Tap, 7. Reservoir Tank, 8. Others,
Diameter	200 mm	**Condition**	1. Hole, 2. Crack, 3. Packing, 4. Loose Connection, 5. Over Flow, 6. Unknown, 7. Others ( )
Service Pipe	1. PEP, 2. PVC, 3. GP, 4. Others ( )	**Cause**	1. Corrosion, 2. Deterioration (Aging), 3. Traffic Load, 4. Wrong Construction, 5. Less Adhesive, 6. Pressure Fluctuation, 7. Defective Valve, 8. Destruction, 9. Other Construction, 10. Unknown, 11. Others( )
Diameter	mm		
Depth	cm	**Surface**	1.Asphalt, 2.Concrete, 3.Gravel, 4.Grass, 5.Soil, 6.Others
Leakage Size	1. Large, 2. Middium, 3. Small, 4. Drops, Estimated volume (0.6 m3/h)	Detected Method	1. Patrol, 2. Customer Informing, 3. Acoustic, 4. Pinpoint,

Leak Point



Hole/Crack Size:(cm)



Location Map

Photo

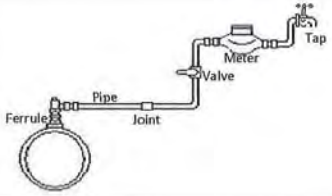
Remarks: Please confirm the boring investigation.

Leakage Record Sheet

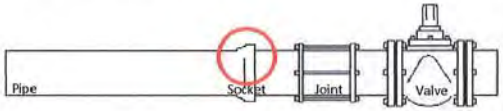
Leak. No 013

Date of survey:	9-Oct-14	Street	
House No,		GPS	N : 07° 20' 23.1" E : 134° 28' 19.8"
Main Pipe	1. CIP, 2. DCIP, 3. PVC, 4. ACP, 5. Others	**Location**	1. Pipe, 2. Joint・Socket, 3. Ferrle, 4. Valve, 5. Meter, 6. Tap, 7. Reservoir Tank, 8. Others,
Diameter	200 mm	**Condition**	1. Hole, 2. Crack, 3. Packing, 4. Loose Connection, 5. Over Flow, 6. Unknown, 7. Others ( )
Service Pipe	1. PEP, 2. PVC, 3. GP, 4. Others ( )	**Cause**	1. Corrosion, 2. Deterioration (Aging), 3. Traffic Load, 4. Wrong Construction, 5. Less Adhesive, 6. Pressure Fluctuation, 7. Defective Valve, 8. Destruction, 9. Other Construction, 10. Unknown, 11. Others( )
Diameter	mm		
Depth	cm	**Surface**	1.Asphal, 2.Concrete, 3.Gravel, 4.Grass, 5.Soil, 6.Others
Leakage Size	1. Large, 2. Middium, 3. Small, 4. Drops, Estimated volume (0.6 m3/h)	Detected Method	1. Patrol, 2. Customer Informing, 3. Acoustic, 4. Pinpoint,

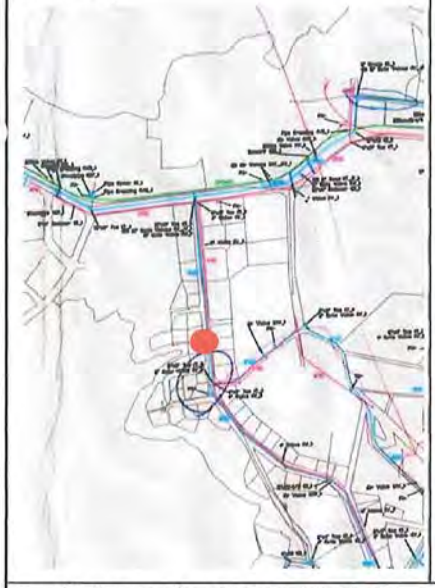
Leak Point



Hole/Crack Size:(cm)



Location Map



Photo

Remarks: Please confirm the boring investigation.

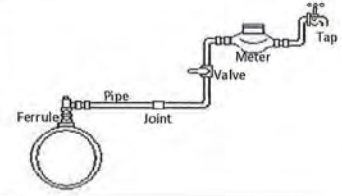
資料-12-9

Leakage Record Sheet

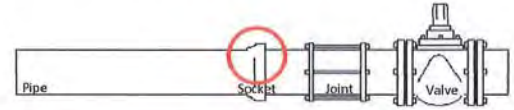
Leak. No 014

Date of survey:	9-Oct-14	Street	
House No,		GPS	N : 07° 20' 23.7" E : 134° 28' 19.9"
Main Pipe	1. CIP, 2. DCIP, 3. PVC, 4. ACP, 5. Others	**Location**	1. Pipe, 2. Joint・Socket, 3. Ferrle, 4. Valve, 5. Meter, 6. Tap, 7. Reservoir Tank, 8. Others,
Diameter	200 mm	**Condition**	1. Hole, 2. Crack, 3. Packing, 4. Loose Connection, 5. Over Flow, 6. Unknown, 7. Others ( )
Service Pipe	1. PEP, 2. PVC, 3. GP, 4. Others ( )	**Cause**	1. Corrosion, 2. Deterioration (Aging), 3. Traffic Load, 4. Wrong Construction, 5. Less Adhesive, 6. Pressure Fluctuation, 7. Defective Valve, 8. Destruction, 9. Other Construction, 10. Unknown, 11. Others( )
Diameter	mm		
Depth	cm	**Surface**	1.Asphal, 2.Concrete, 3.Gravel, 4.Grass, 5.Soil, 6.Others
Leakage Size	1. Large, 2. Middium, 3. Small, 4. Drops, Estimated volume (0.6 m3/h)	Detected Method	1. Patrol, 2. Customer Informing, 3. Acoustic, 4. Pinpoint,

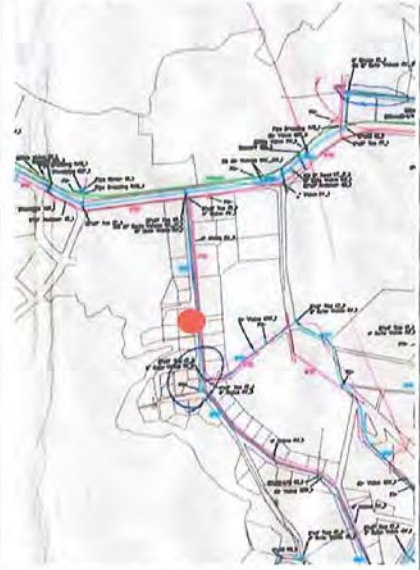
Leak Point



Hole/Crack Size:(cm)



Location Map



Photo

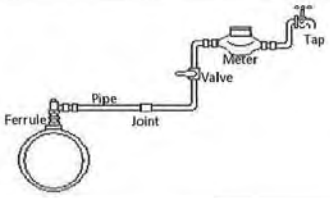
Remarks: Please confirm the boring investigation.

Leakage Record Sheet

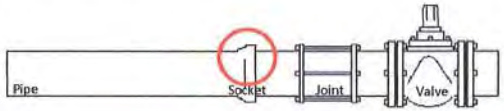
Leak. No 015

Date of survey:	9-Oct-14	Street	
House No,		GPS	N : 07° 20' 37.2" E : 134° 28' 48.0"
Main Pipe	1. CIP, 2. DCIP, 3. PVC, 4. ACP, 5. Others	**Location**	1. Pipe, 2. Joint･Socket, 3. Ferrle, 4. Valve, 5. Meter, 6. Tap, 7. Reservoir Tank, 8. Others,
Diameter	200 mm	**Condition**	1. Hole, 2. Crack, 3. Packing, 4. Loose Connection, 5. Over Flow, 6. Unknown, 7. Others ( )
Service Pipe	1. PEP, 2. PVC, 3. GP, 4. Others ( )	**Cause**	1. Corrosion, 2. Deterioration (Aging), 3. Traffic Load, 4. Wrong Construction, 5. Less Adhesive, 6. Pressure Fluctuation, 7. Defective Valve, 8. Destruction, 9. Other Construction, 10. Unknown, 11. Others( )
Diameter	mm		
Depth	cm	**Surface**	1.Asphal, 2.Concrete, 3.Gravel, 4.Grass, 5.Soil, 6.Others
Leakage Size	1. Large, 2. Middium, 3. Small, 4. Drops, Estimated volume (0.1 m3/h)	Detected Method	1. Patrol, 2. Customer Informing, 3. Acoustic, 4. Pinpoint,

Leak Point



Hole/Crack Size:(cm)



Location Map

Photo

Remarks: Please confirm the boring investigation.

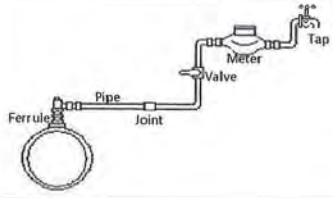
資料-12-10

Leakage Record Sheet

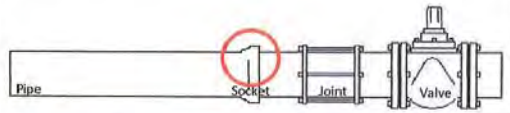
Leak. No 016

Date of survey:	9-Oct-14	Street	
House No,		GPS	N : 07° 20' 39.4" E : 134° 28' 50.1"
Main Pipe	1. CIP, 2. DCIP, 3. PVC, 4. ACP, 5. Others	**Location**	1. Pipe, 2. Joint･Socket, 3. Ferrle, 4. Valve, 5. Meter, 6. Tap, 7. Reservoir Tank, 8. Others,
Diameter	200 mm	**Condition**	1. Hole, 2. Crack, 3. Packing, 4. Loose Connection, 5. Over Flow, 6. Unknown, 7. Others ( )
Service Pipe	1. PEP, 2. PVC, 3. GP, 4. Others ( )	**Cause**	1. Corrosion, 2. Deterioration (Aging), 3. Traffic Load, 4. Wrong Construction, 5. Less Adhesive, 6. Pressure Fluctuation, 7. Defective Valve, 8. Destruction, 9. Other Construction, 10. Unknown, 11. Others( )
Diameter	mm		
Depth	cm	**Surface**	1.Asphal, 2.Concrete, 3.Gravel, 4.Grass, 5.Soil, 6.Others
Leakage Size	1. Large, 2. Middium, 3. Small, 4. Drops, Estimated volume (0.3 m3/h)	Detected Method	1. Patrol, 2. Customer Informing, 3. Acoustic, 4. Pinpoint,

Leak Point



Hole/Crack Size:(cm)



Location Map

Photo

Remarks: Please confirm the boring investigation.

資料-13

社会条件調査結果

（現地再委託）

1. Methodology

Community participation has always been an important aspect of environmental work in Palau because the community level activities generally determine the success or failure of a project. With large projects, communities are involved in public hearings, consultations, workshops, and meetings. Negative community reactions tend to lead to the failure of projects. Because of miscommunications in the past with regional and international environmental projects, communities may be hesitant to embrace new projects. In order to have receptive community participation, any project must clearly state its goals and objectives, as well as the funding and allocation of funds.

The social responsibility of having to pay for water is gradually being accepted, as people get more information on the cost of treatment and lack of cost recovery. The general focus of a stakeholder water survey needs to include the following:

i. Ability to pay
ii. Willingness to pay
iii. General water awareness

The survey should increase community awareness of:

i. Water as a finite resource
ii. Cost of treatment
iii. Waste

資料-13-1

Survey Objectives

Specific objectives of the Water Supply System Improvement Project, Social Condition Survey include the following:

1. To grasp in-depth social conditions of target communities in Koror and Airai areas in order to contribute to appropriate planning for the Project
2. To analyse issues relative to Operations, Maintenance, and Management for water supply facilities in prospective target communities.
3. To analyse issues relative to the knowledge attitudes and practices of water, sanitation, and hygiene, in target communities
4. To obtain basic information for consideration of issues relating to the social environment
5.

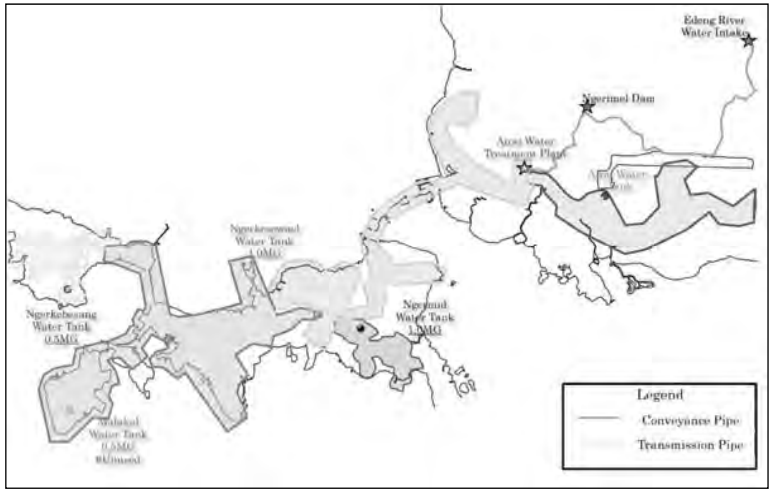
B. Survey Scope of Work

The Scope of Work for the Social Condition Survey includes:

1. Preparation work
   a. Preparation of equipment and goods for surveys
   b. Arrangement of surveys and training for the necessary surveyors' work
   c. Prepare the Work schedule to show JICA survey team
2. Survey Works
   a. Document or existing data collection and analysis
   b. Preliminary Survey based on the questionnaire sheets
   c. Baseline Survey (structured interview with questionnaire in the target area)
3. Reporting
   a. Draft Survey Report (at completion of Demonstration Survey)
   b. Final Survey Report (at completion of remaining surveys)
      i. Quantifiable data will be analyzed and charted below in 3.Baseline Survey Results

C. Location of the Survey Area:

Survey area shall be water serviced areas in Koror and Airai States.



Total Survey consists of 100 Interviews: Household=70 + Office/Restaurant/Hotel=30

Survey coverage by water service area:

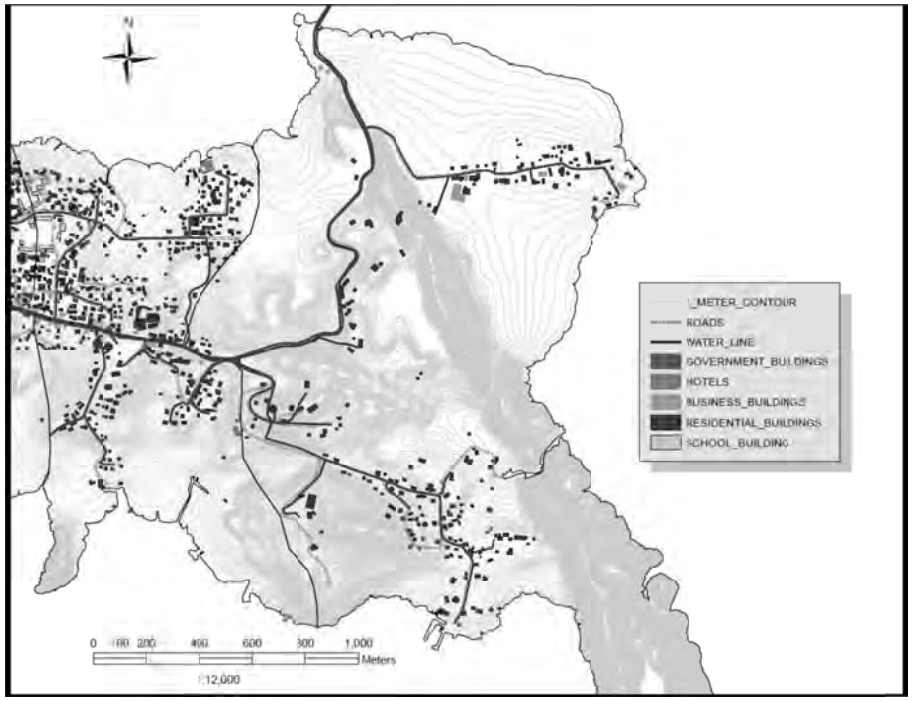
1) Airai Treatment Plant Direct Supply : Household:12 + Other 5 = Total 17
2) Airai Water Tank Area : Household:6 + Other 3 = Total 9
3) Ngermid Water Tank Area : Household:3 + Other 1 = Total 4
4) Ngerkesoal Water Tank Area: Household:45 + Other 19 = Total 64
5) Arakabesang Water Tank Area: Household:4 + Other 2 = Total 6

i. Field interviews will be conducted at individual residences, places of business, restaurants and hotels. Their locations will be plotted using Global Positioning System (GPS).

ii. Station interviews will be conducted at an established station with high public traffic, such as a department store

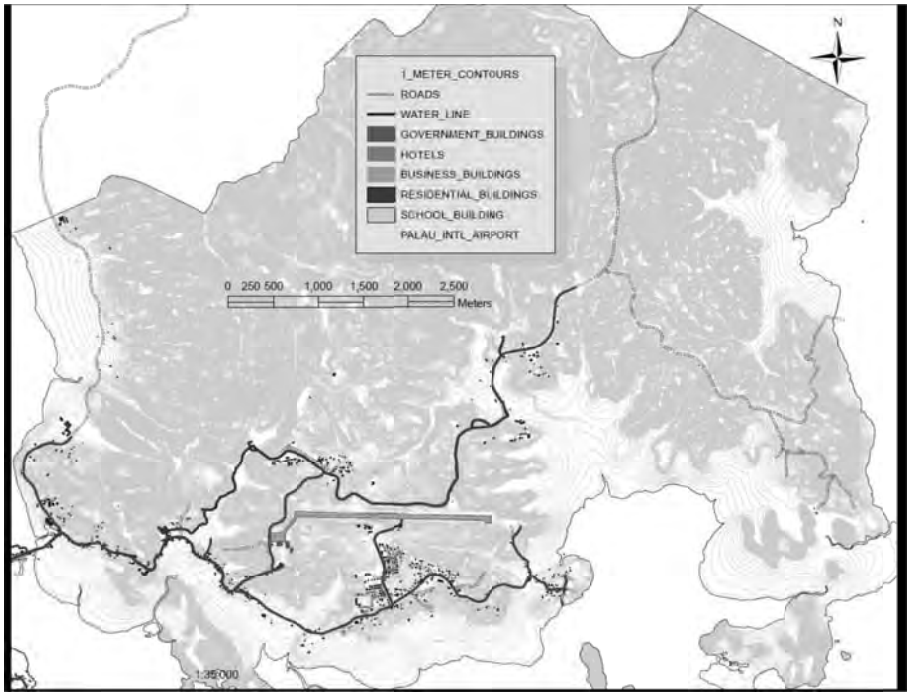
iii. Both 'field interviews' and 'station interviews' will comply with the breakdown shown above for each 'water service area' (1-5)

Airai Treatment Plant Direct Supply and Ngermid Water Tanks Service Area:

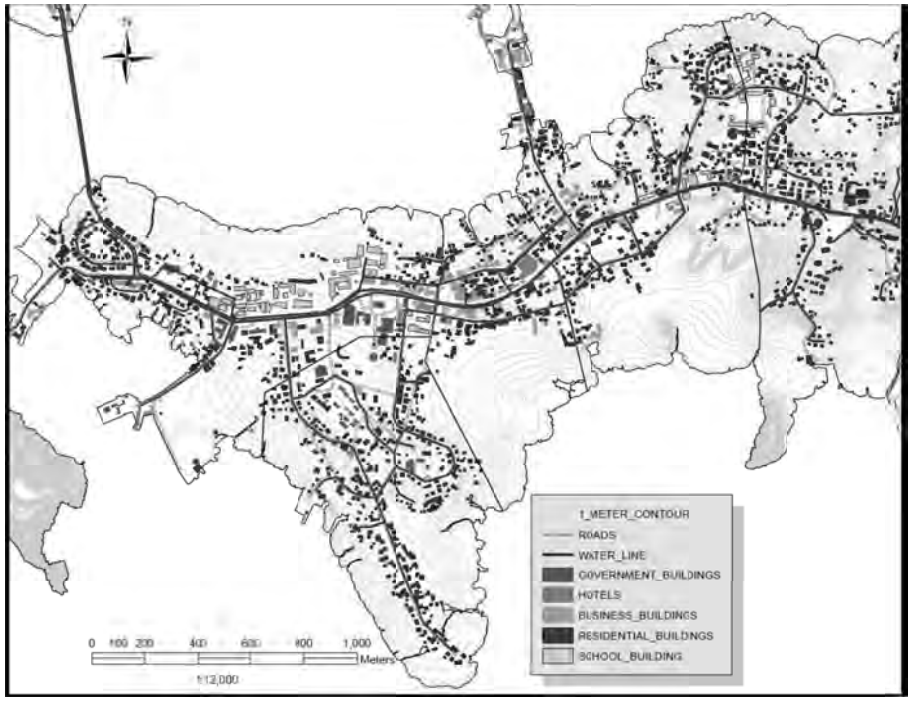


資料-13-2

Airai Water Tank Service Area:



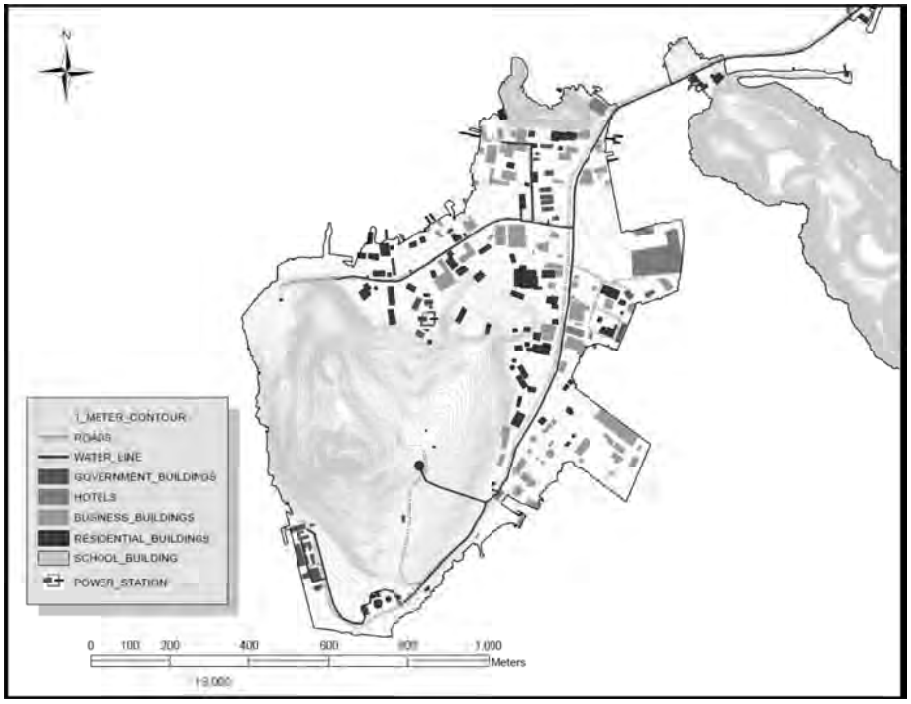
Ngerkesoaol Water Tank Service Area: 1



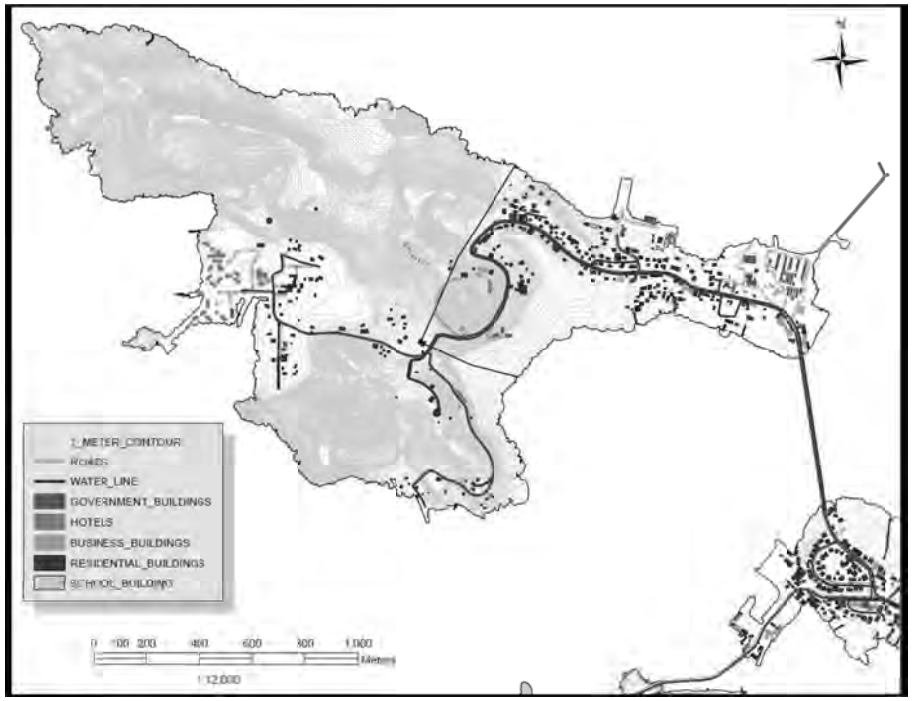
資料-13-3

Ngerkesoaol Water Tank Service Area: 2

Palau Water Supply Improvement: Social Condition Survey | November 2014



Arakabesang Water Tank Service Area: 2



資料-13-4

Palau Water Supply Improvement: Social Condition Survey | November 2014

2. Baseline Survey Results

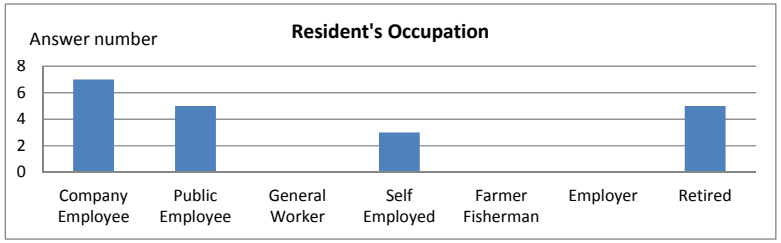
A. Airai Treatment Plant Direct Supply Area

i. Household: general and economic condition

a) Population and composition of household:

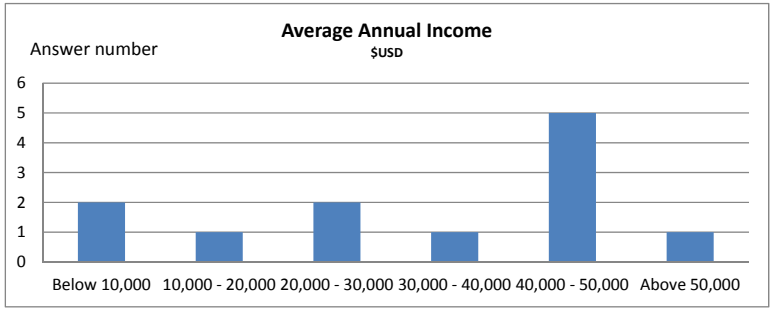
12 respondents
Average persons living in house: 4.9
Average adults living in house: 3.6
Average children living in house: 1.3
Average adult gender: Male-1.5, Female-2.1

b) Means of Livelihood



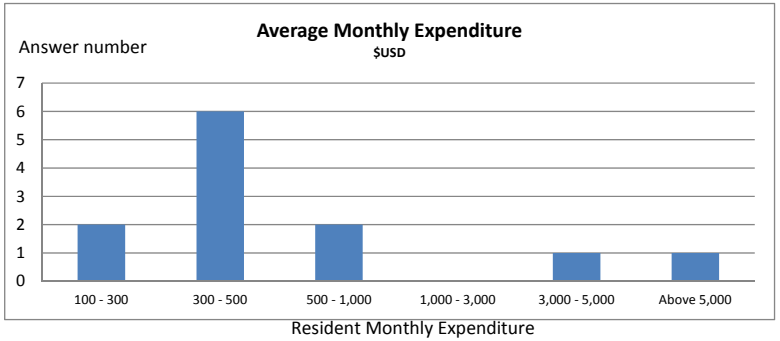
Resident's Occupation

c) Average Annual Income:

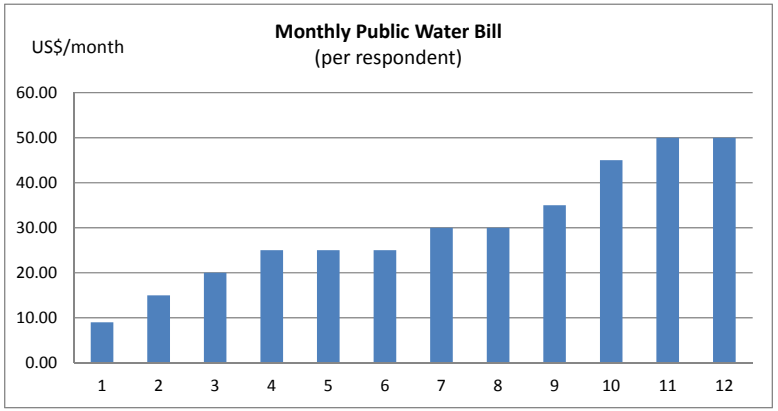


Resident Annual Income

d) Average Monthly Expenditure:

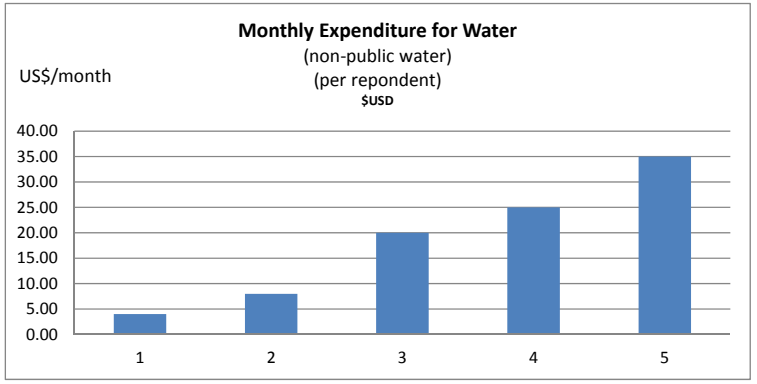


e) Monthly Public Water Bill (per respondent)

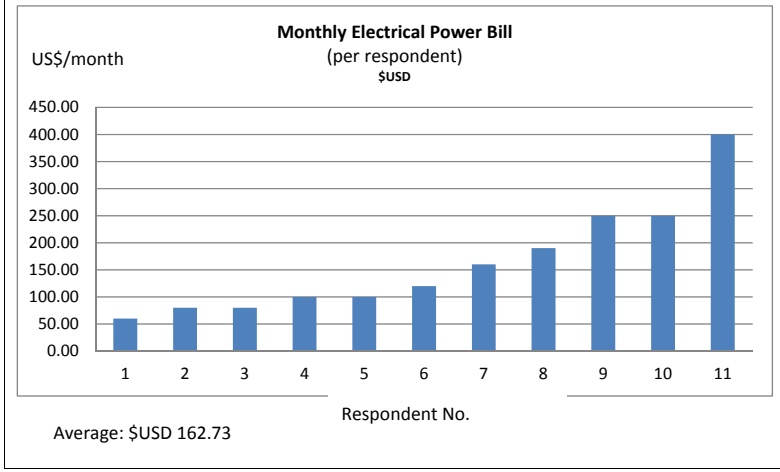


Palau Water Supply Improvement: Social Condition Survey | November 2014

f) Monthly Expenditure for Non-public Water (per respondent):

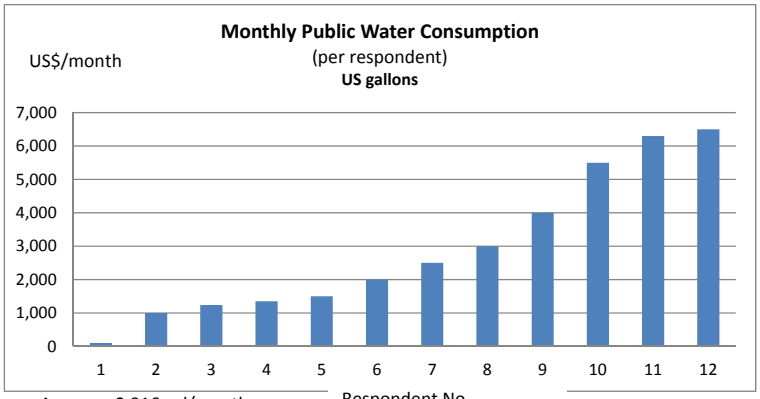


g) Monthly Electrical Power Bill (per respondent):



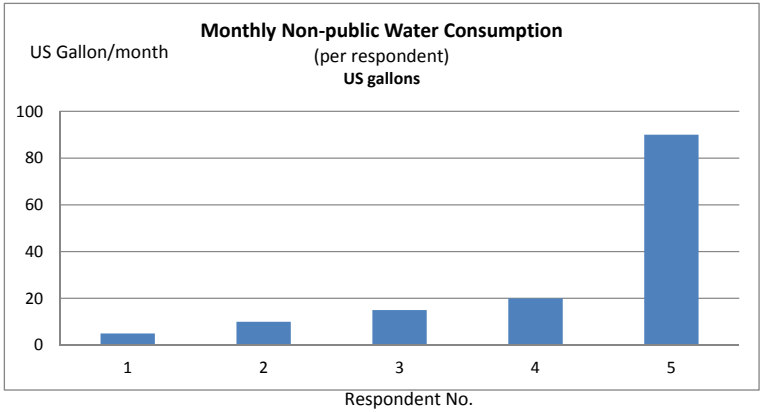
ii. Household present water use

a) Amount of consumption



Average: 2,916 gal/month

(Water uses: refer to Appendix 1: 4.Survey Input _ Airai Treatment, Section B, No. 26)

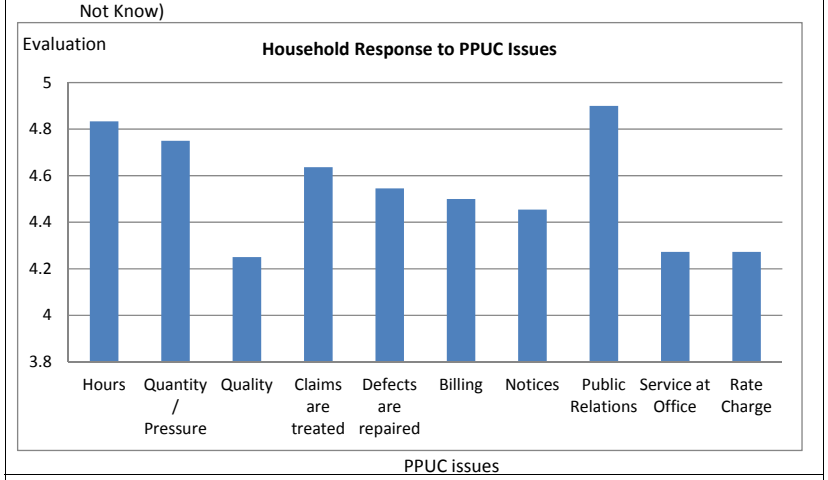


資料-13-6

iii. Awareness and satisfaction with water supply

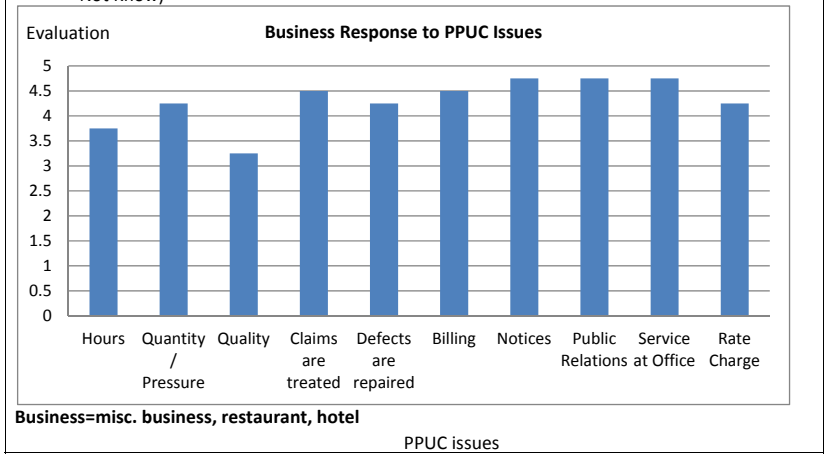
a) Household/Business Response to PPUC Water Utility Issues (per respondent):

A=6 (Very Good) B=5 (Good) C=4 (Fair) D=3 (Bad) E=2 (Very Bad) F=1 (Do Not Know)



b) Business Response to PPUC Water Utility Issues (per respondent):

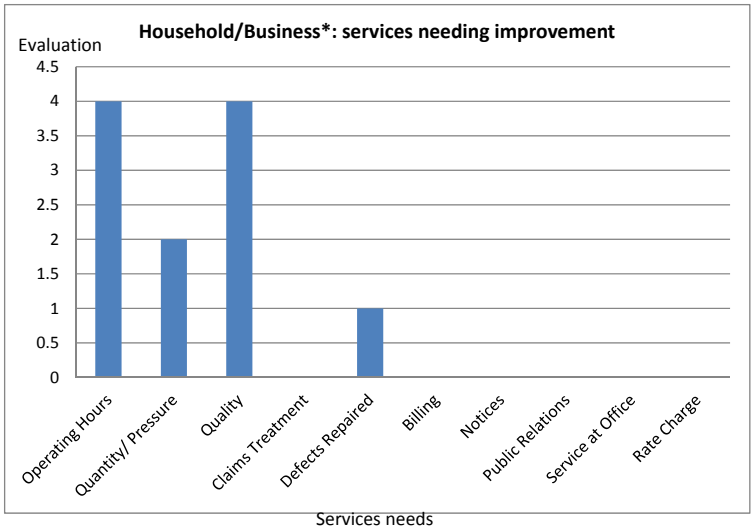
A=6 (Very Good) B=5 (Good) C=4 (Fair) D=3 (Bad) E=2 (Very Bad) F=1 (Do Not Know)



Business=misc. business, restaurant, hotel

iv. Evaluation of proposed water supply improvements

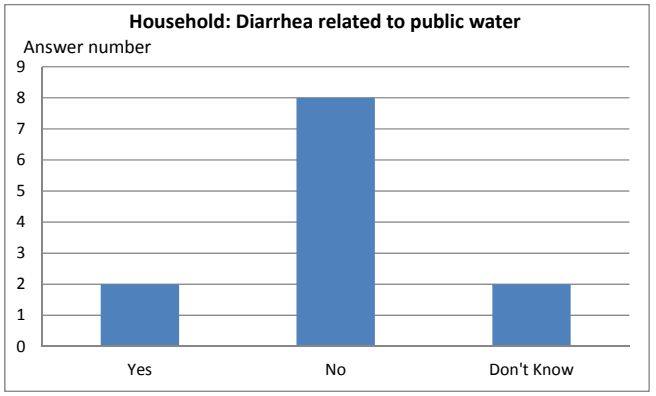
a) Household/Business* evaluation of services needing improvement:



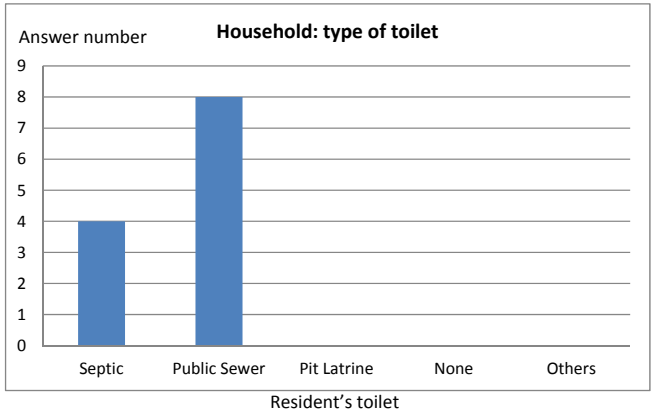
Business* = misc. business, restaurant, hotel

v. Household sanitation and hygiene conditions

a) Household: Diarrhea cases related to public water



b) Household: type of toilet used



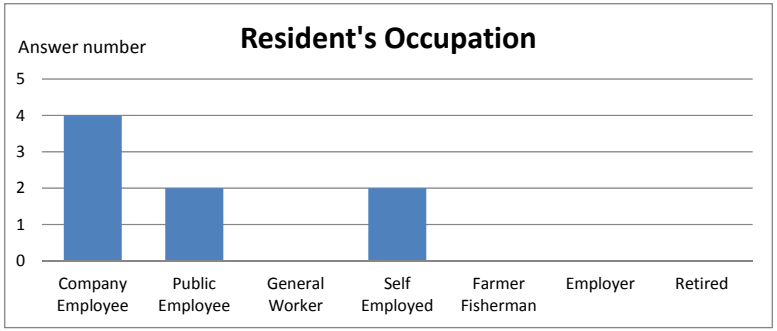
B. Airai Water Tanks Area

i. Household: general and economic condition

a) Population and composition of household:

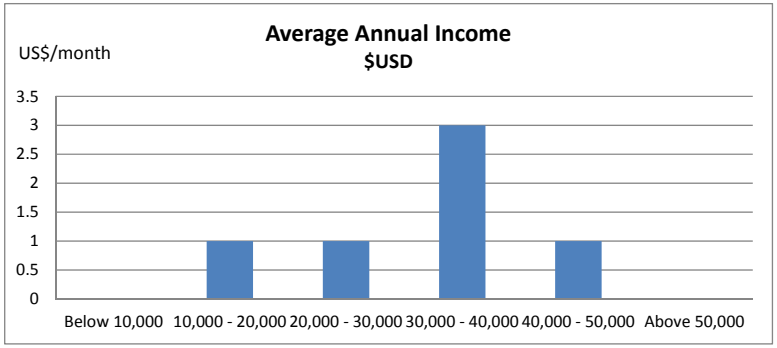
6 respondents
Average persons living in house: 3.8
Average adults living in house: 2.7
Average children living in house: 1.2
Average adult gender: Male-1.5, Female-1.4

b) Means of Livelihood



Resident's Occupation

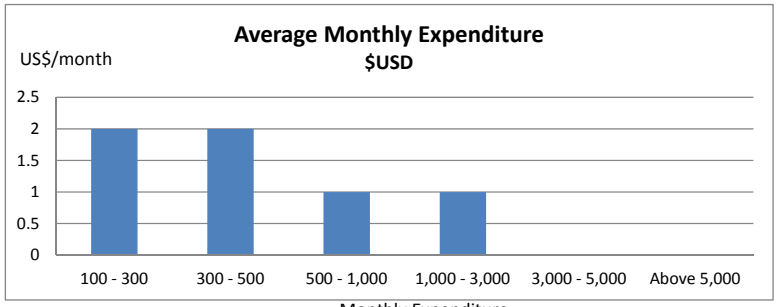
c) Average Annual Income:



Annual Income

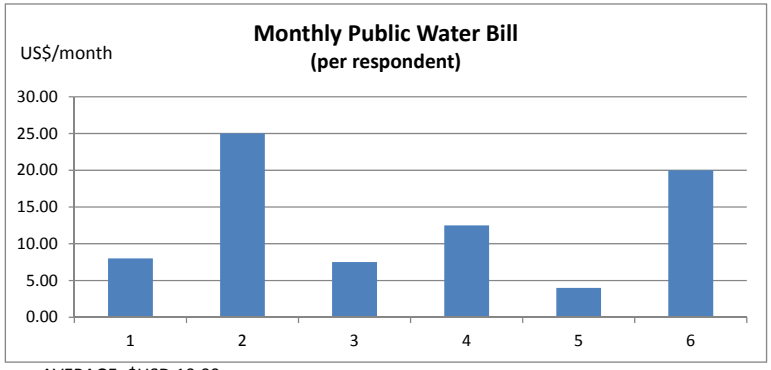
Palau Water Supply Improvement: Social Condition Survey | November 2014

d) Average Monthly Expenditure:



Monthly Expenditure

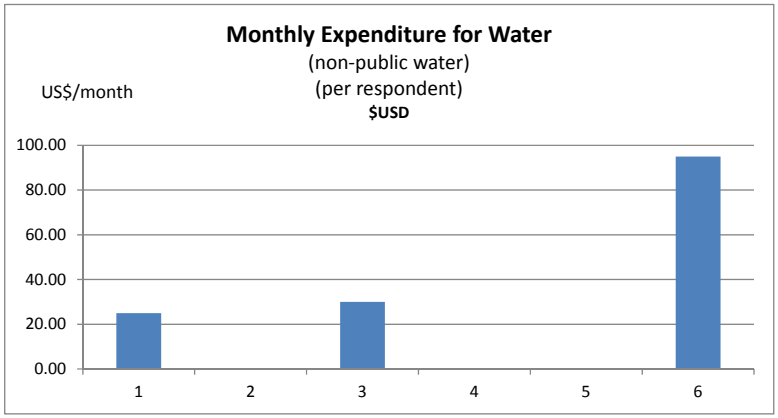
e) Monthly Public Water Bill (per respondent)



AVERAGE: $USD 10.00

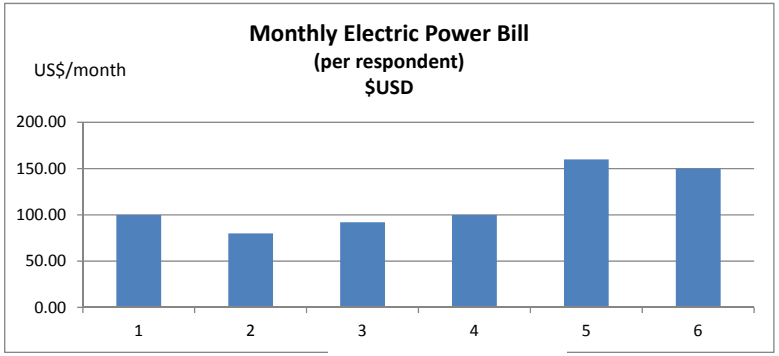
Respondent No.

f) Monthly Expenditure for Non-public Water (per respondent):



Average: $USD 12.33

g) Monthly Electrical Power Bill (per respondent):



Average: $USD 113.67

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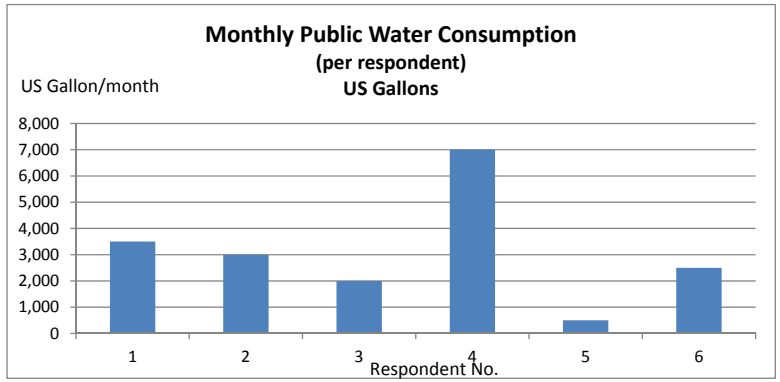
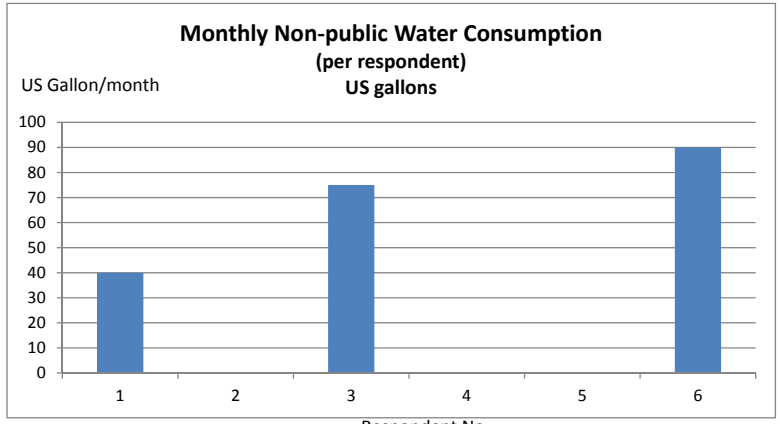
ii. Household: present water use

a) Amount of consumption



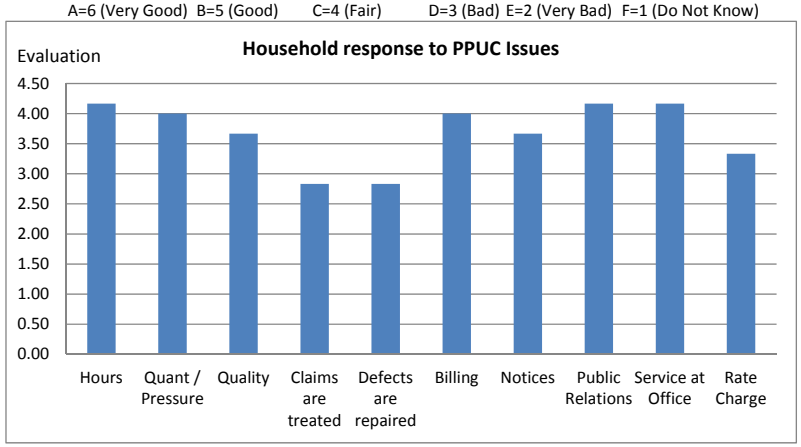
(Water uses: refer to Appendix 1: 4.Survey Input _ Airai Water Tank, Section B, No. 26)



iii. Awareness and satisfaction with water supply

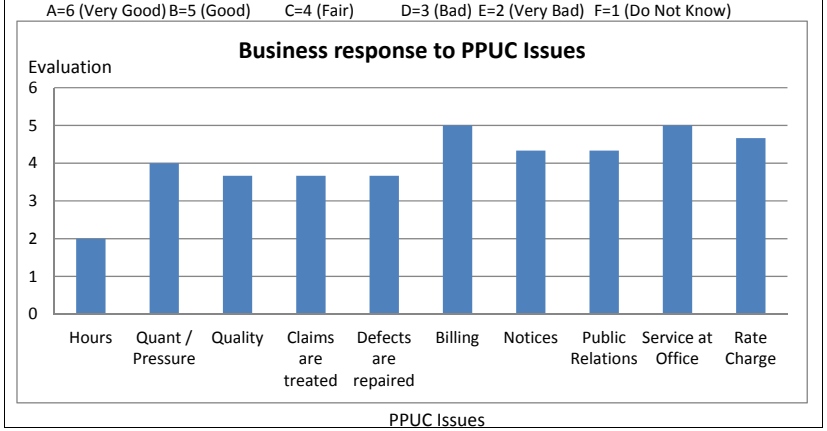
a) Household Response to PPUC Water Utility Issues (per respondent):

A=6 (Very Good) B=5 (Good) C=4 (Fair) D=3 (Bad) E=2 (Very Bad) F=1 (Do Not Know)



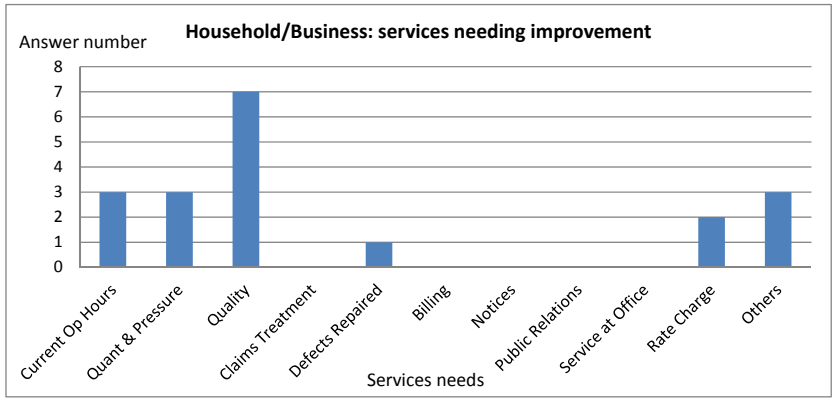
b) Others* (business, restaurant, hotel) Response to PPUC Water Utility Issues (per respondent):

A=6 (Very Good) B=5 (Good) C=4 (Fair) D=3 (Bad) E=2 (Very Bad) F=1 (Do Not Know)



iv. Evaluation of proposed water supply improvements

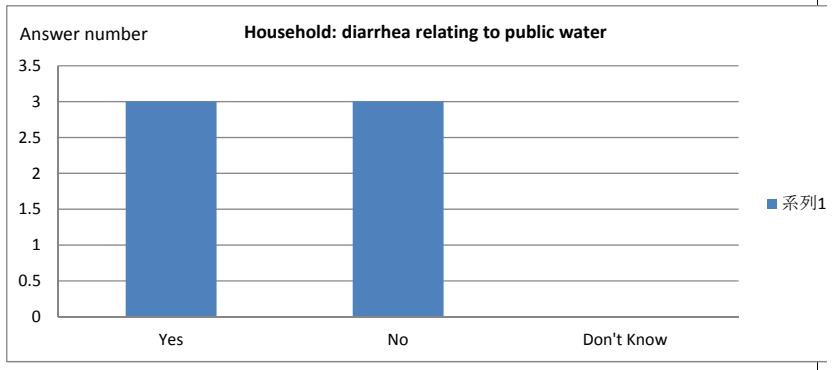
a) Household/Business*: evaluation of services needing improvement:



***Business=misc.business, restaurant, hotel**

v. Household: sanitation and hygiene conditions

a) Household: Diarrhea cases related to public water



b) Household: type of toilet used

Septic tank use only in Airai. No sewer system present

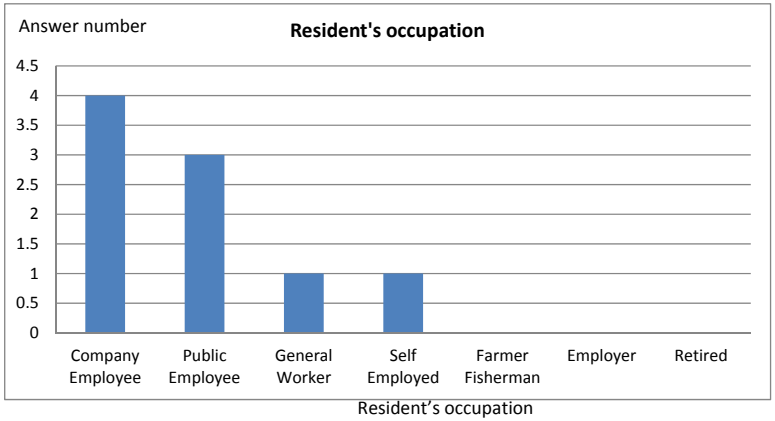
C. Ngermid Water Tank Area

i. Household: general and economic condition

a) Population and composition of household:

4 respondents
Average persons living in house: 5
Average adults living in house: 3.8
Average children living in house: 1.3
Average adult gender: Male-2, Female-1.8

b) Means of Livelihood



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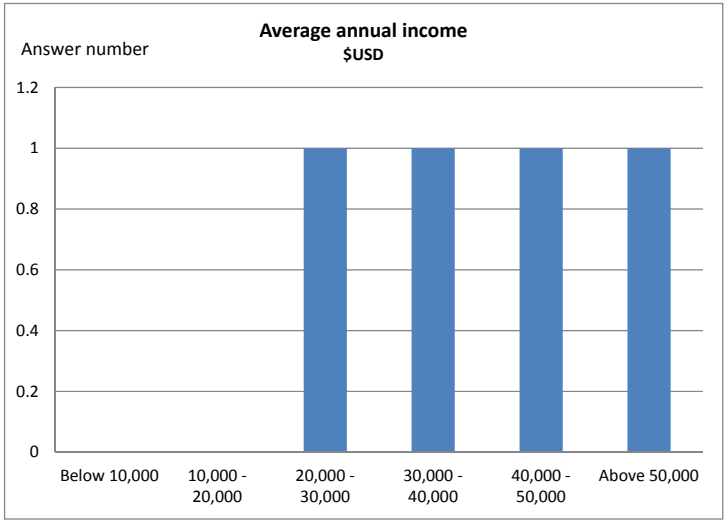
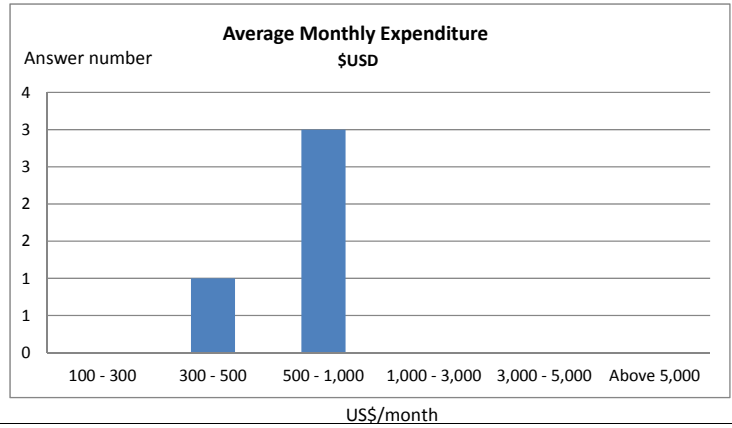
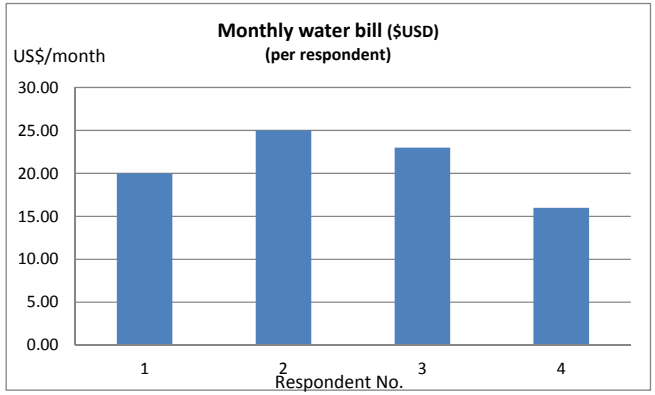
c) Average Annual Income:



d) Average Monthly Expenditure



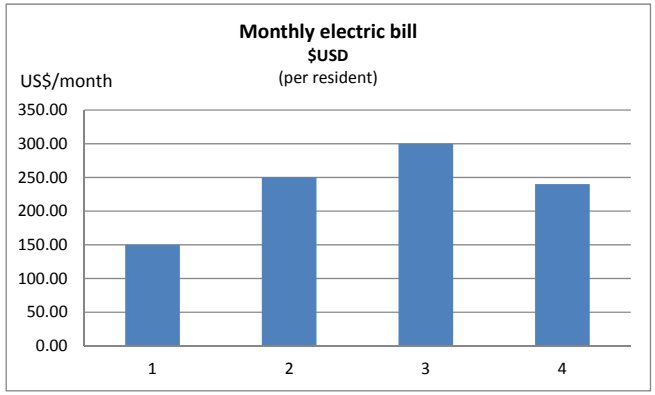
e) Monthly Public Water Bill (per respondent)



(Water uses: refer to Appendix 1: 4.Survey Input _ Ngermid, Section B, No. 26)

f) Monthly Expenditure for Non-public Water (per respondent):
One respondent: $USD 35.00

g) Monthly Electrical Power Bill (per respondent):



Average: $USD 235.00

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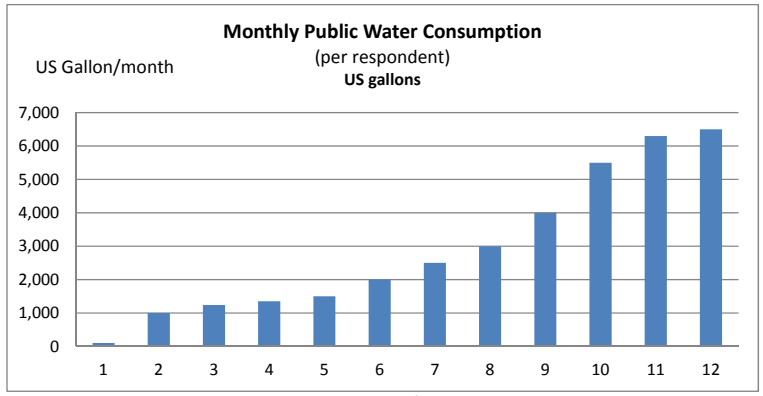
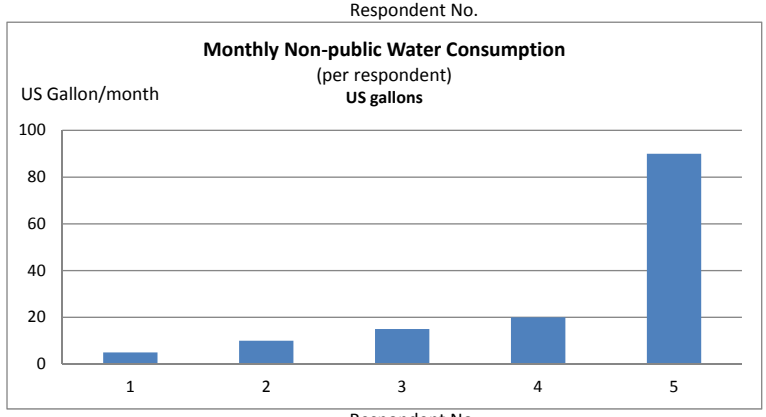
ii. Household: present water use

a) Amount of consumption

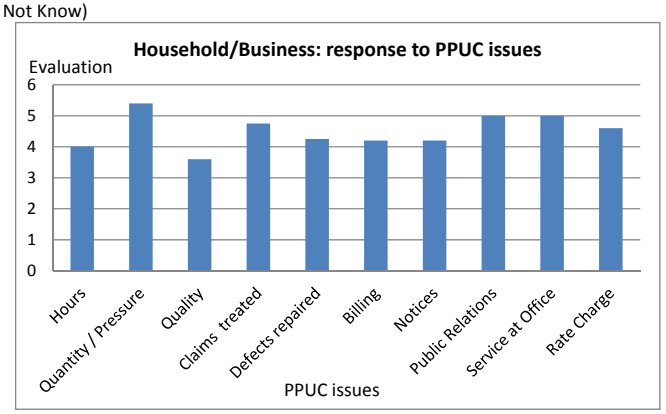




Water uses: refer to Appendix 1: Survey Input _Ngermid Tank Area, Section B, No.24,26

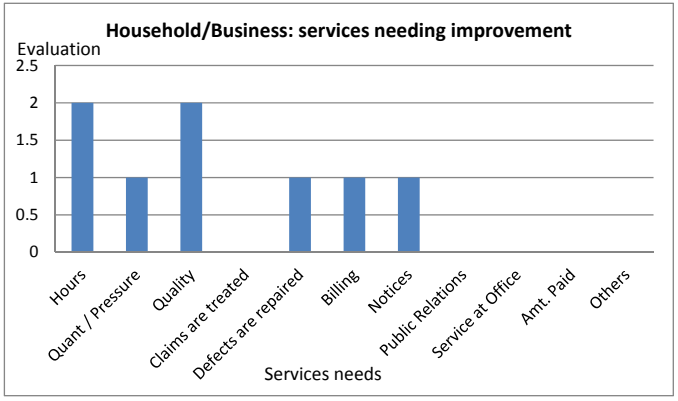
iii. Awareness and satisfaction with water supply

a) Household/Business: response to PPUC Water Utility Issues (per respondent):
A=6 (Very Good) B=5 (Good) C=4 (Fair) D=3 (Bad) E=2 (Very Bad) F=1 (Do Not Know)



iv. Evaluation of proposed water supply improvement

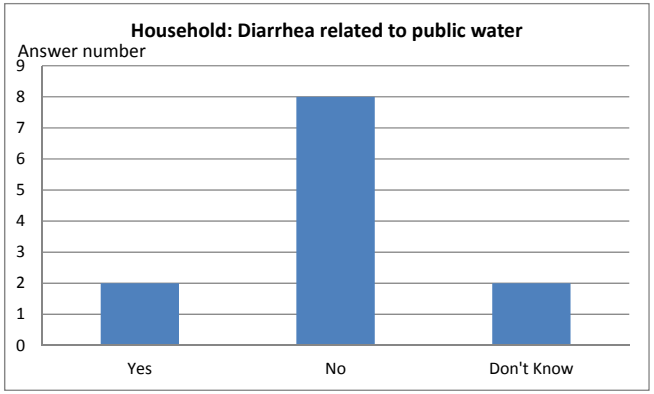
a) Household/Business* evaluation of services needing improvement:



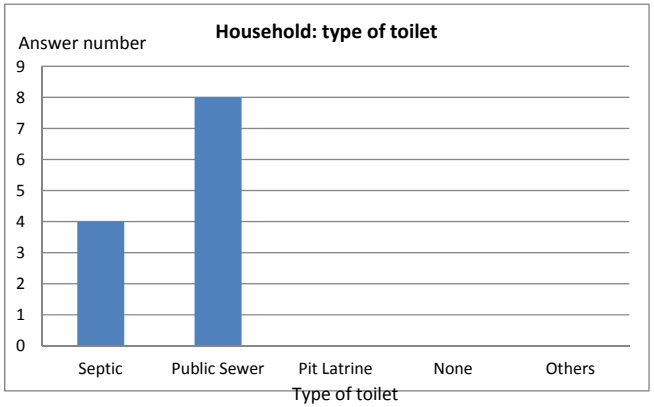
***Business= misc. Business, restaurant, hotel**

v. Household: sanitation and hygiene conditions

a) Household: Diarrhea cases related to public water



b) Household: type of toilet used



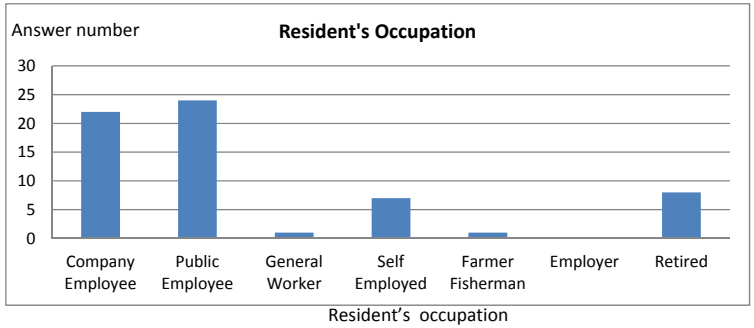
D. Ngerkesoaol Water Tank Area

i. Household: general and economic condition

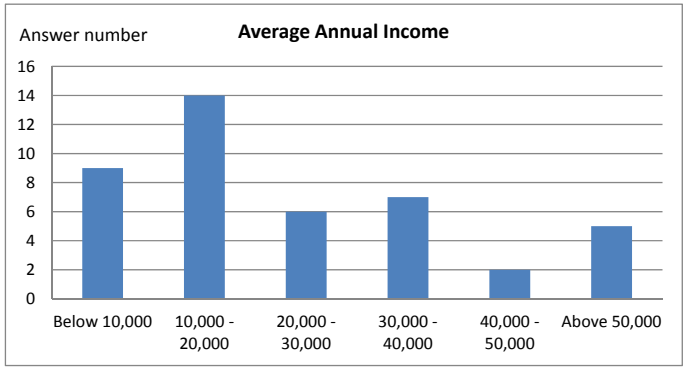
a) Population and composition of household:

45 respondents
Average persons living in house: 5.6
Average adults living in house: 3.9
Average children living in house: 1.6
Average adult gender: Male-1.6, Female-2.4

b) Means of Livelihood



c) Average Annual Income:



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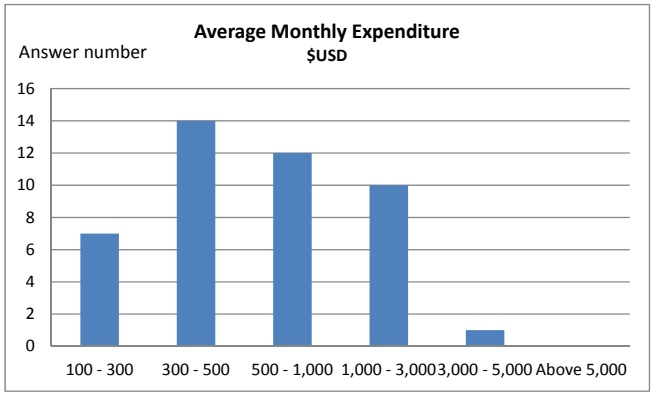
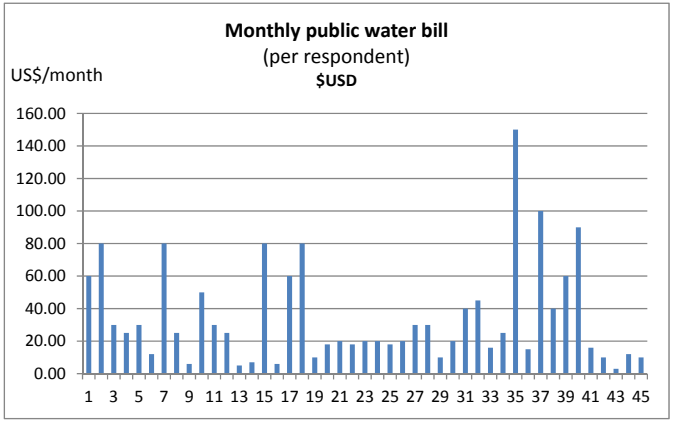
d) Average Monthly Expenditure:

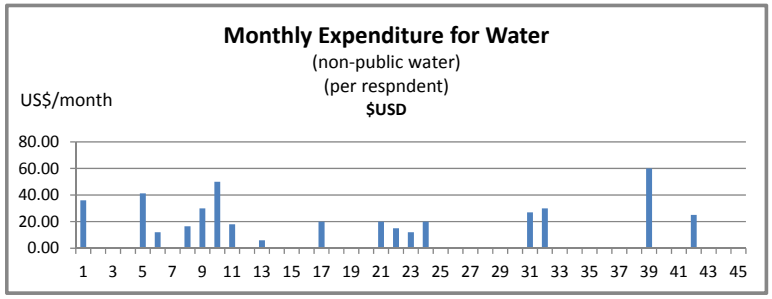


e) Monthly Public Water Bill (per respondent)



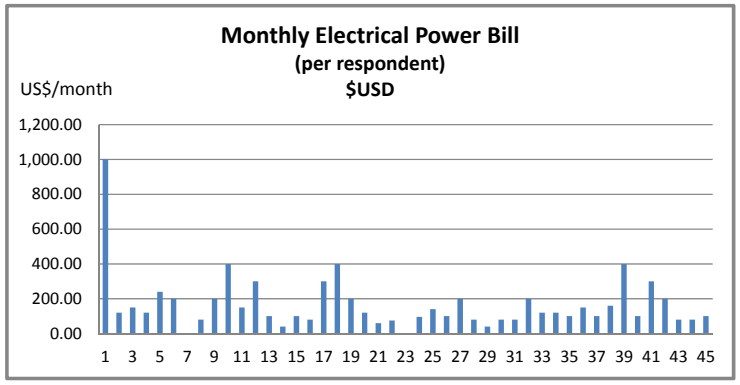
AVERAGE: $USD 34.60

f) Monthly Expenditure for Non-public Water (per respondent):



Average: $USD 25.80 Respondent No.

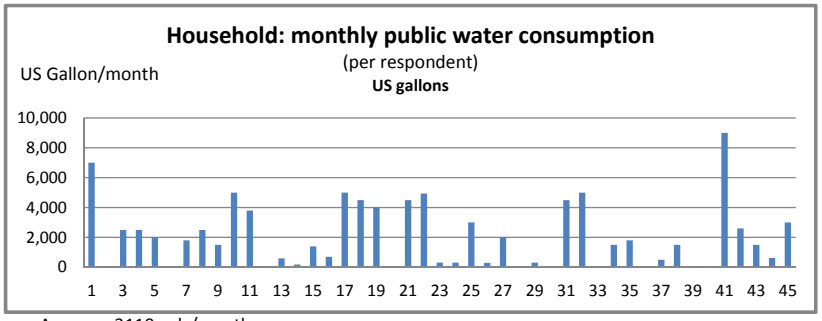
g) Monthly Electrical Power Bill (per respondent):



Average: $USD 165.80 Respondent No.

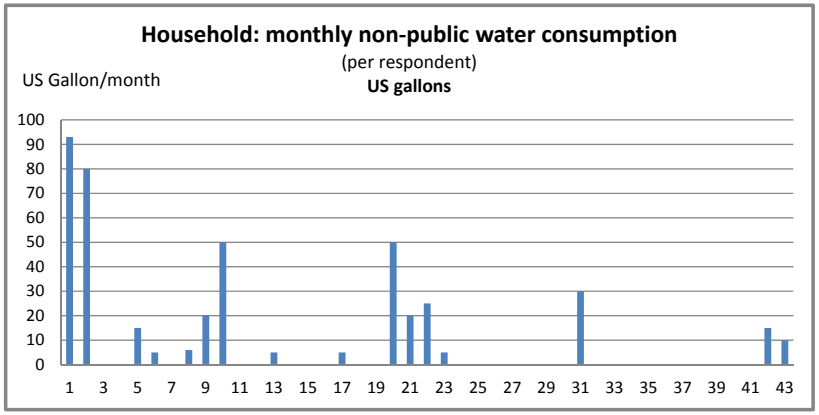
ii. Household/Business: present water use

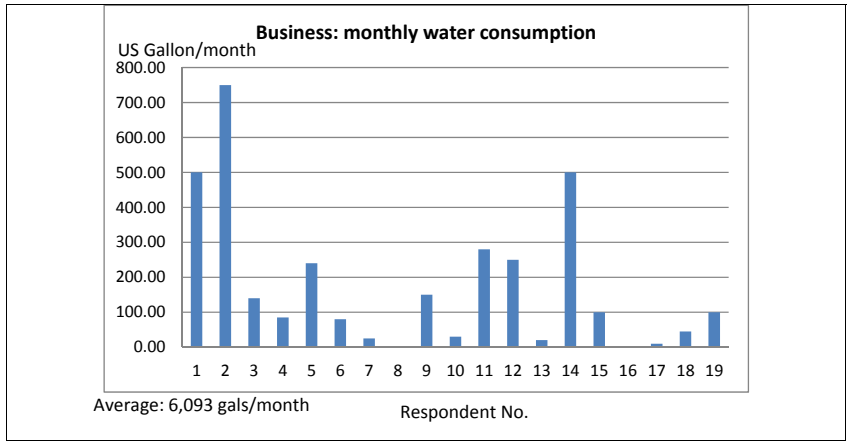
a) Amount of consumption



Average: 3119 gals/month Respondent No.

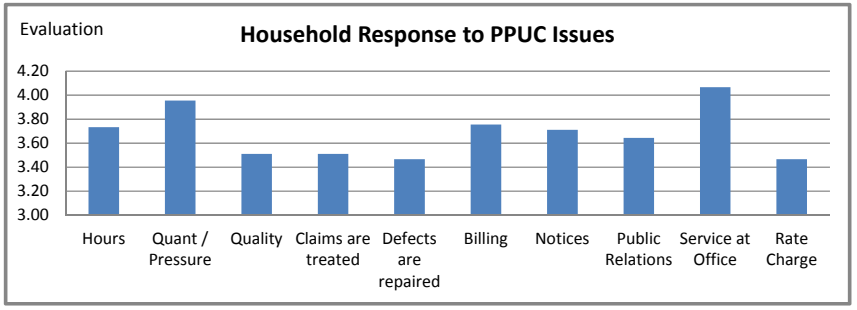
(Water uses: refer to Appendix 1: 4.Survey Input _ Ngerkesoaol, Section B, No. 24, 26)



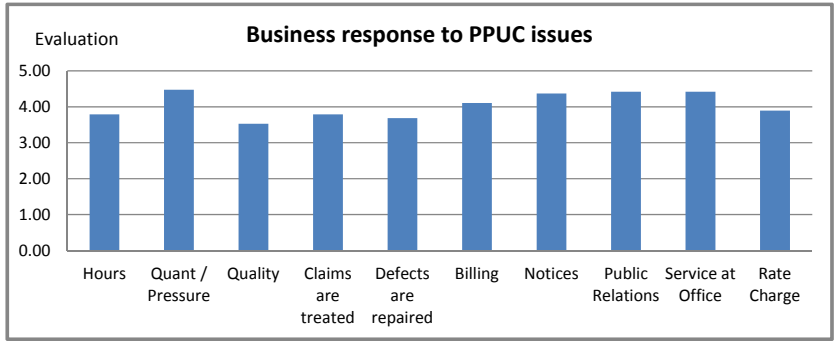


iii. Awareness and satisfaction with water supply

a) Household Response to PPUC Water Utility Issues (per respondent):
A=6 (Very Good) B=5 (Good) C=4 (Fair) D=3 (Bad) E=2 (Very Bad) F=1 (Do Not Know)

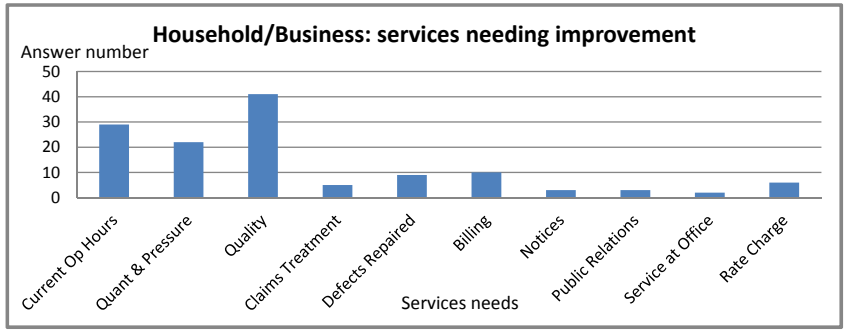


b) Business (misc. business, restaurant, hotel) Response to PPUC Water Utility Issues (per respondent):
A=6 (Very Good) B=5 (Good) C=4 (Fair) D=3 (Bad) E=2 (Very Bad) F=1 (Do Not Know)



iv. Evaluation of proposed water supply improvements

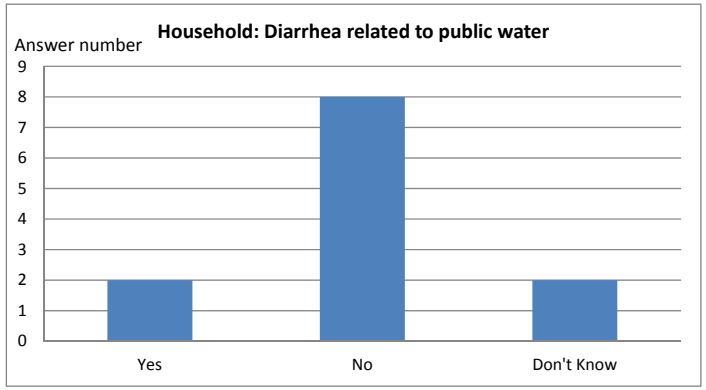
a) Household/Business* evaluation of services needing improvement:



***Business= misc. business, restaurant, hotel**

v. Household: sanitation and hygiene conditions

a) Household: Diarrhea cases related to public water



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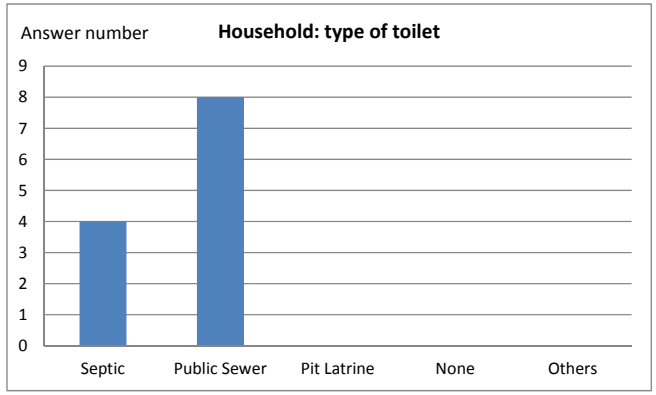
b) Household: type of toilet used



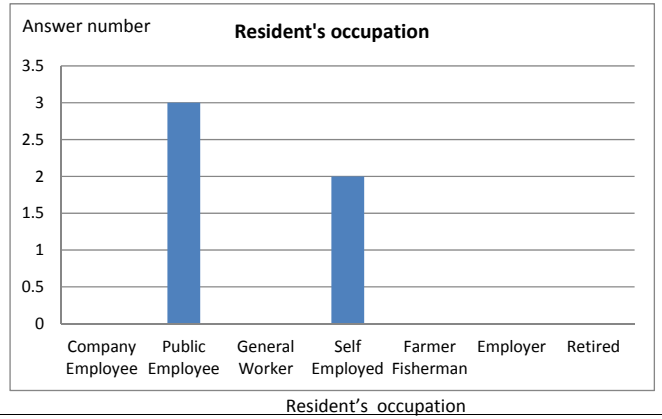
E. Arakabesang Water Tank Area

i. Household: general and economic condition

a) Population and composition of household:

4 respondents
Average persons living in house: 4.8
Average adults living in house: 3.0
Average children living in house: 1.8
Average adult gender: Male-1.5, Female-1.5

b) Means of Livelihood



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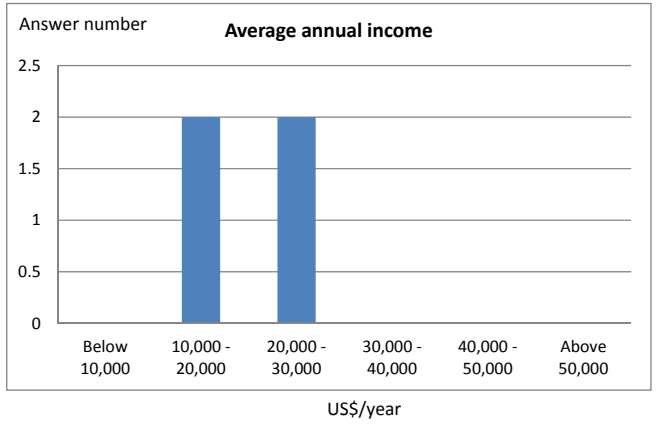
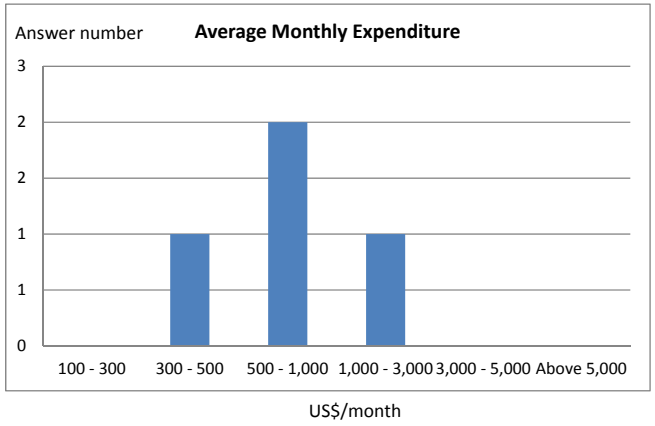
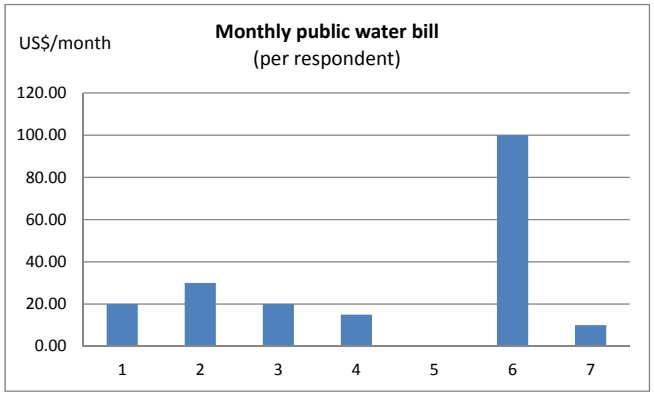
c) Average Annual Income:



d) Average Monthly Expenditure:



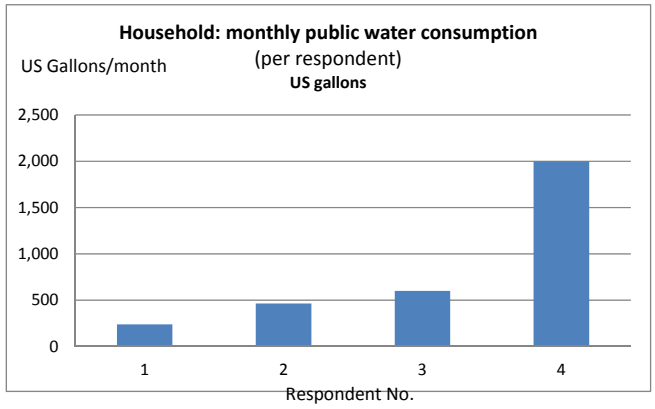
e) Monthly Public Water Bill (per respondent)



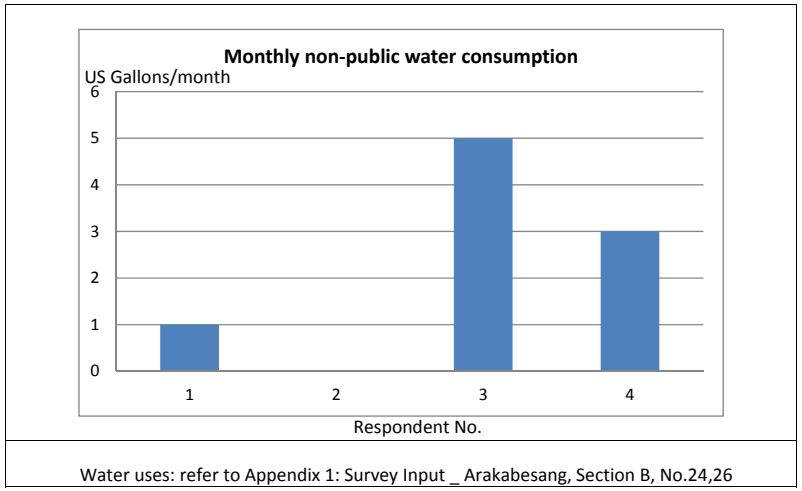
AVERAGE: $USD 32.50

ii. **Household: present water use**

b) Amount of consumption



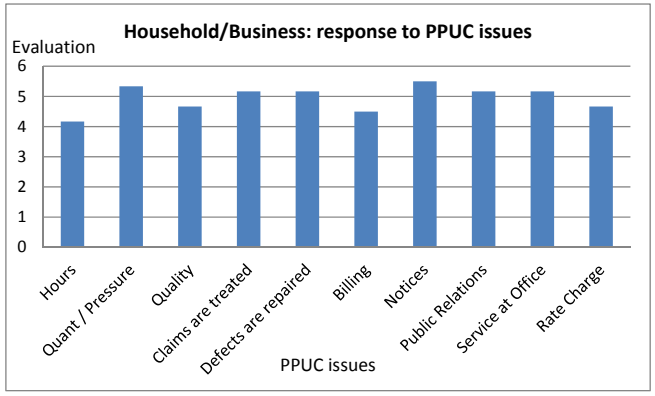
(2 businesses with public water consumption of 4000 gal/ month and 600 gal/month)



Water uses: refer to Appendix 1: Survey Input _ Arakabesang, Section B, No.24,26

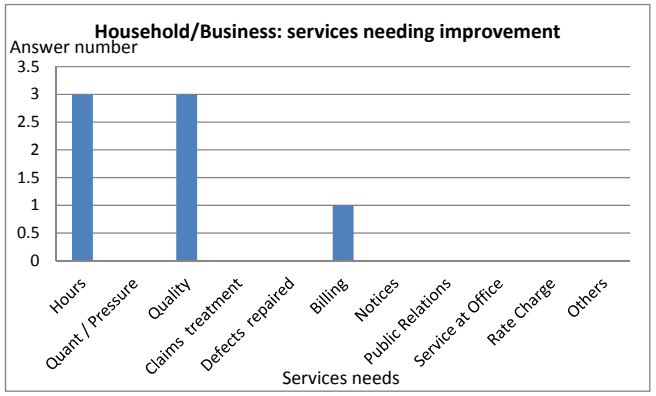
iii. **Awareness and satisfaction with water supply**

a) Household/Business response to PPUC Water Utility Issues (per respondent):
A=6 (Very Good) B=5 (Good) C=4 (Fair) D=3 (Bad) E=2 (Very Bad) F=1 (Do Not Know)



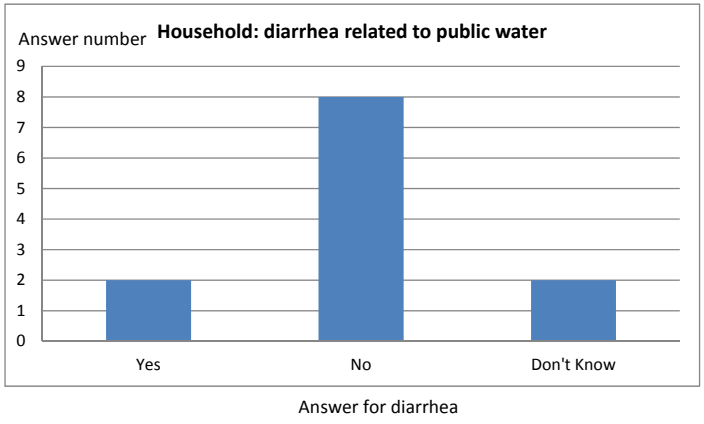
iv. Evaluation of proposed water supply improvements

a) Household/Business: evaluation of services needing improvement



v. Household: sanitation and hygiene conditions

a) Household: diarrhea cases related to public water



b) Household: type of toilet: all respondents on public sewer

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3. Analysis and Discussions

A. Survey Results

This social conditions survey were conducted field interviews at individual residences, places of business, restaurants and hotels together with station interviews such as department stores and governmental offices for total 100 samples in the 5 existing water supply districts namely 1) Airai treatment plant district, 2) Airai water tank area, 3) Ngermid water tank area, 4) Ngerkesoal water tank area, and 5) Arakabesang water tank area. The results of the survey indicate that individual residents have particular complaints toward the PPUC current water supply services such as low water pressure and turbidity of water quality. Therefore, the people pointed out strongly to improve present water supply services in the aspect of as follows;

(1) Water supply quantity and water pressure

(2) Turbid water problems

(3) Stable water supply

The scope of the works and objectives of this Project, Water Supply Improvement Koror and Airai States of the national important centers such as trade, commercial and tourism, are to reconstruct stable and safe water supply system for the service districts in 24 hours.

In the other term, the Project is expected to contribute to improve the PPUC water management performance due to present Non-revenue water of 48% in 2013 together with public water charges within the customers satisfaction rating upon the completion of this Project including Soft Components.

The survey results of outline are summarized as follows;

Water District & Household	Average PPUC Water Bill/month	Average Non-Public Water Bill/month	Average Electric Power Bill/month	Average PPUC Water Consumption	Average Annual Income	Survey samples
1.Airai Treatment Plant District	US$29.92	US$18.40	US$162.73	2,916 gal/month	US$40,000	17
2.Airai Water Tank Area	US$10.00	US$12.33	US$113.67	6,000 gal/month	US$35,000	9
3.Ngermid Water Tank Area	US$35.00	US$50.00	US$235.00	5,000 gal/month	US$50,000	4
4.Ngerkesoal Water Tank Area	US$34.60	US$25.80	US$165.80	3,000 household 6,093 business gal/month	US$30,000	64
5.Arakabesang Water Tank Area	US$32.50	-	-	600 household 4,000 business gal/month	US$20,000	6

B. Low Pressure and Turbid Water

This social condition survey intended all of the interviewees have experienced with problems of low pressure and turbid water occurrence in particular during rainy season. Although there is no existing PPUC water quality and low pressure survey result available for turbidity in tap water except some EQPB survey. Therefore, the PPUC has more closed discussions with the EQPB for the security of drinking water in the country including the technical training and methodology for improvement of low water supply pressure and turbid water.

In the Project, the water is currently transmitted through a pipeline from KAWTP to 4 units of the exiting Water Service Tanks. The water is distributed from the water service tanks for 24 hours by gravity to the residences, commercial facilities, governmental facilities, schools, and others. The water sources are surface water originated by natural rainwater from reservoir and river water intakes are operated by the PPUC, Water and Sewer Division. The States of Koror and Airai people have access to almost 100% piped treated water without any good solution of turbidity and low water pressure.

C. Affordability and Willingness to Pay

The summarized survey table on the above shows the monthly average PPUC public water bills ranging from US$29.92 to US$35.00 which could be installed water meter and the affordability and willingness to pay for the survey results of 4 water district namely Airai Treatment Plant area, Ngermid water tank area, Ngerkesoal water tank area and Arakabesang water tank area, except Airai water tank district of US$10.00 per month due to the remaining flat rate. On the other hand, an average PPUC water consumption of the 4 water district is ranging from 2,916 to 5,000 gal/month but the Airai water tank district consume the max of 6,000 gal/month with the lowest costs. Therefore, the water charge system should be renewed.

At the same time, the results of the social conditions survey for household income estimated the average annual is ranging from US$50,000 in the maxim to US$20,000 in the lowest. The different average annual income indicate the highest electric power bill of US$235.00 per household together with the highest non-public water bill of US$50.00 per month for to buy bottled commercial drinking water due to the water quality.

資料-13-22

Questionnaire
For
Households, which connected to PPUC water supply services

Section-A Personal Information

1. Interviewer's Name: _____ 2. Date of Interview: _____ 3. Ser.No. _____

4.Survey Area: [a] Airai [b] Ngermid [c] Koror [d] Malakal [e] Arakabesang

Longitude: ° ′ ″ Latitude: ° ′ ″ Elevation: m

5. Respondent's Name: _____

6 Respondent's Family Name: _____

7. Sex of Respondent: _____ 8. Age of Respondent: _____

9.Sex of Household Head: _____ 10.Age of Household Head: _____

11. Marital Status of Household Head: [a] Married [b] Single/never married [c] Widow Divorced [d] Separated

12. Relationship of Respondent with Household Head: _____

13. Living Address: _____

14. Duration of living in this area: Year/Month _____

15. Duration of living in current house/apartment: Year/Month _____

1）Water from PPUC tap? Yes/No 3)Paid by？ （Water Mater/Flat Rate） Free _____

2）Any Problems of Water? Yes/No 4) How much? ($/month) _____

16. Housing Ownership: [a] Self-Owned house [b] Rented house [c] Self-Owned apartment [d] Rented apartment

17. No. of Rooms and Bath Room in Home [a] number of Rooms: [b] number of Bath Rooms:

Section-B Water Supply and Water Use

18. How many water taps do you have in-house and/or in-yard?

	Number of Tap
A. In-house	
B. In-yard	
Total	

19. Is water always available, every day, 24 hours?

[a] Yes [b] No, only : ～ : available

20. Is quantity and pressure enough?

[a] Yes No [b] Quantity is not enough [c] Pressure is not enough

FORM-A HOUSEHOLDS
Questionnaire (**Connected**) / Social Condition Survey for the Water Supply System Improvement Project in the Republic of Palau

21. Do you have any problem concerning water quality? Any smell, turbidity, colour?

[a] No Yes [b] Smell [c] Turbidity [d] Colour

22. Do you reserve water from public service in your house?

[a] Yes (go to 23 & 24) [b] No (go to 25)

23. What kind of container do you mainly use for reserving water?

[a] Plastic Container [b] Bucket [c] Plastic/Masonry/Concrete/Panel Tank

[d] Drum [e] Bath tab [f] Others (specify:)

24. How much do you reserve the water in a day?

[a]. _____Gallons/day

25. For which purposes followed do you use the water from public water supply service? (Multiple Answer)

【Interviewer shall ask the following one by one, and tick off.】

[a] Drinking [b] Cooking [c] Washing Dishes [d] Washing Clothes

[e] Washing Bicycle/Motor Bike/Car [f] Bathing [g] Flushing Toilet

[h] Irrigating Garden [I] Irrigating Farmland (crops)

[j] Domestic animals (cattle/donkey/sheep/goat)

[k] **Business (**specify:_____) [l] **Others** (specify:_____)

[m] How many times does it take shower in a day per person? Adult ( ) Children ( )

26. For which purpose do you use water from other sources? (Multiple Answer)

【Interviewer shall ask the following one by one, and tick off & put code below for source】

Purpose	Source	Purpose	Source
[a] Drinking		[g] Flushing toilet	
[b] Cooking		[h] Irrigating garden	
[c] Washing Dishes		[I] Irrigating farmland	
[d] Washing Clothes		[j] Domestic animal (cattle/donkey/sheep/goat)	
[e] Washing Bicycle/Motor Bike /Car		[k] Business (specify:)	
[f] Bathing		[l] Others (specify:)	

Source:

A=tube well / borehole with pump, B=protected dug well, protected spring, C=bottled water, D=rain water collection, E=unprotected dug well or spring, F=pound, river, stream, G=vender tanker, truck, H=Public service through neighbour, I=public stand pipe, communal tap, J=spring gravity fed water system, K=others (specify)

27. Do you buy any bottled water?

[a] Yes (go to 28 & 29) [b] No (go to 30)

28. How much bottled water do you use per day/month? How much do you pay for bottled water per

day/month?

A. How much do you use	B. How much do you pay?
_____Litre per day	_____$ per day
_____Litre / m^3 per month	_____$ per month

29. Why do you buy the bottled water though you can get public water supply service? (Multiple Answer)

【Question shall be opened, tick off the following answered】

[a] Since it is safe	[d] Since the public water supply is not enough
[b] Since it is tasty	[e] Since I feel well-off / it is fashionable
[c] Since it is cheap	[f] Others (specify)

30. Do you have any well/boreholes in your house?

[a] Yes (go to 31 to 34) [b] No (go to 35)

31. If "Yes", check size of the well and type of pump.

[a]. Diameter_____mm [b] Depth_____m

[c]. Type of pump: [d] electric pump [e] hand pump [f] water radar [g] none

[h] Others (specify:)

32. How much did it cost for installation of well/borehole? 【Convert the amount into present value】

_____$. [ ] I do not know

33. How much do you pay in average for operation and maintenance of pump per month?

_____$/ month

_____$/ month (for electricity, if interviewee knows)

34. How much water do you use from well per day/month?

_____gallons per day _____gallons per month

35. Are there any private water vendors around your living area?

[a] yes (go to 36) [b] no (go to 12)

36 Do you frequently purchase drinking water from water vendors/company?

[a] yes (go to 37 to 42) [b] no (go to 43) [c] On shortage of water supply

[d] For festivals/ construction of buildings

FORM-A HOUSEHOLDS
Questionnaire (**Connected**) / Social Condition Survey for the Water Supply System Improvement Project in the Republic of Palau

37. How much water do you obtain from private water vendors/company?

_____gallons per day _____gallons per month

_____gallons per day whenever needed

38. How much do you pay for private vender/company per month?

_____$ per month _____$ per month whenever needed

39. How much water from PPUC services does your family use per day / month? Is the consumption metered?

A. _____gallons per day _____gallons per month

B. Metered?: [a] Yes [b] No

40. How much do you pay for public water supply per month?

_____$ per month

41. To what extent do you think PPUC water is expensive?

[a] Very expensive [b] Expensive [c] Fair [d] Cheap [e] Very cheap

42. In case of expensive or cheap in the question above, how much water charges is reasonable for your water consumption?

_____$ per month (in case of expensive)

_____$ per month (in case of cheap)

43. How much water from other source (including bottled water, vender and well) does your family use per day / month?

_____gallons per day _____gallons per month

44. Do you pay for water from other sources (including bottled water and well)?

[a] Yes (go to 45 & 46) [b] No (go to 47)

45. If "Yes", how much do you pay?

_____$ per month

46. Do you think it is expensive?

[a] Very expensive [b] Expensive [c] Fair [d] Cheap [e] Very cheap

47. Do you share the water from public service with your neighbours?

[a] Yes (go to 48 & 49) [b] No (go to 50)

48. How much water do you share with your neighbours per day/month?

_____gallons per day _____gallons per month

[ ] don't know because I don't watch during fetching water

49. How much do you charge for neighbours for water shared per day/month?

_____$ per day _____$ per month No charges

Section-C Users' Awareness and Satisfaction on current service

50. Are there any positive change on your life style after connecting water supply services?

[a] Yes (go to 51) [b] No (go to 52) [c] I never know situation without public water service (go to 2)

51: How it is changed? 【Question shall be opened, tick off the following answered】

[a] Sanitation and Hygiene condition is improved	[e] Cost to buy water is reduced
[b] Time and burden to obtain water is consumed	[f] Opportunity to learn/work is increased
[c] Medical expense is decreased	[g] Others (specify)
[d] Water is available regardless of time	

52. Do you save water from public water supply service?

[a] Yes (go to 53) [b] No (go to 54)

53. Why do you save water from public water supply service? (Multiple Answer)

【Question shall be opened, tick off the following answered.】

[a] Since water is common and limited resource	[c] Due to publicity for water conservation
[b] Since water rate is expensive/ to save expenditure for water	[d] Without any particular reasons
[e] Others, Specify:	

54. Why you do not save water from public water supply service? (Multiple Answer)

【Question shall be opened, tick off the following answered.】

[a] Since water is plenty	[d] Since water supply is irregular, water tap shall be kept always open
[b] Since water rate is cheap	[e] Since it is clean and safe
[c] Since only limited amount is used	[f] Without any reason
[g] Others, Specify:	

55. Do you have any complain with current public water supply services?

[a] Yes (go to 56) [b] No (go to 57)

56. If "Yes", what kind of complain? (Multiple Answer)

【Question shall be opened, tick off the followings answered】

[a] Current operation hours of the water supply	[f] Manner of billing
[b] Quantity and pressure	[g] Manner of notice
[c] Quality of water supplied	[h] Manner of public relations
[d] Manner in which claims are treated	[I] Services at the pay office
[e] Manner in which defects are repaired	[j] Amount paid
[k] Others (specify)	

57. On a scale of 1-5, how do you rate the following issues of PPUC water services?

A=Very Good, B=Good, C=Fair, D=Bad, E=Very Bad, F=I do not know

Issues	Rate	Issues	Rate
[a] Current operation hours of the water supply		[f] Manner of billing	
[b] Quantity and pressure		[g] Manner of notice	
[c] Quality of water supplied		[h] Manner of public relations	
[d] Manner in which claims are treated		[I] Services at the pay office	
[e] Manner in which defects are repaired		[j] Amount paid	

58. Do you know the process where do agencies obtain water for PPUC water services, how do they purify water and distribute water?

	Source	Purification	Distribution
Response	[yes] [no]	[yes] [no]	[yes] [no]

59. Do you know which PPUC service tank has jurisdiction of public water supply service? 【Also, ask the PPUC service tank name of jurisdiction, then if it is correct, tick off "Correct", otherwise, "Incorrect"】

Response	Airai	Ngermid	Koror	Malakal	Arakabesang
Correct Answers					
Actual Response					

[a] Correct [b] Incorrect

60. Do you know the basic principle that almost of all the cost for running public water supply services shall be covered by the user fee collected?

[a] Yes (go to 62) [b] No (go to 61)

61. If "No", how do you think from the followings?

[a] I thought the half to be covered by tax/government

[b] I thought the most to be covered by tax/government

[c] free of cost at expense of tax/government

62. Are there any in-house/yard leakage, or pipe/tap always opened or broken, at present?

[a] Yes (go to 63) [b] No (go to 64)

63. Why do not you fix it? 【Question shall be opened, tick off the followings answered】

[a] Since water rate is cheap	[d] Since water supply is irregular / limited
[b] Since it leaks only a little	[e] Others (specify)
[c] Since it shall be responsible of public water supply provider	

64. What do you think the role and responsibility of users for use of public water supply services?

【Multiple Answer: Answer shall be selected from the followings by interviewee】

[a] Paying connection fee	[c] Paying water bill
[b] Repairing in-house/yard leakage from pipeline	[d] Cleaning of drainage near house
[e] Others (specify)	

Section-D Users' Valuation on Improvement of Public Water Supply Service

65. Do you have any request for improvement of water supply services?

[a] Yes (go to 66) [b] No (go to 67)

66. If "Yes", what kind of services/issues to be improved?

【Question shall be opened, tick off the followings answered】

[a] Current operation hours of the water supply	[f] Manner of billing
[b] Quantity and pressure	[g] Manner of notice
[c] Quality of water supplied	[h] Manner of public relations
[d] Manner in which claims are treated	[I] Services at the pay office
[e] Manner in which defects are repaired	[j] Amount paid
[k] Others (specify)	

67. Do you want much improved public water supply service, even if current water rate is increased?

[a] I am satisfying current service and rate	[d] No, even if it is reasonable raise
[b] Yes, if it is reasonable raise	[e] No, if it is steep raise
[c] Yes, even if it is steep raise	[f] I do not know

68. What do you want to know about water supply management?

【Three (3) answers shall be selected from the following by interviewee】

[a] How water rate is decided (rate setting)	[f] How the water rate collected is utilized
[b] Water quality control	[g] Extension, rehabilitation plan

[c] Financial status of water providing organization/company (Financial Management)	
[d] What is water source, how the water treated, transmitted, and distributed	
[e] How the water business is run (business management)	[h] When and where the water supply is cut-off
[I] Others, Specify	

69. What do you think the most important in water supply among the following?

【Two (2) answers form the following shall be selected by interviewee】

[a] That water quality/taste is good	[c] That amount of water and pressure is enough
[b] That water rate is cheap	[d] That water is always supplied enough without cut-off and low pressure
[e] Others, Specify:	

70. Are there any companies concerning water (including water supply services)? If there are, what kind of activities are they doing?

[a] Yes (go to 71) [b] No (go to 72)

71. What is name of the companies and what is main activities?

[a]. Company:_____

[b]. Activities:_____

Section-E Sanitary Condition

72. Is frequency of diarrhoea decreased after having water supply services?

[a] Yes [b] No [c] No Change/I do not know

73. What kind of toilet do you use?

[a] Flush toilet to sewerage or septic tank [b] Pour flush toilet

[c] Dry/Traditional pit latrine [d] None

[e] Others (specify)_____

74. Do you have problem on your toilet?

[a] No problem (go to 76) [b] Yes (go to 75)

75. What kind of problem do you have?

[a] Drainage [b] Septic Tank [c] Water for flushing [d] Vermin [e] Smell

[f] Others (specify) _____

76. How often do you withdraw sludge from the toilet? Who usually do this work? How much do you pay for the withdrawing?

A. Frequency of withdrawing sludge	_____Per day/week/year
B. Persons withdrawing sludge	[a] family member [b] hired worker [c] others (specify:)
C. Cost for withdrawing sludge	_____$ Per day/week/month/year

77. When you get sick, how much does your family spend for doctor's inspection fee and medicine per month in average?

Total_____$ per month per family in average

78. How much does your family spend for doctor's inspection fee and medicines per month in average for diseases relating water (diarrhoea, stomach worms, hepatitis)?

Water relating_____ $ per month per family in average

Section-F Family Status

79. How many persons usually live in your household?

[a] Adult men_____ [b] Adult women_____

[c] Own children _____ [d] Other children_____ [e] Total_____

(Child = under 12 years old)

80. What are the occupations of the members earning money?

[a] Company employee [b] Public employee [c] Waged labour/worker

[d] Self-employed [e] Farmer/Fisher [f] Employer

[g] Others (specify) _____

81. How much is your family expenditure per month in average?

_____$ per month

82. How much is your family income per month in average?

_____$ per month

83. Do you pay for house rent?

[a] Yes (go to 4-2) [b] No (go to 5)

84. How much do you pay?

_____$ per month

85. How much do you pay for public electric supply per month?

_____ $ per month

86. To what extent, do you think it is expensive?

[a] Very expensive [b] Expensive [c] Fair [d] Cheap [e] Very cheap

87. Out of following items, what do you have in your house? (Multiple Answer)

[a] Television [b] Radio/Cassette player [c] Refrigerator [d] Electric cooker [e] Electric dining plate washer [f] Motorbike [g] Car [h] washing cloth machines

Questionnaire

For

Households, which are not connected to water supply services

Section-A Personal Information

1. Interviewer's Name: _____ 2. Date of Interview: _____ 3. Ser.No. _____

4.Survey Area: [a] Airai [b] Ngermid [c] Koror [d] Malakal [e] Arakabesang)

Longitude: ° ′ ″ Latitude: ° ′ ″ Elevation: m

5. Respondent's Name: _____

6 Respondent's Family Name: _____

7. Sex of Respondent: _____ 8. Age of Respondent: _____

9.Sex of Household Head: _____ 10.Age of Household Head: _____

11. Marital Status of Household Head: [a] Married [b] Single/never married [c] Widow Divorced [d] Separated

12. Relationship of Respondent with Household Head: _____

13. Living Address: _____

14. Duration of living in this area: Year/Month 15. Duration of living in current house/apartment: Year/Month

16. Housing Ownership: [a] Self-Owned house [b] Rented house [c] Self-Owned apartment [d] Rented apartment

17. No. of Rooms and Bath Rooms in Home [a] number of Rooms: [b] number of Bath Rooms:

Section-B Water Supply and Water Use

18. Is quantity of PPUC water supply enough?

[a] Yes [b] No [c] Satisfactory

19. Do you have any problem concerning water quality? Any smell, turbidity, colour?

[a] No Yes [b] Smell [c] Turbidity [d] Colour

20. Do you reserve water in your house from any water source?

[a] Yes (go to ,21 & 22) [b] No (go to 23)

21. What type of container do you mainly use for reserving water?

[a] Plastic Container [b] Bucket [c] Plastic/Masonry/Concrete/Panel Tank

[d] Drum [e] Bath tab [f] Others (specify:)

22. How much do you reserve water in a day ?

a. _____Gallons

23. How long does it take to carry water from major source (inc. public service) for your house use?

_____hours_____minutes per time

FOAM-B NOT CONNECTED
Questionnaire (**Connected**) / Social Condition Survey for the Water Supply System Improvement Project in the Republic of Palau

25. How many times a day do you carry water from a major source?

_____ Times/day

26. Who does mainly carry water from its major source?

[a] Adult female [b] Adult male [c] Male child [d] Female child [e] Servant/Labour

[e] Others (specify:)

27. For which purpose do you use water from other sources? (Multiple Answer)

【Interviewer shall ask the following one by one, and tick off & put code below for source】

Purpose	Source	Purpose	Source
[a] Drinking		[g] Flushing toilet	
[b] Cooking		[h] Irrigating garden	
[c] Washing Dishes		[I] Irrigating farmland	
[d] Washing Clothes		[j] Domestic animal (cattle/donkey/sheep/goat)	
[e] Washing Bicycle/Motor Bike /Car		[k] Business (specify:)	
[f] Bathing		[l] Others (specify:)	

Source:

A=tube well / borehole with pump, B=protected dug well, protected spring, C=bottled water, D=rain water collection, E=unprotected dug well or spring, F=pound, river, stream, G=vender tanker, truck, H=Public service through neighbour, I=public stand pipe, communal tap, J=Spring gravity fed water system,

K=others (specify)

28. Do you buy any bottled water?

[a] Yes (go to 29) [b] No (go to 30)

29. How much bottled water do you use per day/month? How much do you pay for bottled water per day/month?

A. How much do you use	B. How much do you pay?
_____Litre per day	_____$ per day
_____Litre / m^3 per month	_____$ per month

29. Do you have any wells?

[a] Yes (go to 30) [b] No (go to 34)

30. If "Yes", check size of the well and type of pump.

[a]. Diameter_____mm [b] Depth_____m

[c]. Type of pump: [d] electric pump [e] hand pump [f] water radar [g] none

[h] Others (specify:)

31. How much did it cost for installation of well/borehole? 【Convert the amount into present value】

_____$ [ ] I do not know

32. How much do you pay in average for operation and maintenance of pump per month?

_____$/ month

_____$/ month (for electricity, if interviewee knows)

33. How much water do you use from well per day/month?

_____gallons per day _____gallons per month

34. Are there any private water vendors around your living area?

[a] yes (go to 12-1) [b] no (go to 13)

35. Do you frequently purchase water from water vendors?

[a] yes (go to 36 & 37) [b] no (go to 38) [c] Whenever needed

[d] For festivals/ construction of buildings

36. How much water do you obtain from private water vendors?

_____gallons per day _____gallons per month

37. How much do you pay for private vender per month?

_____$ per month _____$ Whenever needed

38. Do you obtain water of public service from neighbours?

[a] yes (go to 39 & 40) [b] no (go to 14)

39. How much water of public service do you obtain from neighbours per day/month?

_____gallons per day _____gallons per month

40. How much do you pay for neighbours for water shared per day/month?

_____$ per day _____$ per month No charges

41. How much water in total does your family use per day / month?

_____Gallons per day _____Gallons per month

42. How much do you spend for water per day/month in total from all sources?

_____$ per day _____$ per month

No expenditure involves since you fetch water from spring/pond/stream

43. In your opinion to what extent water is expensive?

[a] Very expensive [b] Expensive [c] Fair [d] Cheap [e] Very cheap

Section-C Users' Awareness and Satisfaction on Current Water Supply Situation (PPUC)

44. Do you have any complain with current all water supply sources?

[a] Yes (go to 45) [b] No (go to 46)

45. If "Yes", what kind of complain? (Multiple Answer)

【Question shall be opened, tick off the followings answered】

Issues	Issues
[a] Quantity of available water	[d] Time and period when water is available
[b] Quality of available water	[e] Amount spent for water
[c] Time and energy spent to obtain water	[f] Others (specify:)

46. On the five-scale followed, how do you rate the following situations of current water supply?

A=Very satisfied, B=Satisfied, C=Fair, D=Dissatisfied, E=Very Dissatisfied

Issues	Rate	Issues	Rate
[a] Quantity of available water		[d] Time and period when water is available	
[b] Quality of available water		[e] Amount spent for water	
[c] Time and energy spent to obtain water			

47. Do you know which PPUC service tank has jurisdiction of public water supply service? 【Also, ask the PPUC service tank name of jurisdiction, then if it is correct, tick off "Correct", otherwise, "Incorrect"】

Response	Airai	Ngermid	Koror	Malakal	Arakabesang
Correct Answers					
Actual Response					

[a] Correct [b] Incorrect

48. Do you know the process where do agencies obtain water for public water supply services, how do they purify water and distribute water?

	Source	Purification	Distribution
Response	[yes] [no]	[yes] [no]	[yes] [no]

49. Do you know the basic principle that almost of all the cost for running public water supply services shall be covered by the user fee collected?

[a] Yes [b] No (go to 50)

50. If "No", how do you think from the followings?

[a] the half to be covered by tax/government

[b] the most to be covered by tax/government

[c] free of cost at expense of tax/government

51. What do you think about the role and responsibility of the users of public water supply services.

【Multiple Answer: Answer shall be selected from the followings by interviewee】

[a] Paying connection fee	[c] Paying water bill
[b] Repairing in-house/yard leakage from pipeline	[d] Cleaning of drainage near house
[e] Others (specify)	

Section-D Users' Valuation on Improvement of Water Supply Service

52. Are you willing to connect to public water supply?

[a] Yes (go to 53 & 54) [b] No (go to 55)

53. How much are you willing to pay for the new connection?

I can pay _____ Rs. for new connection. Depends on government's decision Don't know

54. How much are you willing to pay for water consumption per month?

_____$ per month

55. If "No", why is it? (Multiple Answer)

【Question shall be opened, tick off the following answered】

[a] Since cost for connection shall be borne by the water agency/government

[b] Since water shall be free

[c] Since there is alternative water source (wells, bottled water, springs, etc.)

[d] Since water from public service can be available from neighbours

[e] Since the services might not be reliable/satisfactory

[f] Since it is expensive

[g] Without any reasons

[h] Others (specify) _____

Section-E Sanitary Condition

56. Would you think after getting water supply services, the incidences of diarrhoea will decrease?

[a] Yes [b] No [c] No Change/I do not know

57. What kind of toilet do you use?

[a] Flush toilet to sewerage or septic tank [b] Pour flush toilet

[c] Dry/Traditional pit latrine [d] None

[e] Others (specify)_____

58. Do you have problem on your toilet?

[a] No problem (go to 60) [b] Yes (go to 59)

59. What kind of problem do you have?

[a] Drainage [b] Septic Tank [c] Water for flushing [d] Vermin [e] Smell

[f] Others (specify) _____

60. How often do you withdraw sludge from the toilet? Who usually do this work? How much do you pay for the withdrawing?

Frequency of withdrawing sludge	_____Per day/week/year
Persons withdrawing sludge	[a] family member [b] hired worker [c] others (specify:)
Cost for withdrawing sludge	_____ $ Per day/week/month/year

61. When you get sick, how much does your family spend for doctor's inspection fee and medicine per month in

average?

Total_____$ per month per family in average

62. How much does your family spend for doctor's inspection fee and medicines per month in average for diseases relating water (diarrhoea, stomach worms, hepatitis)?

Water relating_____ $ per month per family in average

Section-F Family Status

63. How many persons usually live in your household?

[a] Adult men_____ [b] Adult women_____

[c] Own children _____ [d] Other children_____ [e] Total_____

(Child = under 12 years old)

64. What are the occupations of the members earning money?

[a] Company employee [b] Public employee [c] Waged labour/worker

[d] Self-employed [e] Farmer/Fisher [f] Employer

[g] Others (specify) _____

65. How much is your family expenditure per month in average?

_____$ per month

66. How much is your family income per month in average?

_____$ per month

67. Do you pay for house rent?

[a] Yes (go to 68) [b] No (go to 69)

68. How much do you pay?

_____$ per month

69. How much do you pay for public electric supply per month?

_____$ per month

70. To what extent, do you think electric supply is expensive?

[a] Very expensive [b] Expensive [c] Fair [d] Cheap [e] Very cheap

71. Out of following items, what do you have in your house? (Multiple Answer)

[a] Television [b] Radio/Cassette player [c] Refrigerator [d] Electric cooker [e] Electric dining plate washer

[f] Motorbike [g] Car [h] washing cloth machines

資料-13-31

Questionnaire
For
Office, which connected to PPUC water supply services

Section-A Personal Information

1. Interviewer's Name: _____ 2. Date of Interview: _____ 3. Ser.No. _____

4.Survey Area: [a] Airai [b] Ngermid [c] Koror [d] Malakal [e] Arakabesang

Longitude: ° ′ ″ Latitude: ° ′ ″ Elevation: m

5. Respondent's Name: _____

6 Office Name: _____

7. Sex of Respondent: _____ 8. Age of Respondent: _____

9.Type of Office Work: _____ 10.Number of Office Staff: _____

11. Type of Office: [a] Government [b] Local government [c] Private [d] Others

12. Water from PPUC service: 1) Yes 2) No

13. Type of PPUC water service: 1) Flat rate 2) Water meter 3) How much? ($/month)

14. Any Problems of Water? 1) No. 2) Yes.

15. Office Ownership: [a] Self-Owned [b] Rented office

17. No. of Rooms [a]

Section-B Water Supply and Water Use

18. How many water taps do you have in-office and/or outside in-yard?

	Number of Tap
A. In-office	
B. outside	
Total	

19. Is water always available, every day, 24 hours?

[a] Yes [b] No, only : ～ : available

20. Is quantity and pressure enough?

[a] Yes No [b] Quantity is not enough [c] Pressure is not enough

21. Do you have any problem concerning water quality? Any smell, turbidity, colour?

[a] No Yes [b] Smell [c] Turbidity [d] Colour

22. Do you reserve water from public service in your office?

[a] Yes (go to 23 & 24) [b] No (go to 25)

23. What kind of container do you mainly use for reserving water?

[a] Plastic Container [b] Bucket [c] Plastic/Masonry/Concrete/Panel Tank

[d] Drum [e] Bath tab [f] Others (specify:)

24. How much do you reserve the water in a day?

[a]. _____Gallons/day

25. For which purposes followed do you use the water from PPUC water service? (Multiple Answer)

【Interviewer shall ask the following one by one, and tick off.】

[a] Drinking [b] Cooking [c] Washing Dishes [d] Washing Clothes

[e] Washing Bicycle/Motor Bike/Car [f] Bathing [g] Flushing Toilet

[h] Irrigating Garden [I] Irrigating Farmland (crops)

[j] Domestic animals (cattle/donkey/sheep/goat)

[k] **Business (**specify:_____) [l] **Others** (specify:_____)

[m] How many times does it take shower in a day per person? Adult ( ) Children ( )

26. For which purpose do you use water from other sources? (Multiple Answer)

【Interviewer shall ask the following one by one, and tick off & put code below for source】

Purpose	Source	Purpose	Source
[a] Drinking		[g] Flushing toilet	
[b] Cooking		[h] Irrigating garden	
[c] Washing Dishes		[I] Irrigating farmland	
[d] Washing Clothes		[j] Domestic animal (cattle/donkey/sheep/goat)	
[e] Washing Bicycle/Motor Bike /Car		[k] Business (specify:)	
[f] Bathing		[l] Others (specify:)	

Source:

A=tube well / borehole with pump, B=protected dug well, protected spring, C=bottled water, D=rain water collection, E=unprotected dug well or spring, F=pound, river, stream, G=vender tanker, truck, H=Public service through neighbour, I=public stand pipe, communal tap, J=spring gravity fed water system, K=others (specify)

27. Do you buy any bottled water?

[a] Yes (go to 28 & 29) [b] No (go to 30)

28. How much bottled water do you use per day/month? How much do you pay for bottled water per day/month?

A. How much do you use	B. How much do you pay?
_____Litre per day	_____$ per day
_____Litre / m^3 per month	_____$ per month

29. Why do you buy the bottled water though you can get public water supply service? (Multiple Answer)

【Question shall be opened, tick off the following answered】

[a] Since it is safe	[d] Since the public water supply is not enough
[b] Since it is tasty	[e] Since I feel well-off / it is fashionable
[c] Since it is cheap	[f] Others (specify)

30. Do you have any well/boreholes in your office?

[a] Yes (go to 31 to 34) [b] No (go to 35)

31. If "Yes", check size of the well and type of pump.

[a]. Diameter_____mm [b] Depth_____m

[c]. Type of pump: [d] electric pump [e] hand pump [f] water radar [g] none

[h] Others (specify:)

32. How much did it cost for installation of well/borehole? 【Convert the amount into present value】

_____$. [ ] I do not know

33. How much do you pay in average for operation and maintenance of pump per month?

_____$/ month

_____$/ month (for electricity, if interviewee knows)

34. How much water do you use from well per day/month?

_____gallons per day _____gallons per month

35. Are there any private water vendors around your living area?

[a] yes (go to 36) [b] no (go to 12)

36 Do you frequently purchase drinking water from water vendors/company?

[a] yes (go to 37 to 42) [b] no (go to 43) [c] On shortage of water supply

[d] For festivals/ construction of buildings

37. How much water do you obtain from private water vendors/company?

_____gallons per day _____gallons per month

_____gallons per day whenever needed

38. How much do you pay for private vender/company per month?

_____$ per month _____$ per month whenever needed

39. How much water from PPUC services does your office use per day/month? Is the consumption metered?

A. _____gallons per day _____gallons per month

B. Metered?: [a] Yes [b] No

40. How much do you pay for PPUC water per month?

_____$ per month

41. To what extent do you think PPUC water is expensive?

[a] Very expensive [b] Expensive [c] Fair [d] Cheap [e] Very cheap

42. In case of expensive or cheap in the question above, how much water charges is reasonable for your water consumption?

_____$ per month (in case of expensive)

_____$ per month (in case of cheap)

43. How much water from other source (including bottled water, vender and well) does your office use per day / month?

_____gallons per day _____gallons per month

44. Do you pay for water from other sources (including bottled water and well)?

[a] Yes (go to 45 & 46) [b] No (go to 47)

45. If "Yes", how much do you pay?

_____$ per month

46. Do you think PPUC water is expensive?

[a] Very expensive [b] Expensive [c] Fair [d] Cheap [e] Very cheap

47. Do you share the water from PPUC service with others?

[a] Yes (go to 48 & 49) [b] No (go to 50)

48. How much water do you share with other office per day/month?

_____gallons per day _____gallons per month

[ ] don't know because I don't watch during fetching water

49. How much do you charge for others for water shared per day/month?

_____$ per day _____$ per month No charges

Section-C Users' Awareness and Satisfaction on current service

50. Are there any positive change on your life style after connecting water supply services?

[a] Yes (go to 51) [b] No (go to 52) [c] I never know situation without public water service (go to 2)

51: How it is changed? 【Question shall be opened, tick off the following answered】

[a] Sanitation and Hygiene condition is improved	[e] Cost to buy water is reduced
[b] Time and burden to obtain water is consumed	[f] Opportunity to learn/work is increased
[c] Medical expense is decreased	[g] Others (specify)
[d] Water is available regardless of time	

52. Do you save water from PPUC water service?

[a] Yes (go to 53) [b] No (go to 54)

53. Why do you save water from PPUC water service? (Multiple Answer)

【Question shall be opened, tick off the following answered.】

[a] Since water is common and limited resource	[c] Due to publicity for water conservation
[b] Since water rate is expensive/ to save expenditure for water	[d] Without any particular reasons
[e] Others, Specify:	

54. Why you do not save water from PPUC water service? (Multiple Answer)

【Question shall be opened, tick off the following answered.】

[a] Since water is plenty	[d] Since water supply is irregular, water tap shall be kept always open
[b] Since water rate is cheap	[e] Since it is clean and safe
[c] Since only limited amount is used	[f] Without any reason
[g] Others, Specify:	

55. Do you have any complain with current PPUC water services?

[a] Yes (go to 56) [b] No (go to 57)

56. If "Yes", what kind of complain? (Multiple Answer)

【Question shall be opened, tick off the followings answered】

[a] Current operation hours of the water supply	[f] Manner of billing
[b] Quantity and pressure	[g] Manner of notice
[c] Quality of water supplied	[h] Manner of public relations
[d] Manner in which claims are treated	[I] Services at the pay office
[e] Manner in which defects are repaired	[j] Amount paid
[k] Others (specify)	

57. On a scale of 1-5, how do you rate the following issues of PPUC water services?

A=Very Good, B=Good, C=Fair, D=Bad, E=Very Bad, F=I do not know

Issues	Rate	Issues	Rate
[a] Current operation hours of the water supply		[f] Manner of billing	
[b] Quantity and pressure		[g] Manner of notice	
[c] Quality of water supplied		[h] Manner of public relations	
[d] Manner in which claims are treated		[I] Services at the pay office	
[e] Manner in which defects are repaired		[j] Amount paid	

58. Do you know the process where do agencies obtain water for PPUC water services, how do they purify water and distribute water?

	Source	Purification	Distribution
Response	[yes] [no]	[yes] [no]	[yes] [no]

59. Do you know which PPUC service tank has jurisdiction of public water supply service? 【Also, ask the PPUC service tank name of jurisdiction, then if it is correct, tick off "Correct", otherwise, "Incorrect"】

Response	Airai	Ngermid	Koror	Malakal	Arakabesang
Correct Answers					
Actual Response					

[a] Correct [b] Incorrect

60. Do you know the basic principle that almost of all the cost for running PPUC water services shall be covered by the user fee collected?

[a] Yes (go to 62) [b] No (go to 61)

61. If "No", how do you think from the followings?

[a] I thought the half to be covered by tax/government

[b] I thought the most to be covered by tax/government

[c] free of cost at expense of tax/government

62. Are there any in-office/yard leakage, or pipe/tap always opened or broken, at present?

[a] Yes (go to 63) [b] No (go to 64)

63. Why do not you fix it? 【Question shall be opened, tick off the followings answered】

[a] Since water rate is cheap	[d] Since water supply is irregular / limited
[b] Since it leaks only a little	[e] Others (specify)
[c] Since it shall be responsible of PPUC water supply provider	

64. What do you think the role and responsibility of users for use of PPUC water services?

【Multiple Answer: Answer shall be selected from the followings by interviewee】

[a] Paying connection fee	[c] Paying water bill
[b] Repairing in-house/yard leakage from pipeline	[d] Cleaning of drainage near house
[e] Others (specify)	

Section-D Users' Valuation on Improvement of PPUC Water Service

65. Do you have any request for improvement of water supply services?

[a] Yes (go to 66) [b] No (go to 67)

66. If "Yes", what kind of services/issues to be improved?

【Question shall be opened, tick off the followings answered】

[a] Current operation hours of the water supply	[f] Manner of billing
[b] Quantity and pressure	[g] Manner of notice
[c] Quality of water supplied	[h] Manner of public relations
[d] Manner in which claims are treated	[I] Services at the pay office
[e] Manner in which defects are repaired	[j] Amount paid
[k] Others (specify)	

67. Do you want much improved PPUC water service, even if current water rate is increased?

[a] I am satisfying current service and rate	[d] No, even if it is reasonable raise
[b] Yes, if it is reasonable raise	[e] No, if it is steep raise
[c] Yes, even if it is steep raise	[f] I do not know

68. What do you want to know about PPUC water supply management?

【Three (3) answers shall be selected from the following by interviewee】

[a] How water rate is decided (rate setting)	[f] How the water rate collected is utilized
[b] Water quality control	[g] Extension, rehabilitation plan
[c] Financial status of water providing organization/company (Financial Management)	
[d] What is water source, how the water treated, transmitted, and distributed	
[e] How the water business is run (business management)	[h] When and where the water supply is cut-off
[I] Others, Specify	

69. What do you think the most important in water supply among the following?

【Two (2) answers form the following shall be selected by interviewee】

[a] That water quality/taste is good	[c] That amount of water and pressure is enough
[b] That water rate is cheap	[d] That water is always supplied enough without cut-off and low pressure
[e] Others, Specify:	

70. Are there any companies concerning water (including water supply services)? If there are, what kind of activities are they doing?

[a] Yes (go to 71) [b] No (go to 72)

71. What is name of the companies and what is main activities?

[a]. Company:_____

[b]. Activities:_____

_____

Section-E Sanitary Condition

72. Is frequency of diarrhoea decreased after having water supply services?

[a] Yes [b] No [c] No Change/I do not know

73. What kind of toilet do you use?

[a] Flush toilet to sewerage or septic tank [b] Pour flush toilet

[c] Dry/Traditional pit latrine [d] None

[e] Others (specify)_____

74. Do you have problem on your toilet?

[a] No problem (go to 76) [b] Yes (go to 75)

75. What kind of problem do you have?

[a] Drainage [b] Septic Tank [c] Water for flushing [d] Vermin [e] Smell

[f] Others (specify) _____

76. How often do you withdraw sludge from the toilet? Who usually do this work? How much do you pay for the withdrawing?

A. Frequency of withdrawing sludge	_____Per day/week/year
B. Persons withdrawing sludge	[a] family member [b] hired worker [c] others (specify:)
C. Cost for withdrawing sludge	_____$ Per day/week/month/year

Section-F Office Status

77. How many persons usually working in your office?

[a] Adult men_____ [b] Adult women_____

[c] Total_____

78. What are the occupations of the members office?

[a] Company employee [b] Public employee [c] Waged labour/worker

[d] Self-employed [e] Farmer/Fisher [f] Employer

[g] Others (specify) _____

79. Do you pay for office rent?

[a] Yes (go to 4-2) [b] No (go to 5)

80. How much do you pay?

_____$ per month

81. How much do you pay for PPUC electric supply per month?

_____ $ per month

82. To what extent, do you think it is expensive?

[a] Very expensive [b] Expensive [c] Fair [d] Cheap [e] Very cheap

87. Out of following items, what do you have in your office? (Multiple Answer)

[a] Television [b] Radio/Cassette player [c] Refrigerator [d] Electric cooker [e] Electric dining plate washer

[f] Motorbike [g] Car [h] washing cloth machines

資料-13-36

Questionnaire
For
Restaurant, which connected to PPUC water supply services

Section-A Personal Information

1. Interviewer's Name: _____ 2. Date of Interview: _____ 3. Ser.No. _____

4.Survey Area: [a] Airai [b] Ngermid [c] Koror [d] Malakal [e] Arakabesang

Longitude: ° ′ ″ Latitude: ° ′ ″ Elevation: m

5. Respondent's Name: _____

6 Hotel Name: _____

7. Sex of Respondent: _____ 8. Age of Respondent: _____

9.Type of Office Work: _____ 10.No of Restaurant Staff: _____

11. Type of Restaurant: [a] Government [b] Local government [c] Private [d] Others

12. Water from PPUC service: 1) Yes 2) No

13. Type of PPUC water service: 1) Flat rate 2) Water meter 3) How much? ($/month)

14. Any Problems of Water? 1) No. 2) Yes.

15. Restaurant: Ownership: [a] Self-Owned [b] Rented office [c] No of Employee ( )

17. No. of Rooms [a]

Section-B Water Supply and Water Use

18. How many water taps do you have in- Restaurant and/or outside in-yard?

	Number of Tap
A. In- Restaurant	
B. outside	
Total	

19. Is water always available, every day, 24 hours?

[a] Yes [b] No, only : ～ : available

20. Is quantity and pressure enough?

[a] Yes No [b] Quantity is not enough [c] Pressure is not enough

21. Do you have any problem concerning water quality? Any smell, turbidity, colour?

[a] No Yes [b] Smell [c] Turbidity [d] Colour

22. Do you reserve water from public service in your Restaurant?

[a] Yes (go to 23 & 24) [b] No (go to 25)

23. What kind of container do you mainly use for reserving water?

[a] Plastic Container [b] Bucket [c] Plastic/Masonry/Concrete/Panel Tank

[d] Drum [e] Bath tab [f] Others (specify:)

24. How much do you reserve the water in a day?

[a]. _____Gallons/day

25. For which purposes followed do you use the water from PPUC water service? (Multiple Answer)

【Interviewer shall ask the following one by one, and tick off.】

[a] Drinking [b] Cooking [c] Washing Dishes [d] Washing Clothes

[e] Washing Bicycle/Motor Bike/Car [f] Bathing [g] Flushing Toilet

[h] Irrigating Garden [I] Irrigating Farmland (crops)

[j] Domestic animals (cattle/donkey/sheep/goat)

[k] **Business (**specify:_____) [l] **Others** (specify:_____)

[m] How many times does it take shower in a day per person? Adult ( ) Children ( )

26. For which purpose do you use water from other sources? (Multiple Answer)

【Interviewer shall ask the following one by one, and tick off & put code below for source】

Purpose	Source	Purpose	Source
[a] Drinking		[g] Flushing toilet	
[b] Cooking		[h] Irrigating garden	
[c] Washing Dishes		[I] Irrigating farmland	
[d] Washing Clothes		[j] Domestic animal (cattle/donkey/sheep/goat)	
[e] Washing Bicycle/Motor Bike /Car		[k] Business (specify:)	
[f] Bathing		[l] Others (specify:)	

Source:

A=tube well / borehole with pump, B=protected dug well, protected spring, C=bottled water, D=rain water collection, E=unprotected dug well or spring, F=pound, river, stream, G=vender tanker, truck, H=Public service through neighbour, I=public stand pipe, communal tap, J=spring gravity fed water system, K=others (specify)

27. Do you buy any bottled water?

[a] Yes (go to 28 & 29) [b] No (go to 30)

28. How much bottled water do you use per day/month? How much do you pay for bottled water per day/month?

A. How much do you use	B. How much do you pay?
_____Litre per day	_____$ per day
_____Litre / m^3 per month	_____$ per month

29. Why do you buy the bottled water though you can get public water supply service? (Multiple Answer)

【Question shall be opened, tick off the following answered】

[a] Since it is safe	[d] Since the public water supply is not enough
[b] Since it is tasty	[e] Since I feel well-off / it is fashionable
[c] Since it is cheap	[f] Others (specify)

30. Do you have any well/boreholes/rainwater collection in your Restaurant?

[a] Yes (go to 31 to 34) [b] No (go to 35)

31. If "Yes", check size of the well and type of pump.

[a]. Diameter_____mm [b] Depth_____m

[c]. Type of pump: [d] electric pump [e] hand pump [f] water radar [g] none

[h] Others (specify:)

32. How much did it cost for installation of well/borehole/rainwater tank? 【Convert the amount into present value】

_____$. [ ] I do not know

33. How much do you pay in average for operation and maintenance of pump per month?

_____$/ month

_____$/ month (for electricity, if interviewee knows)

34. How much water do you use from well/rain water per day/month?

_____gallons per day _____gallons per month

35. Are there any private water vendors around your area?

[a] yes (go to 36) [b] no (go to 12)

36 Do you frequently purchase working water from water vendors/company?

[a] yes (go to 37 to 42) [b] no (go to 43) [c] On shortage of water supply

[d] For festivals/ construction of buildings

37. How much water do you obtain from private water vendors/company?

_____gallons per day _____gallons per month

_____gallons per day whenever needed

FORM-A RESTAURANT
Questionnaire (**Connected**) / Social Condition Survey for the Water Supply System Improvement Project in the Republic of Palau

38. How much do you pay for private vender/company per month?

_____$ per month _____$ per month whenever needed

39. How much water from PPUC services does your office use per day/month? Is the consumption metered?

A. _____gallons per day _____gallons per month

B. Metered?: [a] Yes [b] No

40. How much do you pay for PPUC water per month?

_____$ per month

41. To what extent do you think PPUC water is expensive?

[a] Very expensive [b] Expensive [c] Fair [d] Cheap [e] Very cheap

42. In case of expensive or cheap in the question above, how much water charges is reasonable for your water consumption?

_____$ per month (in case of expensive)

_____$ per month (in case of cheap)

43. How much water from other source (including bottled water, vender and well) does your hotel use per day / month?

_____gallons per day _____gallons per month

44. Do you pay for water from other sources (including bottled water and well)?

[a] Yes (go to 45 & 46) [b] No (go to 47)

45. If "Yes", how much do you pay?

_____$ per month

46. Do you think PPUC water is expensive?

[a] Very expensive [b] Expensive [c] Fair [d] Cheap [e] Very cheap

47. Do you share the water from PPUC service with others?

[a] Yes (go to 48 & 49) [b] No (go to 50)

48. How much water do you share with others per day/month?

_____gallons per day _____gallons per month

[ ] don't know because I don't watch during fetching water

49. How much do you charge for others for water shared per day/month?

_____$ per day _____$ per month No charges

Section-C Users' Awareness and Satisfaction on current service

50. Are there any positive change on your life style after connecting water supply services?

[a] Yes (go to 51) [b] No (go to 52) [c] I never know situation without public water service (go to 2)

51: How it is changed? 【Question shall be opened, tick off the following answered】

[a] Sanitation and Hygiene condition is improved	[e] Cost to buy water is reduced
[b] Time and burden to obtain water is consumed	[f] Opportunity to learn/work is increased
[c] Medical expense is decreased	[g] Others (specify)
[d] Water is available regardless of time	

52. Do you save water from PPUC water service?

[a] Yes (go to 53) [b] No (go to 54)

53. Why do you save water from PPUC water service? (Multiple Answer)

【Question shall be opened, tick off the following answered.】

[a] Since water is common and limited resource	[c] Due to publicity for water conservation
[b] Since water rate is expensive/ to save expenditure for water	[d] Without any particular reasons
[e] Others, Specify:	

54. Why you do not save water from PPUC water service? (Multiple Answer)

【Question shall be opened, tick off the following answered.】

[a] Since water is plenty	[d] Since water supply is irregular, water tap shall be kept always open
[b] Since water rate is cheap	[e] Since it is clean and safe
[c] Since only limited amount is used	[f] Without any reason
[g] Others, Specify:	

55. Do you have any complain with current PPUC water services?

[a] Yes (go to 56) [b] No (go to 57)

56. If "Yes", what kind of complain? (Multiple Answer)

【Question shall be opened, tick off the followings answered】

[a] Current operation hours of the water supply	[f] Manner of billing
[b] Quantity and pressure	[g] Manner of notice
[c] Quality of water supplied	[h] Manner of public relations
[d] Manner in which claims are treated	[I] Services at the pay office
[e] Manner in which defects are repaired	[j] Amount paid
[k] Others (specify)	

57. On a scale of 1-5, how do you rate the following issues of PPUC water services?

A=Very Good, B=Good, C=Fair, D=Bad, E=Very Bad, F=I do not know

Issues	Rate	Issues	Rate
[a] Current operation hours of the water supply		[f] Manner of billing	
[b] Quantity and pressure		[g] Manner of notice	
[c] Quality of water supplied		[h] Manner of public relations	
[d] Manner in which claims are treated		[I] Services at the pay office	
[e] Manner in which defects are repaired		[j] Amount paid	

58. Do you know the process where do agencies obtain water for PPUC water services, how do they purify water and distribute water?

	Source	Purification	Distribution
Response	[yes] [no]	[yes] [no]	[yes] [no]

59. Do you know which PPUC service tank has jurisdiction of public water supply service? 【Also, ask the PPUC service tank name of jurisdiction, then if it is correct, tick off "Correct", otherwise, "Incorrect"】

Response	Airai	Ngermid	Koror	Malakal	Arakabesang
Correct Answers					
Actual Response					

[a] Correct [b] Incorrect

60. Do you know the basic principle that almost of all the cost for running PPUC water services shall be covered by the user fee collected?

[a] Yes (go to 62) [b] No (go to 61)

61. If "No", how do you think from the followings?

[a] I thought the half to be covered by tax/government

[b] I thought the most to be covered by tax/government

[c] free of cost at expense of tax/government

62. Are there any in-office/yard leakage, or pipe/tap always opened or broken, at present?

[a] Yes (go to 63) [b] No (go to 64)

63. Why do not you fix it? 【Question shall be opened, tick off the followings answered】

[a] Since water rate is cheap	[d] Since water supply is irregular / limited
[b] Since it leaks only a little	[e] Others (specify)
[c] Since it shall be responsible of PPUC water supply provider	

64. What do you think the role and responsibility of users for use of PPUC water services?

【Multiple Answer: Answer shall be selected from the followings by interviewee】

[a] Paying connection fee	[c] Paying water bill
[b] Repairing in-house/yard leakage from pipeline	[d] Cleaning of drainage near house
[e] Others (specify)	

Section-D Users' Valuation on Improvement of PPUC Water Service

65. Do you have any request for improvement of water supply services?

[a] Yes (go to 66) [b] No (go to 67)

66. If "Yes", what kind of services/issues to be improved?

【Question shall be opened, tick off the followings answered】

[a] Current operation hours of the water supply	[f] Manner of billing
[b] Quantity and pressure	[g] Manner of notice
[c] Quality of water supplied	[h] Manner of public relations
[d] Manner in which claims are treated	[I] Services at the pay office
[e] Manner in which defects are repaired	[j] Amount paid
[k] Others (specify)	

67. Do you want much improved PPUC water service, even if current water rate is increased?

[a] I am satisfying current service and rate	[d] No, even if it is reasonable raise
[b] Yes, if it is reasonable raise	[e] No, if it is steep raise
[c] Yes, even if it is steep raise	[f] I do not know

68. What do you want to know about PPUC water supply management?

【Three (3) answers shall be selected from the following by interviewee】

[a] How water rate is decided (rate setting)	[f] How the water rate collected is utilized
[b] Water quality control	[g] Extension, rehabilitation plan
[c] Financial status of water providing organization/company (Financial Management)	
[d] What is water source, how the water treated, transmitted, and distributed	
[e] How the water business is run (business management)	[h] When and where the water supply is cut-off
[I] Others, Specify	

FORM-A RESTAURANT
Questionnaire (**Connected**) / Social Condition Survey for the Water Supply System Improvement Project in the Republic of Palau

69. What do you think the most important in water supply among the following?

【Two (2) answers form the following shall be selected by interviewee】

[a] That water quality/taste is good	[c] That amount of water and pressure is enough
[b] That water rate is cheap	[d] That water is always supplied enough without cut-off and low pressure
[e] Others, Specify:	

70. Are there any companies concerning water (including water supply services)? If there are, what kind of activities are they doing?

[a] Yes (go to 71) [b] No (go to 72)

71. What is name of the companies and what is main activities?

[a]. Company:_____

[b]. Activities:_____

_____

Section-E Sanitary Condition

72. Is frequency of diarrhoea decreased after having water supply services?

[a] Yes [b] No [c] No Change/I do not know

73. What kind of toilet do you use?

[a] Flush toilet to sewerage or septic tank [b] Pour flush toilet

[c] Dry/Traditional pit latrine [d] None

[e] Others (specify)_____

74. Do you have problem on your toilet?

[a] No problem (go to 76) [b] Yes (go to 75)

75. What kind of problem do you have?

[a] Drainage [b] Septic Tank [c] Water for flushing [d] Vermin [e] Smell

[f] Others (specify) _____

76. How often do you withdraw sludge from the toilet? Who usually do this work? How much do you pay for the withdrawing?

A. Frequency of withdrawing sludge	_____Per day/week/year
B. Persons withdrawing sludge	[a] family member [b] hired worker [c] others (specify:)
C. Cost for withdrawing sludge	_____$ Per day/week/month/year

Section-F Restaurant Status

77. How many persons usually working in your Restaurant?

[a] Adult men_____ [b] Adult women_____

[c] Total_____

78. What are the occupations of the Restaurant?

[a] Company employee [b] Public employee [c] Waged labour/worker

[d] Self-employed [e] Farmer/Fisher [f] Employer

[g] Others (specify) _____

79. How many customers have you in a day/month?

[a] in a day ( ) [b] in a month ( )

80. Which month do you have many customers?

1) Jan. 2) Feb 3) March 4) April 5) May 6) June 7) July 8) Aug 9) Sept 10) Oct 11) Nov 12) Dec

81. How much do you pay for PPUC electric supply per month?

_____ $ per month

82. To what extent, do you think it is expensive?

[a] Very expensive [b] Expensive [c] Fair [d] Cheap [e] Very cheap

87. Out of following items, what do you have in your Restaurant? (Multiple Answer)

[a] Television [b] Radio/Cassette player [c] Refrigerator [d] Electric cooker [e] Electric dining plate washer

[f] Motorbike [g] Car [h] washing cloth machines

資料-13-41

Questionnaire
For
Hotel, which connected to PPUC water supply services

Section-A Personal Information

1. Interviewer's Name: _____ 2. Date of Interview: _____ 3. Ser.No. _____

4.Survey Area: [a] Airai [b] Ngermid [c] Koror [d] Malakal [e] Arakabesang

Longitude: ° ′ ″ Latitude: ° ′ ″ Elevation: m

5. Respondent's Name: _____

6 Hotel Name: _____

7. Sex of Respondent: _____ 8. Age of Respondent: _____

9.Type of Office Work: _____ 10.No of Restaurant Staff: _____

11. Type of Hotel: [a] Government [b] Local government [c] Private [d] Others

12. Water from PPUC service: 1) Yes 2) No

13. Type of PPUC water service: 1) Flat rate 2) Water meter 3) How much? ($/month)

14. Any Problems of Water? 1) No. 2) Yes.

15. Hotel Ownership: [a] Self-Owned [b] Rented [c] No of Employee ( )

17. No. of Rooms [a]

Section-B Water Supply and Water Use

18. How many water taps do you have in- hotel and/or outside in-yard?

	Number of Tap
A. In- hotel	
B. outside	
Total	

19. Is water always available, every day, 24 hours?

[a] Yes [b] No, only : ～ : available

20. Is quantity and pressure enough?

[a] Yes No [b] Quantity is not enough [c] Pressure is not enough

21. Do you have any problem concerning water quality? Any smell, turbidity, colour?

[a] No Yes [b] Smell [c] Turbidity [d] Colour

22. Do you reserve water from public service in your Restaurant?

[a] Yes (go to 23 & 24) [b] No (go to 25)

23. What kind of container do you mainly use for reserving water?

[a] Plastic Container [b] Bucket [c] Plastic/Masonry/Concrete/Panel Tank

[d] Drum [e] Bath tab [f] Others (specify:)

24. How much do you reserve the water in a day?

[a]. _____Gallons/day

25. For which purposes followed do you use the water from PPUC water service? (Multiple Answer)

【Interviewer shall ask the following one by one, and tick off.】

[a] Drinking [b] Cooking [c] Washing Dishes [d] Washing Clothes

[e] Washing Bicycle/Motor Bike/Car [f] Bathing [g] Flushing Toilet

[h] Irrigating Garden [I] Irrigating Farmland (crops)

[j] Domestic animals (cattle/donkey/sheep/goat)

[k] **Business (**specify:_____) [l] **Others** (specify:_____)

[m] How many times does it take shower in a day per person? Adult ( ) Children ( )

26. For which purpose do you use water from other sources? (Multiple Answer)

【Interviewer shall ask the following one by one, and tick off & put code below for source】

Purpose	Source	Purpose	Source
[a] Drinking		[g] Flushing toilet	
[b] Cooking		[h] Irrigating garden	
[c] Washing Dishes		[I] Irrigating farmland	
[d] Washing Clothes		[j] Domestic animal (cattle/donkey/sheep/goat)	
[e] Washing Bicycle/Motor Bike /Car		[k] Business (specify:)	
[f] Bathing		[l] Others (specify:)	

Source:

A=tube well / borehole with pump, B=protected dug well, protected spring, C=bottled water, D=rain water collection, E=unprotected dug well or spring, F=pound, river, stream, G=vender tanker, truck, H=Public service through neighbour, I=public stand pipe, communal tap, J=spring gravity fed water system, K=others (specify)

27. Do you buy any bottled water?

[a] Yes (go to 28 & 29) [b] No (go to 30)

28. How much bottled water do you use per day/month? How much do you pay for bottled water per day/month?

A. How much do you use	B. How much do you pay?
_____Litre per day	_____$ per day
_____Litre / m^3 per month	_____$ per month

29. Why do you buy the bottled water though you can get public water supply service? (Multiple Answer)

【Question shall be opened, tick off the following answered】

[a] Since it is safe	[d] Since the public water supply is not enough
[b] Since it is tasty	[e] Since I feel well-off / it is fashionable
[c] Since it is cheap	[f] Others (specify)

30. Do you have any well/boreholes/rainwater collection in your hotel ?

[a] Yes (go to 31 to 34) [b] No (go to 35)

31. If "Yes", check size of the well and type of pump.

[a]. Diameter_____mm [b] Depth_____m

[c]. Type of pump: [d] electric pump [e] hand pump [f] water radar [g] none

[h] Others (specify:)

32. How much did it cost for installation of well/borehole/rainwater tank? 【Convert the amount into present value】

_____$. [ ] I do not know

33. How much do you pay in average for operation and maintenance of pump per month?

_____$/ month

_____$/ month (for electricity, if interviewee knows)

34. How much water do you use from well/rain water per day/month?

_____gallons per day _____gallons per month

35. Are there any private water vendors around your area?

[a] yes (go to 36) [b] no (go to 12)

36 Do you frequently purchase working water from water vendors/company?

[a] yes (go to 37 to 42) [b] no (go to 43) [c] On shortage of water supply

[d] For festivals/ construction of buildings

37. How much water do you obtain from private water vendors/company?

_____gallons per day _____gallons per month

_____gallons per day whenever needed

FORM-A HOTEL
Questionnaire (**Connected**) / Social Condition Survey for the Water Supply System Improvement Project in the Republic of Palau

38. How much do you pay for private vender/company per month?

_____$ per month _____$ per month whenever needed

39. How much water from PPUC services does your office use per day/month? Is the consumption metered?

A. _____gallons per day _____gallons per month

B. Metered?: [a] Yes [b] No

40. How much do you pay for PPUC water per month?

_____$ per month

41. To what extent do you think PPUC water is expensive?

[a] Very expensive [b] Expensive [c] Fair [d] Cheap [e] Very cheap

42. In case of expensive or cheap in the question above, how much water charges is reasonable for your water consumption?

_____$ per month (in case of expensive)

_____$ per month (in case of cheap)

43. How much water from other source (including bottled water, vender and well) does your hotel use per day / month?

_____gallons per day _____gallons per month

44. Do you pay for water from other sources (including bottled water and well)?

[a] Yes (go to 45 & 46) [b] No (go to 47)

45. If "Yes", how much do you pay?

_____$ per month

46. Do you think PPUC water is expensive?

[a] Very expensive [b] Expensive [c] Fair [d] Cheap [e] Very cheap

47. Do you share the water from PPUC service with others?

[a] Yes (go to 48 & 49) [b] No (go to 50)

48. How much water do you share with others per day/month?

_____gallons per day _____gallons per month

[ ] don't know because I don't watch during fetching water

49. How much do you charge for others for water shared per day/month?

_____$ per day _____$ per month No charges

Section-C Users' Awareness and Satisfaction on current service

50. Are there any positive change on your life style after connecting water supply services?

[a] Yes (go to 51) [b] No (go to 52) [c] I never know situation without public water service (go to 2)

51: How it is changed? 【Question shall be opened, tick off the following answered】

[a] Sanitation and Hygiene condition is improved	[e] Cost to buy water is reduced
[b] Time and burden to obtain water is consumed	[f] Opportunity to learn/work is increased
[c] Medical expense is decreased	[g] Others (specify)
[d] Water is available regardless of time	

52. Do you save water from PPUC water service?

[a] Yes (go to 53) [b] No (go to 54)

53. Why do you save water from PPUC water service? (Multiple Answer)

【Question shall be opened, tick off the following answered.】

[a] Since water is common and limited resource	[c] Due to publicity for water conservation
[b] Since water rate is expensive/ to save expenditure for water	[d] Without any particular reasons
[e] Others, Specify:	

54. Why you do not save water from PPUC water service? (Multiple Answer)

【Question shall be opened, tick off the following answered.】

[a] Since water is plenty	[d] Since water supply is irregular, water tap shall be kept always open
[b] Since water rate is cheap	[e] Since it is clean and safe
[c] Since only limited amount is used	[f] Without any reason
[g] Others, Specify:	

55. Do you have any complain with current PPUC water services?

[a] Yes (go to 56) [b] No (go to 57)

56. If "Yes", what kind of complain? (Multiple Answer)

【Question shall be opened, tick off the followings answered】

[a] Current operation hours of the water supply	[f] Manner of billing
[b] Quantity and pressure	[g] Manner of notice
[c] Quality of water supplied	[h] Manner of public relations
[d] Manner in which claims are treated	[I] Services at the pay office
[e] Manner in which defects are repaired	[j] Amount paid
[k] Others (specify)	

57. On a scale of 1-5, how do you rate the following issues of PPUC water services?

A=Very Good, B=Good, C=Fair, D=Bad, E=Very Bad, F=I do not know

Issues	Rate	Issues	Rate
[a] Current operation hours of the water supply		[f] Manner of billing	
[b] Quantity and pressure		[g] Manner of notice	
[c] Quality of water supplied		[h] Manner of public relations	
[d] Manner in which claims are treated		[I] Services at the pay office	
[e] Manner in which defects are repaired		[j] Amount paid	

58. Do you know the process where do agencies obtain water for PPUC water services, how do they purify water and distribute water?

	Source	Purification	Distribution
Response	[yes] [no]	[yes] [no]	[yes] [no]

59. Do you know which PPUC service tank has jurisdiction of public water supply service? 【Also, ask the PPUC service tank name of jurisdiction, then if it is correct, tick off "Correct", otherwise, "Incorrect"】

Response	Airai	Ngermid	Koror	Malakal	Arakabesang
Correct Answers					
Actual Response					

[a] Correct [b] Incorrect

60. Do you know the basic principle that almost of all the cost for running PPUC water services shall be covered by the user fee collected?

[a] Yes (go to 62) [b] No (go to 61)

61. If "No", how do you think from the followings?

[a] I thought the half to be covered by tax/government

[b] I thought the most to be covered by tax/government

[c] free of cost at expense of tax/government

62. Are there any in-office/yard leakage, or pipe/tap always opened or broken, at present?

[a] Yes (go to 63) [b] No (go to 64)

63. Why do not you fix it? 【Question shall be opened, tick off the followings answered】

[a] Since water rate is cheap	[d] Since water supply is irregular / limited
[b] Since it leaks only a little	[e] Others (specify)
[c] Since it shall be responsible of PPUC water supply provider	

64. What do you think the role and responsibility of users for use of PPUC water services?

【Multiple Answer: Answer shall be selected from the followings by interviewee】

[a] Paying connection fee	[c] Paying water bill
[b] Repairing in-house/yard leakage from pipeline	[d] Cleaning of drainage near house
[e] Others (specify)	

Section-D Users' Valuation on Improvement of PPUC Water Service

65. Do you have any request for improvement of water supply services?

[a] Yes (go to 66) [b] No (go to 67)

66. If "Yes", what kind of services/issues to be improved?

【Question shall be opened, tick off the followings answered】

[a] Current operation hours of the water supply	[f] Manner of billing
[b] Quantity and pressure	[g] Manner of notice
[c] Quality of water supplied	[h] Manner of public relations
[d] Manner in which claims are treated	[I] Services at the pay office
[e] Manner in which defects are repaired	[j] Amount paid
[k] Others (specify)	

67. Do you want much improved PPUC water service, even if current water rate is increased?

[a] I am satisfying current service and rate	[d] No, even if it is reasonable raise
[b] Yes, if it is reasonable raise	[e] No, if it is steep raise
[c] Yes, even if it is steep raise	[f] I do not know

68. What do you want to know about PPUC water supply management?

【Three (3) answers shall be selected from the following by interviewee】

[a] How water rate is decided (rate setting)	[f] How the water rate collected is utilized
[b] Water quality control	[g] Extension, rehabilitation plan
[c] Financial status of water providing organization/company (Financial Management)	
[d] What is water source, how the water treated, transmitted, and distributed	
[e] How the water business is run (business management)	[h] When and where the water supply is cut-off
[I] Others, Specify	

FORM-A HOTEL
Questionnaire (**Connected**) / Social Condition Survey for the Water Supply System Improvement Project in the Republic of Palau

69. What do you think the most important in water supply among the following?

【Two (2) answers form the following shall be selected by interviewee】

[a] That water quality/taste is good	[c] That amount of water and pressure is enough
[b] That water rate is cheap	[d] That water is always supplied enough without cut-off and low pressure
[e] Others, Specify:	

70. Are there any companies concerning water (including water supply services)? If there are, what kind of activities are they doing?

[a] Yes (go to 71) [b] No (go to 72)

71. What is name of the companies and what is main activities?

[a]. Company: _____

[b]. Activities: _____

_____

Section-E Sanitary Condition

72. Is frequency of diarrhoea decreased after having water supply services?

[a] Yes [b] No [c] No Change/I do not know

73. What kind of toilet do you use?

[a] Flush toilet to sewerage or septic tank [b] Pour flush toilet

[c] Dry/Traditional pit latrine [d] None

[e] Others (specify)_____

74. Do you have problem on your toilet?

[a] No problem (go to 76) [b] Yes (go to 75)

75. What kind of problem do you have?

[a] Drainage [b] Septic Tank [c] Water for flushing [d] Vermin [e] Smell

[f] Others (specify) _____

76. How often do you withdraw sludge from the toilet? Who usually do this work? How much do you pay for the withdrawing?

A. Frequency of withdrawing sludge	_____Per day/week/year
B. Persons withdrawing sludge	[a] family member [b] hired worker [c] others (specify:)
C. Cost for withdrawing sludge	_____$ Per day/week/month/year

Section-F Hotel Status

77. How many persons usually working in your hotel?

[a] Adult men_____ [b] Adult women_____

[c] Total_____

78. What are the occupations of the hotel?

[a] Company employee [b] Public employee [c] Waged labour/worker

[d] Self-employed [e] Farmer/Fisher [f] Employer

[g] Others (specify) _____

79. How many tourists have you receiver in a year/month?

[a] Years ( ) [b] Month ( )

80. Which month is the busy in a year?

1) Jan. 2) Feb 3) March 4) April 5) May 6) June 7) July 8) Aug 9) Sept 10) Oct 11) Nov 12) Dec

81. How much do you pay for PPUC electric supply per month?

_____ $ per month

82. To what extent, do you think it is expensive?

[a] Very expensive [b] Expensive [c] Fair [d] Cheap [e] Very cheap

87. Out of following items, what do you have in your hotel? (Multiple Answer)

[a] Television [b] Radio/Cassette player [c] Refrigerator [d] Electric cooker [e] Electric dining plate washer

[f] Motorbike [g] Car [h] washing cloth machines

資料-14

テクニカルノート

THE PREPARATORY SURVEY

ON

WATER SUPPLY SYSTEM IMPROVEMENT PROJECT

IN THE REPUBLIC OF PALAU

TECHNICAL NOTES

October 31, 2014

YACHIYO ENGINEERING CO., LTD.

NIHON SUIKO SEKKEI CO., LTD.

資料-14-1

Memorandums

Japan International Cooperation Agency (JICA) has conducted the field surveys from June to November 2014 for the Water Supply System Improvement Project (the Project). The survey team (the Team) is headed by Ms. Eriko TAMURA, Director of Water Resources Management Team 1 in Global Environment Department of JICA, and formed by and with consultant members from Yachiyo Engineering Co., Ltd. and Nihon Suiko Sekkei Co., Ltd.

The consultant members have prepared these technical notes to confirm technical findings and basic information for the Project, at the end of the field surveys. The information on the technical notes will be utilized for further examination on the Project's components as well as preparation of outline designs for target facilities, together with the Sector Development Framework which was separately submitted by the Team. The information contained in these technical notes is not committed ones for the Japan's Grant Aid.

These technical notes were submitted by Chief Consultant of the Team, Mr. Katsumi FUJII belonging to Yachiyo Engineering Co., Ltd., to Chief Executive Officer (CEO) of Palau Public Utilities Corporation (PPUC), Mr. Kione J. Isechal, at the end of October 2014.

Koror, October 31, 2014

Received by	Submitted by
Kione J. Isechal Chief Executive Officer / General Manager Palau Public Utilities Corporation	For H. Igarashi Katsumi FUJII Chief Consultant of the JICA Survey Team Department Manager for Urban Environmental System, International Division Yachiyo Engineering Co., Ltd.

THE PREPARATORY SURVEY
ON WATER SUPPLY SYSTEM IMPROVEMENT PROJECT
IN THE REPUBLIC OF PALAU

Contents of Technical Notes

資料-14-3

Chapter 1: Basic Conditions for Design

1.1 Water Demand to be applied for Facilities Design

1.1.1 Target Year for the Project

The target year for the Project should be 2020 in accordance with the Minutes of Discussions signed on October 9, 2014 between the Palauan and the Japanese sides.

1.1.2 Design Maximum Daily Water Supply (Water Production)

The survey team estimates that the water production decrease to 3.09MG/d for average and 3.3MG/d for daily maximum, as the forecast water demand for 2020. It is simulated under the following assumptions:

- 22.1km (13.8 mile) of larger asbestos pipelines are replaced, together with lateral connections.
- NRW ration is decreased from 48% to 32%.

Before or in initial stage of the pipe replacement, the planned reduction of NRW is not anticipated. Accordingly, the Team will use the current flow for Design Maximum Daily Water Supply (Water Production) to design the facilities for the Project. It is 4.0MG/d.

The Team distributes the mentioned volume of water to nods for hydraulic analysis in accordance with consumption data for June-July 2013. Then, the Team calculates the water flows by distribution zone as follows:

Current Water Distribution According to June-July 2013								
Item		Direct Zone	Airai	Ngermid	Ngerkesoaol	Arakabesang	Malakal	Total
Recorded Consumption June-July 2013	(G/month)	10,714,950	5,588,208	2,635,978	40,058,559	2,840,784		61,838,479
	(%)	17.3%	9.0%	4.3%	64.8%	4.6%	0.0%	
Converted into Maximum Daily Supply	MG/d	0.69	0.36	0.17	2.6	0.18	0	4
	m^3/d	2,623	1,368	645	9,808	696	0	15,140
Design Water Distribution for a Case after Rearrangement of Zones								
Item		Direct Zone	Airai	Ngermid	Ngerkesoaol	Arakabesang	Malakal	Total
Assumed Consumption June-July 2013	(G/month)		6,985,260	11,953,875	31,801,314	4,734,640	6,363,390	61,838,479
	(%)	0.0%	11.3%	19.3%	51.4%	7.7%	10.3%	
Converted into Maximum Daily Supply	MG/d	0	0.45	0.77	2.06	0.31	0.41	4
	m^3/d	0	1,710	2,927	7,786	1,159	1,558	15,140

1.1.3 Design Maximum Hourly Water Flow

(1) Design maximum water flow

Recently, Population of Koror and Airai area is thinning, but tourists are increasing slightly. Water consumption in these areas is expected to go sideways in the short term until 2020. Therefore, design maximum daily water flow is set as same as current value.

Table 1.1.3-1 Design maximum design water flow

Period	Value
Current	4MG/day (15,140m^3/day)
Design	4MG/day (15,140m^3/day)

(2) Design maximum flow in each water distribution zone

Revenue earning water of Koror and Airai area has been aggregated into each district of 12 as 1) Airai, 2) Meketii, 3) Ikelau, 4) Medalaii (include Malakal), 5) Ngerbeched, 6)Idid, 7) Dngeronger, 8) Iyebukl, 9) Ngerkesoaol, 10) Ngerchemai, 11) Meyuns (include Ngerkebesang) and 12) Ngermid. The flow ratios in each water distribution zone are set by allocating these values to each distribution zone. Current and Design maximum flow in each water distribution zone is set using these ratios.

Current and Design flow in each water distribution zone based on past record of revenue earning water is shown in Table 1.1.3-2 and 1.1.3-3.

Table 1.1.3-2 Current Maximum flow in each water distribution zone

District			Accounted-for Water(G) (June～July. 2013) Billed usage in 1000gals(flat rate) Domestic	Billed usage in 1000gals(Metered) Domestic	Billed usage in 1000gals(flat rate) Non-Domestic	Billed usage in 1000gals(flat rate) Non-Domestic	Usage Totals	Accounted-for Water in each district: direct from KAWTP	Airai	Ngermid	Ngerkesoaol	Arakabesang	Malakal	Total
Airai State	No	① Airai	1,974,460	3,557,690	266,710	1,186,400	6,985,260	1,397,052	5,588,208				—	6,985,260
Koror State Hamlets		② Meketii	1,709	1,011,480	0	931,660	1,944,849				1,944,849		—	1,944,849
		③ Ikelau	0	989,930	0	1,052,510	2,042,440				2,042,440		—	2,042,440
		④ Medalaii+Malakal	12,820	3,622,390	6,152,180	11,423,910	21,211,300				21,211,300		—	21,211,300
		⑤ Ngerbeched	25,640	4,277,820	400,520	1,432,240	6,136,220				6,136,220		—	6,136,220
		⑥ Idid	0	1,779,070	38,200	617,580	2,434,850				2,434,850		—	2,434,850
		⑦ Dngeronger	0	892,710	0	2,863,350	3,756,060				3,756,060		—	3,756,060
		⑧ Iyebukl	0	1,810,830	31,410	312,410	2,154,650	2,154,650					—	2,154,650
		⑨ Ngerkesoaol	0	1,857,750	0	272,200	2,129,950	1,490,965			638,985		—	2,129,950
		⑩ Ngerchemai	0	3,664,640	96,860	491,410	4,252,910	4,252,910					—	4,252,910
		⑪ Meyuns+Arakabesang	0	3,048,230	334,820	1,351,590	4,734,640				1,893,856	2,840,784	—	4,734,640
		⑫ Ngermid	0	2,959,740	24,610	1,071,000	4,055,350	1,419,373		2,635,978			—	4,055,350
		Usage Totals(G)	2,014,629	29,472,280	7,345,310	23,006,260	61,838,479	10,714,950	5,588,208	2,635,978	40,058,560	2,840,784	0	61,838,479

Table 1.1.3-3 Design Maximum flow in each water distribution zone

District			Accounted-for Water(G) (June − July 2013) Billed usage in 1000gals(flat rate) Domestic	Billed usage in 1000gals(Metered) Domestic	Billed usage in 1000gals(flat rate) Non-Domestic	Billed usage in 1000gals(flat rate) Non-Domestic	Usage Totals	Accounted-for Water in each district: direct from KAWTP	Airai	Ngermid	Ngerkesoaol	Arakabesang	Malakal	Total
Airai State	No	① Airai	1,974,460	3,557,690	266,710	1,186,400	6,985,260	—	6,985,260					6,985,260
Koror State Hamlets		② Meketii	1,709	1,011,480	0	931,660	1,944,849	—			1,944,849			1,944,849
		③ Ikelau	0	989,930	0	1,052,510	2,042,440	—			2,042,440			2,042,440
		④ Medalaii+Malakal	12,820	3,622,390	6,152,180	11,423,910	21,211,300	—			14,847,910		6,363,390	21,211,300
		⑤ Ngerbeched	25,640	4,277,820	400,520	1,432,240	6,136,220	—			6,136,220			6,136,220
		⑥ Idid	0	1,779,070	38,200	617,580	2,434,850	—			2,434,850			2,434,850
		⑦ Dngeronger	0	892,710	0	2,863,350	3,756,060	—			3,756,060			3,756,060
		⑧ Iyebukl	0	1,810,830	31,410	312,410	2,154,650	—		2,154,650				2,154,650
		⑨ Ngerkesoaol	0	1,857,750	0	272,200	2,129,950	—		1,490,965	638,985			2,129,950
		⑩ Ngerchemai	0	3,664,640	96,860	491,410	4,252,910	—		4,252,910				4,252,910
		⑪ Meyuns+Arakabesang	0	3,048,230	334,820	1,351,590	4,734,640	—				4,734,640		4,734,640
		⑫ Ngermid	0	2,959,740	24,610	1,071,000	4,055,350	—		4,055,350				4,055,350
		Usage Totals(G)	2,014,629	29,472,280	7,345,310	23,006,290	61,838,479	0	6,985,260	11,953,875	31,801,314	4,734,640	6,363,390	61,838,479

(3) Design Maximum Hourly Water Flow

Design maximum hourly water flow is multiplied by maximum water flow and "Time factor". However, it is difficult to set this value based on past record, because flow rate at each service tank has not been measured. Accordingly, time factor is set to 1.3 by the estimates of the Ngerkesoaol distribution zone. Current and design maximum water flow and maximum hourly water flow in each distribution is shown in Table 1.1.3-4.

- Time factor: 1.3

Table 1.1.3-4 Current and Design maximum water flow and maximum hourly water flow

O Current Maximum Daily Supply and Maximum Hourly Supply of each Distribution Zone

Water Distribution District		direct from KAWTP	Airai	Ngermid	Ngerkesoaol	Arakabesang	Malakal	Total
Accounted-for Water(G) (June~July. 2013)		10,714,950	5,588,208	2,635,978	40,058,559	2,840,784	—	61,838,479
Maximum Daily Supply(Current)	MG/d	0.69	0.36	0.17	2.60	0.18	—	4.0
	m3/d	2,623	1,368	645	9,808	696	—	15,140
	%	17.3	9.0	4.3	64.8	4.6	—	100
Maximum Hourly Supply(Current)	Hourly Factor	1.3	1.3	1.3	1.3	1.3	—	1.3
	MG/d	0.90	0.47	0.22	3.38	0.23	—	5.2
	m3/d	3,410	1,778	839	12,750	905	—	19,682

OPlan Maximum Daily Supply and Maximum Hourly Supply of each Distribution Zone

Water Distribution District		direct from KAWTP	Airai	Ngermid	Ngerkesoaol	Arakabesang	Malakal	Total
Accounted-for Water(G) (June~July. 2013)		—	6,985,260	11,953,875	31,801,314	4,734,640	6,363,390	61,838,479
Maximum Daily Supply(Current)	MG/d	—	0.45	0.77	2.06	0.31	0.41	4.0
	m3/d	—	1,710	2,927	7,786	1,159	1,558	15,140
	%	—	11.3	19.3	51.4	7.7	10.3	100
Maximum Hourly Supply(Current)	Hourly Factor	—	1.3	1.3	1.3	1.3	1.3	1.3
	MG/d	—	0.59	1.00	2.68	0.40	0.53	5.2
	m3/d	—	2,223	3,805	10,122	1,507	2,025	19,682

資料-14-5

1.2 Requirement on Design for Structure and Pipeline

1.2.1 Design Load for Structural Calculation

Design load for structural calculation is decided based on the Specification described in "Koror-Airai Water System Pre-Treatment Plant, Project No.089-95" and the discussions with Capital Improvement Program (CIP) and PPUC.

(1) Seismic Load

Zone 2 in circum-Pacific Seismic Zone is applied.

(2) Wind Load

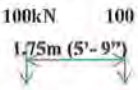
Wind load is applied as follows:

- Design Wind Velocity: 150 MPH
- Basic Wind Pressure: q= (0.00256) (150)2= 57.6 PSF

(3) Traffic Load

T-25 load is applied. Total weight of vehicle of 25 ton (250 kN, 55,066 lb) is considered and the following rear wheel load is applied for design.

- Rear Axle load is 200 kN (44,052 lb)
- Rear Wheel load is 100kN (22,026 lb)



1.2.2 Design Strength and Particular Requirement for Major Materials

(1) Cement Concrete

Concrete shall be according to ACI 301 basically.

- A 28-day compressive strength of minimum 4,000 psi shall be applied for the reinforced concrete Service Tank as water retaining tank.
- A 28-day compressive strength of minimum 3,000 psi shall be applied for other such as earth retaining walls.

(2) Asphalt Concrete

AASHO is applied to the asphalt concrete.

(3) Cement, Aggregate, Sand and Water for Cement Concrete

1) Cement

Type 1 Portland Cement is applied.

2) Aggregate, Sand and Water

(4) Reinforcement Bar

All reinforcing bars shall be deformed bars conforming to SD 345 in JIS G 3112 with yield strength of not less than 345 N/mm2 (50,039 psi) or ASTM A 615/A 615M Grade 40 for #4 and smaller, Grade 60 for #5 and bigger.

Minimum concrete cover shall be as follows:

- Concrete placed against earth: 2.8 inch (7cm)
- Other : 2 inch (5cm)

(5) Back-filling Soil for Pipeline Trench

The selected backfill material may comprise granular or other material arising from excavation works, if approved by the Engineer and shall be free of organic materials, lumps larger than 6" (150 mm) and stones larger than 1.6" (40 mm).

Chapter 2 Water Transmission Main

2.1 Basic Provision

2.1.1 Water Transmission Pump at KAWTP

Currently, treated water is transferred to one Service Tank (Airai Service Tank) in Airai and 3 Service Tanks (Ngermid Service Tank, Ngerkesewaol Service Tank and Arakabesang Service Tank) in Koror through 4 units of Water Transmission pumps, each with 1,050G/min discharge capacity and 286ft (87.2m) total head as shown in the following table. Currently, two or three pumps are operated and one is for stand-by based on the following operation system, in principle:

- From 24:00 to 5:00am: 2 units operation: equiv. 2.5MG/day flow
- From 5:00am to 24:00: 3 units operation: equiv. 3.8MG/day flow

The water transmission volume varies from 2.5 MG/day to 3.8 MG/day according to the record of transmission volume on July 16, 2014.

Table 2.1.1-1 Main Specification of Current Water Transmission Pump

Pump Type	Vertical centrifugal pump
Number of Pump	4 (3 for regular, 1 for spare operations)
Discharge Quantity	1,050G/min (per 1 unit)
Total Head	286ft (87.2m)

PPUC is planning to replace No.1 and No.2 Transmission pumps with 2 sets of new pumps (capacity: 1,400G/min, Head: 293ft) by the end of December, 2014 by the program loan of ADB. The existing Control Panel will be modified in conjunction with the replacement of pumps.

Table 2.1.1-2 Main Specification of Planned Water Transmission Pump

Pump Type	Vertical centrifugal pump
Number of Pump	2 (2 for regular)
Discharge Quantity	1,400G/min (per 1 unit)
Total Head	290ft (88.4m)

Accordingly, new Transmission pumps will be able to send the treated water of 4 MG/day.

2.1.2 Existing Water Transmission Main

The treated Water for Koror-Airai water distribution zone is transmitted from Airai Pump Station (P/S) of KAWTP through one transmission pipeline (Dia. 400mm: 16inches). This line branches to Airai Service Tank by a transmission pipe (Dia.200mm: 8inches). Then, the main pipeline (Dia. 300mm: inches) delivers the water to Koror state. The Transmission pipe for Koror state is currently installed at the bottom of KB Channel and connected to 3 Service Tanks (Ngermid Service Tank, Ngerkesewaol Service Tank and Arakabesang Service Tank). Although there is Malakal Service Tank, it has never been used since it was built in the 1970s.

The current Water Transmission System is shown in the following figure.

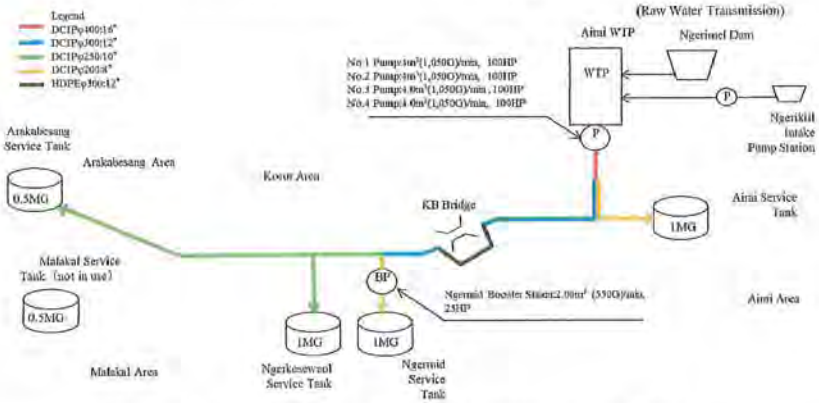


Figure 2.1.2-1 Current Koror - Airai Water Transmission System

The existing transmission main (dia. 16inches to 8inches) was installed in 1993 by a Japan's Grant Aid Project (the Previous Project). Target year of the Previous Project was year 2000 and the design water supply was 2.1 MG/day. On the other hand, the water demand is estimated at 3.3MG/day in 2020 and 4MG/day for the current maximum flow.

The result of hydraulic calculation for the current situation is shown in Section 2.2.2.

2.2 Hydraulic Calculation and Diameter Determination

2.2.1 Locations, Distances and Altitudes of KAWTP and Service Tanks

Locations, distances and altitudes of KAWTP and Service Tanks are shown in the following figure.

資料-14-6

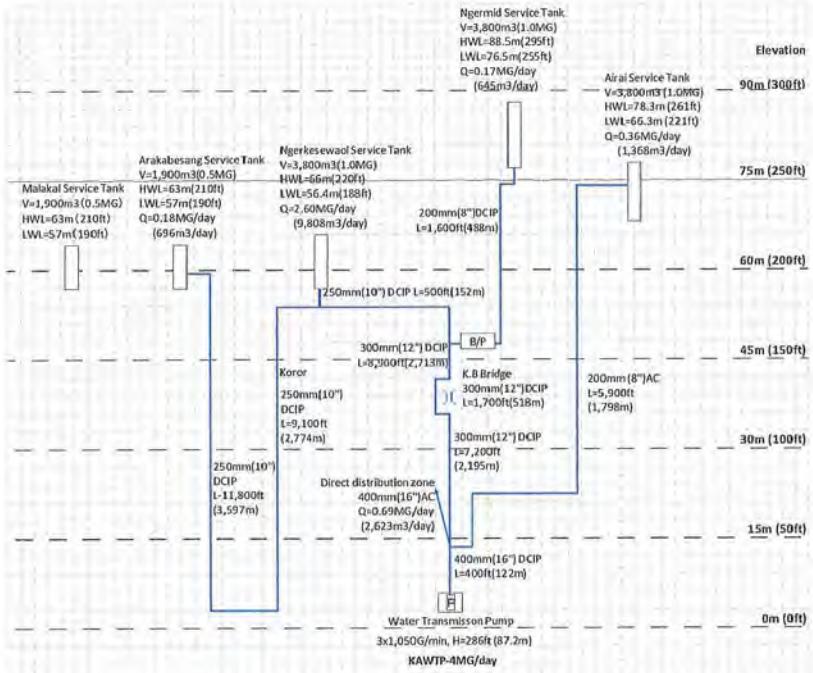


Figure 2.2.1-1 Current Locations, Distances and Altitudes of KAWTP and Service Tanks

2.2.2 Hydraulic Calculation for Current Situation

Hazen-Williams formula is applied to hydraulic calculation for the current situation. The number of 110 is applied to Hazen-Williams coefficient (velocity coefficient). Design maximum flow is 4MG /day (15,140m3/day). Total head of water transmission pump at KAWTP is 286ft (87.2m).

The design capacity of the existing transmission main is insufficient for the forecast water demand in 2020 and the current level of water production as shown in the following table. Countermeasures such as additional transmission main are, therefore, necessary.

Table 2.2.2-1 Result of Hydraulic Calculation for Current Situation

Location *1		Design Flow		Nominal Dia.		Length		Effective Head (End)		Hydrostatic Pressure (End)	
Start	End	MG/d	m3/d	inch	mm	ft	m	ft	m	ft	m
1	2	4.00	15,140	16"	400	400	122	290	88	293	89
2	2'	2.95	11,149	12"	300	7,200	2,195	160	49	265	81
2'	2"	2.95	11,149	12"	300	1,700	518	136	41	265	81
2"	3	2.95	11,149	12"	300	8,900	2,713	-150	-46	106	32
2	9	0.36	1,368	8"	200	5,900	1,798	30	9	46	14
3	4	0.17	645	8"	200	1,600	488	-144 *2	-44 *2	112 *2	34 *2
3	5	2.78	10,504	12"	300	1,800	549	-131	-40	147	45
5	6	2.59	9,808	10"	250	500	152	-206	-63	86	26
5	7	0.18	696	10"	250	9,100	2,774	-8	-3	272	83
7	8	0.18	696	10"	250	11,800	3,597	-187	-57	96	29

Notes: *1: 1:KAWTP, 2:Branch of KAWTP, 2':KB Bridge East, 2":KB Bridge West, 3:Ngermid Branch, 4: Ngermid Service Tank, 5:Ngerkesewaol Branch, 6: Ngerkesewaol Service Tank, 7:PVA intersection, 8:Arakabesang Service Tank, 9:Airai Service Tank, *2: According to Ngermid Booster Pump which total head is 100ft (30.48m)

2.2.3 Alternative Plans and Hydraulic Calculations for Improvement

As mentioned in Section 2.2.2, the capacity of the existing water transmission main is not sufficient to transmit the required volume. To overcome the problem, an additional transmission main is necessary. Figure 2.2.3-1 is a preliminary design to install additional pipeline (Dia. 16 inches) from water transmission pump station in KAWTP to Ngerkesewaol branch and from PVA intersection to Malakal service Tank. To cross the KB Channel, it is recommended to utilize the planned bridge-attached pipeline, which is under tendering procedures. The design of the bridge-attached pipeline and the new transmission main should be integrated.

Hazen-Williams formula is also applied to hydraulic calculation for the improvement plan. The number of 110 is applied to Hazen-Williams coefficient (velocity coefficient). Design maximum flow is 4MG /day (15,140m3/day). Total head of water transmission pump at KAWTP is 290ft (88.4m).

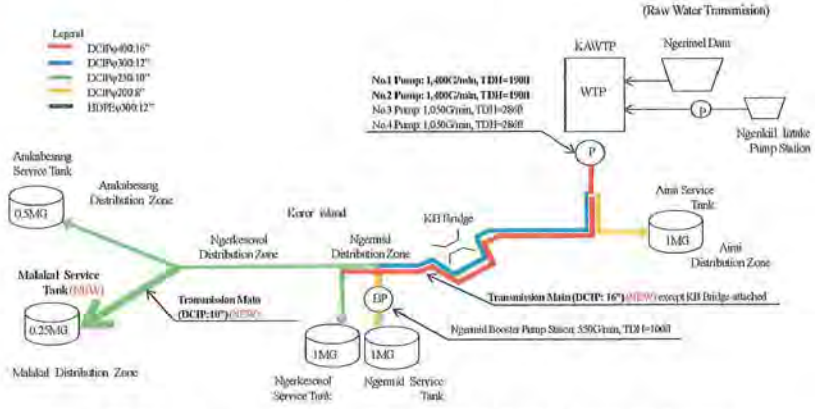


Figure 2.2.3-1 Improvement Plan of Koror - Airai Water Transmission System

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The result of hydraulic calculation for the improvement plan is shown in the following table.

Table 2.2.3-1 Result of Hydraulic Calculation for Improvement Plan

Location *1		Design Flow		Nominal Dia.		Length		Effective Head (End)		Hydrostatic Pressure (End)	
Start	End	MG/d	m3/d	inch	mm	ft	m	ft	m	ft	m
1	2	4.00	15,140	16"	400	400	122	294	90	297	90
2	2'	3.55	13,430	18.5" *3	463 *3	7,200	2,195	249	76	269	82
2'	2"	3.55	13,430	15.6" *3	390 *3	1,700	518	239	73	269	82
2"	3	3.55	13,430	18.5" *3	463 *3	8,900	2,713	59	18	110	33
2	9	0.45	1,710	8"	200	5,900	1,798	28	9	50	15
3	4	0.77	2,927	8"	200	1,600	488	51 *2	16 *2	116 *2	35 *2
3	5	2.77	10,503	18.5" *3	463 *3	1,800	549	97	30	151	46
5	6	2.06	7,786	10"	250	500	152	28	8	90	27
5	7	0.72	2,717	10"	250	9,100	2,774	200	61	276	84
7	8	0.31	1,159	10"	250	11,800	3,597	18	5	100	30
7	10	0.41	1,558	10"	250	8,600	2,621	16	5	100	30

Notes: *1: 1:KAWTP, 2:Branch of KAWTP, 2':KB Bridge East, 2":KB Bridge West, 3:Ngermid Branch, 4: Ngermid Service Tank, 5:Ngerkesewaol Branch, 6: Ngerkesewaol Service Tank, 7:PVA intersection, 8:Arakabesang Service Tank, 9:Airai Service Tank, 10:Malakal Service Tank, *2: According to Ngermid Booster Pump which total head is 100ft (30.48m), *3: Conversion dia. for parallel pipes: 18.5" (463mm) corresponds to "16"+12" (400mm+300mm), and 15.6" (390mm) corresponds to "12"+12" (300mm+300mm). Dia. of additional pipeline between KAWTP and Ngerkesewaol Branch is 16" (400mm) and each dia. of parallel bridge-attached pipe will be installed as 12"+12" (300mm+300mm) on KB bridge.

2.3 Preliminary Design for the Additional Water Transmission Main

2.3.1 Preliminary Result for Outline Design

(1) Outline for Route and Diameter

Outline for the routes and the diameters of the additional water transmission mains are shown in the following table and three figures. Typical standard sections for the location and depth of pipeline are shown in Section 2.3.3. It is necessary to stop the water transmission during connection works to the existing transmission mains in accordance with the plans at the construction stage.

Table 2.3.1-1 Outline of Additional Water Transmission Pump

No.	Location	Pipe	Length (Approx. ft (km))
1	KAWTP – KB Bridge (Airai side)	DCIP, 16"	7,200ft (2.2km)
2	KB Bridge (Korol side) - Ngerkesoal	DCIP, 16"	10,700ft (3.3km)
3	PVA intersection - Malakal Service Tank	DCIP, 10"	8,600ft (2.6km)

Figure2.3.1-1 Additional Water Transmission Main-1 (KAWTP – KB Bridge Eastern side)

Figure2.3.1-2 Additional Water Transmission Main-2 (KB Bridge western side – Ngerkesewaol)

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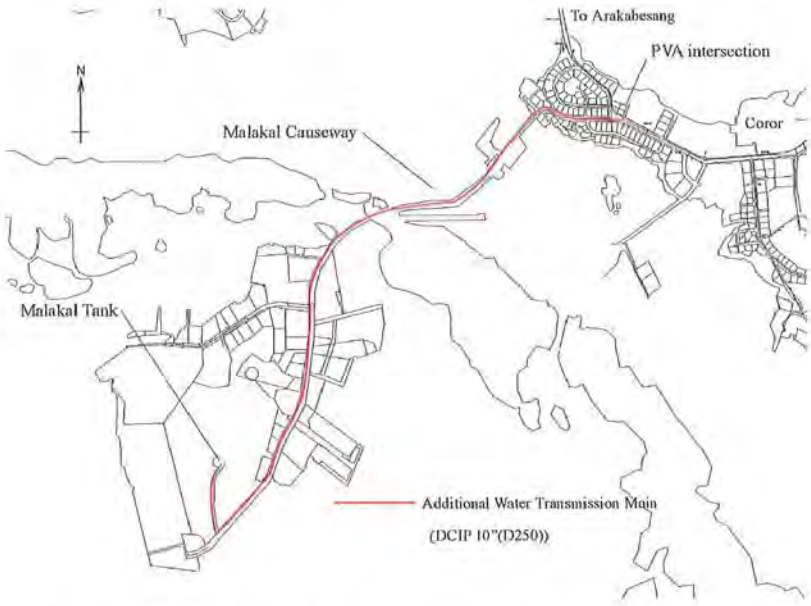


Figure 2.3.1-3 Additional Water Transmission Main-3 (PVA intersection - Malakal Service Tank)

(2) Water Flow Diagram for Transmission

Water flow diagram for water transmission main is shown in the following figure.

資料-14-9

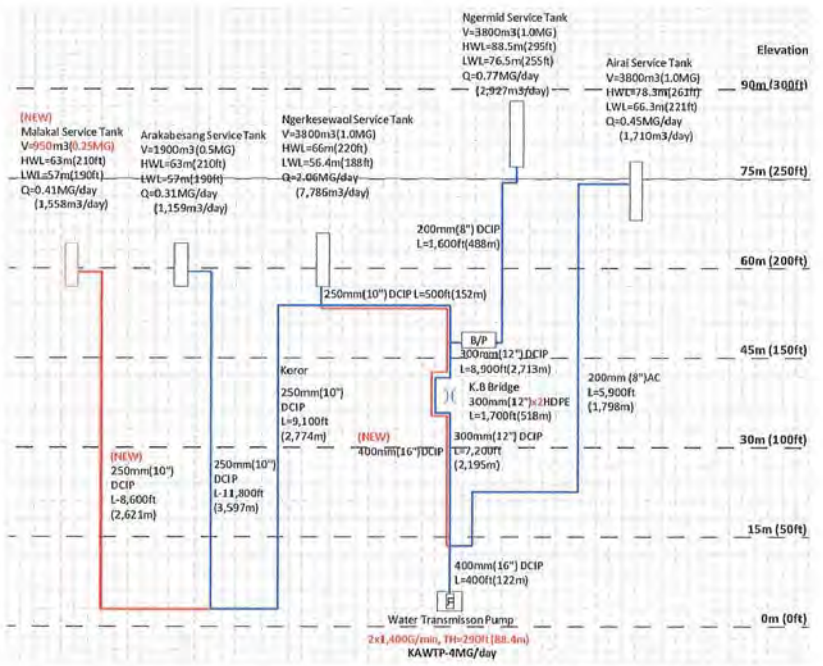


Figure 2.2.1-1 Current Locations, Distances and Altitudes of KAWTP and Service Tanks

(3) Branching from Outlet of KAWTP

Proposed Connection to Branching from Outlet of KAWTP is shown in the following figure.

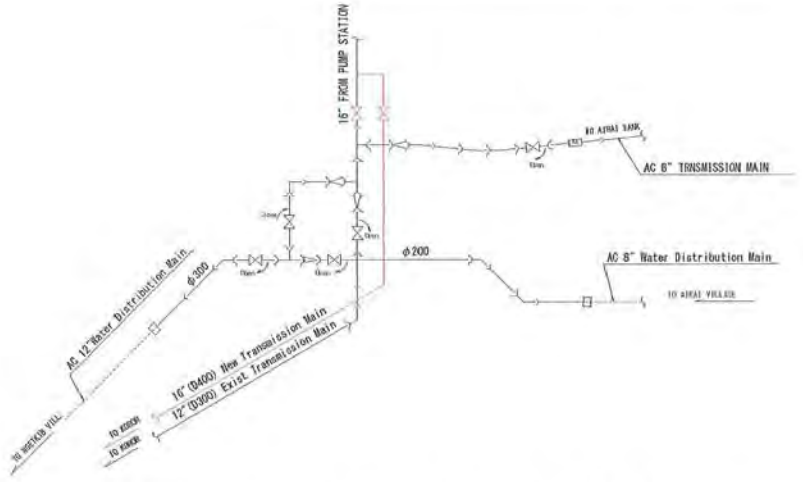
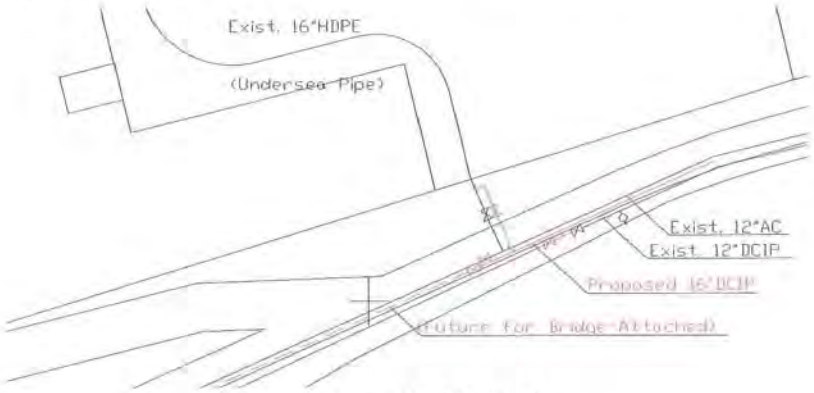


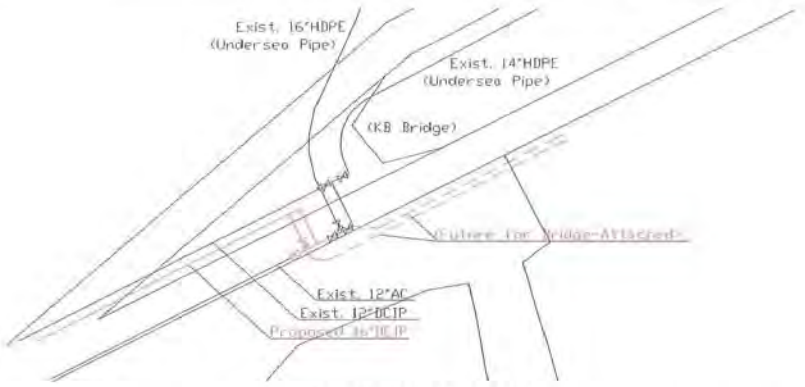
Figure 2.2.1-2 Proposed Connection to Branching from Outlet of KAWTP

(4) Connection to Existing Undersea Pipeline around KB Bridge

Proposed Connections to Existing Undersea Pipeline around KB Bridge are shown in the following figures.



(Eastern side of KB Bridge)



(Western side of KB Bridge)

Figure 2.2.1-3 Proposed Connections to Existing Undersea Pipeline around KB Bridge

(5) Connection to Ngermid Service Tank

Proposed Connection to Ngermid Service Tank is shown in the following figures.

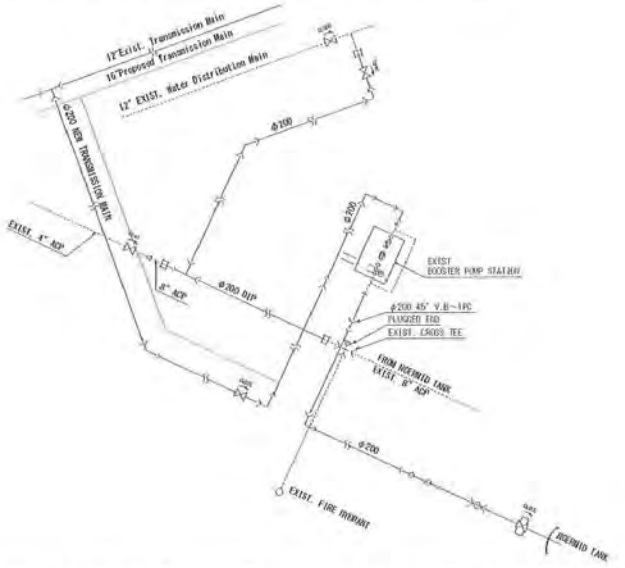


Figure 2.2.1-4 Proposed Connections to Ngermid Service Tank

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(6) Connection to Ngerkesoaol Service Tank

Proposed Connection to Ngerkesoaol Service Tank is shown in the following figures.

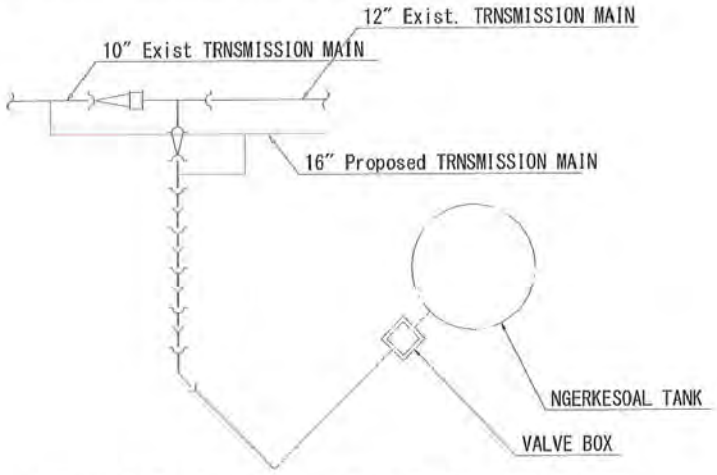


Figure 2.2.1-5 Proposed Connections to Ngerkesoaol Service Tank

(7) Exclusive Transmission Main to Malakal

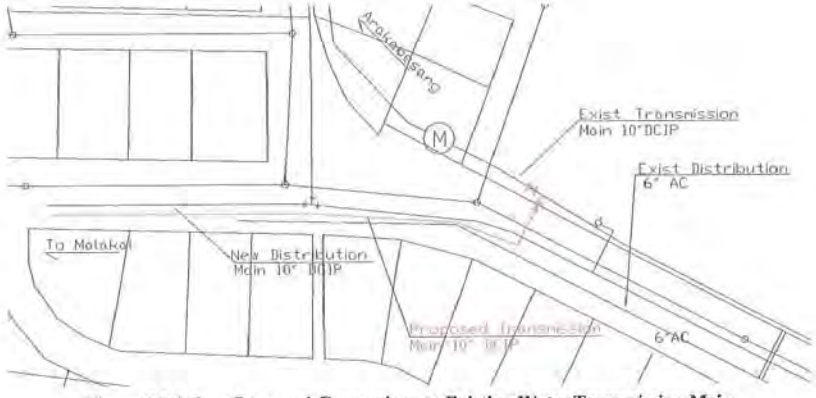


Figure 2.2.1-6 Proposed Connections to Existing Water Transmission Main at PVA intersection

(8) Valves

The sluice valves are installed at every 1-3 km of the water transmission main for the maintenance. Air release valves are installed at the longitudinal peaks of pipeline.

2.3.2 Ductile Cast Iron Pipe (DCIP) for Water Transmission Main

Pipe material is applied to a ductile cast iron (DCIP) according to ISO. T-type (push-on joint), K-9 is applied. Restrained couplings are used for bends, valves and so on, if any.

Since the thrust concrete block was constructed at the bend in the exiting Water Transmission Main, the detachment prevention type pipe will be used at the bend instead of thrust concrete block in order to minimize the clearance between the existing pipe and additional pipe and minimize the space for pipelines.

Connection between existing water transmission main (JIS-DCIP) and additional one (ISO-DCIP) is installed a special socket fitting.

2.3.3 Typical Section for Location and Depth of Pipeline

Typical section of Additional Transmission Main is shown in the following figure. Minimum earth cover of pipe is not less than 36" (900 mm) according to PPUC internal standerd.

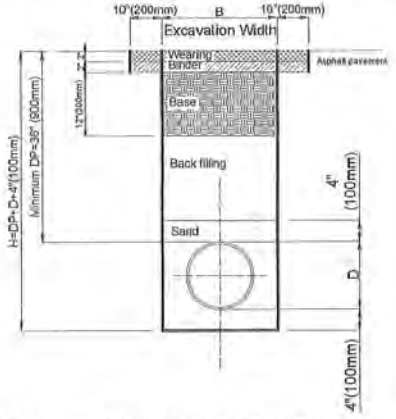


Figure2.3.3-1 Typical Section of Additional Water Transmission Main

Each typical section of the additional water transmission main, which faces from Airai to Malaral, is shown in the following five (5) figures. In general, additional Water Transmission Main is laid parallel with the existing Water Transmission Main with minimum clearance of 1feet (30cm).

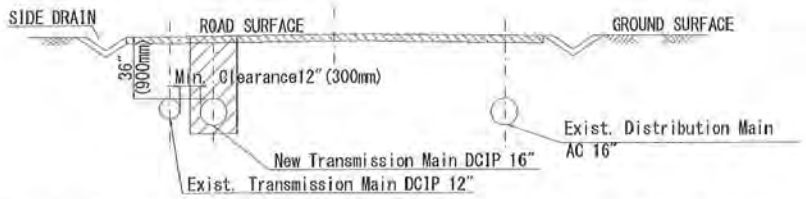


Figure2.3.3-2 Typical Section of Additional Water Transmission Main-1 (KAWTP – KB Bridge)

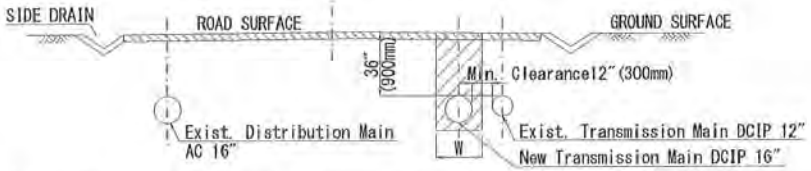


Figure2.3.3-3 Typical Section of Additional Water Transmission Main-2 (KB Bridge – Ngerkesewaol)

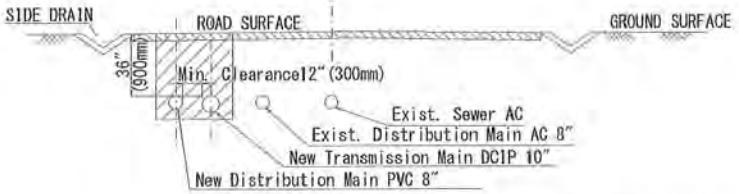


Figure2.3.3-4 Typical Section of Additional Water Transmission Main-3 (PVA intersection – Minatobashi Bridge)

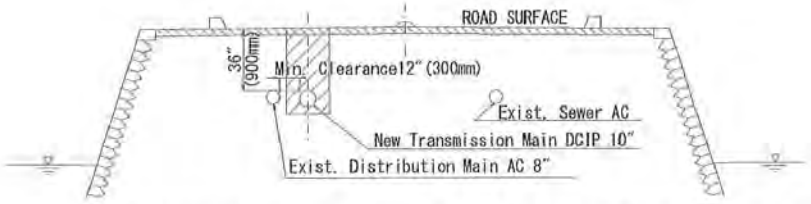


Figure2.3.3-5 Typical Section of Additional Water Transmission Main-4 (Malakal Causeway)

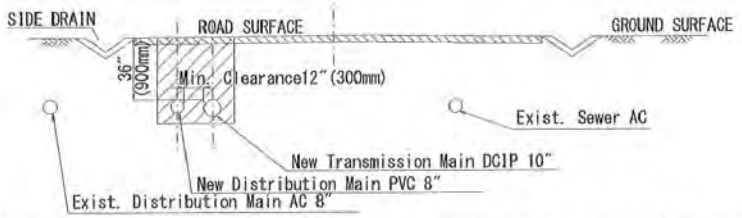


Figure2.3.3-6 Typical Section of Additional Water Transmission Main-5 (Malakal Causeway – Malakal Service Tank)

2.3.4 Requirement for Airai Causeway

The existing Water Transmission Main is installed on the ocean side in the paved road and additional Water Transmission Main will be installed parallel with the existing one in the paved road as shown in Figure Figure2.3.3.3.

2.3.5 Requirement for Minato-bashi Bridge

The existing sewer line is installed at west side of the Minato-bashi. The two existing water distribution pipelines (dia. 4 inches, two pipes) are installed at east side (Long Island side) as shown in Figure 2. The new water transmission main will be installed at east side (Long Island side) of the Minato-bashi.

Minato-bashi (West side) : Existing sewer

Minato-bashi (East side: Long Island side) : Existing water pipeline (dia.4" x 2 lines)

New one Water Transmission Pipeline (dia. 10") will be installed additionally

Figure2.3.5-1 Existing Utilities at Minato-bashi

2.3.6 Requirement for Malakal Causeway

West side walkway should be maintained as a path for walking and jogging. The new water transmission main should be, therefore, installed at the following locations in east side (Long Island side) as shown in Figure2.3.3.5.

資料-14-12

Chapter 3 Malakal Service Tank

3.1 Basic Provision

3.1.1 Location and Demolish of the Existing Tank

The location of new Malakal Service Tank is adjacent to the existing one. The existing Malakal Tank will be not demolished.

3.1.2 Capacity (Size) of Tank

Design capacity of the water service tank has been determined taking into account the following conditions:

- Design water demand in each water distribution district
- Having about 12-hour capacity of the maximum daily water demand

Capacity of Tank is 0.25MG approximately.

3.1.3 Requirement for PPUC on the Land Preparation

- PUCC shall clear the land including the crops, farms and obstacles such as sheds inside new tank area prior to the commencement of construction of new tank.
- PPUC shall make gravel pavements on the existing access road to new Malakal tank area prior to the commencement of construction of new tank.
- PPUC shall provide the fence and gate around new Malakal tank.
- PPUC shall provide the electric power to new Malakal tank area to provide Water Level Monitoring System.

3.2 Preliminary Design for Malakal Tank

3.2.1 Structure, Shape and Dimensions

(1) Structure and Shape

Reinforced concrete (RC) rectangular tank is applied in view of service life and maintenance.

Tank has 2 basins taking into consideration the maintenance. Water can be flowed each other between 2 basins through the intermediate connecting pipe with valve.

(2) Dimensions

Dimension (2 basins): 60 feet 2 inch (18.35m) width, 50 feet 10 inch (15.5m) length and water height 13feet 10inch (4.2m) approximately.

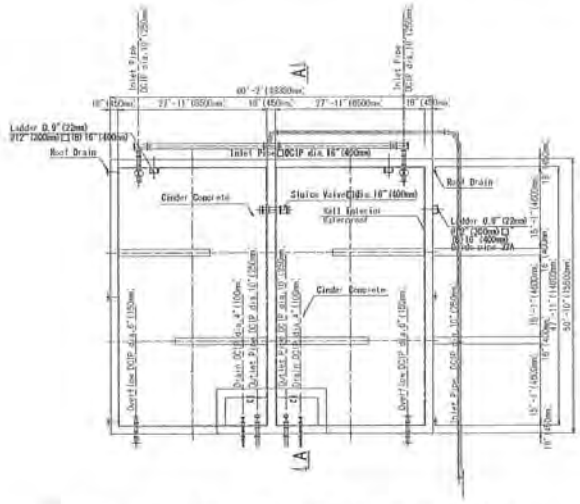
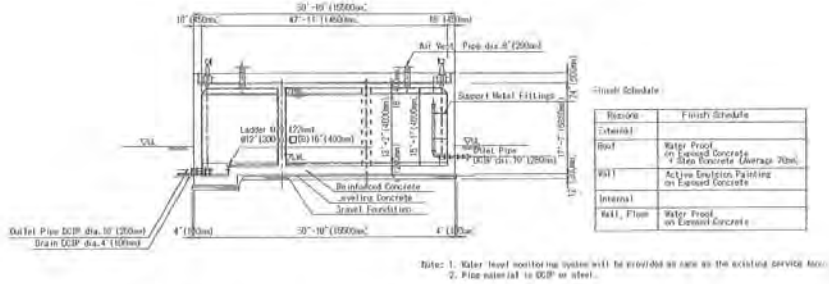


Figure3.2.1-1 Proposed Plan of Malakal Service Tank



Note: 1. Water level monitoring system will be provided as same as the existing service tank.
2. Pipe material is DCIP or steel.

Figure3.2.1-2 Proposed Section of Malakal Service Tank

資料-14-13

3.2.2 Basic Layout as well as In-site Piping

Basic layout of proposed Malakal Service Tank is shown in the following drawing.

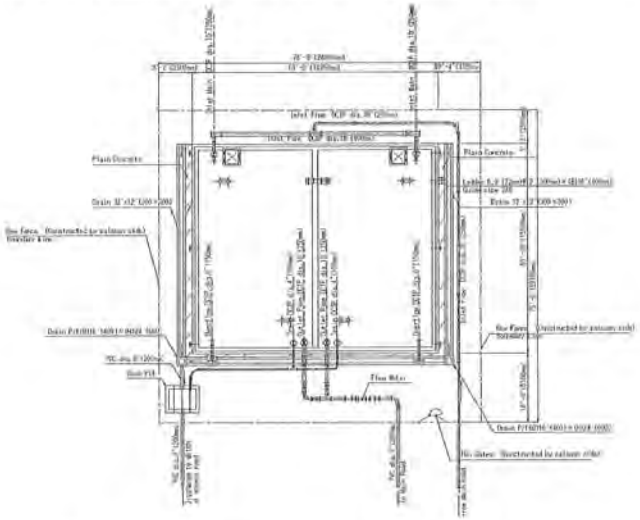


Figure3.2.2-1 Basic Layout of Malakal Service Tank

3.2.3 Water Level (High and Low)

Water level (high and low) is shown in Figure3.2.1.2.

3.2.4 Water Level Monitoring System

Water level monitoring system will be provided as same as the existing Service Tanks.

3.2.5 Finishing of Surfaces of the Tank

Finishing of the surfaces of the Tank is shown as follows.

(1) External

- Roof: Water proof on exposed concrete
- Wall: Active Emulsion Painting on exposed concrete

(2) Internal

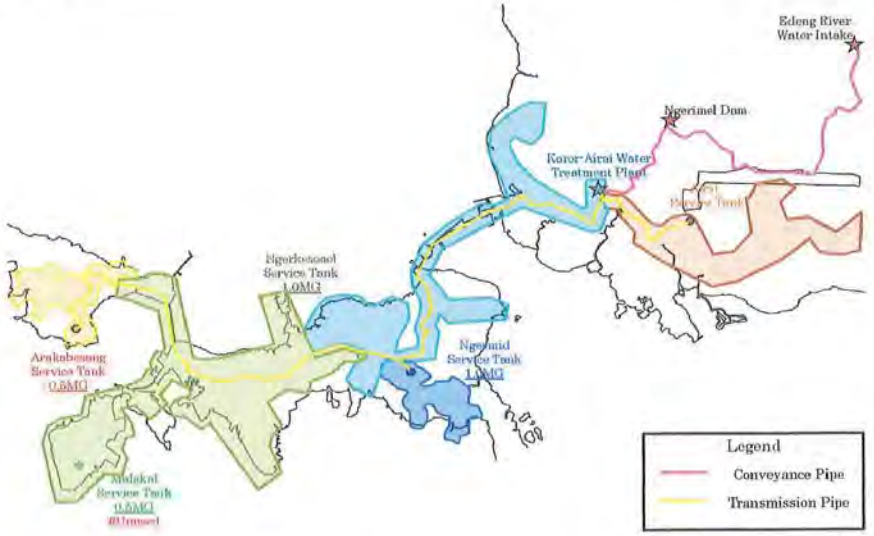
- Wall and Floor: Water proof on exposed concrete

Chapter 4 Water Distribution Networks

4.1 Basic Provision

4.1.1 Existing and Planned Zones for Water Distribution

Current water distribution system is comprised of 5 water distribution zones, Airai, Ngermid, Ngerkesewaol, Arakabesang and direct distribution zone from KAWTP. Currently, water in Malakal zone is distributed through Ngerkesewaol Service Tank. Except for direct distribution zone from KAWTP, water is distributed by gravity. The current situation of the water distribution zones is shown in Figure 4.4.1-1.

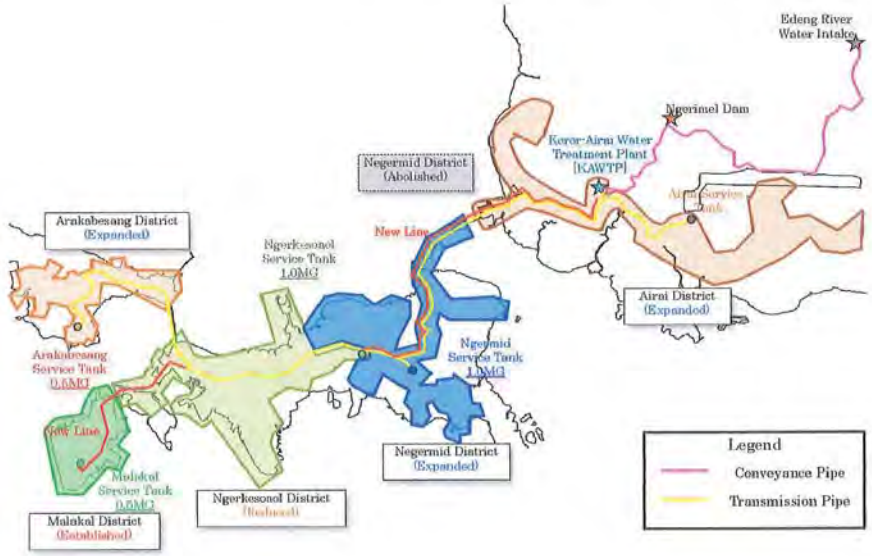


Source: JICA Survey Team, based on PPUC information

Figure 4.1.1-1 Current Water Distribution Zones

To eliminate low water pressure areas and to ensure stability of the water supply of Malakal area, it is urgently required to separate the Malakal area from Ngerkesewaol water distribution zone and re-arrange the covering areas of each zone as shown in Figure 4.1.1-2. For this purpose, renewal of Malakal tank and an exclusive transmission main are necessary. Along the mentioned rehabilitation, district flow meters should be installed at tanks for distribution flow management.

資料-14-14



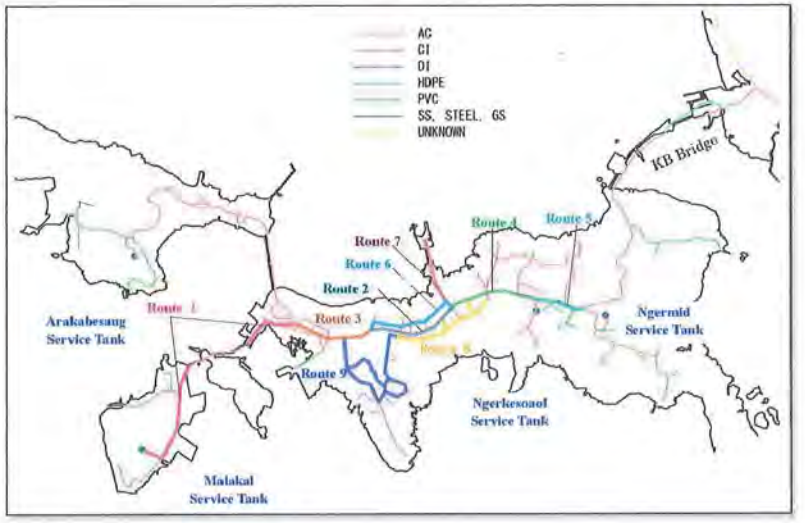
Source: JICA Survey Team, based on PPUC information

Figure 4.1.1-2 Planed Water Distribution Zones

4.1.2 Priority of Target Routes for Replacement

The Reduction of leakage is strongly required for PPUC to improve the business efficiency. The replacement of larger diameter AC pipes should be commenced immediately. Since it is difficult to replace all the pipelines at once, the works should be scheduled in short / medium terms. The works should include the replacement of lateral connection pipes.

As the urgent parts to be replaced, the Team recommends the routes shown in Figure 4.1.2-1. Total length of the urgent routes is around 8.1 miles (13km).



Source: JICA Survey Team

Figure 4.1.2-1 Route for Urgent Replacement for Old Distribution Pipes

4.1.3 Maximum and Minimum Water Pressure in Water Distribution Lines

Maximum and minimum water pressure in water distribution lines are shown in Table 4.1.3-1. These target values are PPUC's regulation.

Table 4.1.3-1 Maximum and minimum water pressure in water distribution lines

Water Pressure	Target value
Maximum	110PSI (0.76MPs)
Minimum	20PSI (0.14MPs)

4.2 Preliminary Results of Hydraulic Calculation and Diameter Determination

4.2.1 Methodology of Hydraulic Calculation and Preliminary Result

Hydraulic calculation is performed using the time factor and design maximum hourly water flow were set in chapter 1.1.3.

(1) Hydraulic formula

The head loss is calculated using the Hazen-Williams formula.

資料-14-15

[Hazen-Williams formula]

$$H = 10.666 \cdot D^{-1.85} \cdot D^{-4.87} \cdot Q^{1.85} \cdot L$$

Where H: Friction head loss (m)
C: Coefficient of velocity
D: Diameter of pipe (m)
Q: Flow (m^3/scc)
L: Length of pipe (m)

(2)Coefficient of velocity: C

This value varies depending on roughness of the inner surface of the pipe and the number of bend and branch in pipe line. Therefore the calculation is performed using C = 110 as the value of the entire pipe network in consideration of these situations, this project.

- Coefficient of velocity: C = 110

(3)Water elevation of service tank

Hydraulic calculation is performed using the LWL of service tank. LWL of each service tank is shown in Table 4.2.1-1.

Table 4.2.1-1 Water Elevation of Service Tank

Service Tank	HWL	LWL
1) Airai	261ft (8.3m)	221ft (66.3m)
2) Negermid	295ft (88.5m)	255ft (76.5m)
3) Ngerkesoaol	220ft (66.0m)	188ft (56.4m)
4) Arakabesang	210ft (63.0m)	190ft (57.0m)
5) Malakal	210ft (63.0m)	190ft (57.0m)

4.2.2 Hydraulic Calculation for Current Situation

According to result of hydraulic calculation for current situation is shown in Figure 4.2.2-1, there are two low pressure areas, Ngerbeched and Malakal in Ngerkesoaol distribution zone. Water pressure is especially low in Ngerbeched area where is hilly, and pressure value is less than 20PSI (useful head: 14m) that is target minimum value.

In another area, Malakal, water pressure is also slightly less than 20PSI.

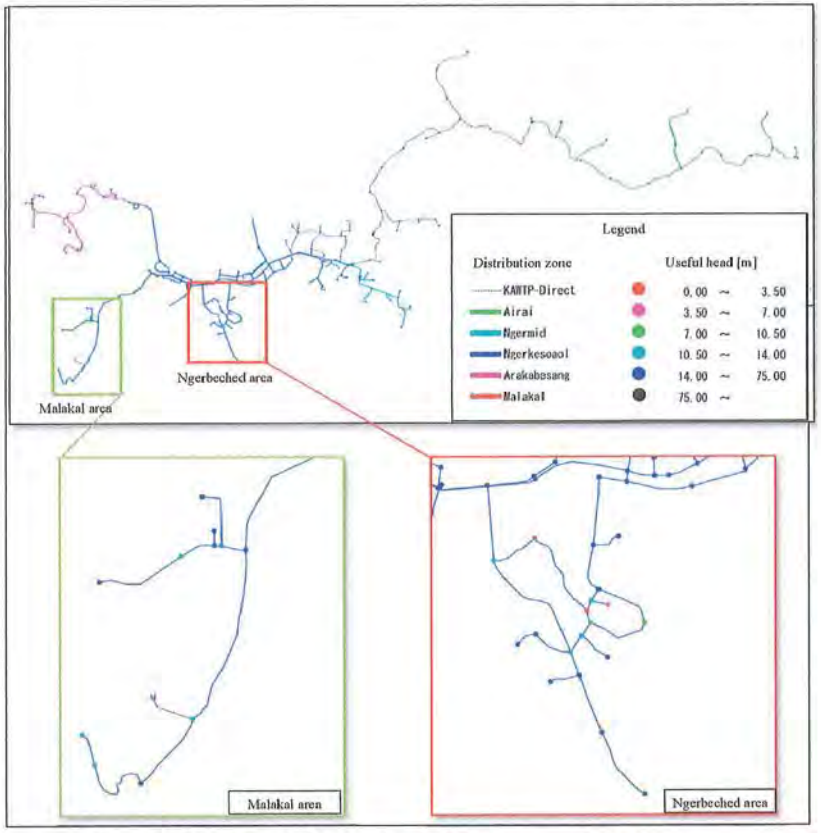


Figure 4.2.2-1 Result of hydraulic calculation for current situation

4.2.3 Alternative Plans and Hydraulic Calculations for Improvement

According to result of hydraulic calculation for improvement is shown in Figure 4.2.3-1, water pressure in Ngerkesoaol distribution zone increases, especially low pressure area in Ngerbeched is improved, by separating Malakal distribution zone from Ngerkesoaol distribution zone where has large area and extending Arakabesang distribution zone.

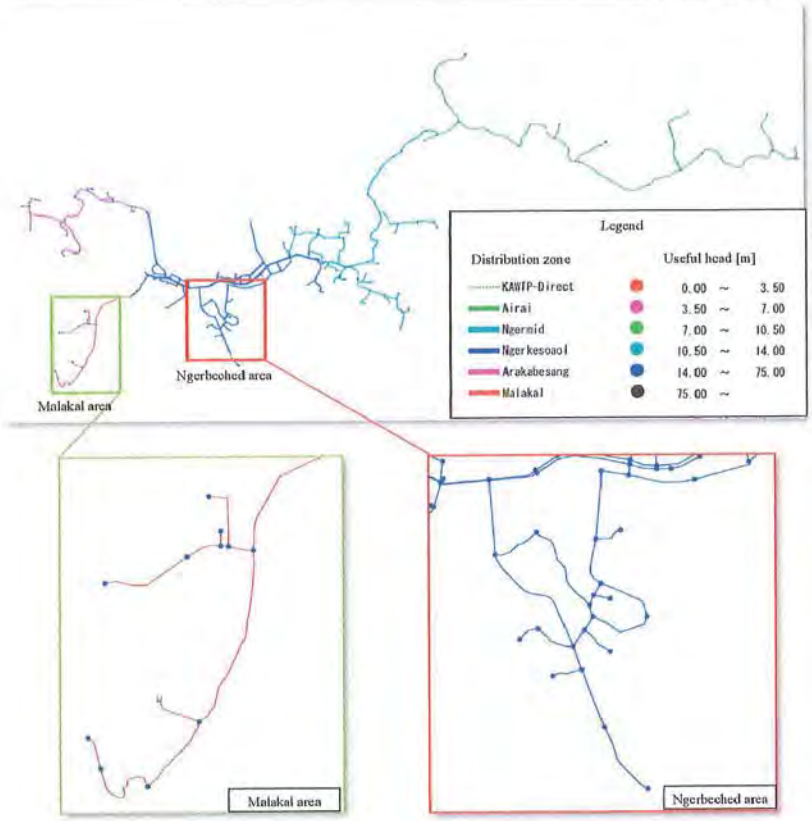


Figure 4.2.3-1 Result of hydraulic calculation for improvement

4.3 Preliminary Design for Water Distribution Management

4.3.1 Installation of District Flow Meter

(1) Location of the flow meter at service tank

Flowmeters have not installed at existing service tanks. Measuring flow at each service tank is important to control inflow and outflow of service tank and to comprehend non-revenue earning water. Therefore flowmeter is installed in the location indicated by Figure 4.3.1-1 at each service tank.

1)Airai Service Tank

2)Ngermid Service Tank

3)Ngerkesoaol Service Tank

Removing Concreat Box
(#unused)

4)Arakabesang Service Tank

Removing Concreat Box
(#unused)

Figure 4.3.1-1 Location of flowmeter at each service tank

(2) Installation method of flowmeter

When installing flowmeter, water distribution from service tank must be stopped temporarily. In 1) Airai and 2) Ngermid service tank where has valve at outlet pipe, water distribution could be stopped by closing this valve. However, in 3) Ngerkesoaol and 4) Arakabesang service tank where do not have valve, it is necessary for stopping water distribution to leave the valve on the water level adjustment valve chamber.

Pattern diagrams of mounting flowmeter are shown in Figure 4.3.1-2 and 4.3.1-3.

1)Airai Service Tank & 2) Negermid Service Tank

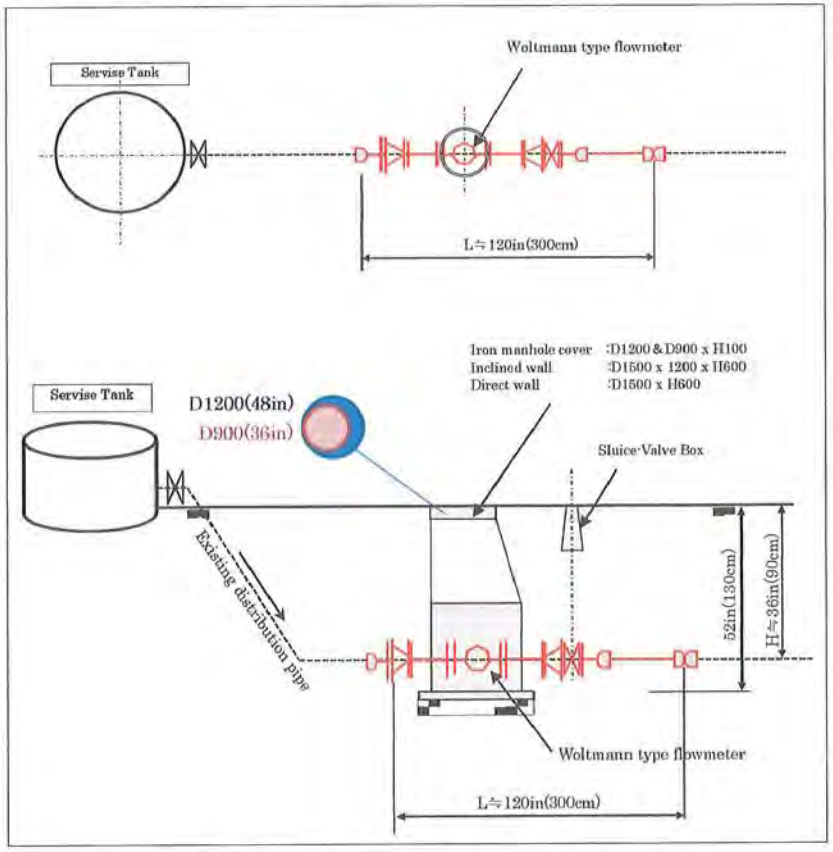


Figure 4.3.1-2 Pattern diagram of mounting flowmeter (1)

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3) Ngerkesoal Service Tank & 4) Arakabesang Service Tank

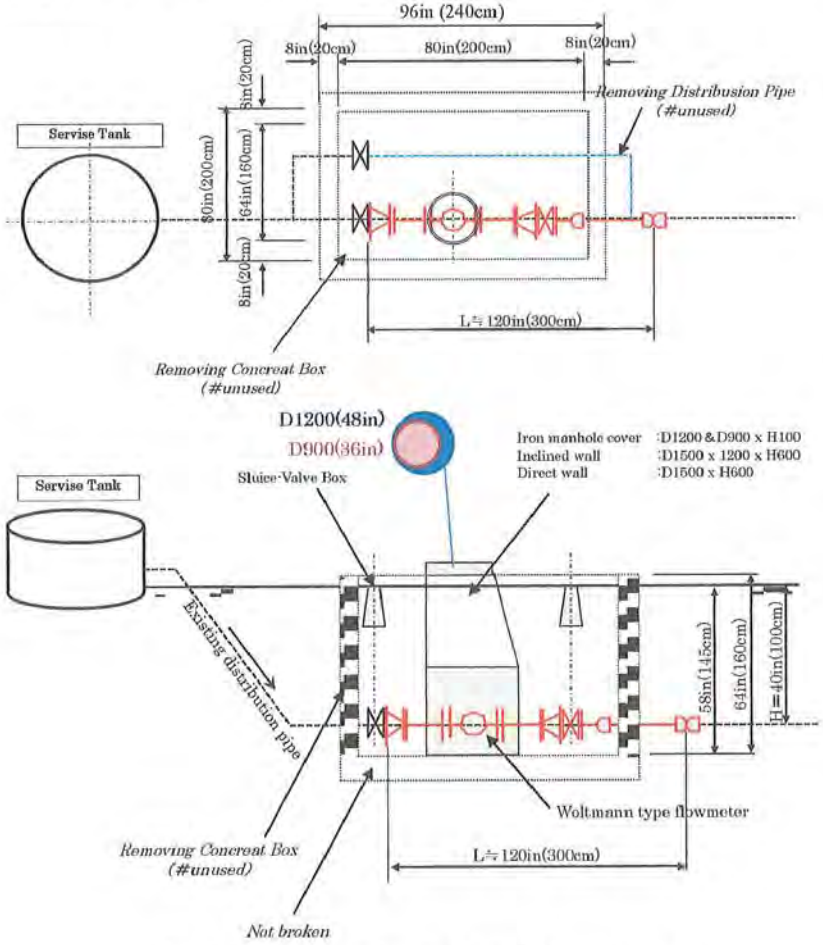


Figure 4.3.1-3 Pattern diagram of mounting flowmeter (2)

4.3.2 Basic Specification of District Flow Meter

The types of flowmeter are such as Woltmann type (mechanical), electromagnetic type and ultrasonic type. In view of the price, the workability and maintenance, adopting Woltmann type that does not require electrical equipment.

The diameter of flowmeter is selected D6in (150mm) as shown in Table 4.3.2-1, out of consideration of flowmeter flow range and the maximum hourly water flow of each service tank.

Table 4.3.2-1 Diameter of Flowmeter

Service Tank	Maximum Hourly Water Flow [G/min]	Diameter of Flowmeter	Flow Range (Min-Max) [G/min]
1) Airai	410 (= 0.59MG/d)	6in (150mm)	20-3100
2) Ngermid	694 (= 1.00MG/d)	6in (150mm)	20-3100
3) Ngerkesoaol	1,861 (= 2.68MG/d)	6in (150mm)	20-3100
4) Arakabesang	278 (= 0.40MG/d)	6in (150mm)	20-3100
5) Malakal	368 (= 0.53MG/d)	6in (150mm)	20-3100

Note: Maximum Hourly Water Flow = Maximum Water Flow x Time Factor (1.3)

4.4 Preliminary Design for Replacement of the Water Distribution Pipelines

4.4.1 Preliminary Result for Outline Design

(1) Outline for Route and Diameter

Recommended route, diameter and length for urgent replacement for old distribution pipes are shown in Table 4.4.1-1 and Figure 4.4.1-1. Priority route number indicates implementation priority.

Table 4.4.1-1 Measure pipelines length

Priority Route No.	Diameter		Length[m]		Remarks
	Inch	mm	Replacement	New	
1	8	200	1,910		
2	10	250		940	
	8	200	940		
3	12	300	910		
	8	200	910		
4	12	300	890		
	8	200	890		
5	12	300	570		
6	8	200	870		
7	8	200	700		
8	8	200	1,500		
9	8	200	2,830		
Sub-total	8	200	10,550	0	
	10	250	0	940	
	12	300	2,370	0	
Total			12,920	940	13,860

Note: Pipeline length is approximate value

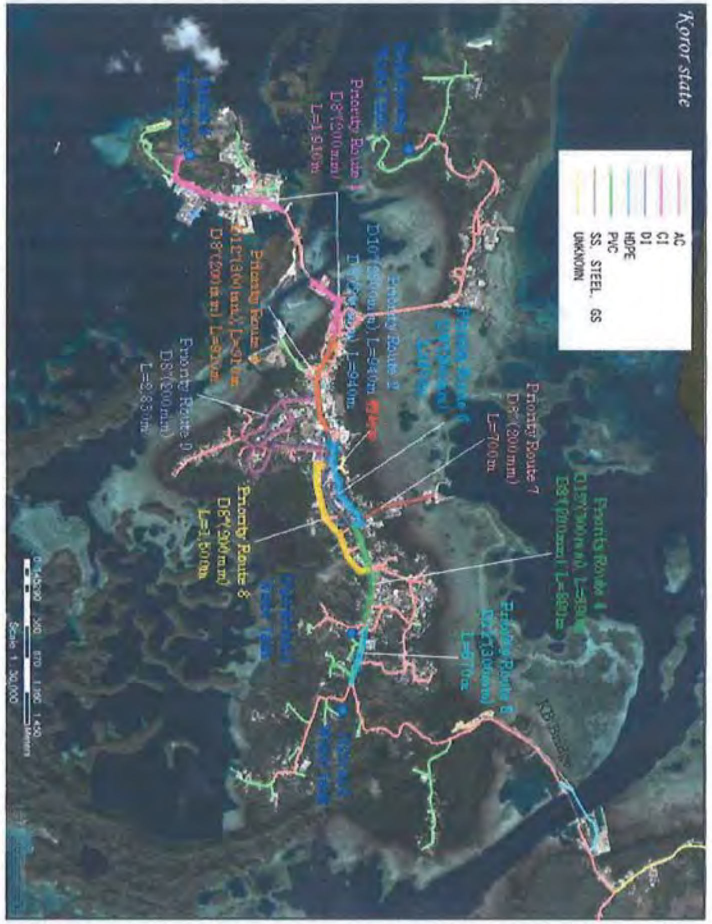


Figure 4.4.1-1 Recommended Route for Urgent Replacement for Old Distribution Pipes

(2) Connection to the Existing Pipelines

Method of connection to the new pipeline and existing pipeline is shown in Figure 4.4.1-2 as conceptual diagram.

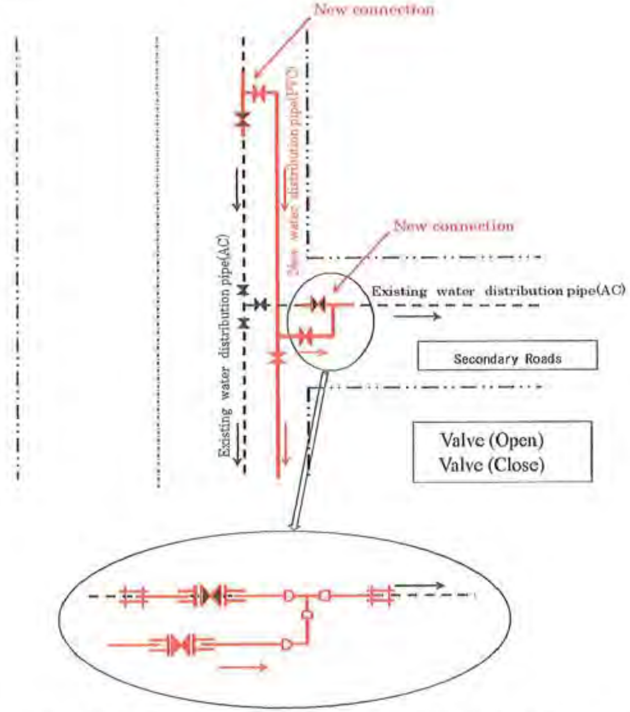


Figure 4.4.1-2 Conceptual diagram of connecting existing and new distribution pipe

(3) Lateral Connection

The water service feeders are laid from the distribution main by 2in PVC pipe. Then these branch in private property and connect to the door-to-door.

The administrative area and construction area of lateral connection in this project is shown in Table 4.4.1-2 and Figure 4.4.1-3.

Table 4.4.1-2 Responsibility range of new water feeder construction in this project

Area	House - Meter	Meter - Lot line	Lot line - Distribution main
Administration	Private	PPUC	PPUC
Construction	-	PPUC	Japan

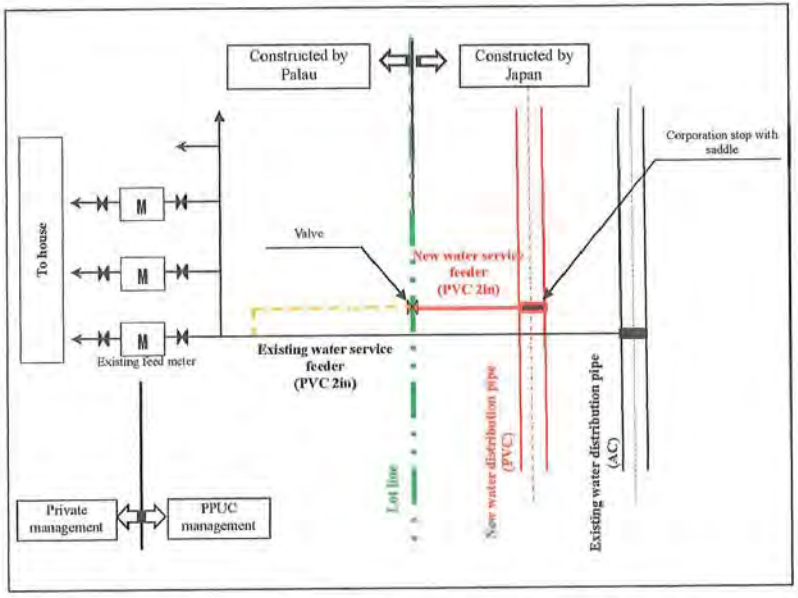


Figure 4.4.1-3 Conceptual diagram of change-over water service feeder

(4) Fire Hydrants

Specification and standard installation method of fire hydrant is shown Figure 4.4.1-4.

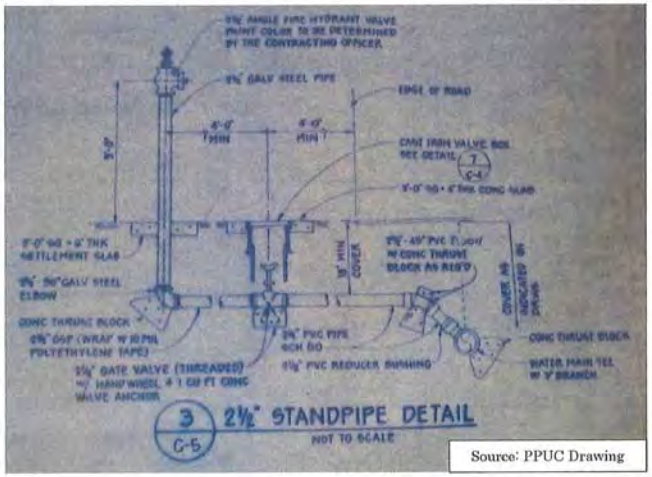


Figure 4.4.1-4 Standard drawing of Fire Hydrant

(5) Air valve

Specification and standard installation method of air valve is shown Figure 4.4.1-5.

Figure 4.4.1-5 Standard drawing of Air valve

資料-14-21

4.4.2 Polyvinyl Chloride (PVC) Pipe for Water Distribution Lines

Distribution pipe type, diameter and construction method are as follows.

- Type: PVC (AWWA C900)
- Diameter: D8 - 12in (200 - 300mm)
- Construction method: Open cut method

Figure 4.4.2-1 PVC Distribution Pipe (KAWTP)

4.4.3 Polyvinyl Chloride (PVC) Pipe for Lateral Connection Pipes

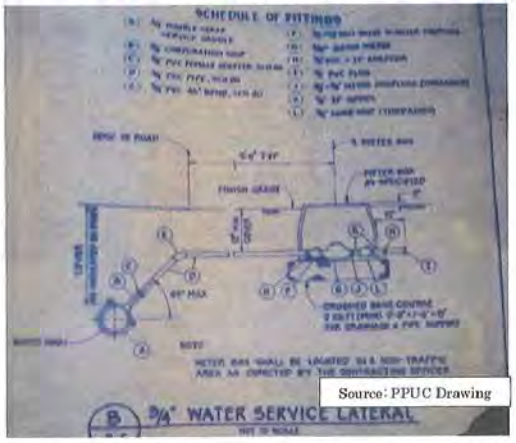
(1) Specification

Lateral connection pipe (water service feeder) type and diameter are as follow

- Type: PVC (AWWA SCH80)
- Diameter: D2in (50mm) #same as the existing lateral connection pipe

(2) Laying method

Standard installation method of air valve is shown figure 4.4.3-2.



Source: PPUC Drawing

Figure 4.4.3-1 Standard drawing of Lateral connection pipe

4.4.4 Basic Standard Section for Location and Depth of Pipeline

(1) Location

Basically, new distribution pipelines are laid opposite side of sewer pipelines in roadway, based on the discussion of PPUC. It is a policy that does not remove the existing asbestos concrete pipe upon pipe replacement.

(2) Earth covering

The minimum earth covering is 36in (900mm), based on the internal reference of PPUC.

(3) Elongation

The horizontal and vertical minimum elongation from existing / new pipes is 12in (30cm), based on the internal reference of PPUC.

(4) Construction method

Open cut method is applied to lay underground pipes, because excavation depth is comparatively shallow (generally less than 60in (1.5m)).

(5) Excavation and Re-pavement of road

Administrator of Main Road is BPW (Bureau of Public Works) and other roads (Secondary roads) are administrated by Koror state. Pavement is classified into 4 types as asphalt, reinforced concreate, plain concrete and gravel. Basically, same pavement as existing is applied to only excavated area. However, full overlay is applied to wearing of asphalt pavement

Pavement type map of pipelines installation routes is shown in Figure 4.4.4-1 and standard cross section drawings of excavation and re-pavement of each pavement type are shown in Figure 4.4.4-2.

Note: Considering installation of pipes under V-ditch (Type C) on side of road at reinforced concrete pavement section of Main Road near by PPUC WWO office.

Figure 4.4.4-2 Standard cross section drawings of excavation and re-pavement of each pavement type

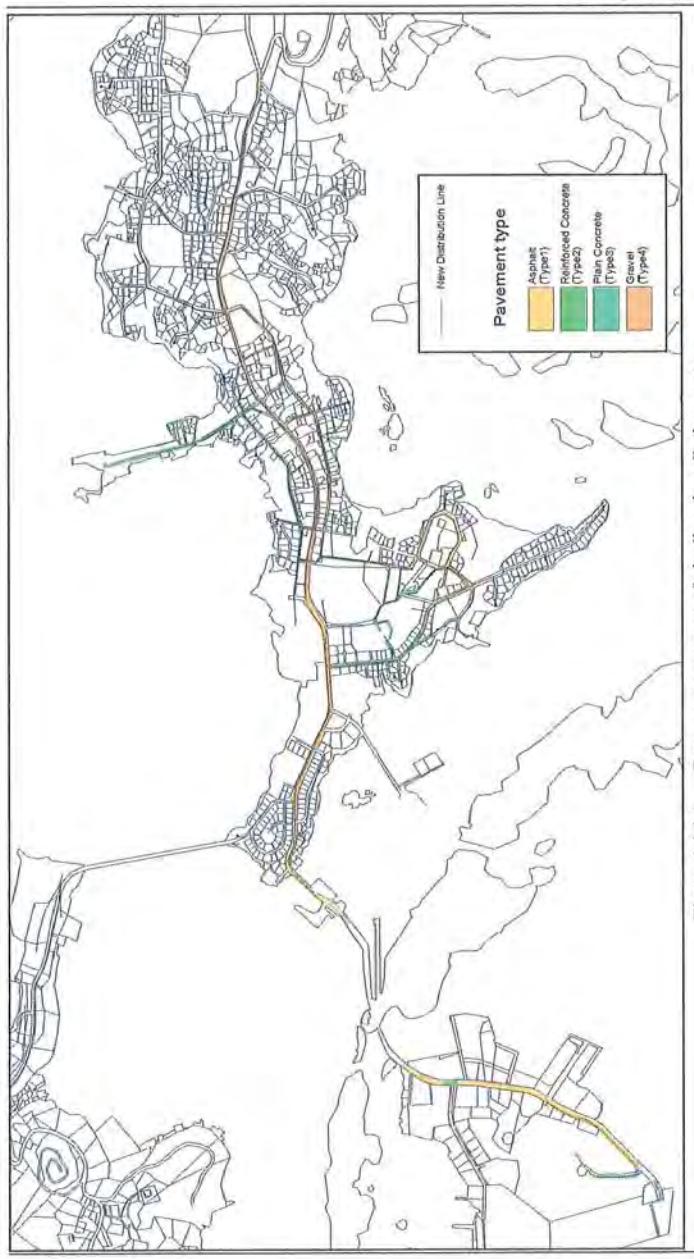


Figure 4.4.4-1 Pavement type map of pipelines installation routes

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Chapter 6 Construction Execution Plan

6.1 Preliminary Schedule for the Project

Preliminary Schedule for the Project is shown as follows:

Preliminary Schedule for the Project
WATER SUPPLY SYSTEM IMPROVEMENT PROJECT IN THE REPUBLIC OF PALAU

2014/10/17

Yachiyo Engineering Co., Ltd.
Nihon Suiko Sekkei Co., Ltd.

Chapter 5 Re-Pavement of Roads

5.1 For Water Transmission Route

Re-pavement of the road for the water transmission route between KAWTP and Ngermid is held in consideration for the damage of the edge as shown in Figure2.3.3-1.

Re-pavement of the road for the other water transmission routes such as between Ngermid and Ngerkesewaol, and between the western side of Koror and Malakal service tank, are held in described on Chapter 4.4.5.2.

5.2 For Water Distribution Routes

Re-pavement of the road for the water distribution routes are held in described on Chapter 4.4.4 (5).

Yachiyo Engineering Co., Ltd.
Nihon Suiko Sekkei Co., Ltd.

6.2 Major Undertakings by the Palauan Side and PPUC

Undertakings by the Palauan Side and PPUC, which are described in "Minites of Discussions on The Preparatory Survey for The Water Supply System Improvement Project in the Republic of Palau", dated on October 9, 2014, are summarized as follows:

- Acquisition of Temporary Yard for Material Storage, Plants, Office, etc.
- Electric power supply for new Malakal service tank.
- Electric power and water supply for the Contractor's office.
- Tax-exempt formalities and import procedure of material and equipments.
- Environmental social consideration formalities
- Construction of Access road to Malakal Service Tank.
- Gravel paved access road to Malakal Service Tank shall be constructed by the Palauan Side and PPUC. Maintenance of Gravel paved Road shall be done by the Contractor during the construction stage. Typical section of access road is recommended as follow:

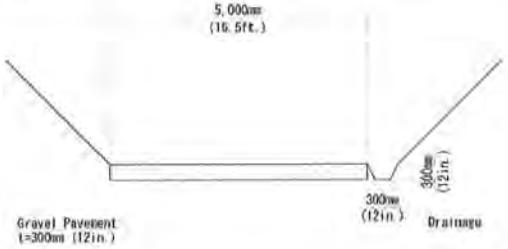

Figure 6.2-1 Typical section of access road to Malakal service tank

6.3 Tax Exemption

The taxes including Value Added Tax (VAT), customs duty, and any other taxes and levies in Palau which are to arise from the Project activities will be exempted by the Palauan side. PPUC will take any procedures necessary for the tax exemption with the Ministry of Finance of Palau on its responsibility.

6.4 Temporary Yard for Material Storage, Plants, Office, etc.

Land of temporary yard for material storage, plants and the Contractor's Office, etc. shall be prepared by PPUC.

Chapter 7 Results of Water Quality and Flow Surveys conducted in the 2nd Survey

7.1 Water Quality Directly Conducted by the JICA Survey Team

The water quality analysis was conducted with equipment owned by Team at KAWTP, Ngimel Dam, and Edeng River during the second filed survey. The items that are easily changing with time are analyzed as reference. The analyzed items are Turbidity, pH, Ammonium nitrogen, Nitrate nitrogen, and E-coli.

As a result shown in Table 7.1-1, there is no particular abnormality, and all items comply with the WHO standards. However, the value of Turbidity, which is analyzed on Oct 4, is higher than that of analyzed on Oct 4. As a reason for that, there is a rainfall on Oct 4.

Table 7.1-1 Result of Water Quality Analysis

Date and Time of Sampling	Sampling point	Turbidity (NTU)	pH	Ammonium nitrogen (ppm)	Nitrate nitrogen (ppm)	E-coli
2014/10/4 13:30	KAWTP Finished Water	1.1	6.5	0.2	< 0.2	None
2014/10/4 15:00	Ngimel Dam	14.4	6.7	0.2-0.5	0.2	Very small quantity
2014/10/4 15:30	Edeng River	2.8	7.0	0.2-0.5	< 0.2	Small quantity
2014/10/9 15:30	KAWTP Finished Water	0.8	6.8	< 0.2	< 0.2	None
2014/10/9 16:00	Ngimel Dam	7.7	7.0	0.2	< 0.2	Small quantity
2014/10/9 16:30	Edeng River	2.1	7.1	<0.2	< 0.2	Large quantity

The result of water quality on sub-contracting work is shown in Appendix2, A2-3. The 37 analysis items are examined with Standard Method for Examination of Water (2011), Japan Water Works Association (JWWA). As a result, all items comply with the WHO standards and water quality standards in Japan. There is no particular abnormality.

7.2 Water Flow Confirmation Conducted by the JICA Survey Team (Reference)

The water flow at KAWTP and at each service tank is measured by ultrasonic flow meter to grasp actual volumes of water flow. Because, the integrating flow meter at KAWTP is not calibrated, and the volume of water flow is not monitored at each service tank. Therefore, the water flow was confirmed at KAWTP and at each service tank in the second survey. However, during the measurement, the leakage accident happened under the KB bridge, and it is difficult to measure the usual water flow rate. Therefore, data in this section are only for reference purpose.

For measurement, flow meters are installed on both of pipes for the raw water and finished water at KAWTP. At each service tank, they are installed on both of transmission pipe and distribution pipe. The sample pictures of installed flow meter are shown in Figure 7.2-1. The measurement is conducted under the condition shown in Table 7.2-1and Table 7.2-2.

Installed on pipe from raw water pump at KAWTP

Installed on distribution pipe at Ngermid service tank

Figure 7.2-1 Installed flow meter on the pipes

Table 7.2-1 Condition of the measurement of water flow (1/2)

Measurement point	KAWTP		Ngermid Service Tank		Ngerkesoal Service Tank (The day of water pipe accident)	
Type of Water Flow	Raw Water	Transmitted	Transmitted	Distributed	Transmitted	Distributed
Started Date and Time	2014/10/2 14:00	2014/10/2 14:00	2014/10/9 12:00	2014/10/9 12:00	2014/10/10 15:00	2014/10/10 15:00
Ended Date and Time	2014/10/5 14:00	2014/10/5 14:00	2014/10/10 12:00	2014/10/10 12:00	2014/10/11 15:00	2014/10/11 15:00
Sampling Time (hour)	72	72	24	24	24	24
Sampling Interval (sec)	60	60	60	60	60	60
Pipe Type	DCIP	SP	DCIP	SP	SP	DCIP
Outer diameter (mm)	476.8	406.4	220	216.3	267.4	245
Thickness (mm)	8	7.9	6	5.8	6.6	6
Lining Layer (mm)	6	0	4	0	0	4
Internal diameter (mm)	448.8	390.6	200	204.7	254.2	225

Table 7.2-2 Condition of the measurement of water flow (2/2)

Measurement point	Airai Service Tank (After water pipe accident)		Arakabesang Service Tank (After water pipe accident)		Ngerkesoal Service Tank (After water pipe accident)	
Type of Water Flow	Transmitted	Distributed	Transmitted	Distributed	Transmitted	Distributed
Started Date and Time	2014/10/13 11:20	2014/10/13 11:20	2014/10/14 14:30	2014/10/14 14:30	2014/10/15 16:00	2014/10/15 16:00
Ended Date and Time	2014/10/14 11:20	2014/10/14 11:20	2014/10/15 14:30	2014/10/15 14:30	2014/10/16 16:00	2014/10/16 16:00
Sampling Time (hour)	24	24	24	24	24	24
Sampling Interval (sec)	60	60	60	60	60	60
Pipe Type	SP	DCIP	SP	DCIP	SP	DCIP
Outer diameter (mm)	216.3	220	267.4	322.8	267.4	245
Thickness (mm)	5.8	6	6.6	6.5	6.6	6
Lining Layer (mm)	0	4	0	6	0	4
Internal diameter (mm)	204.7	200	254.2	297.8	254.2	225

資料 1-4-26

KAWTP

At the time of measurement at KAWTP, the diameter of pipe from the raw water pump is oversized for flowmeter to measure accuracy. Therefore, the value of volume of raw water flow is should be as reference.

The result of measurement of water flow at KAWTP is shown in Figure 7.2-2. The volume of raw water is about 3,000 (G/min) during the day from 6:00 to 20:00, and about 2,000 (G/min) during the night from 20:00 to 6:00. It is clear that the two or three raw water pumps are switched as operation mode account of that capacity of raw water pump is 1,080 (G/min).

The volume of transmitted water for 24h measured by PPUC is 3.13 (MG/day), and the volume transmitted water for 24h measured by JICA Survey Team is 3.07 (MG/day), which is shown in Table 7.2-3. There is little difference between the measurements. Therefore, the value of volume which is measured by PPUC is not abnormal.

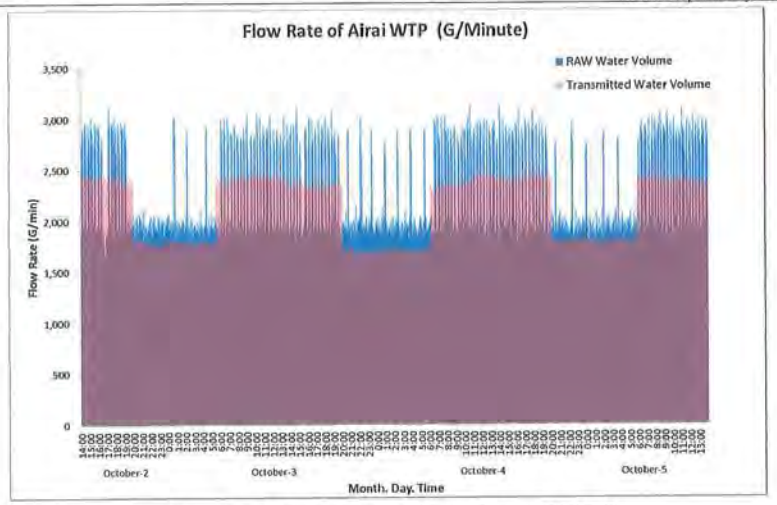

Figure 7.2-2 Time sequence of Flow Rate at KAWTP

Table 7.2-3 The details of Flow Rate at KAWTP

Type of water flow	Measurement date and time	Max Volume (G/min)	Min Volume (G/min)	Ave Volume (G/min)	Amount Volume(MG/day)
Raw Water (Measured by JICA survey team with ultrasonic flow meter)	10/2 14:00～10/3 14:00	3,106	1,395	2,100	3.01
	10/3 14:00～10/4 14:00	3,132	1,586	2,110	3.01
	10/4 14:00～10/5 14:00	3,140	1,533	2,137	3.06
	Ave	3,126	1,505	2,116	3.03
Transmitted Water (Measured by JICA survey team with ultrasonic flow meter)	10/2 14:00～10/3 14:00	2,501	1,639	2,146	3.09
	10/3 14:00～10/4 14:00	2,504	1,568	2,064	2.97
	10/4 14:00～10/5 14:00	2,511	1,594	2,136	3.08
	Ave	2,505	1,600	2,115	3.05
Transmitted Water (Measured by PPUC with integrating flow meter)	10/2 14:00～10/3 14:00	—	—	—	3.17
	10/3 14:00～10/4 14:00	—	—	—	3.05
	10/4 14:00～10/5 14:00	—	—	—	3.16
	Ave	—	—	—	3.13

Ngermid Service Tank

The result of measurement of water flow at Ngermid Service Tank is shown in Figure 7.2-3.This data is measured before the leakage accident.

The volume of transmitted water is about 550 (G/min) during the day until 16:00 on Oct 9. After 16:00, the transmitted water flow is stopped, because water volume in Ngermid Service Tank must be enough. The average volume of distributed water is 64 (G/min) during the whole day, but it is over 100 (G/min) in particular time, 18:00-19:00, 6:00-9:00, and 11:00-11:30. This means that there are three peaks in a day. The details of flow rate are shown in Table 7.2-4.

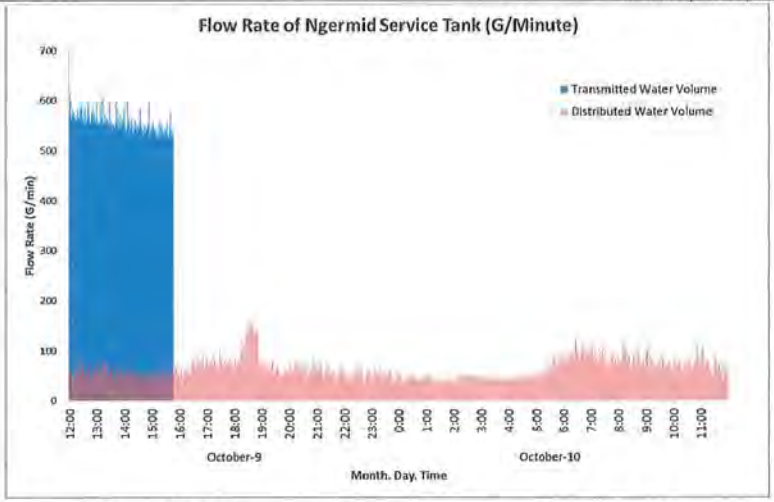

Figure 7.2-3 Time sequence of Flow Rate at Ngermid Service Tank

Table 7.2-4 The details of Flow Rate at Ngermid Service Tank

Type of water flow	Measurement date and time	Max Volume (G/min)	Min Volume (G/min)	Ave Volume (G/min)	Amount Volume (MG/day)
Transmitted Water	10/9 12:00～10/10 12:00	615	0	88	0.13
Distributed Water	10/9 12:00～10/10 12:00	164	29	64	0.09

資料-14-27

Ngerkesoal Service Tank

The result of measurement of water flow at Ngerkesoal Service Tank is shown in Figure 7.2-4. During this measurement, the leakage accident happened at KB Bridge. From amount volume shown in Table 7.2-5, it is clear that the amount volume of distributed water is higher than that of transmitted water. Although the distribution of water is cut off, the balance is lost.

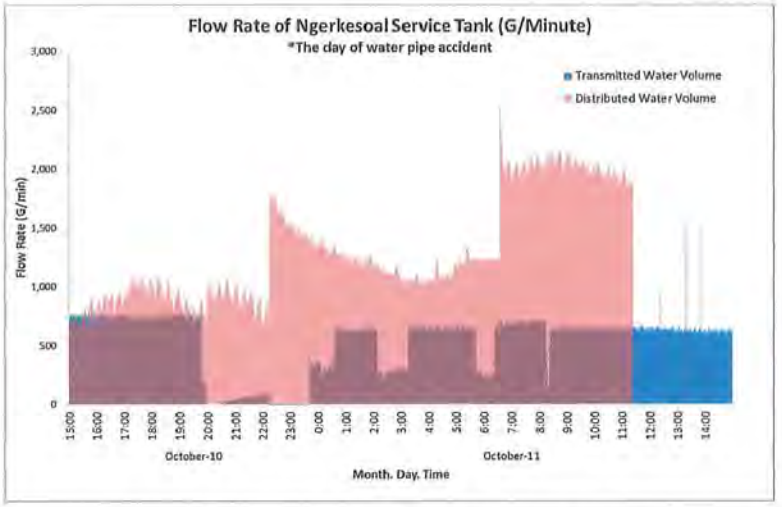

Figure 7.2-4 Time sequence of Flow Rate at Ngerkesoal Service Tank

Table 7.2-5 The details of Flow Rate at Ngerkesoal Service Tank

Type of water flow	Measurement date and time	Max Volume (G/min)	Min Volume (G/min)	Ave Volume (G/min)	Amount Volume (MG/day)
Transmitted Water	10/10 15:00～10/11 15:00	806	0	526	0.76
Distributed Water	10/10 15:00～10/11 15:00	2,586	0	1,105	1.59

Airai Service Tank

The result of measurement of water flow at Airai Service Tank after water pipe accident is shown in Figure 7.2-5. From the Figure 7.2-5, the water outage period is estimated from 15:00 to 5:00. At 5:00, the valve for distributed water is opened, and the volume of distributed water increase sharply. It is clear that the water inside distribution pipes is lost during the water outage. Then, from amount volume shown in Table 7.2-6, the amount volume of distributed water is higher than that of transmitted water. It is clear that the balance is lost although the distribution of water is cut off.

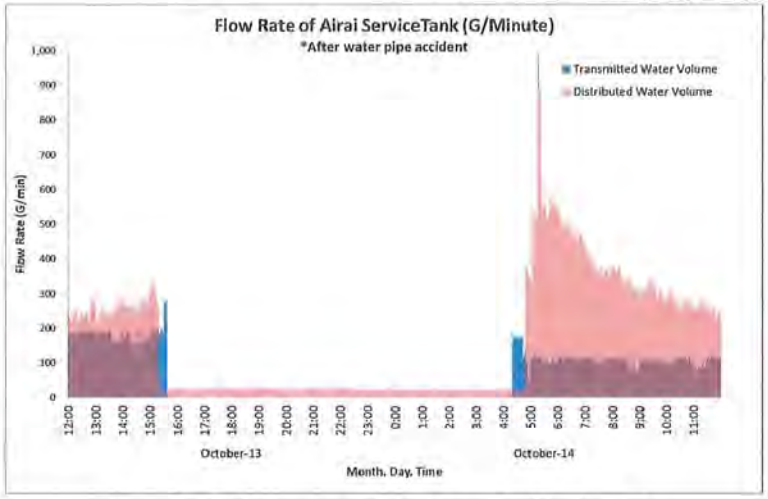

Figure 7.2-5 Time sequence of Flow Rate at Airai Service Tank

Table 7.2-6 The details of Flow Rate at Airai Service Tank

Type of water flow	Measurement date and time	Max Volume (G/min)	Min Volume (G/min)	Ave Volume (G/min)	Amount Volume (MG/day)
Transmitted Water	10/13 12:00～10/14 12:00	280	0	63	0.09
Distributed Water	10/13 12:00～10/14 12:00	998	0	160	0.23

資料-14-28

Arakabesang Service Tank

The result of measurement of water flow at Arakabesang Service Tank after water pipe accident is shown in Figure 7.2-6. From the Figure 7.2-6, the water outage period is estimated from 15:45 to 5:45 and from 13:00 to 14:30. At 5:45, the valve for distributed water is opened, and the volume of distributed water increase sharply. It is clear that the water inside distribution pipes is lost during the water outage. From the Table 7.2-7, it is clear that the amount volume of transmitted water is higher than that of distributed water. Therefore, the balance is being kept after water pipe accident.

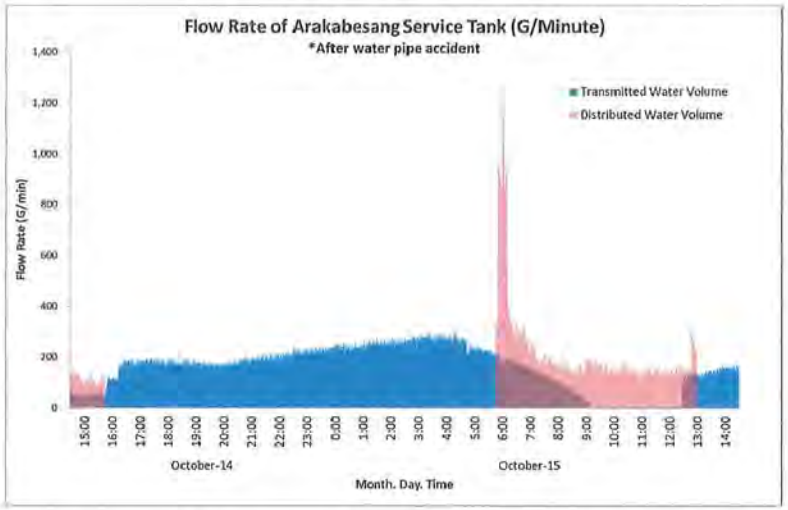

Figure 7.2-6 Time sequence of Flow Rate at Arakabesang Service Tank

Table 7.2-7 The details of Flow Rate at Arakabesang Service Tank

Type of water flow	Measurement date and time	Max Volume (G/min)	Min Volume (G/min)	Ave Volume (G/min)	Amount Volume (MG/day)
Transmitted Water	10/14 14:30～10/15 14:30	307	0	158	0.23
Distributed Water	10/14 14:30～10/15 14:30	1,275	0	70	0.10

Ngerksoal Service Tank

The result of measurement of water flow at Ngerkesoal Service Tank after water pipe accident is shown in Figure 7.2-7. From amount volume shown in Table 7.2-6, the amount volume of distributed water is higher than that of transmitted water. It is clear that the balance is lost although the distribution of water is cut off.

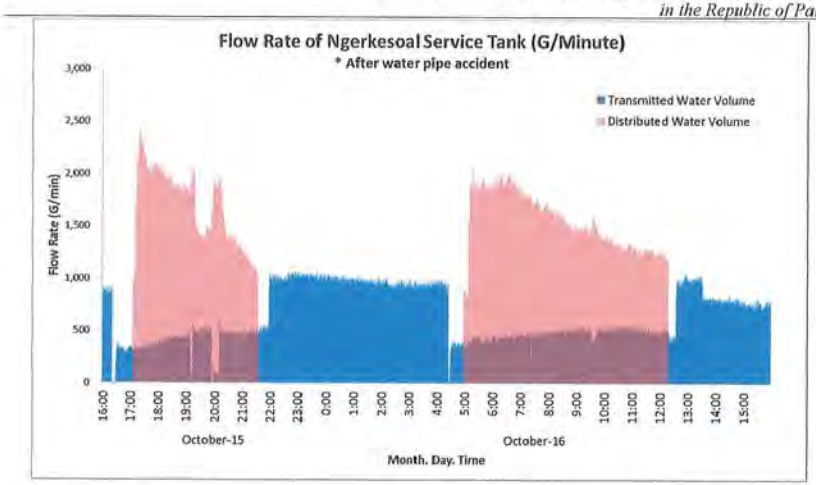

Figure 7.2-7 Time sequence of Flow Rate at Ngerkesoal Service Tank

Table 7.2-8 The details of Flow Rate at Ngerkesoal Service Tank

Type of water flow	Measurement date and time	Max Volume (G/min)	Min Volume (G/min)	Ave Volume (G/min)	Amount Volume (MG/day)
Transmitted Water	10/15 16:00～10/16 16:00	1,070	0	650	0.94
Distributed Water	10/15 16:00～10/16 16:00	2,436	0	791	1.14

資料-14-29

資料-15

環境チェックリスト

Environmental Checklist: 14. Water Supply（2）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(4) Noise and Vibration	(a) Do noise and vibrations generated from the facilities, such as pumping stations comply with the country's standards?	(a) -	(a) The project will not install any devices which generate noise, such as pump. There are no country's standards on noise, regulating water facilities such as pumping station. During construction stage, some noises and vibrations are anticipated due to construction machinery. Since no standard is available for noise / vibration, the project monitors noises and vibrations according to Noise / Vibration Regulation Laws of Japan.
	(5) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	(a) N	(a) There is no plan to extract the groundwater.
3. Natural Environment	(1) Protected Areas	(a) Is the project site or discharge area located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) There is no possibility that the project affects the protected areas. Water service tank is planned in a far location from the protected areas. Water pipelines are planned to be installed under the existing roads. There is no construction work in conservation area for nature.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site or discharge area encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	(a) N (b) N (c) N (d) N	(a) Planed sites for the project facilities do not include the conserved / protected area for ecology. (b) Planed sites for the project facilities do not include the conserved / protected area for habitudes and endangered species. (c) No significant and ecological impact is anticipated. (d) The volume of in-taken water will not be increased according to the project. No adverse impact is anticipated on the surface and groundwater.
	(3) Hydrology	(a) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect surface water and groundwater flows?	(a) N	(a) The volume of in-taken water will not increase according to the project. No adverse impact is anticipated in hydrology of the surface and groundwater.
4. Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, and people below the poverty line, ethnic minorities, and indigenous peoples?	(a) N (b) N (c) N (d) N (e) N (f) N (g) N (h) N (i) N (j) N	(a), (b), (c), (d), (e), (f), (g), (h), (i) and (j) Any involuntary resettlement is not included in this project. The planned land for Malakal service tank belongs to Koror State. PPUC has discussed the approval of the land utilization with Koror State. However, there are families using the land for vegetables farms. The Koror State will undertake amicable removals of the farms.

Environmental Checklist: 14. Water Supply（1）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1. Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) N (b) N (c) N (d) N	(a) IEE report has been prepared and submitted to EQPB in October 2014. The IEE report is approved by EQPB. PPUC is, however, requested by EQPB to submit the Permit Application (PA) for official approval. PA is under preparation by PPUC. According to EQPB, EIA report will not be necessary for the project. Final permit approval for construction will be based on the review of the PA and detailed design. (b), (c), and (d) As described in the above (a).
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) Y (b) Y	(a) PPUC had explanation meetings in September - December 2014 with the state Governments of Koror and Airai, Bureau of Public Works (BPW) and Capital Improvement Program (CIP) for the contents of project and mitigation measures of negative impacts such as re-pavement of road and alternative plan for Malakal service tank as well as land acquisition. (b) It was agreed that roads paved with asphalt concrete should be restored fully for the pavement surface in case for replacement of water distribution pipeline.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) The alternative plans for pipeline routes and Malakal service tank were examined during the outline design stage.
2. Pollution Control	(1) Air Quality	(a) Is there a possibility that chlorine from chlorine storage facilities and chlorine injection facilities will cause air pollution? Are any mitigating measures taken? (b) Do chlorine concentrations within the working environments comply with the country's occupational health and safety standards?	(a) - (b) -	(a), (b) Not applicable. The project has no component related to chlorine injection and storage. No choline leakage is anticipated for the project during and after construction works.
	(2) Water Quality	(a) Do pollutants, such as SS, BOD, COD contained in effluents discharged by the facility operations comply with the country's effluent standards?	(a) N	(a) Since the Project is not for sewage management, no effluent standard is applicable. No pollutant is generated by the facilities to be constructed. During construction stage, SS may be high in rainy days for drained rainwaters from excavated sections. No standard is available for such drained rainwater for water quality. The project, therefore, monitors SS during construction works according to Water Pollution Control Law of Japan.
	(3) Wastes	(a) Are wastes, such as sludge generated by the facility operations properly treated and disposed in accordance with the country's regulations?	(a) Y	(a) No waste such as sludge is generated from the facilities to be constructed in the project. Water treatment plant generates the sludge in treatment processes. The generated sludge is properly managed and disposed. During construction stage, the Contractor transports the construction waste to M-Dock landfill Ssite. The waste will be disposed properly at the landfill site.

Environmental Checklist: 14. Water Supply（4）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? (d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(c) Y (d) Y	working hours schedule will be managed / undertaken by the Contractor. (b) and (c) No adverse impact is anticipated. (d) During construction along roads, the Contractor will provide mitigation measures such as traffic guides, sign board and detours.
5 Others	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Y (b) Y (c) Y (d) N	(a) and (b) PPUC prepared monitoring program and forms during outline design stage. PPUC will manage data and monitor the environmental conditions during and after construction. Items and frequencies for monitoring are shown in the monitoring forms. (c) PPUC will establish a monitoring team along with the project implementation. Basically, current organization and budget for O&M of water pipelines are utilized. (d) No special requirement is given by regulatory organization for the monitoring.
6. Note	(1) Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Dam and River Projects checklist should also be checked.	(a) N	(a) Not applicable.
	(2) Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) N	(a) The project will not have adverse impacts for global issues such as transboundary waste treatment, acid rain, destruction of the ozone layer.

Environmental Checklist: 14. Water Supply（3）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?		
4. Social Environment	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect the existing water uses and water area uses?	(a) N (b) N	(a) The project will contribute to improve the living conditions. No adverse impact is anticipated. (b) Surface water is utilized for the water supply. The volume of water will not be increased by the project for water supply. No adverse impact is anticipated.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) No heritage site is included in lands for facilities of the project.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) Main components for the project are pipelines under roads. No adverse impact on landscape is anticipated for the pipelines. Malakal service tank will be constructed at top of the hill. Since it will be small and constructed at an adjacent land of the existing tank, little adverse impact is anticipated for landscape.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous people? (b) Are all of the rights of ethnic minorities and indigenous people in relation to land and resources respected?	(a) N (b) N	(a) and (b) Ethnic minorities and indigenous peoples are not involved in the project site.
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) N (b) Y (c) Y (d) Y	(a) All project activities will be implemented in accordance with laws of Palau and ordinances associated with the working conditions. (b) Sufficient protection measures are considered in the design of water pipelines such as sheet piles against landslide during excavation works. (c) Periodical meetings / trainings for construction methods and safety plans will be conducted among PPUC, the Consultant and the Contractor. (d) Since working sites will be along the existing roads, security guards will be deployed by the Contractor. For working place on asbestos pipes, Malakal service tank and stores / depots, other security guards will be deployed to prevent third parties' entry into the sites. When working on asbestos pipes, the Contractor will keep the pipes wet and enclose the site by dustproof-sheets, not to scatter the pollutants.
5. Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases,	(a) Y (b) Y	(a) Mitigation measures such as fence around working site, utilization of low noise / vibration equipment, appropriate

資料-16

モニタリングフォーム（案）

1) **Monitoring Form (Construction Phase)**

I. Institutional Requirements and Environmental Monitoring Plan

A. MONITORING FORM (Construction Phase)

-If environmental reviews indicate the need of monitoring by JICA, JICA undertakes monitoring for necessary items that are decided by environmental reviews. JICA undertakes monitoring based on regular reports including measured data submitted by the project proponent; PPUC. When necessary, PPUC should refer to the following monitoring form for submitting reports.

-When monitoring plans including monitoring items, frequencies and methods are decided, project phase or project life cycle (such as construction phase and operation phase) should be considered.

1. Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	**Monitoring Results during Report Period**
Responses / Actions to Comments and Guidance from Government Authorities	

2. Mitigation Measures

- Air Quality（Emission Gas / Ambient Air Quality）

Item	**Unit**	**Measured Value (Mean)**	**Measured Value (Max.)**	**Country's Standards**	**Referred International Standards**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Dust	-	-	-	Visual check	-	Visual check at project sites and its surrounding area, once per week.
Complaints of residents and stakeholders	-	-	-	Acceptance of complaints	-	Visual check per acceptance of complaints.

- Water Quality (Effluent/Wastewater/Ambient Water Quality)

Item	**Unit**	**Measured Value (Mean)**	**Measured Value (Max.)**	**Country's Standards**	**Referred International Standards**	**Remarks (Measurement Point, Frequency, Method, etc.)**
SS: Suspended Solid for Turbid Water	mg/L	150mg/L	200mg/L	-	Mean: 150mg/L Max.: 200mg/L by Water Pollution Control Law, Japan	Measurement of SS by mobile meter at excavation sites and drain channels near the sites, once per week and on rainy days.

- Noise / Vibration

Item	**Unit**	**Measured Value (Mean)**	**Measured Value (Max.)**	**Country's Standards**	**Referred International Standards**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Noise / Vibration level	db	-	85db for noise 75db for vibration	-	85db for noise by Noise Regulation Law, Japan 75db for vibration by Vibration Regulation Law, Japan	Measurement of noise / vibration by mobile meter at project sites and its surrounding area, once per week.
Complaints of residents and stakeholders	-	-	-	Acceptance of complaints	-	Visual check per acceptance of complaints.

3. Social Environment

- Existing Infrastructure and Social Services

Monitoring Item	**Monitoring Results during Report Period**
Situation and complaints on traffic jams and temporary traffic control measures	
Duration and complaints of the residents and stakeholders for water suspension	

- Occupational Health, Safety, Labor Environment and Accident

Monitoring Item	**Monitoring Results during Report Period**
Arrangement of safety precaution	
Contents and frequency of safety meeting and training programs	

2) Monitoring Form (After Delivery, Operation Phase)

B. MONITORING FORM (Operation Phase)

-If environmental reviews indicate the need of monitoring by JICA, JICA undertakes monitoring for necessary items that are decided by environmental reviews. JICA undertakes monitoring based on regular reports including measured data submitted by the project proponent; PPUC. When necessary, PPUC should refer to the following monitoring form for submitting reports.

-When monitoring plans including monitoring items, frequencies and methods are decided, project phase or project life cycle (such as construction phase and operation phase) should be considered.

1. Social Environment

- Existing Infrastructure and Social Services

Monitoring Item	**Monitoring Results during Report Period**	**Remarks (Period & Frequency)**
Water pressures at residential houses: 20psi (0.14MPa) or more		Once per month