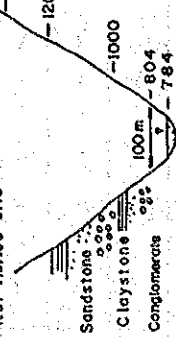


G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-6-23	Scheme	TANUDAN		Province	MT. PROVINCE	River Basin	TANUDAN	Stream	TANUDAN	
Coordinates	17°10'15" N. LAT	121°12'38" E. LONG		Type of Development	RUN OF RIVER		/Weir Type	CONCRETE	River bed	El.	784 m	Width	50 m
Topo. Map No.	3271-IV	SCALE	1:50,000	Length of Water Way	8710 m	Reservoir Area			Crest	El.	787 m	Max. Height	6 m

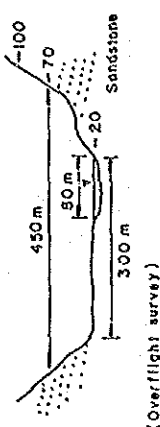
Geologic formation and Age of the Site	Alova Formation/Lubagan Formation (Early - Middle Miocene) Sandstone and Claystone with Conglomerate		Geologic Structure		No major fault near powerhouse site		CONSPICUOUS MATERIALS		Location		1 Km. north of weir		
	This formation located at east side of elevated zone, therefore structure is homocline and dip towards to east gently		Rock Type & Age		Sandstone and Claystone with Conglomerate (Early - Middle Miocene)		Rock Coarse Aggregates		Rock Type & Age		Sandstone, Conglomerate (Early - Middle Miocene)		
Geologic Structure	Both Abutments to rather hard and compacted partially slightly to moderately weathered and jointed		Rock Quality		Probably hard to rather hard and compacted, slightly to moderately weathered		Sand		Quality & Volume		Rather hard		
	This formation located at east side of elevated zone, therefore structure is homocline and dip towards to east gently		Overburden		Residual soil, Terrace deposits and weathered rock		Material		Location		1-2 Km. downstream from powerhouse site		
Rock Type and Age of Bed-rock	Sandstone and Claystone with Conglomerate (Early - Middle Miocene)		Geologic Structure		No major fault in the waterway site		Earth Material		Quality & Volume		River deposits (sand, gravel and cobble)		
	Both Abutments to rather hard and compacted partially slightly to moderately weathered and jointed		Rock Quality		Probably hard to rather hard and compacted partially weathered and slightly fractured				Location				
Rock Quality	Probably hard to rather hard and compacted partially slightly to moderately weathered and jointed		Overburden		Enough thickness for tunnel excavation		Topographic Condition		Soil Type		V - Sh o p e d		
	Overall		Geologic Structure		Probably watertight except jointed weathered zone		Probably hard to rather hard and compacted partially weathered and slightly fractured		Quality & Volume		Not visited site		
Permeability	Probably watertight except jointed weathered zone		Lithology & Age		Sandstone and Claystone with Conglomerate (Early - Middle Miocene)		Geologic Sketch		Topographic Condition		V - Sh o p e d		
	Both Abutments		Permeability and Ground-water		Probably watertight		Probably watertight		Quality & Volume		Not visited site		
Overburden	Thin residual soil and slightly to moderately weathered zone		Slope Stability		Stable		Power House		Soil Type		Good		
	River bed fitted with gravel cobble and boulder		Sedimentation		Less		Reservoir		Quality & Volume		Excellent		
Overall		Geologic Structure		Probably watertight except jointed weathered zone		Probably watertight		Dam Construction		Quality & Volume		Good / Acceptable	



GEOLOGICAL DATA SHEET

Region No.	"	I.D. No.	2-8-17-24	Scheme	BANTAY	Province	CAGAYAN	River Basin	PARET	Stream	PARET
Coordi- nates	17°55'00" N. LAT	121°49'00" E. LONG	Type of Development	DAM & RESERVOIR	Dam/ Reservoir Area	EARTH FILL	River Cross Section at Dam/ Weir	River- Bed	River- Crest	20 m Width	80 m
Topo. Map No. 1:50,000	No. 3373-1	Geo. Map SCALE	Length of Water Way	m	121.6 km					70 m Height	50 m

Geologic Formation and Age of the Site	Cebogan Formation (Miocene - Pliocene) Sandstone Quaternary Alluvium		Geologic Structure	No major faults near Powerhouse site		CONSTRUCTION MATERIALS	Rock & Coarse Aggre- gates		Location		Remote from damsite		
	Strike : NE trend Dip : gently			Sandstone (Miocene - Pliocene)			Rock Type & Age		Quality & Volume		Rock Type & Age		Quality & Volume
Rock Type and Age of Bed- rock	Sandstone (Miocene - Pliocene)		Geologic Structure	Soft to rather hard (at the right bank site)		PROFILE OF DAM AXIS	Earth Material		Location		Dish Shaped		
	Both Abutments			Alluvial deposits			Rock Quality		Topographic Condition		Soil Type		Residual soil of Sandstone
Rock Quality	Soft to rather hard and deeply weathered at shallow part		Geologic Structure	The alluvial deposits underlie most of reservoir area		GENERAL ASSESSMENT	Sand		Location		3 Km. ENE from damsite		
	Probably high permeability at shallow part			Sandstone (Miocene - Pliocene) Quaternary Alluvium			Overburden		Geologic Sketch		Quality & Volume		Probably suitable
Perme- ability	Thick residual soil		Lithology & Age	Probably water tight		Damsite		Damite		Acceptable		Acceptable	
	Both Abutments			Stable		Waterway/Power Tunnel		Waterway/Power Tunnel		Topographic Condition		Not visited site	
Over- burden	Sandy river deposits		Permeability and Ground- water	Probably water tight		Power House		Power House		Good/Acceptable		Good/Acceptable	
	Probably vary thick			Sediment- ation		Common		Reservoir		Reservoir		Good	
DAM MARKS		DAM MARKS		DAM MARKS		DAM MARKS		DAM MARKS		DAM MARKS		DAM MARKS	



G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-8-25	Scheme	D A B B A		Province	C A G A Y A N	River Basin	PIN de TUGUEGARAO	Stream	PINACANAUAN de TUGUEGARAO
Coordi- nates	N. LAT 17°42'05"	E. LONG 121°05'05"	DAM & RESERVOIR	DAM & RESERVOIR	DAM & RESERVOIR	DAM & RESERVOIR	DAM & RESERVOIR	DAM & RESERVOIR	River Cross Section at Dam/Spillway	River bed El.	38 m	Width 60 m
Topo. Map No. 1:50,000	No. 3373-II	Geo. Map SCALE	1:600,000	Length of Water Way	m	Reservoir Area	km ²	Height	74 m			

Geologic formation and Age of the Site	Callea Formation (Late Miocene) Limestone Lubuogan Formation (Early Miocene) wecke, microbreccia, SS Coraballo Group (Cretaceous - Pleogene) Andesite and Diatite		Well bedded limestone, Bedding N-S/E Many fractured joints		Limestone (Late Miocene)		Hard, rich joint, partially fractured (at left bank site)		Residual soil Riverbed deposits		Geologic Structure		Geologic Structure		Lithology & Age		Permeability and Groundwater		Slope Stability		Sedimentation		
	Geologic Structure	Massive and dense to rich cave and jointed. Strike: NS trend Dip: west well bedding	Geologic Structure	Overburden	Geologic Structure	Rock Type & Age	Rock Quality	Overburden	Geologic Structure	Rock Type & Age	Rock Quality	Overburden	Geologic Structure	Lithology & Age	Permeability and Groundwater	Slope Stability	Sedimentation	Right Abutment	Thin residual soil	Left Abutment	Thick residual soil	River Bottom	The riverbed is filled with sand and gravel
Rock Type and Age of Bedrock	Limestone (Late Miocene)	Geologic Structure	Overburden	Geologic Structure	Rock Type & Age	Rock Quality	Overburden	Geologic Structure	Rock Type & Age	Rock Quality	Overburden	Geologic Structure	Lithology & Age	Permeability and Groundwater	Slope Stability	Sedimentation	Right Abutment	Thin residual soil	Left Abutment	Thick residual soil	River Bottom	The riverbed is filled with sand and gravel	
Rock Quality	Both Abutment	Hard to rather hard, partially slightly weathered and rich joint and cracks	Geologic Structure	Overburden	Geologic Structure	Rock Type & Age	Rock Quality	Overburden	Geologic Structure	Rock Type & Age	Rock Quality	Overburden	Geologic Structure	Lithology & Age	Permeability and Groundwater	Slope Stability	Sedimentation	Right Abutment	Thin residual soil	Left Abutment	Thick residual soil	River Bottom	The riverbed is filled with sand and gravel
Permeability	Overfall	Very high, due to limestone cave and joint	Geologic Structure	Overburden	Geologic Structure	Rock Type & Age	Rock Quality	Overburden	Geologic Structure	Rock Type & Age	Rock Quality	Overburden	Geologic Structure	Lithology & Age	Permeability and Groundwater	Slope Stability	Sedimentation	Right Abutment	Thin residual soil	Left Abutment	Thick residual soil	River Bottom	The riverbed is filled with sand and gravel
Overburden	Right Abutment	Thin residual soil	Geologic Structure	Overburden	Geologic Structure	Rock Type & Age	Rock Quality	Overburden	Geologic Structure	Rock Type & Age	Rock Quality	Overburden	Geologic Structure	Lithology & Age	Permeability and Groundwater	Slope Stability	Sedimentation	Right Abutment	Thin residual soil	Left Abutment	Thick residual soil	River Bottom	The riverbed is filled with sand and gravel
Construction Materials	CONSTRUCTION MATERIALS																						
Topographic Condition	U-shaped, Karst																						
Geologic Sketch																							
Dam Site	Poor																						
Waterway/Power Tunnel	Good																						
Power House	Acceptable																						
Reservoir	Good																						
Dam Construction Material	Good																						

G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-8-27	Scheme	TUGUEGARAO	Province	CAGAYAN	River Basin	PIN. de TUGUEGARAO	Stream	PINACUAN de TUGUEGARAO
Coordi- nates	17°36'59" N. LAT	122°03'23" E. LONG	Type of Dam/Weir	Run of River			River Cross Section at Weir	River bed El.	301m	Width	40m
Topo. Map No. 1:50,000	No. 3472-IV	Geo. Map No. 1:600,000 SCALE	Length of Water Way	3630 M.	Reservoir Area			Creast El.	305m	Max. Height	7m

Geologic formation and Age of the Site	Geologic Structure		CONSTRUCTION MATERIALS		PROFILES OF DAM AXIS		GENERAL ASSESSMENT	
	Geologic Structure	Rock Type and Age of Bed-rock	Geologic Structure	Rock Type and Age	Topographic Condition	Geologic Sketch	Dam Site	Dam Construction Material
Metavolcanics - Metasediments (Cretaceous - Paleogene)	Several geologic lineament occur near powerhouse	Metavolcanics (Cretaceous - Paleogene)	Metavolcanics (Cretaceous - Paleogene)	Metavolcanics (Cretaceous - Paleogene)	Not visited site		Excellent	Excellent
	No major fault occur, but several geologic lineament occur around the damsite	Probably hard to very hard slightly weathered	Thin residual soil	Probably hard to very hard slightly weathered	Elm		Good	Good
Metavolcanics - Metasediments (Cretaceous - Paleogene)	Probably hard to very hard slightly weathered	Thin residual soil	No major fault occur along the waterway	Metavolcanics (Cretaceous - Paleogene)			Waterway/Power Tunnel	Good
	Probably hard to very hard slightly weathered	Thin residual soil	Enough thickness for tunnel excavation	Metavolcanics (Cretaceous - Paleogene)			Power House	Good
Both Abutments Probably hard to very hard slightly weathered	Probably hard to very hard slightly weathered	Thin residual soil	Several geologic lineament occur along the river	Metavolcanics (Cretaceous - Paleogene)			Reservoir	Excellent
	Probably hard to very hard slightly weathered	Thin residual soil	Several geologic lineament occur along the river	Metavolcanics (Cretaceous - Paleogene)			Dam Construction Material	Excellent
Permeability	Probably waterlight except shallow part	Thin residual soil	Probably waterlight	Metavolcanics (Cretaceous - Paleogene)				
	Probably waterlight except shallow part	Thin residual soil	Probably waterlight	Metavolcanics (Cretaceous - Paleogene)				
Overburden	Thin residual soil	Thin residual soil	Stable	Stable				
	Filled with Cobble and Boulder	Filled with Cobble and Boulder	Less	Less				

G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-9-28	Scheme	SAN PABLO		Province	ISABELA		River Basin	PINACANAUAN		Stream	PINACANAUAN	
Coordi- nates	17°28'30" N. LAT	121°55'00" E. LONG	Type of Development		DAM & RESERVOIR		Dam/Weir Type			River- bed	El.		98 m	Width	40 m
Topo. Map No. 3372-II 1:50,000	Geo. Map SCALE		Length of Water Way		M		Reservoir Area	km ²		Section at Dam/ Weir	El.		260 m	Height	162 m

Geologic formation and Age of the Site	UV (Cretaceous-Paleogene) Metamorphosed spilites, basalt and andesite Pg (Paleocene-Eocene) Wacks, shale and sandstone Lupangan Formation (Early-Middle Miocene) Sandstone and shale Callao Formation (Late Miocene) Limestone	M P O R . K M P O A	Assumed fault (NW-SE) occur 0.5 Km. west of powerhouse	Geologic Structure	CONSTRUCTION MATERIALS		Rock & Coarse Aggregate Gates	Location	4 Km. east from damsite
	Wacks, shale and sandstone (Paleocene-Eocene)		Wacks, shale and sandstone (Paleocene-Eocene)		Rock Type & Age	Rock Type & Age			
Geologic Structure	Lubagan Formation unconformably overlies Pg Formation. Assumed fault (NW-SE trend) occur of left bank site of damsite		Rather hard (at left bank site)	Rock Quality		Sand Material	Location	4 Km. downstream of damsite	
Rock Type and Age of Bed- rock	Wacks, shale and sandstone (Paleocene-Eocene)		Residual soil, terrace deposits	Overburden		Earth Material	Quality & Volume	River and Terrace deposits	
Rock Quality	Right Abutment Probably, hard indurated and compacted slightly weathered			Geologic Structure			Location	4 Km. east from damsite	
Perme- ability	Left Abutment Probably, hard to rather hard but soft in the upper weathered zone			Rock Type & Age			Soil Type	Residual soil of Metamorphosed volcanics	
	Overall Probably waterlight, except shallow weathered zone			Rock Quality			Quality & Volume	Probably suitable	
Over- burden			No major fault occur in the reservoir	Overburden		Topographic Condition		Open U-Shaped	
			Wacks, shale and sandstone (Pliocene-Eocene) Metamorphosed spilites, basalt and andesite (Cretaceous-Paleogene)	Geologic Structure		Geologic Sketch	Near visited site		
		Probably waterlight, except deep weathered fault zone	Lithology & Age	Permeabi- lity and Ground- water	Damite				6000 / Acceptable
			Stable, except some rock falls and thick overburden	Slope Stability		Waterway/Power Tunnel		Good	
			Common	Sediment- ation		Reservoir		Good	
						Dam Construction Material		Excellent	

G E O L O G I C A L D A T A S K E E T

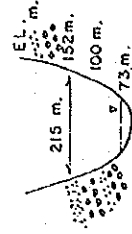
Region No.	ISABELA	TAMAUNI - I	Province	ISABELA	River Basin	TAMAUNI	Stream	PINACANAUAN DE TAMAUNI
Coordinates	17°18'25" N. LAT	DAM B RESERVOIR	Dam/Weir Type		River Cross Section at Dam	River-bed EL.	128 m	Width 10 m
Topo. Map No. 1:50,000	3371-1	Geo. Map SCALE	Reservoir Area		Dam Crest EL.	263 m	Height	135 m
I.D. No.	2-8-11-29	Scheme						
Type of Development								
Length of Water Way								

Geologic formation and Age of the Site	Kpg (Cretaceous - Paleogene) Undifferentiated graywacke and meta-morphosed shale with siltite UV (Cretaceous - Paleogene) Metamorphosed siltites, basalt and andesite Pg (Paleogene - Eocene) Wackes, shales and pyroclastics N1 (Early - Middle Miocene) Conglomerate, wackes and shale		No major fault		Geologic Structure		No major fault		Rock & Coarse Aggregates		Location		1 Km south of damsite	
	N1 formation unconformably overlies Pg		Wackes and Shale (Paleogene - Eocene)		Rock Type & Age		Wackes and Shale (Paleogene - Eocene)		Rock Type & Volume		Quality & Volume		Hard	
Geologic Structure	No major fault occur on damsite		Residual soil and some debris		Overburden		Residual soil and some debris		Sand Material		Location		4 Km downstream of damsite	
Rock Type and Age of Bed-rock	Wackes and Shale (Paleogene - Eocene)				Geologic Structure				Earth Material		Location		3 Km. east of damsite	
Rock Quality	Probably hard to very hard and deeply weathered along the gully				Rock Type & Age				Topographic Condition		Quality & Volume		Probably suitable	
Permeability	Probably watertight, except deeply weathered faults zone		Assumed faults (NW-SE trend) across the Pliocene river		Rock Quality				Geologic Sketch		Topographic Condition		V-Shaped	
Overall	Probably watertight, except deeply weathered faults zone		Wackes and shales (Paleogene - Eocene) Conglomerate and shale (Early - Middle Miocene) Metamorphosed volcanic (Cretaceous - Paleogene)		Overburden				Dam Site		Geologic Sketch		Not visited site (Overflight survey)	
Abutments	Probably hard to very hard and deeply weathered along the gully		Probably watertight, except deeply weathered faults zone		Geologic Structure		Assumed faults (NW-SE trend) across the Pliocene river		Waterway/Power Tunnel		Geologic Sketch		502 m	
River Bottom	Residual soil (medium thickness)		Probably watertight, except deeply weathered faults zone		Lithology & Age		Wackes and shales (Paleogene - Eocene) Conglomerate and shale (Early - Middle Miocene) Metamorphosed volcanic (Cretaceous - Paleogene)		Power House		Geologic Sketch		263	
Overburden	Residual soil (medium thickness)		Probably watertight, except deeply weathered faults zone		Permeability and Groundwater		Probably watertight, except deeply weathered faults zone		Reservoir		Geologic Sketch		200	
	Residual soil (medium thickness)		Probably watertight, except deeply weathered faults zone		Slope Stability		Stable		Dam Construction Material		Geologic Sketch		128	
	Residual soil (medium thickness)		Probably watertight, except deeply weathered faults zone		Sedimentation		Less to common				Geologic Sketch		600 d	

GEOLOGICAL DATA SHEET

Region No.	II	I.D. No.	2-8-12-32	Scheme	T A B U K		MT. PROVINCE	River Basin	M A L I G	Stream	M A L I G
Coordi- nate	17°16'40" N. LAT	121°31'00" E. LONG	Type of Development	DAM & RESERVOIR	Province	Dam/Weir Type	Province	River bed	M A L I G	73 m Width	20 m
Topo. Map No. 1:50,000	No. 3371-IV	Geo. Map No. 1:250,000	Length of Water Way	m	Reservoir Area	km ²	Reservoir Area	Dam Crest	EL.	152 m Height	79 m
		SCALE									

Geologic Formation and Age of the Site	Lubacop Formation (Miocene-Oligocene) Sandstone, siltstone, claystone, conglomerate Cobogan Formation (Late-Middle Miocene) shale, sandstone Ilogon Formation (Pleistocene-Pliocene) Shale, Sandstone, Conglomerate Tabuk Formation (Quaternary - Alluvium) sand, clay and gravel	Geologic Structure	Bedding N-S, Dip 30° E	Geologic Structure	Bedding N-S, Dip 30° E	Rock Type & Age	Sandstone, Conglomerate (Pleistocene - Pliocene)	Rock & Coarse Aggre- gates	Location	16 Km. west of damsite
Geologic Structure	Bedding: N-S, Dip 30° E well bedded.	Rock Type and Age of Bed- rock	Sandstone, Conglomerate (Pleistocene - Pliocene)	Rock Quality	Probably soft slightly consolidated to loose	Overburden	Residual soil, Alluvial deposits	Sand	Location	2 Km. east of damsite
Rock Quality	Both Abutments Probably soft slightly consolidated to loose	Permeability	Overall Probably watertight, except shallow part of weathered zone	Overburden		Geologic Structure		Material	Quality & Volume	River and Terrace deposits
Overburden	Both Abutments Thick residual soil and Talus River bottom Riverbed is filled with sand and gravel	Slope Stability	Possibility of land slip, especially after impending	Geologic Structure	Bedding NW-SE, N-S Dip 30°-60° Several Syncline and anticline across the Malig river	Rock Type & Age		Earth Material	Location	2-3 Km. east of damsite
				Lithology & Age	Sandstone siltstone, claystone (Miocene-Oligocene) Shale, Sandstone (Late-Middle Miocene) Shale, Sandstone, Conglomerate (Pliocene - Pliocene)	Rock Quality		Topographic Condition	Soil Type	River and Terrace deposits
				Permeability	Probably watertight, except shallow part of weathered zone and deeply weathered fault zone	Overburden		Geologic Sketch	Quality & Volume	Probably suitable
				Sedimentation	Less to Common			Damsite	Topographic Condition	U-Shaped
								Waterway/Power Tunnel	Geologic Sketch	Not visited site
								Power House	Geologic Sketch	
								Reservoir	Geologic Sketch	
								Dam Construction Material	Geologic Sketch	



G E O L O G I C A L D A T A S K E E T

Region No.	II	I.D. No.	2-8-12-33	Scheme	S A N A T A O		K A L I N G A - A P A Y A O		M A L I G		M A L I G	
Coordi- nates	17°18'06" N. LAT	121°28'55" E. LONG	Type of Development	D A M & R E S E R V O I R		Province		River Basin		Stream		
Topo. Map No. 1:50,000	No. 3271-1	Geo. Map SCALE	Length of Water Way	RESEVOIR		Dam/Weir Type		River Cross Section at Dam/Weir		El.		10 m
				M		Reservoir Area				Dam Creat El.		44 m
										160 m		160 m

G E O L O G I C A L	Geologic formation and Age of the Site	Ilogan Formation (Pleistocene-Pliocene) Shale, Sandstone, Conglomerate Cabangan Formation (Late-Middle Miocene) Shale, Sandstone Lubuagan Formation (Miocene-Oligocene) Sandstone, Shale	Geologic Structure	Ilogan Formation conformably overlies Cabangan Formation	Rock & Coarse Aggregate	Shale, Sandstone (Late-Middle Miocene)	Location	10 Km. west of damsite
	Geologic Structure	Bedding NW-SE Dip: NE 17-21° Syncline trend NE-SW trend, occur 1 Km. north of damsite	Rock Type & Age of Bed-rock	Rather hard (at right bank site)	Sand		Location	6 Km. west of damsite
S T R U C T U R E	Rock Quality	Probably soft to rather hard slightly consolidated to loose	Overburden	Thick residual soil and Alluvial deposits	Material		Quality & Volume	River and Terrace deposits
	Permeability	Probably watertight except shallow part of weathered loose zone	Geologic Structure		Earth Material		Location	6 Km. West of damsite
A B U T M E N T S	Both Abutments		Rock Type & Age				Soil Type	River and Terrace deposits
	Overall		Rock Quality				Quality & Volume	Probably suitable
D A M			Overburden				Topographic Condition	U-Shaped
			Geologic Structure	Bedding N-S Dip 30° - 60° Several Syncline and Anticline occur and Assumed faults trend NE-SW and NW-SE run along and across the Malig river.			Geologic Sketch	Not visited site
P R O F I L E			Lithology & Age	Shale, SS, Conglomerate (Pleistocene-Pliocene) Shale, Sandstone (late-Middle Miocene) Sandstone, Shale (Miocene-Oligocene)				Et.m -300 -160 -116
			Permeability	Probably watertight, except shallow part of weathered zone and deeply weathered faults zone				
G E N E R A L	Both Abutments		Slope Stability	Possibility of land slip, especially after impending			Damsite	Good - Acceptable
	River Bottom		Sedimentation	Less to Common			Waterway/Power Tunnel	
							Power House	Acceptable
							Reservoir	Acceptable
							Dam Construction Material	Good

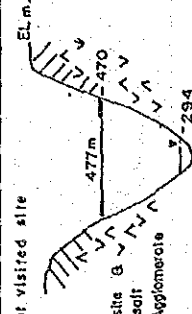
GEOLOGICAL DATA SHEET

Region No.	II	I.D. No.	2-8-14-34	Scheme	MALIANO	Province	ISABELA	River Basin	ILAGAN	Stream	PINACANAUAN de ILAGAN
Coordi- nates	16°44'36" N. LAT	122°04'00" E. LONG	Type of Development	DAMB RESERVOIR	Dam/ Type	ROCK FILL	River- bed	145 m Width	60 m		
Topo. Map No.	3470-III	Geo. Map SCALE	Length of Water Way	37.1 km ²	Reservoir Area	37.1 km ²	Section at Dam/ Veil	298 m Height	153 m		

Geologic Formation and Age of the Site	Metavolcanics (Cretaceous - Paleogene) Andesite, Basalt, Agglomerate Intrusive Rocks (Paleogene) Diorite/Quartz diorite Lubagan Formation (Early-Middle Miocene) Sandstone, Conglomerate, Shale Cabagan Formation (Miocene - Pliocene) Sandstone, Conglomerate, Claystone		Pillow structures. Joints are closely to moderately spaced	Geologic Structure	M D O H	M D O H	Pillow structures. Joints are closely to moderately spaced	Rock Type & Age Andesite (Cretaceous - Paleogene)	Rock Quality Hard and firm (at left bank site)	Overburden Residual soil	Geologic Structure	M D O H	M D O H	Geologic Structure	Rock Type & Age	Rock Quality	Overburden	Geologic Structure	Rock Type & Age	Rock Quality	Overburden	Geologic Structure	Lithology & Age	Permeability and Ground-water	Slope Stability	Sedimentation	CONSTRUCTION MATERIALS	Rock & Coarse Aggr- gates	Location Rock Type & Age Quality & Volume	1.5 Km. SE of damsite Andesite with diorite dikes Hard to very hard																											
	Geologic Formation and Age of the Site	Pillow structures (Andesite). Joints are closely to moderately spaced, cemented by quartz and calcite, volcanic flow trend N-E/35° SE. There are no major faults																													Andesite (Cretaceous - Paleogene)	Both Abutments Probably, hard to very hard, generally highly indurated except weathered joints and fault.	Overall Probably, watertight Lugeon valve average 0.75-2.35 max. valve 4.95 right abutments rather high permeability	Both Abutments Residual soil is rather thick in high elevation portion	River Bottom The river bed fills with cobbles to boulder with sand and gravel (rather thick)	Location Soil Type Quality & Volume	5.0 Km. SE of damsite Residual soil of diorite Probably suitable																				
PROFILE OF DAM AXIS																												TOPOGRAPHIC CONDITION		Geologic Sketch		Damsite		Waterway/Power Tunnel		Power House		Reservoir		Dam Construction Material		GENERAL ASSESSMENT		TOPOGRAPHIC CONDITION		Geologic Sketch		Damsite		Waterway/Power Tunnel		Power House		Reservoir		Dam Construction Material	
																												TOPOGRAPHIC CONDITION		Geologic Sketch		Damsite		Waterway/Power Tunnel		Power House		Reservoir		Dam Construction Material		GENERAL ASSESSMENT		TOPOGRAPHIC CONDITION		Geologic Sketch		Damsite		Waterway/Power Tunnel		Power House		Reservoir		Dam Construction Material	

G E O L O G I C A L D A T A S H E E T

Region No.	I.I.D. No.	2-8-14-35	Scheme	I L A G A N - I	Province	I S A B E L A	River Basin	I L A G A N	Stream	PINACAUAN de ILAGAN	
Coordi- nates	16° 35' 03" N. LAT	122° 01' 19" E. LONG	Type of Development	DAM & RESERVOIR	Dam/Weir Type		River Cross Section at Dam/Weir	River-bed El.	294 m	Width	40 m
Topo. Map No. 1:50,000	No. 3469-IV	SCALE 1:250,000	Length of Water Way	M	Reservoir Area	km ²		Dam Crest El.	470 m	Height	176 m

Geologic formation and Age of the Site	Metavolcanics (Cretaceous-Eocene) Basalt, Andesite, agglomerate Lubangon Formation (Early to Middle Miocene)		Geologic Structure	Assumed fault trend NE-SW occur 1 Km. NW of damsite		Geologic Structure	Assumed fault trend NE-SW occur 1 Km. NW of Power house site		CONSTRUCTION MATERIALS	Rock & Coarse Aggregate	Basalt, Andesite, agglomerate (Cretaceous to Eocene) Hard to very hard	Location	2 Km. SSE of damsite	
	Geologic Structure	Assumed fault trend NE-SW occur 1 Km. NW of damsite		Rock Type & Age	Basalt, Andesite, agglomerate (Cretaceous to Eocene)		Location	Basalt, Andesite, agglomerate (Cretaceous to Eocene)		Quality & Volume	Hard to very hard		Location	5-8 Km. upstream from damsite
Rock Type and Age of Bed-rock	Basalt, andesite, agglomerate (Cretaceous-Eocene)		Geologic Structure			Rock Type & Age			PROFILE OF DAM AXIS	Earth Material			Topographic Condition	V-Shaped
Rock Quality	Both Abundant Probably hard to very hard, indurated and compacted joints widely spaced		Geologic Structure			Rock Quality				Geologic Sketch	Not visited site 		Quality & Volume	
Permeability	Overall Probably watertight except shallow part of river bottom		Geologic Structure	No major fractured fault		Permeability and Ground-water	Probably watertight		GENERAL ASSESSMENT	Dam Site	Good		Waterway/Power Tunnel	
Overburden	Both Probably thick residual soil or deeply weathered thick zone of higher elevation		Lithology & Age	Basalt, andesite, agglomerate (Cretaceous to Eocene)		Slope Stability	S t a b l e			Power House	Good		Reservoir	Excellent
	River Bottom Riverbed filled		Sedimentation	L e s s					Dam Construction Material	Excellent				

G E O L O G I C A L D A T A S H E E T

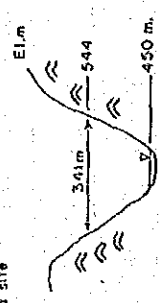
Region No.	II	I.D. No.	2-6-14-36	Scheme	ILAGAN-2	Province	ISABELA	River Basin	ILAGAN	Stream	PINACAUAN de ILAGAN
Coordi- nates	16°30'13" N. LAT	122°00'01" E. LONG	Type of Development	DAM & RESERVOIR	Dam/Wear Type		River bed	403m	Width	60m	
Topo. Map No. 3369-IV	1:50,000 SCALE	1:250,000	Length of Water Way	M	Reservoir Area		Dam Crest	554 m	Height	151 m	

Geologic formation and Age of the Site	N1 (Lower-Middle Miocene) Conglomerate, wackes, shales and reef limestones, associated with basic to intermediate flows and pyroclastics		Geologic Structure		Geologic contact of N1 formation and Kpg formation occur 500m south of powerhouse		Rock & Coarse Aggregates	Location	4Km. N-E of damsite		
	Geologic Structure	Assumed faults occur about 2 Km. south-west of damsite		N1 (Lower-Middle Miocene)		Kpg (Cretaceous-Paleogene)					
Rock Type and Age of Bed-rock	N1 Conglomerate, wackes, shales and reef limestones (Lower-Middle Miocene)		Rock Type & Age		Probably hard to rather hard with weathered zone. (at right bank site)		Quality & Volume		Hard to very hard		
Rock Quality	Both Abutments Probably hard to rather hard with weathered tight jointed rock		Rock Quality		Talus deposits		Sand		4-7 Km. downstream from damsite		
Permeability	Overall		Geologic Structure		Assumed faults (trend NW-SE) occur along the Pincanuan de Ilagan		Earth Material		4 Km. N-E of damsite		
	Probably water/tight except weathered fractured zone		Lithology & Age		Probably Kpg (Cretaceous-Paleogene) N1 (Lower-Middle Miocene)		Residual soil of Kpg		Probably suitable		
Overburden	Both Abutments		Permeability and Ground-water		Probably water/tight		Topographic Condition		V-Shaped		
	Thick to medium residual soil of high elevation of abutments		Slope Stability		Probably stable		Not visited site		Elm		
River Bottom	River bed filled with some boulders and cobble		Sedimentation		Common		Geologic Sketch				
							Dam Construction Material		Excellent		
			M A T E R I A L S			P R O F I L E O F D A M A X I S			G E N E R A L A S S E S S M E N T		

GEOLOGICAL DATA SHEET

Region No.	II	I.D. No.	2-8-14-37	Scheme	DINA PIQUI	Province	ISABELA	River Basin	ILAGAN	Stream	DINA PIQUI
Coordi- nates	16°32'34" N. LAT		122°08'24" E. LONG		DAM & RESERVOIR	Dam/Weir Type		River- bed	El. 450 m	Width	80 m
Topo. Map No. 3469-IV	Geo. Map SCALE 1:250,000		Length of Water Way			Reservoir Area		Dam Crest	El. 544 m	Height	94 m

Geologic Formation and Age of the Site	BC (Basement complex) Kpg Undifferentiated schist and quartzite (Cretaceous - paleogene) Undifferentiated graywackes and metamorphosed shale with siltite, basic flows and pyroclastics Intrusive Rocks (Neogene) Quartz diorite, granodiorite		Geologic Structure	No major fault of powerhouse site		CONSTRUCTION MATERIALS	Location		1.5 km east of damsite		
	Geologic Structure	Undifferentiated schist and quartzite (Basement complex)		Rock & Coarse Aggre- gaten	Rock Type & Age		Quartz diorite (Neogene)				
Geologic Structure	Quartz diorite / granodiorite intrudes into undifferentiated graywackes		Overburden	Talus deposits and Terrace deposits		Earth Material	Location		1.5 km east of damsite		
Rock Type and Age of Bed- rock	Kpg Undifferentiated graywackes and metamorphosed shale with siltite (Cretaceous - paleogene)		Geologic Structure	Several assumed faults intersect at first outlet and middle second tunnel route			Quality & Volume		River deposits sand and gravel		
Rock Quality	Both Abutments Probably hard to very hard sound fresh massive rocks slightly weathered and jointed near surface		Rock Type & Age	Quartz diorite at inlet side of first tunnel Kpg at middle of first tunnel. Schist and quartzite at other parts		Topographic Condition	Location		1.5 km. east of damsite		
Overall	Probably watertight except weathered and jointed orso		Rock Quality	Largely hard to very hard sound fresh massive rocks partially fractured due fault activities			Soil Type		Residual soil of quartz diorite		
Permeability	Overall		Overburden	Enough thickness		Geologic Sketch	Quality & Volume		Probably suitable		
	Probably watertight except weathered and jointed orso		Geologic Structure	Quartz diorite / granodiorite intrusives into undifferentiated graywackes			Topographic Condition		V-shaped		
Overburden	Both Abutment Medium thickness of residual soil top of the abutment		Lithology & Age	Largely quartz diorite and granodiorite (Neogene). Kpg located near damsite (Cretaceous - paleogene).		GENERAL ASSESSMENT	Geologic Sketch		Not visited site		
	Riverbed filled with sand and gravel		Permeability and Ground- water	Probably watertight			Damsite		Waterway/Power Tunnel		Excellent
River Bottom	Riverbed filled with sand and gravel		Slope Stability	Probably stable		Power House		Good		Good	
	Riverbed filled with sand and gravel		Sediment- ation	Common		Reservoir		Good		Good	
						Dam Construction Material		Good / Acceptable		Good / Acceptable	



G E O L O G I C A L D A T A S H E E T

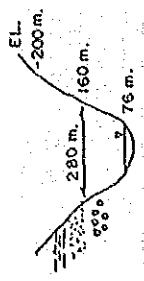
Region No.	II	I.D. No.	2-8-16-40	Scheme	CATALANGAN	Province	I S A B E L A	River Basin	DISABUNGAN	Stream	CATALANGAN
Coordinates	16° 59' 24" N. LAT	122° 04' 05" E. LONG	Type of Development	DAM & RESERVOIR	Dam/Weir Type		River Bed	River-El.	59 m	Width	60 m
Topo. Map No. 1:50,000	No. 3470-IV	Geo. Map SCALE 1/250,000	Length of Water Way	m	Reservoir Area	km ²	Dam Crest	El.	160 m	Height	101 m

Geologic Formation and Age of the Site	Metavolcanics-Caraballo Group? (Cretaceous-Paleogene) Andesite flow, dykes, Pyroclastics, agglomerates Zigzag Formation. (Oligocene-Miocene) Agglomerates and andesitic flows Cabangan Formation (Late-Middle Miocene) shale, sandstone, limestone (Cullao F.) Diorite (Tertiary)		M D C H	Geologic Structure	Bedding N-S / vertically	CONSTRUCTION MATERIALS	Rock & Coarse Aggregates	Location	3.5 Km. north-east of damsite Andesites, Agglomerates (Cretaceous - Paleogene) Hard to vary hard
	Rock Type and Age of Bedrock	Location					2 Km. downstream from damsite		
Rock Quality	Bedding: N-S, Dip: very steep		M M F V F	Geologic Structure	Residual soil probably rather thick	PROFILE OF DAM AXIS	Earth Material	Location	4.5 Km. east of damsite Residual soil Probably suitable
	Both Abutments	Location					210 m.		
Permeability	Probably watertight except weched shallow part		M M O V F	Geologic Structure	Assumed fault across the Catalangan river at 4 and 5 Km. from dam site	GENERAL ASSESSMENT	Topographic Condition	V-Shaped Not visited site	
	Overall	Location					210 m.		
Overburden	Residual soil probably rather thick		M M G M H	Lithology & Age	Andesite flow, dykes, Pyroclastics, agglomerates (Cretaceous - Paleogene) Diorite (Tertiary)	Dam Site	Geologic Sketch		
	Both Abutments	Location					210 m.		
River Bottom	Residual soil probably rather thick		M M G M H	Permeability and Groundwater	Probably watertight except deeply weathered zone	Waterway/Power Tunnel	Damsite	Good	
	River Bottom	Location					210 m.		
Slope Stability	Generally stable however some possibility of landslide often impending		M M G M H	Slope Stability	Generally stable however some possibility of landslide often impending	Power House	Waterway/Power Tunnel	Good	
	Reservoir	Location					210 m.		
Sedimentation	C o m m o n		M M G M H	Sedimentation	C o m m o n	Dam Construction Material	Power House	Good	
	Dam Construction Material	Location					210 m.		

G E O L O G I C A L D A T A S H E E T

Region No.	11	I.D. No.	2-8-16-41	Scheme	DISUSUAN		Province	ISABELA	River Basin	DISABUNGAN Stream		DISABUNGAN	
Geordi-nate	16°57'28" N. LAT	122°06'07" E. LONG		Type of Development	DAMA RESERVOIR		Dam/Veir Type		River Bed	El.	76 m	Width	10 m
Topo. Map	No. 3470-IV	Geo. Map SCALE	1:250,000	Length of Water Way	m		Reservoir Area	km ²	Dam Section at Dam/ Veir	El.	160 m	Height	84 m

	Geologic Formation and Age of the Site	Metavolcanics (Cretaceous - Paleogene) Andesite, Basalt, agglomerates Calleo Limestones (Miocene) Cabaogan Formation (Miocene - Pliocene) sandstone, claystone, Conglomerates Ilogan Formation (Pliocene - Pleistocene) Sandstone, Conglomerates, siltstone	Geologic Structure	No major fault on the powerhouse site	CONSTRUCTION MATERIALS	Rock & Coarse Aggregate	Location	5 Km. ENE of damsite Limestone (Miocene) Hard and compacted
	Geologic Structure	No major fault on the damsite	Geologic Structure	No major fault on the powerhouse site	CONSTRUCTION MATERIALS	Sand	Location	3 Km. downstream from damsite
	Rock Type and Age of Bed-rock	Sandstone, Conglomerates, siltstone (Pliocene - Pleistocene)	Rock Type & Age	Sandstone, Conglomerates, siltstone (Pliocene - Pleistocene)	CONSTRUCTION MATERIALS	Earth Material	Quality & Volume	River and terrace deposits
	Rock Quality	Both Abutments probably weathered with joints and cracks and slightly consolidated to loose	Rock Quality	Soft to rather hard (at right bank site)	PROFILE OF DAM AXIS		Topographic Condition	2 Km. west of damsite
	Permeability	Overall Probably watertight except weathered joints	Geologic Structure	Caves and open joints produced by solution of limestone	PROFILE OF DAM AXIS		Geologic Sketch	Residual soil of Sandstone, Conglomerate, siltstone Probably suitable
	Overburden	Probably rather thick residual soil	Overburden	Probably high permeability due to wide limestone area	GENERAL ASSESSMENT		Damite	Acceptable
			Permeability and Ground-water	Probably high permeability due to wide limestone area	GENERAL ASSESSMENT		Waterway/Power Tunnel	Acceptable/Good
			Slope Stability	Stable	GENERAL ASSESSMENT		Power House	Acceptable/Good
			Sedimentation	Less to Common	GENERAL ASSESSMENT		Reservoir	Poor
					GENERAL ASSESSMENT		Dam Construction Material	Good



G E O L O G I C A L D A T A S H E E T

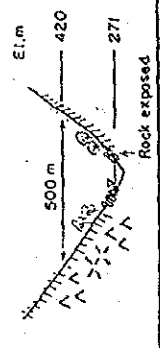
Region No.	II	I.D. No.	2-8-19-43	Scheme	ALIMIT-1	Province	IFUGAO	River Basin	ALIMIT	Stream	ALIMIT
Coordi- nates	16° 46' 30" N. LAT	121° 15' 45" E. LONG	Type of Dam/Weir	DAM & RESERVOIR	Dam/Weir Type	Reservoir		River Cross Section at Dam/ Weir	River- bed El.	191 m Width	30 m
Topo. Map Scale	No. 3270-II	Geo. Map Scale	1:500,000	Length of Water Way	M	Area	km ²		Dam Crest El.	306 m Height	115 m

	Geologic Formation and Age of the Site	Metavolcanics (Cretaceous - Paleogene) Agglomerate, andesite Zigzag Formation (Early - middle Miocene) well bedded clastic sedimentary rocks. It consist of intercalated well compacted and poor sorted conglomerate, volcanic flows and wackes.	Scheme	ALIMIT-1	Province	IFUGAO	River Basin	ALIMIT	Stream	ALIMIT
G E O L O G I C A L	Geologic Structure	Bedding N 50 - 65° W								
E N G I N E E R I N G	Rock Type and Age of Bed- rock	Agglomerate, andesite (Cretaceous - Paleogene)								
D A M	Rock Quality	Both Abutment								
S Y S T E M	Perme- ability	Probably hard to very hard however near surface and exposed rocks slightly moderately weathered								
P R O J E C T	Over- burden	Over all								
P R O F I L E	Geologic Structure	Probably waterfright except weathered rock zone								
O F	Lithology & Age									
D A M	Permeabi- lity and Ground- water									
A X I S	Slope Stability	Residual soil (medium thickness)								
P R O F I L E	Sediment- ation	Riverbed filled with sand and gravel								
O F	Geologic Structure									
D A M	Rock Type & Age									
P R O F I L E	Rock Quality									
O F	Overburden									
D A M	Geologic Structure									
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O F	Rock Type & Age									
D A M	Rock Quality									
P R O F I L E	Overburden									
O F	Geologic Structure									
D A M	Rock Type									

G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-19-44	Scheme	A L I M I T - 2	Province	I F U G A O	River Basin	A L I M I T	Stream A L I M I T
Coordi- nates	N. LAT	16°54'00"	121°16'22"	Type of Development	DAM & RESERVOIR	Dam/Weir Type		River bed	Ri.	271 m Width
Scale	1:50,000	Geo. Map No. 3270-1	1:250,000	Length of Water Way		Reservoir Area		Dam Crest EL.	420 m	Height
										149 m

G E O L O G I C A L D A T A S H E E T		C O N S T R U C T I O N M A T E R I A L S				P R O F I L E O F D A M A X I S				G E N E R A L A S S E S S M E N T				
		Geologic Structure	Rock Type & Age	Rock Quality	Overburden	Geologic Structure	Rock Type & Age	Rock Quality	Overburden	Geologic Structure	Lithology & Age	Permeability and Groundwater	Slope Stability	Sedimentation
Geologic formation and Age of the Site	Metavolcanics (Cretaceous-Paleogene) Agglomerate, andesite Zipsog Formation (Early-middle Miocene) well bedded clastic sedimentary rocks it consists of intercalated well compacted and poor sorted conglomerate, volcanic flows and wackes	No major fault, wide spaced joints with calcite filled	No major fault, wide spaced joints with Calcite filled	No major fault, wide spaced joints with Calcite filled	No major fault, wide spaced joints with Calcite filled	Agglomerate and Andesitic flows (Early-middle Miocene)	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Both Abutments	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced
Geologic Structure	No major fault, wide spaced joints with calcite filled	No major fault, wide spaced joints with calcite filled	No major fault, wide spaced joints with calcite filled	No major fault, wide spaced joints with calcite filled	No major fault, wide spaced joints with calcite filled	Agglomerate and Andesitic flows (Early-middle Miocene)	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Both Abutments	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced
Rock Type and Age of Bedrock	Agglomerate and Andesitic flows (Early-middle Miocene)	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced
Rock Quality	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced	Probably, hard indurated, compacted, however exposed rocks slightly weathered and jointed moderately spaced
Permeability	Probably water tight except weathered weakly jointed rock zone	Probably water tight except weathered weakly jointed rock zone	Probably water tight except weathered weakly jointed rock zone	Probably water tight except weathered weakly jointed rock zone	Probably water tight except weathered weakly jointed rock zone	Probably water tight except weathered weakly jointed rock zone	Probably water tight except weathered weakly jointed rock zone	Probably water tight except weathered weakly jointed rock zone	Probably water tight except weathered weakly jointed rock zone	Probably water tight except weathered weakly jointed rock zone	Probably water tight except weathered weakly jointed rock zone	Probably water tight except weathered weakly jointed rock zone	Probably water tight except weathered weakly jointed rock zone	Probably water tight except weathered weakly jointed rock zone
Overburden	Residual soil rather thick in upper portion	Residual soil rather thick in upper portion	Residual soil rather thick in upper portion	Residual soil rather thick in upper portion	Residual soil rather thick in upper portion	Residual soil rather thick in upper portion	Residual soil rather thick in upper portion	Residual soil rather thick in upper portion	Residual soil rather thick in upper portion	Residual soil rather thick in upper portion	Residual soil rather thick in upper portion	Residual soil rather thick in upper portion	Residual soil rather thick in upper portion	Residual soil rather thick in upper portion



GEOLOGICAL DATA SHEET

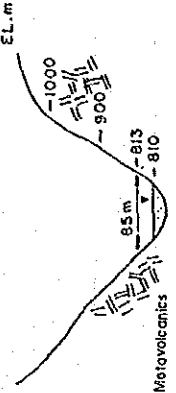
Region No.	II	I.D. No.	2-8-20-45	Scheme	H U O A B	I F U G A O	I B U L A O	I B U L A O
Coordi- nates	M. LAT	16°44'36" E. LONG	121°10'00"	Type of Development	DAM B RESERVOIR	Province	River Basin	Stream
Topo. Map No. 3270-III	Geo. Map SCALE	1:250,000	Length of Water Way	M AREA	Reservoir	Dam Type	River Cross Section at Dam/Weir	River Bed El. 315 m Width 50 m
							Dam Crest El. 463 m Height 148 m	

Geologic formation and Age of the Site	Metavolcanics / Metasediments (Paleogene - Cretaceous) Agglomerate, Basalt, Conglomerate (Pleistocene)	Probably assumed fault occur along the Ibulao river	Geologic Structure	Probably assumed fault occur along the Ibulao river	CONSTRUCTION MATERIALS	Location	1.5-3 km upstream of damsite
	Geologic Structure	Left bank side steep dipping probably minor fault along the river stream	Rock Type & Age	Probably agglomerates / Basalt conglomerate		Rock & Coarse Aggre- Gates	Rock Type & Age
Rock Type and Age of Bed-rock	Metasediments / Metavolcanics (Paleogene - Cretaceous) at left abutment and river bottom. Agglomerate / Basalt conglomerate at right	Overburden	Overburden	River terrace deposit (right river bank site)	Sand	Location	1 km downstream and 1-3 km upstream of damsite
Rock Quality	Right Abutment: Rather soft and strongly weathered, rather thick Left Abutment: Hard and weathered	Geologic Structure	Geologic Structure		Material	Quality & Volume	Medium to coarse gravel river sand
Permeability	Over all: High permeability at shallow weathered part. Probably permeability is decreased towards deeper portion.	Rock Quality	Rock Quality		Earth Material	Location	1 km downstream of damsite
	Right Abutment: Residual soil, thick heavy weathered zone wide river terrace at downstream of damsite. Left Abutment: Talus or rock slide wide river terrace deposit River Bottom: The riverbed is filled with gravel, boulder, and sand, thickness 3-5 m.	Overburden	Overburden		Topographic Condition	Soil Type	Silty clay of river terrace Residual soil of agglomerate
					Geologic Sketch	Quality & Volume	Probably suitable
						Topographic Condition	Open V-shaped
						Geologic Sketch	Visited site (Overflight survey) 674 m. Elev. 463 m. 315 m.
					GENERAL ASSESSMENT	Dam Site	Good / Acceptable
						Waterway/Power Tunnel	
						Power House	Acceptable
						Reservoir	Acceptable
						Dam Construction Material	Excellent

G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-6-22	Scheme	IBULAO	Province	IFUGAO	River Basin	IBULAO	Stream	TAONG
Coordi- nates	16°46'19" N. LAT	120°59'29" E. LONG	Type of Development	RUN OF RIVER	/Weir Type	CONCRETE	River Cross Section	River-bed	El.	810 m	Width
Topo. Map No. 1:50,000	No. 3170-II	Geo. Map No. 1:600,000	Length of Water Way	8500 m	Reservoir Area	km ²	weir	Crest El.	813 m	Max. Height	6 m

Geologic formation and Age of the Site	Metavolcanics (Cretaceous-Paleogene) Lubuagan Formation (Early - Middle Miocene) Volcanic wakes, Microbreccia Conglomerate		Geologic Structure	Bedding: E-W	CONSTRUCTION MATERIALS	Rock & Coarse Aggregate	Location	1.5Km. north of main weir.
	Long assumed fault (trend N-S) occur along the Taong river							
Geologic Structure	Both Abutments folded and jointed		Geologic Structure	Thin residual soil	PROFILE OF DAM AXIS	Earth Material	Location	—
Rock Type and Age of Bed-rock	Metavolcanics: Largely spilites and basalts (Cretaceous - Paleogene)		Geologic Structure	Assumed fault or fractured zone across the middle of waterway trend NW-SE		Geologic Sketch	Soil Type	—
Rock Quality	Probably hard to very hard, Both Abutments folded and jointed		Rock Type and Age	Metavolcanics and Metasediment (Cretaceous - Paleogene) Volcanic wakes, Microbreccia Conglomerate (Early - Middle Miocene)	GENERAL ASSESSMENT	Quality & Volume	Quality & Volume	—
Permeability	Probably watertight except river bottom		Rock Quality	Probably hard to very hard indurated and compacted		Dam Site	Topographic Condition	Topographic Condition
Overburden	Both Abutments		Overburden	Enough thickness for tunneling	Waterway/Pover Tunnel	Pover House	Reservoir	Dam Construction Material
	River Bottom		Geologic Structure	Assumed fault (trend N-S) occur along the Taong river.				
	Thin residual soil		Lithology & Age	Metavolcanics (Cretaceous - Paleogene)	Pover House	Reservoir	Excellent	Excellent
	River bed filled with gravel, cobbles		Permeability and Groundwater	Probably watertight	Reservoir	Dam Construction Material	Excellent	Excellent



GEOLOGICAL DATA SHEET

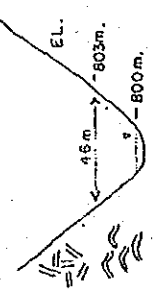
Region No.	II	I.D. No.	2-8-22-47	Scheme	MATUNO-IR	Province	I FUGAO	River Basin	MATUNO	Stream	C A D A C L A N G
Coordi- nates	16°39'46" N. LAT	121°01'51" E. LONG	Type of Development	Length of Water Way	RUN OF RIVER	Dam/Weir Type		River bed	EL. 752 m	Width	80 m
Topo. Map	No. 3269-IV	Geo. Map	1:600,000	SCALE	9385	Reservoir Area		Section at	EL. 756 m	Height	6 m

Geologic formation and Age of the Site	Metavolcanics and Metasediments (Cretaceous - Paleogene). Corobollo group		Geologic Structure	Bedding NNE-SSW, Dip 50-70° NW. Assumed fault occur along the river		CONSTRUCTION MATERIALS	Rock & Coarse Aggregates	Location	1 Km. SE of damsite
	Lubbocon Formation (Early - Middle Miocene) Conglomerate with alternating sandstone and mudstone			Rock Type & Age	Conglomerate with alternating sandstone (Early to Middle Miocene)		Sand Material	Location	Within 1 Km. from damsite
Geologic Structure	No major fault		Overburden	Talus deposits		Earth Material	Location		
Rock Type and Age of Bed-rock	Metavolcanics and Metasediments		Geologic Structure	Bedding NNE-SSW			Soil Type		
Rock Quality	Both Abutments Probably hard to very hard Compacted and indurated		Rock Type & Age	Metavolcanics and Metasediments (Cretaceous to Paleogene) Conglomerates with sandstone (Early to Middle Miocene)			Quality & Volume		
Permeability	Overall		Rock Quality	Probably hard to very hard but partially deeply weathered		Topographic Condition	V-Shaped Not visited site		
	Probably watertight except river bottom		Overburden	Generally enough thickness tunneling except at 3 Km. point from power house		Geologic Sketch			
Overburden	Both Abutments		Geologic Structure	No major fault		Damsite	Excellent		
	Thin residual soil		Lithology & Age	Metavolcanics and Metasediments (Cretaceous to Paleogene)		Waterway/Power Tunnel	Good		
River Bottom	The riverbed filled with gravel and Cobble		Permeability and Ground-water	Probably watertight		Power House	Good		
			Slope Stability	S i b i l e		Reservoir	Excellent		
			Sedimentation	L e s s		Dam Construction Material	Excellent		

GEOLOGICAL DATA SHEET

Region No.	II	I.D. No.	2-8-29-59	Scheme	MATUNO-2R	Province	NUEVA VISCAYA	River Basin	MATUNO	Stream	TRIBUTATED of MATUNO
Coordi- nates	16°32'34" N. LAT	120°58'49" E. LONG		Type of Development	RUN OF RIVER	Dam/Weir Type		River bed	El. 800 m	Width	40 m
Topo. Map	No. 3169-1	Geo. Map	1:250,000	Length of Water Way	7060 m	Reservoir Area		Crest	El. 803 m	Max. Height	6 m
		SCALE									

Geologic formation and Age of the Site	Metavolcanics - Metasediments (Cretaceous to Eocene)	Geologic Structure	Inferred faults (trend N-S) occur 1 Km. west of powerhouse site	Geologic Structure	CONSTRUCTION MATERIALS	Location	2 Km. west of damsite
	Lubogon Formation (Early to Middle Miocene) Conglomerates, sandstone, with siltstone		Rock Type & Age				Conglomerates, sandstone with siltstone (Early to Middle Miocene)
Geologic Structure	Geologic contact of Metavolcanics-Metasediments and Lubogon Formation occur 500 east of damsite	Geologic Structure	Residual soil and Talus deposits	Geologic Structure	CONSTRUCTION MATERIALS	Location	7 Km. downstream from damsite
	Metavolcanics - Metasediments (Cretaceous to Eocene)		Rock Type & Age				Probably hard, moderately weathered and jointed
Rock Quality	Both Abutments compacted and indurated	Geologic Structure	Several inferred faults trend N-S across the waterway route	Geologic Structure	CONSTRUCTION MATERIALS	Location	River deposits sand and gravel
	Probably hard to very hard		Rock Type & Age				Mainly conglomerate, sandstone with siltstone partially consists of Metavolcanics (Early to Middle Miocene)
Permeability	Overall river bottom	Geologic Structure	Probably hard but fractured zone developed due to faults	Geologic Structure	CONSTRUCTION MATERIALS	Soil Type	
	Probably watertight except river bottom		Rock Quality				Enough thickness for tunnel excavation
Overburden	Thin residual soil	Geologic Structure	No major fractured fault	Geologic Structure	PROFILE OF DAM AXIS	Quality & Volume	
	The riverbed filled with gravel and cobble		Overburden				Metavolcanics (Cretaceous to Eocene)
Both Abutments	Both Abutments	Geologic Structure	Metavolcanics (Cretaceous to Eocene)	Geologic Structure	GENERAL ASSESSMENT	Quality & Volume	
	The riverbed filled with gravel and cobble		Permeability				Probably watertight
River Bottom	Thin residual soil	Geologic Structure	Probably watertight	Geologic Structure	GENERAL ASSESSMENT	Quality & Volume	
	The riverbed filled with gravel and cobble		Slope Stability				S t a b l e
Overburden	Thin residual soil	Geologic Structure	Probably watertight	Geologic Structure	GENERAL ASSESSMENT	Quality & Volume	
	The riverbed filled with gravel and cobble		Sedimentation				L e s s



GEOLOGICAL DATA SHEET

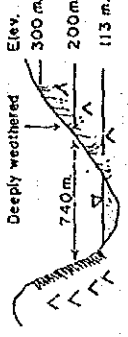
Region No.	11	I.D. No.	2-8-22-49	Scheme	STA. CRUZ	Province	NUEVA VIZCAYA	River Basin	MAGAT	Stream	STA. CRUZ
Coordi- nates	N. LAT 16°22'00"	E. LONG 121°02'00"	Type of Development	DAMS RESERVOIR	Dam/Weir Type			River bed	River- bed EL.	387 m	Width 20 m
Topo. Map No. 3269-III	Geo. Map SCALE 1:100,000	Length of Water Way			Reservoir Area			Dam Section at Dam	Great EL.	440 m	Height 53 m

Geologic Formation and Age of the Site	Intrusive rock (Neogene) Tonalite (Quartz diorite) Andesite		Basaltic lava (Caraballo G.; upper Cretaceous to Eocene) SS, Cgl. and claystone (Mabang F.; Miocene) LS (Santa Fe F.; Miocene)		Terraça Deposit, Recent Deposit	
	E - W / dip 80° south - east					
Geologic Structure	E - W / dip 80° south - east					
Rock Type and Age of Bedrock	Tonalite (Neogene)					
Rock Quality	Right & Left Abutment: Hard and thick weathered zone					
Permeability	Right & Left Abutment		Probably high permeability in the weathered zone			
	Riverbed		High permeability river deposits			
Overburden	Bedrock of River		High permeability of weathered zone			
	Right Abutment		Rock and lava slips. Tolu deposit, Residual soil			
Overburden	Left Abutment		Wide terraça deposit with specific height 1.5m, Residual soil			
	Riverbed		gravel, sand, silt The thickness of deposit is probably very thick			
CONSTRUCTION MATERIALS						
Rock & Coarse Aggregates	Location		3 km downstream of damsite			
Sand	Rock Type & Age		Intrusive Rock Andesite (Neogene)			
	Quality & Volume		Good and enough for rock filled dam			
Material	Location		1-3 km downstream from damsite			
	Quality & Volume		River deposits enough for construction			
Earth Material	Location		3 km upstream of damsite			
	Soil Type		Terraça deposits and Residual soil			
Topographic Condition	Quality & Volume		Probably good			
	Topographic Condition		Dish shaped valley			
Geologic Sketch	Visited site					
	Geologic Sketch					
GENERAL ASSESSMENT						
Damsite	Waterway/Power Tunnel		Good			
Power House	Reservoir		Acceptable			
Dam Construction Material	Reservoir		Acceptable			
	Common to much		Good			

G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-26-50	Scheme	PINARI PAD		QUIRINO		ADDALAM		ADDALAM	
Coordi- nates	N. MAT 16°27'56"	E. LONG 121°34'50"		Type of Development	DAMB RESERVOIR		Province Dam/Weir Type		River Basin		Stream	
Topo. Map Scale	No. 3369-III 1:50,000	Geo. Map SCALE		Length of Water Way	M		Reservoir Area		River Cross Section at Dam/ Year		Dam Crest EL. 200 M Height 87 M	

G E O L O G I C A L	Geologic formation and Age of the Site	Mampung Formation (Oligocene) Andesitic lava, tuff breccia, basalt lava, mudstone, tuff conglomerate Adigwey Formation (Late Miocene) limestone Matano Formation (Pliocene) sandstone and mudstone		Geologic Structure	Bedding: N60°W/10°SW	CONSTRUCTION MATERIALS		Rock & Coarse Aggre- gates	Location	2.5 km. SW of damsite
	Geologic Structure	Bedding: N 60° W, Dip: 10° SW		Rock Type & Age	Agglomerate (Oligocene)	PROFILE OF DAM AXIS		Sand	Rock Type & Age	Andesite, Agglomerate (Oligocene)
	Rock Type and Age of Bed- rock	Agglomerate, andesite (Oligocene)		Rock Quality	Moderately weathered (at left bank site)	GENERAL ASSESSMENT		Material	Quality & Volume	Hard to rather hard
	Rock Quality	Hard and deeply to moderately weathered		Overburden	Thick residual soil	Damsite		Earth Material	Location	2-7 km downstream from damsite
	Right Abutment	Hard to very hard fractures open discontinuous		Geologic Structure		Waterway/Power Tunnel			Quality & Volume	River and terrace deposits sand and gravel
	Left Abutment	Probably waterlight except shallow weathered zone		Rock Type & Age		Power House			Topographic Condition	Residual soil of Agglomerate
	Over- burden	Very thick deeply weathered soil		Overburden		Reservoir			Geologic Sketch	Probably suitable
	River Bottom	Thin residual soil and Talusdeposits		Geologic Structure	Anticline trend N-S occur 4 km. west of damsite, fault occur along the Addalam river 3 km southwest of damsite	Dam Construction Material			Geologic Sketch	Open V shape wide valley
		Riverbed filled with sand and gravel		Lithology & Age	Agglomerate, Andesite, Conglomerate (Oligocene)				Geologic Sketch	Not visited site (Overflight survey)
				Permeabi- lity and Ground- water	Probably water tight, except deeply weathered faults				Geologic Sketch	Deeply weathered Elev. 300 m. 200 m. 113 m.



G E O L O G I C A L D A T A S H E E T

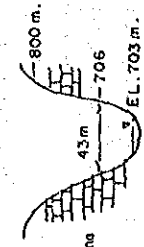
Region No.	II	I.D. No.	2-8-2852	Scheme	CABINGATAN	Province	QUIRINO	River Basin	CONWAP	Stream	CONWAP
Coordi- nates	16°13'32" N. LAT	121°37'31" E. LONG	Type of Development	DAM & RESERVOIR	Dam/Weir Type		River Cross Section & Dam	River bed	CONWAP	163 m Width	CONWAP
Topo. Map No. 1:50,000	No. 3368-IV	Geo. Map SCALE 1:600,000	Length of Water Way		Reservoir			Dam Crest	CONWAP	310 m Height	CONWAP

1:600,000

Geologic Formation and Age of the Site	Metasediment (Cretaceous - Paleogene) Waxes and Shales (Miocene Formation (Early Miocene) Limestone)		Geologic Structure	Well bedded limestones associated moderately spaced joints	CONSTRUCTION MATERIALS	Location	4 Km. south-west of damsite
	Geologic Structure	Common trend of all tectonic structures is NNE oriented, several anticline and syncline occur upstream of damsite	Rock Type & Age	Limestone (Early Miocene)		Rock & Coarse Aggre- gates	Rock Type & Age
Geologic Structure			Rock Quality	Hard, slightly weathered (at left bank site)	CONSTRUCTION MATERIALS	Quality & Volume	Hard, slightly weathered
Rock Type and Age of Bed- rock			Overburden	River deposits		Sand	Location
Rock Quality			Geologic Structure		CONSTRUCTION MATERIALS	Material	Alluvial deposits
			Rock Type & Age			Earth Material	Location
Overall			Rock Quality		PROFILE OF DAM AXIS	Soil Type	Alluvial deposits
Permeability			Overburden			Quality & Volume	Quality & Volume
Overburden			Geologic Structure	Meta-sediment rocks are conformably overlain by thick bedded limestone	GENERAL ASSESSMENT	Topographic Condition	U - She p e d
			Lithology & Age	Wack and shale (Cretaceous - Paleogene) Limestone (Early Miocene)		Geologic Sketch	Not visited site (Overflight survey)
			Permeability and Ground-water	Probably low permeability in wacks and shale, however high permeability in the limestone zone	GENERAL ASSESSMENT	Geologic Sketch	
			Slope Stability	The gently inclined slopes are stable. Even the steep slopes not slide endangered			
			Sedimentation		Waterway / Power Tunnel		
					Power House		G o o d
					Reservoir		P o o r
					Dam Construction Material		G o o d

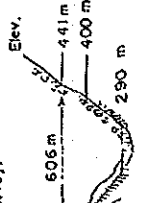
G E O L O G I C A L D A T A S K E E T

Region No.	II	I.D. No.	2-8-28-53	Scheme	G A N I P		Province	QUIRINO	River Basin	C O N W A P		C O N W A P
Coordi- nates	N. LAT 16° 04' 41"	E. LONG 121° 20' 23"	Type of Development	Length of Water Way	RUN OF RIVER	Dam/Weir Type	Dam/Weir Type	River Cross Section at Weir	River- bed El.	703 m	Width	40 m
Topo. Map No. 3268-II	Geo. Map SCALE	1:250,000			3350 M	Reservoir Area	Reservoir Area		Great El.	706 m	Max. Height	6 m

Geologic formation and Age of the Site	Matuno Formation (upper miocene) Mudstone, sandstone and conglomerate		Limestone unconformably overlies Matuno Formation		Limestone unconformably overlies Matuno Formation		Limestone (Oligocene)		Location		3 Km. north-east of damsite	
	Site Fe Formation (Oligocene) L i m s t o n e		Hard and rich joints and caves slightly weathered		Hard and rich joints and caves slightly weathered		Limestone (Oligocene)		Rock Type & Age		Limestone (Oligocene)	
Geologic Structure	Limestone unconformably overlies Matuno Formation		Residual soil and T o l u s d e p o s i t s		Residual soil and T o l u s d e p o s i t s		Limestone (Oligocene)		Quality & Volume		Hard and rich joints and caves slightly weathered	
	Limestone (Oligocene)		Caves and open joints occur along the waterway		Caves and open joints occur along the waterway		Limestone (Oligocene)		Location		3.5 Km. north of damsite	
Rock Type and Age of Bed- rock	Both		Probably hard and rich joints and caves slightly weathered		Probably hard and rich joints and caves slightly weathered		Limestone (Oligocene)		Earth Material		Residual soil of limestone	
	Abutments		Probably hard and rich joints and caves slightly weathered		Probably hard and rich joints and caves slightly weathered		Limestone (Oligocene)		Soil Type		Probably suitable	
Rock Quality	Overall		Probably high permeability due to cracks and caves of limestones		Probably high permeability due to cracks and caves of limestones		Limestone (Oligocene)		Topographic Condition		U-Shaped	
	Abutments		Probably high permeability due to cracks and caves of limestones		Probably high permeability due to cracks and caves of limestones		Limestone (Oligocene)		Geologic Sketch			
Perme- ability	Both		Thick residual soil at high elevation of abutments		Thick residual soil at high elevation of abutments		Probably high permeability due to cracks and caves of limestone		Damsite		Acceptable / poor	
	River		The riverbed filled with some boulders and cobbles		The riverbed filled with some boulders and cobbles		Probably high permeability due to cracks and caves of limestone		Waterway/Power Tunnel		Acceptable	
Over- burden	Bottom		The riverbed filled with some boulders and cobbles		The riverbed filled with some boulders and cobbles		Probably stable		Power House		G o o d	
	Bottom		The riverbed filled with some boulders and cobbles		The riverbed filled with some boulders and cobbles		Probably stable		Reservoir		Acceptable	
						L e s s		Dam Construction Material		Good/Acceptable		

GEOLOGICAL DATA SHEET

Region No.	II	I.D. No.	2-8-29-54	Scheme	D A K G A N		Province	QUIRINO	River Basin	CASECNAN Stream	CASECNAN
Coordi- nates	16°03'04" N. LAT	E. LONG	121°27'31"	Type of Development	D A M B RESERVOIR		Dam/Weir Type		River bed	El. 290 m	Width 60 m
Topo. Map No. 1:50,000	3268-II	Geo. Map SCALE	1:250,000	Length of Water Way	m		Reservoir Area	km ²	Dam Crest	El. 441 m	Height 151 m

Geologic formation and Age of the Site	Corallo Group (Cretaceous to Eocene) Formation I; andesitic tuff breccia, andesitic lava and well bedded alternations of sandstone and shale. Formation II; basaltic lava, dolerite, basalt tuff breccia and interbedded siliceous shale and sandstone Formation III; andesitic lava, andesitic tuff breccia and interbedded siliceous shale and limestone		M D D O H	Geologic Structure	Bedding N 45° E, Dip 20° SE		CONSTRUCTION MATERIALS	Rock & Coarse Aggre- gates	Location	5 km. NNE of dam site
	Geologic Structure	Interbedded siliceous shale and sandstone (Cretaceous to Eocene)			Rock Type & Age	Hard and slightly weathered (at left bank site)		Sand	Material	River deposit sand and gravel
Geologic Structure	Syncline trend north east across the left abutment of dam site. Assumed fault run parallel to the dam axis at 200-300m upstream side. Fractured zone occur toe of right abutment. Bedding N 45° E, Dip 20-30°	M M M O H	Geologic Structure	Overburden	Residual soil and River deposits	Earth Material	Topographic Condition	Open V-shaped	Not visited site (overflight survey)	
Rock Type and Age of Bed- rock	Andesitic lava, andesitic tuff breccia and interbedded siliceous shale and sandstone (Cretaceous to Eocene)	K V A H M	Rock Type & Age	Rock Quality		Geologic Sketch	Geologic Sketch	Probably suitable		
Rock Quality	Both Abutments: Probably hard to very hard, slightly weathered and jointed	M M M H	Rock Quality	Overburden		Damite	Damite	Good / Acceptable		
Permea- bility	overall: Probably water tight, except weathered jointed zone of near surface and fractured zone.	K M O A	Geologic Structure	Lithology & Age	No major fault in the reservoir area except near dam site	Waterway/Power Tunnel	Waterway/Power Tunnel	Good		
Over- burden	Both Abutment: Residual soil (very thin)	K M O S	Permeability and Ground- water	Slope Stability	Probably water tight except deeply weathered faults	Reservoir	Reservoir	Good		
	River Bottom: Volcanic rocks exposed at toe of the abutment and riverbed is partially filled with sand and gravel.	M M	Sediment- ation		Less to common	Dam Construction Material	Dam Construction Material	Good		

GEOLOGICAL DATA SHEET

Region No.	II	I.D. No.	2-8-29-55	Scheme	M A D D E L A	Province	QUIRINO	River Basin	CASEC NAN	Stream	TABOYONG
Coordi- nates	16°01'04" N. LAT.	E. LONG	121°27'33"	Type of Development	DAM B RESERVOIR	Dam/Weir Type		River Cross Section at Dam/ Weir	River- bed El.	240 m	Width 20 m
Topo. Map No.	3268-II	Geo. Map SCALE	1:250,000	Length of Water Way	m	Reservoir Area	km ²		Dam Crest El.	471 m	Height 131 m

Geologic formation and Age of the Site	Caraballo Group (Cretaceous to Eocene) Formation I: Andesitic tuff breccia, andesitic lava and well bedded alternation of sandstone and shale Formation II: Basaltic lava, dolerite, basaltic tuff breccia and interbedded siliceous shale and sandstone Formation III: Andesitic lava, andesitic tuff breccia and interbedded siliceous shale and limestone		Geologic Structure	Bedding: E-W/NW		CONSTRUCTION MATERIALS	Location		1.5 Km. SW of damsite	
	Rock Type & Age of Bed- rock	Andesitic lava, andesitic tuff breccia and inter- bedded siliceous shale and sandstone (Cretaceous to Eocene)		Rock & Coarse Aggre- gates	Andesitic tuff breccia, andesitic lava and well bedded alternation of sandstone and shale Hard and slightly weathered (at right bank site)		Rock Type & Age	Andesitic lava and tuff breccia (Cretaceous to Eocene) Hard to very hard		
Geologic Structure	Bedding: E-W/NW Assumed fault (NNW trend) occur 1 Km. east of damsite		Overburden	Residual soil		Sand Material	Location		1-2 Km. upstream from damsite	
Rock Quality	Both Abutments Probably hard to very hard slightly weathered and jointed		Geologic Structure			Earth Material	Location		1 Km. SE and SW of damsite	
Perme- ability	Overall		Rock Type & Age			PROFILE OF DAM AXIS	Soil Type		Residual soil of andesitic lava and tuff breccia	
	Probably watertight, except weathered jointed zone of shallow suburfaces		Rock Quality				Quality & Volume		Probably suitable	
Over- burden	Both Abutments Residual soil and Talus, gully deposits and till River Bottom Volcanic rocks exposed at toe of the abutment and riverbed is filled sand		Overburden	Less to common		GENERAL ASSESSMENT	Topographic Condition		Open V-Shaped	
	Probably watertight, except weathered jointed zone of shallow suburfaces		Geologic Structure	Several folding axis (E-W trend) and assumed fault occur in the reservoir area			Geologic Sketch		Not visited site (Overflight survey)	
				Permeability	Probably watertight except deeply weathered faults		Damsite		Good / Excellent	
				Slope Stability	Probably stable but some possibility of land slip occur after impending		Waterway/Power Tunnel		Good	
				Sediment- ation	Less to common		Power House		Good	
							Reservoir		Good	
							Dam Construction Material		Excellent	

G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-29-56	Scheme	KAGIPSIPAN	Province	NUEVA VIZCAYA	River Basin	CASECNAN	Stream	C ASECNAN	
Coordi- nates	N. LAT	16°01'29"	E. LONG	121°22'43"	DAM & RESERVOIR	Dam/Weir Type		River Cross Section at Dam/ Weir	River- bed	El.	360 m Width	30 m
Topo. Map No. 3268-II	Geo. Map SCALE	1:250,000	SCALE	1:250,000	Length of Water Way	Reservoir Area	km ²		Dam Crest	El.	531 m Height	171 m

	Geologic Formation and Age of the Site	Caraballo group (Cretaceous to Eocene) Formation I: Andesitic tuff breccia, andesitic lava and well bedded alternation of sandstone and shale. Formation II: Basaltic lava, spherite, basaltic tuff breccia and interbedded siliceous shale and sandstone. Formation III: Andesitic lava, andesitic tuff breccia and interbedded siliceous shale and limestone.	Geologic Structure	Bedding N-S. Dip west	CONSPICUOUS MATERIALS	Rock & Coarse Aggre- gates	Location	2 km north-west of damsite. Andesitic tuff breccia and lava Hard to very hard 3-5 km upstream from damsite
	Geologic Structure	Bedding N-S trend, Dip west	Geologic Structure	Bedding N-S. Dip west		Sand	Location	4 km WNS of damsite
	Rock Type and Age of Bed- rock	Andesitic tuff breccia, andesitic lava and well bedded alternation of sandstone and shale (Cretaceous to Eocene)	Rock Type & Age	Andesitic tuff breccia, andesitic lava and well bedded alternation of sandstone and shale. (Cretaceous to Eocene)		Earth Material	Soil Type	Residual soil of andesitic tuff breccia and lava
	Rock Quality	Both Probably hard to very hard slightly weathered and jointed fractured rock exposed at toe of the abutments.	Rock Quality	Hard to very hard slightly weathered (at left bank site)			Quality & Volume	Probably suitable
	Permea- bility	Overall Probably watertight, except weathered and fractured zone.	Overburden	Residual soil and talus deposits		Topographic Condition		V-shaped
	Over- burden	Both Abutment Residual soil River Bottom Volcanic rocks exposed at riverbed filled with sand	Geologic Structure	Assumed fault occur along the Casinyon River and right bank of Abaca River through Noyo to Maghanyay		Geologic Sketch		Not visited site (over flight survey) El. 553 m 474 m 360 m Roads Jointed bedrock Land slip
			Lithology & Age	Andesitic tuff breccia and lava, basaltic tuff breccia and lava (Cretaceous to Eocene)		Damsite		Good / Excellent
			Permeabi- lity and Ground- water	Probably watertight except deeply weathered faults		Waterway/Power Tunnel		Excellent
			Slope Stability	Probably stable however some possibility of landslip occur often impounding		Power House		Good / Excellent
			Sediment- ation	Less to common		Reservoir		Excellent
						Dam Construction Material		Excellent

G E O L O G I C A L D A T A S H E E T

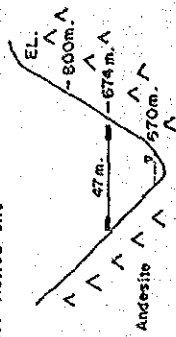
Region No.	II	I.D. No.	2-8-29-57	Scheme	G A D E N G		NUEVA VIZCAYA	River Basin	CASECNAN	CASECNAN
Coordi- nates	N. LAT 16°01'30"	E. LONG 121°20'54"	Type of Development	DAM & RESERVOIR	Province	DAM/Weir Type	River Cross Section	River- bed	Stream	CASECNAN
Topo. Map 1:50,000	No. 3268-II	Geo. Map SCALE	Length of Water Way	M	Reservoir Area	M	Dam/ Weir	El. Crest	554M	155 m
								Width	399 m	40 m
								Height	554M	155 m

G E O L O G I C A L	Geologic formation and Age of the Site	Coraballo Group (Cretaceous to Eocene) Formation I; Andesitic tuff breccia, andesitic lava and well bedded alternation of sandstone and shale. Formation II; Basaltic lava, dolerite, basaltic tuff breccia and interbedded siliceous shale & sandstone. Formation III; Andesitic lava, andesitic tuff breccia and interbedded siliceous shale and limestone.	Geologic Structure	Coraballo Formation II conformably overlies Formation I.	Geologic Structure	Coraballo Formation II conformably overlies Formation I.	CONSTRUCTION MATERIALS	Rock & Coarse Aggregate	Location	1.5 km. north-east of dam site.
	Geologic Structure	Coraballo Formation	Geologic Structure	Coraballo Formation II conformably overlies Formation I.	Geologic Structure	Coraballo Formation II conformably overlies Formation I.	CONSTRUCTION MATERIALS	Sand	Location	1-2 km upstream and downstream from dam site.
	Rock Type and Age of Bed-rock	Andesitic tuff breccia, andesitic lava, basaltic lava, dolerite, basaltic tuff breccia and interbedded siliceous shale and sandstone (Cretaceous to Eocene)	Geologic Structure	Andesitic tuff breccia, andesitic lava and well bedded alternation of sandstone and shale (Cretaceous to Eocene)	Geologic Structure	Andesitic tuff breccia, andesitic lava and well bedded alternation of sandstone and shale (Cretaceous to Eocene)	CONSTRUCTION MATERIALS	Material	Quality & Volume	River deposits sand and gravel.
	Rock Quality	Probably hard to very hard	Geologic Structure	Hard to very hard, slightly weathered (at left bank site)	Geologic Structure	Hard to very hard, slightly weathered (at left bank site)	CONSTRUCTION MATERIALS	Earth Material	Quality & Volume	1.5 km north of dam site.
	Permeability	Probably water tight except weathered and fractured zone	Geologic Structure	Probably water tight except deeply weathered faults	Geologic Structure	Probably water tight except deeply weathered faults	GENERAL ASSESSMENT	Damite	Quality & Volume	Residual soil of andesitic tuff breccia and lava.
	Overburden	Riverbed filled with sand and gravel	Geologic Structure	Probably stable however some possibility of landslip occur after impounding	Geologic Structure	Probably stable however some possibility of landslip occur after impounding	GENERAL ASSESSMENT	Waterway/Power Tunnel	Topographic Condition	Open V-shaped
			Geologic Structure	Less to common	Geologic Structure	Less to common	GENERAL ASSESSMENT	Power House	Geologic Sketch	Not visited site (overflight survey)
			Geologic Structure		Geologic Structure		GENERAL ASSESSMENT	Reservoir		
			Geologic Structure		Geologic Structure		GENERAL ASSESSMENT	Dam Construction Material		

G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-29-59	Scheme	UPPER CASECNAN	Province	NUEVA VISCAYA	River Basin	CASECNAN	Stream	CASIGNAN
Coordi- nates	16°06'39" N. LAT	121°15'39" E. LONG		Type of Development	RUN OF RIVER	/Weir Type	CONCRETE	River Cross Section & Weir	River- bed	670 m Width	40 m
Topo. Map No. 1:50,000	No-3268-II	Geo. Map SCALE	1:250,000	Length of Water Way	7000 M	Reservoir Area	— km ²		Crest EL.	674 m	Max. height 7 m

G E O L O G I C A L D A T A S H E E T		UPPER CASECNAN		NUEVA VISCAYA		CASECNAN		C A S I G N A N									
Geologic Formation and Age of the Site	Caraballo Group (Cretaceous to Eocene) Formation I; Andesitic tuff breccia and lava, well bedded alternation of sandstone and shale.	Formation II; basaltic lava and tuff breccia interbedded siliceous shale and sandstone	Formation III; Andesitic lava and tuff breccia interbedded siliceous shale and limestone	Assumed fault occurred at right bank site of Cosignan river. Anticline axis trend E-S across the near power house site. Bedding E-W Dip North	Anticline axis trend E-S located 200m. north of power house	Andesitic tuff breccia and lava, well bedded alternation of sandstone and shale (Cretaceous - Eocene)	Probably hard to very hard indurated and compacted slightly weathered (Cretaceous - Eocene)	Thin residual soil and Tolu deposits	Assumed fault occurred at right bank site of Cosignan river	Andesitic tuff breccia and lava, basaltic lava and tuff breccia interbedded siliceous shale and sandstone (Cretaceous-Eocene)	Probably hard to very hard indurated and compacted and slightly weathered	Partially not enough thickness for tunnel because several cracks across the tunnel route	Assumed fault trend N-S occur right bank of Cosignan river	Andesitic lava and tuff breccia interbedded siliceous shale (Cretaceous to Eocene)	Probably water tight	S t a b l e	Less to Common
Geologic Structure	Assumed fault occurred at right bank site of Cosignan river. Anticline axis trend E-S across the near power house site. Bedding E-W Dip North																
Rock Type and Age of Bed-rock	Andesitic lava and tuff breccia interbedded siliceous shale and limestone (Cretaceous - Eocene)																
Rock Quality	Both Abutments Indurated and compacted slightly weathered exposed rock																
Permeability	Overall Probably watertight except riverbed																
Overburden	Soth. Abutments Probably thick residual soil in higher elevation of abutments																
River Bottom	The riverbed filled with gravel and cobbles																
CONSTRUCTION MATERIALS		PROFIE OF DAM AXIS		GENERAL ASSESSMENT		ROCK & Coarse Aggre- gates		Location		Rock Type & Age		Quality & Volume		Location		Quality & Volume	
Earth Material		Topographic Condition		Dam Site		Sand		Not visited site		Basaltic lava and tuff breccia (Cretaceous to Eocene)		Hard to very hard		River flood plain near dam site		River deposits sand and gravel	
Geologic Sketch		V-Shaped		Waterway/Power Tunnel		Material		Geologic Sketch		River		River		River		River	
Dam Construction Material		Good		Power House		Material		Geologic Sketch		River		River		River		River	
Reservoir		Good		Reservoir		Material		Geologic Sketch		River		River		River		River	
Excellent		Good		Reservoir		Material		Geologic Sketch		River		River		River		River	



G E O L O G I C A L D A T A S H E E T

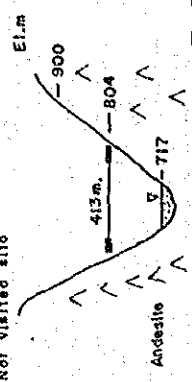
Region No.	II	I.D. No.	2-8-29-60	Scheme	UPPER CASECNAN-2	NUEVA VIZCAYA	River Basin	CASECNAN	Stream	CASIGNAN
Coordi- nates	16°06'45" N. LAT	121°15'28" E. LONG	Type of Development	DAM & RESERVOIR and WATERWAY	Province		River bed	El.	680 m	Width 30 m
Topo. Map No.	3268-II	Geo. Map No.	1:250,000	Length of Water Way	Reservoir Area	9200 m ²	Dam Crest	El.	802 m	Height 122 m
Scale	1:50,000	SCALE								

Geologic Formation and Age of the Site	Caraballo Group (Cretaceous to Eocene) Formation I: Andesitic tuff breccia and lava, well bedded alternation of sandstone and shale. Formation II: Basaltic lava and tuff breccia interbedded siliceous shale and sandstone. Formation III: Andesitic lava and tuff breccia interbedded siliceous shale and limestones.		Geologic Structure	Anticline axis trend E-S located 200m north of powerhouse	Construction Materials	Rock & Coarse Aggre- Gates	Location	4 Km. SSE of damsite
	Geologic Structure	Assumed fault occurred at right bank site of Casignan river. (Anticline axis trend E-S across the near powerhouse site) Bedding E-W, Dip north	Overburden	Thin residual soil and Toluus deposits	Topographic Condition	Sand	Location	1-3 Km. upstream from damsite
Rock Type and Age of Bed- rock	Andesitic lava and tuff breccia interbedded siliceous shale (Cretaceous to Eocene)	Geologic Structure	Assumed fault occurred at right bank site of Casignan river	Earth Material	Geologic Sketch	Material	Quality & Volume	River deposits (sand and gravel)
Rock Quality	Both Abutments Probably hard to very hard, indurated and compacted, partially slightly weathered and fractured at right abutment	Rock Type & Age	Andesitic tuff breccia and lava, basaltic lava and tuff breccia, inter bedded siliceous shale and sandstone (Cretaceous to Eocene)	Overburden	Mostly enough thickness	Soil Type	Quality & Volume	Residual soil of basaltic lava
Permeability	Overall	Geologic Structure	Probably waterlight except riverbed	Geologic Structure	Assumed fault trend N-S occur right bank of Casignan river	Topographic Condition	Not visited site	V - Shaped
	Both Abutments	Lithology & Age	Probably waterlight	Lithology & Age	Andesitic lava and tuff breccia inter bedded siliceous shale (Cretaceous to Eocene)	Geologic Sketch	Elm	425m -602 -680
Overburden	River Bottom	Permeability and Ground- Water	Probably waterlight	Permeability and Ground- Water	Probably waterlight	Damsite	Waterway/Power Tunnel.	Good
		Slope Stability	Probably waterlight	Slope Stability	Siebia	Power House	Reservoir	Good
		Sediment- ation	Less	Sediment- ation	Less	Dam Construction Material	Excellent	

G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-29-61	Scheme	UPPER CASECNAN-3	NUEVA VIZCAYA	River Basin	CASECNAN	CASIGNAN
Coordi- nates	16°08'09" N. LAT	121°14'34" E. LONG	Type of Development	DAM & WATERWAY	Province	River Cross Section at Dam/ Water	River-bed El.	717 m	Stream
Topo. Map No.	3268-III	Geo. Map No.	1:250,000	Length of Water Way	14000 M	Reservoir Area	Dam Crest El.	804 m	Height
Scale	1:50,000	Scale	1:100,000						Width
									20 m
									87 m

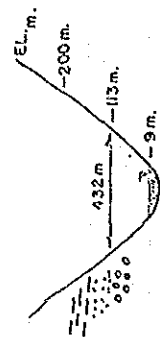
Geologic formation and Age of the Site	Mamporang Formation (Oligocene) Dacitic tuff, Basaltic Pyroclastic Caraballo Group (Cretaceous to Eocene) Formation II: Basaltic lava and tuff breccia interbedded siliceous shale and sandstone Formation III: Andesitic lava and tuff breccia interbedded siliceous shale and limestone		Geologic Structure	Assumed fault occur along the Mango river		Rock & Coarse Aggre- gates	Location		1km. south of damsite
	Geologic Structure	Assumed fault (trend N30°W) occur, right abutment of damsite. Syncline (trend N45°E) occur 1km. downstream of damsite Bedding N45°E		Rock Type & Age	Siliceous shale of Formation III belongs to Caraballo Group (Cretaceous to Eocene)		Rock Type & Age	Andesitic lava and tuff breccia (Cretaceous to Eocene)	
Rock Type and Age of Bed- rock	Andesitic lava and tuff breccia interbedded siliceous shale (Cretaceous to Eocene)		Rock Quality	Probably hard and locally occur fractured joints		Earth Material	Location		2Km. upstream from damsite
Rock Quality	Probably hard to very hard, indurated and compacted, slightly weathered		Overburden	Talus deposits and debris			Material	Quality & Volume	
Left Abutment	Probably hard to very hard and fractured due to effect of fault		Geologic Structure	Assumed fault trend N30°W across the middle way of tunnel route		Topographic Condition	Location		2Km. north of damsite
	Right Abutment	Probably hard to very hard and fractured due to effect of fault		Rock Type & Age	Andesite lava and tuff breccia interbedded siliceous shale (Cretaceous-Eocene) Dacitic tuff (Oligocene) Basaltic lava and tuff breccia (Cretaceous-Eocene)		Soil Type	Residual soil of dacitic tuff	
Overall	Probably watertight except weathered fractured zone		Rock Quality	Probably hard indurated locally slightly weathered and fractured		Geologic Sketch	Quality & Volume		Probably suitable
	Probably watertight except weathered fractured zone		Overburden	Enough thickness of tunneling without full support, except crossing point of the Casignan river			Topographic Condition	V-Shape d	
Permeability	Probably watertight except weathered fractured zone		Geologic Structure	Assumed fault trend N30°W occur right bank of Casignan		Dam site	Waterway/Pover Tunnel		Acceptable
	Probably watertight except weathered fractured zone		Lithology & Age	Andesitic lava and tuff breccia interbedded siliceous shale (Cretaceous to Eocene) Dacitic tuff (Oligocene)			Waterway/Pover Tunnel	Acceptable	
Both Abutments	Residual soil and Talus deposits		Permeability and Ground-water	Probably watertight		Power House	Reservoir		Good
	The riverbed filled with gravel, boulder and sand		Slope Stability	Stable			Reservoir	Dam Construction Material	
River Bottom	The riverbed filled with gravel, boulder and sand		Sedimentation	Less					



G E O L O G I C A L D A T A S H E E T

Region No.	11	I.D. No.	2-32-0-1	T A B O A N		CAGAYAN	River Basin	T A B O A N	Stream	T A B O A N	
Coordinates	17° 55' 58" N. LAT	122° 07' 50" E. LONG	DAM & RESERVOIR	Province	DAM & RESERVOIR	Province	River Bed	River-El.	9 m	Width	60 m
Topo. Map	No. 3473-IV	Geo. Map	1:600,000	DAM	RESERVOIR	DAM	Cross Section at Dam	Dam Crest	113 m	Height	104 m
Scale	1:50,000	SCALE	1:600,000	Water Way	Water Way	Water Way	Reservoir Area	km ²			
Scheme		Type of Development		Length of Water Way							

Geologic Formation and Age of the Site	Metavolcanics (Cretaceous-Paleogene)		Basalt, andesite, Diolite		Lubacuan Formation (Middle Miocene)		Conglomerate, sandstone, shale		Culoo Formation (Late Miocene)		Limestone	
	Sedimentation		Bedding N 45° E									
Geologic Structure	Both		Probably hard indurated		Cemented and compacted		partially jointed and weathered					
	Overall		Probably watertight except riverbed									
Permeability	Both		Probably thick residual soil occur		at higher elevation of abutments							
	River Bottom		The riverbed filled with thick sand and gravel									
Overburden	Geologic Structure		Geologic lineament (NNW-SSE) occur just downstream of powerhouse site		Conglomerate, Sandstone, Shale (Middle Miocene)		Hard and slightly to moderately weathered (at right bank site)		Terrace deposits Talus deposits			
	Rock Type & Age		Rock Quality		Overburden		Geologic Structure		Rock Type & Age		Rock Quality	
Rock Quality	Geologic Structure		Geologic Structure		Geologic Structure		Geologic Structure		Rock Type & Age		Rock Quality	
	Overburden		Overburden		Overburden		Overburden		Overburden		Overburden	
Damite	Geologic Structure		Geologic Structure		Geologic Structure		Geologic Structure		Rock Type & Age		Rock Quality	
	Lithology & Age		Lithology & Age		Lithology & Age		Lithology & Age		Lithology & Age		Lithology & Age	
Waterway/Power Tunnel	Permeability and Groundwater		Permeability and Groundwater		Permeability and Groundwater		Permeability and Groundwater		Permeability and Groundwater		Permeability and Groundwater	
	Slope Stability		Slope Stability		Slope Stability		Slope Stability		Slope Stability		Slope Stability	
Power House	Sedimentation		Sedimentation		Sedimentation		Sedimentation		Sedimentation		Sedimentation	
	Stable		Stable		Stable		Stable		Stable		Stable	
Reservoir	Common		Common		Common		Common		Common		Common	
	Good		Good		Good		Good		Good		Good	
Dam Construction Material	Good		Good		Good		Good		Good		Good	
	Poor		Poor		Poor		Poor		Poor		Poor	



G E O L O G I C A L D A T A S H E E T

Region No.	11	I.D. No.	2-47-0-1	Scheme	P A L A N A N	Province	I S A B E L A	River Basin	- P A L A N A N	Stream	P I N A C A N A U A N	
Coordi- nates	16°55'15" N. LAT		122°23'50" E. LONG		DAM B RESERVOIR		Dam/Weir Type		River- bed	El.	35 m Width	20 m
Topo. Map 1:50,000	No. 3470-1	Geo. Map SCALE	1:250,000	Type of Development	Reservoir		Reservoir Area	Section at Dam/ Weir	Crest	EL.	100 m Height	65 m

		Limestone (Lower-Middle Miocene) Basic and Ultrabasic, mainly peridotite. (Cretaceous-Paleogene)	Many caves and open joints in the limestone	Geologic Structure	CONSTRUCTION MATERIALS	Rock & Coarse Aggre- gates	Location	3-5 km. NE from damsite
Geologic formation and Age of the Site	Metamorphic rocks, Undifferentiated schist and quartzite	NS direction Thrust fault located 5 km. west from damsite	Limestone (Miocene)	Rock Type & Age	Sand	Location	Quality & Volume	Hard
Geologic Structure	NS direction Thrust fault located 5 km. west from damsite	Limestone (Miocene)	Hard rich jointed (at the left bank)	Rock Quality	Material	Location	Quality & Volume	Within 4 km. from damsite
Rock Type and Age of Bed- rock	Limestone (Miocene)	Limestone (Miocene) Basic and Ultrabasic Rock (Cret-Paleogene) Metamorphic rocks (Pre-Jurassic)	Residual soil, riverbed deposits	Geologic Structure	Earth Material	Location	Quality & Volume	River deposits
Rock Quality	Probably rather hard with abundant rich joints and cracks	Probably high permeability	Assumed fault occur along the Panoconouan river, rich caves and joints in the limestone	Rock Quality	Topographic Condition	Location	Quality & Volume	3-4 km. north from damsite
Perme- ability	Probably high permeability	Probably high permeability	Probably high permeability	Overburden	Geologic Sketch			
Over- burden	Residual soil	Stable but some possible of long slip, rock creep	Common	Sediment- ation	Damsite			
Overall	Probably high permeability	Probably high permeability	Probably high permeability	Slope Stability	Power House	Reservoir	Good	
Overall	Probably high permeability	Probably high permeability	Probably high permeability	Sediment- ation	Dam Construction Material	Reservoir	Poor	
Overall	Probably high permeability	Probably high permeability	Probably high permeability	Sediment- ation	Dam Construction Material	Dam Construction Material	Good	

G E O L O G I C A L D A T A S H E E T

Region No.	III	I.D. No.	3-13-0-1	Scheme	M A L U P A		A U R O R A		River Basin	C A B A T A G A N		Stream	M A L U P A
Coordi- nates	15°44'40" N. LAT	121°21'30" E. LONG		Type of Development	D A M & R E S E R V O I R		Dam/Weir Type		River Cross Section	River- bed	El.	94 m	Width 40 m
Topo. Map 1:50,000	No. 3267-II	Geo. Map SCALE 1:200,000		Length of Water Way	m		Reservoir Area		km ²	Dam Crest	El.	186 m	Height 86 m

Geologic formation and Age of the Site	Cerro del Group (Cretaceous-Paleocene) Essentially spilitic and basic flows. Andesite, basalt, agglomerate and tuff Transgressive on "basement" rocks Intrusive Rocks (Middle-Early Miocene) Largely intra-Miocene quartz diorite. Mostly batholiths and stocks, some localities include granodiorite and diorite porphyry.		Gently folded, and jointed NW-SE trends structural feature		Geologic Structure		Gently folded, and jointed NW-SE trends structural feature		CONSTRUCTION MATERIALS		Rock & Coarse Aggregates		Location		2 Km. south east of damsite	
	Geologic Structure	Several faults (trend NW-SE), occur near damsite, which are controlled by the Philippine Fault		Rock Type & Age		Andesite, basalt, agglomerate (Cretaceous-Paleocene)		Hard to rather hard with moderately jointed (at left bank site)		Sand		Quality & Volume		Hard		Andesite, Basalt, Agglomerate (Cretaceous-Paleocene)
Rock Type and Age of Bed-rock	Basalt, Andesite, Agglomerate (Cretaceous-Paleocene)		Overburden		River deposits and terrace deposits		Hard to rather hard with moderately jointed (at left bank site)		Earth Material		Quality & Volume		River deposits (sand and gravel)		2 Km. west of damsite	
Rock Quality	Overall Hard and indurated moderately jointed and gently folded		Geologic Structure				River deposits and terrace deposits		Topographic Condition		Quality & Volume		Dish Shaped		Not visited site	
Permeability	Overall Probably low permeability		Lithology & Age		Andesite, basalt, Agglomerate (Cretaceous-Paleocene) Diorite, Quartz diorite (Miocene)		Several faults occur in the reservoir area		Geologic Sketch		Quality & Volume		Probably suitable		Elm	
Overburden	Riverbed filled with thick sand and gravel		Permeability and Ground-water		Probably waterlight		Probably waterlight		Dam Site		Quality & Volume		Good		1028 m	
	Very thick residual soil occur at top of Abutments		Slope Stability		Stable		Stable		Waterway/Over Tunnel		Quality & Volume		Good		186	
	River Bottom		Sedimentation		Common		Common		Power House		Quality & Volume		Good			
									Reservoir		Quality & Volume		Good			
									Dam Construction Material		Quality & Volume		Excellent			

G E O L O G I C A L D A T A S H E E T

Region No.	III	I.D. No.	3-23-0-1	Scheme	UMIRAY-3	Province	AURORA	River Basin	UMIRAY	Stream	UMIRAY
Coordi- nates	15°04'32" N. LAT	121°21'35" E. LONG	Type of Development	DAM & RESERVOIR	Dam/Weir Type	Reservoir Area	DAM	River- bed	UMIRAY	60 m Width	40 m
Topo. Map No. 3265-II	Geo. Map SCALE	1:1,000,000	Length of Water Way	m	Reservoir Area	km ²	Section at Dam/ Weir	Dam Creat	UMIRAY	161 m Height	101 m

Geologic formation and Age of the Site	Pg. (Paleocene-Eocene) Thick, extensively, transgressive mixed shif wackes and shales (flysch) associated with minor basalt conglomerate reef limestone and andesitic flows and pyroclastics. N: (Oligocene-Miocene) Largely wackes, shales and limestone		Fault (trend N-S) occur near powerhouse site		Location 2.5 Km. south of damsite	
	Several faults (trend N-S) occur within 1 Km. from damsite. These faults connected with Philippine fault		Wacke sandstone, shales and conglomerate (Paleocene-Eocene) Pg is probably equivalent to Bayabas Formation		Rock Type & Age	
Geologic Structure	Several faults (trend N-S) occur within 1 Km. from damsite. These faults connected with Philippine fault		Thick residual soil and talus deposits		Quality & Volume	
Rock Type and Age of Bed- rock	Wacke Sandstone, Shales and Conglomerate (Paleocene-Eocene) Pg is probably equivalent to Bayabas Formation		Overburden		Location	
Rock Quality	Hard and indurated probably accompa- nied with folded and fractured zone		Geologic Structure		Soil Type	
Permea- bility	Overall Probably low permeability except fractured weathered zone		Overburden		Quality & Volume	
	Both Abutments River Bottom		Geologic Structure		Topographic Condition	
Over- burden	Rather thick residual soil occur at higher elevation		Lithology & Age		Not visited site	
	Riverbed filled with sand and gravel		Permeability and Ground- water		Geologic Sketch	
			Several faults running along the Umiray river			
			Wacke sandstone, shale and conglomerate (Paleocene-Eocene) Limestone (Oligocene-Miocene)			
			High permeability at limestone area, exposed level around 80m in elevation			Damsite Waterway/Power Tunnel Power House Reservoir Dam Construction Material
			Probably stable			
			L o s s			Good
			Probably stable			Acceptable
			Probably stable			Poor
			Probably stable			Excellent

G E O L O G I C A L D A T A S H E E T

Region No.	III	I.D. No.	3-25-2-2	Scheme	BALINTINGAN	Province	NUEVA ECIJA	River Basin	PEÑARANDA	Stream	SUMBACAO
Coordi- nates	15°18'01" N. LAT	121°07'19" E. LONG		Type of Development	DAM & RESERVOIR	Dam/Weir Type		River Cross Section at Dam/ Valley	River- bed El.	74 m	Width 20 m
Topo. Map Scale	No. 3285-IV	Geo. Map Scale		Length of Water Way	M	Reservoir Area	km ²		Dam Crest El.	164 m	Height 90 m

Geologic formation and Age of the Site	Poz (?) (Oligocene) Minor limestone /or wackes and shales Generally associated with Karstophyre and andesitic flows Nt (Lower-Middle Miocene) Conglomerates, wackes, shales and limestone associated with basic flow intrusive rocks (Neogene) Quartz diorite		Fault trend N-S occur just besides powerhouse site Wackes with Andesite flows (Oligocene) Hard (at right bank site) Residual soil and Totus deposits		2.5Km. south of damsite Quartz diorite (Neogene) Hard to very hard 10Km. downstream from damsite River deposits (sand and gravel)			
	Geologic Structure	N-S trend fault intersect of 0.5Km. downstream of damsite		Location 2.5Km. south of damsite				
Rock Type and Age of Bed- rock	Wackes with Andesite flows (Oligocene)		Rock Type & Age		Rock & Coarse Aggre- gates			
Rock Quality	Both Abutments Probably hard and indurated compacted rock with some joints		Rock Quality		Sand Material			
Perme- ability	Overall Probably watertight except fractured joints		Geologic Structure		Earth Material			
	Both Abutments Medium thickness of residual soil River bed filled with some boulder and gravel		Lithology & Age		Quality & Volume			
Over- burden	Both Abutments River Bottom		Slope Stability		Location 2.5Km. south of damsite			
	River Bottom		Sediment- ation		Soil Type			
D A M			CONSTRUCTION MATERIALS			Topographic Condition		
P R O F I L E			Geologic Sketch			Not visited site		
O V E R B U R D E N			Overburden			V-Shaped		
G E N E R A L			Geologic Structure			Elm -200 -140 -74		
A S S E S S M E N T			Lithology & Age			Damsite		
P E R M E A B I L I T Y			Permeability and Ground- water			Waterway/Pover Tunnel		
O V E R B U R D E N			Overburden			Pover House		
S L O P E			Slope Stability			Reservoir		
S E D I M E N T A T I O N			Sediment- ation			Dam Construction Material		
G E N E R A L			Geologic Sketch			Excellent		

GEOLOGICAL DATA SHEET

Region No.	III	I.D. No.	3-25-2-3	Scheme	PAPAYA		NUEVA ECILJA	River Basin	PEÑARANDA	Stream	CHICO
Coordinates	15°21'39" N. LAT	121°10'26" E. LONG	Type of Development	DAM & RESERVOIR	Province			River Cross Section at Dam/Weir	River bed El.	92 m	Width 20 m
Topo. Map No. 1:50,000	No. 3266-III	Geo. Map SCALE	Length of Water Way	M	Reservoir Area			Dam Crest El.	167 m	Height	75 m

Geologic formation and Age of the Site	Kpd (Cretaceous-Paleogene) Undifferentiated greywackes and metamorphosed shales with spilitic, basic flow and pyroclastics		M P O H	Geologic Structure	Limestones unconformably overlies wackes with andesite flows		CONSTRUCTION MATERIALS	Rock & Coarse Aggregate	Location	2 Km. west of damsite
	Pg (Oligocene) Wackes generally associated with Keratophyre and andesite flows				Wackes with andesite flows (Oligocene)					
Geologic Structure	Ni (Lower-Middle Miocene) Conglomerate, wacke, Limestone		M M O M	Rock Quality	Hard (at right bank site)		Sand	Location	8-10 Km. downstream of damsite	
	Normal fault (N45°W) intersect the Peñaranda river at just upstream of damsite, Limestone occur on just downstream of damsite				Residual soil and Talus deposits					Material
Rock Type and Age of Bedrock	Wackes with andesite flows (Oligocene)		M A Y	Geologic Structure			Earth Material	Soil Type	Residual soil of Limestone	
	Both Abutments Probably hard to very hard indurated compacted rock with some joints									Quality & Volume
Rock Quality	Overall Probably water/tight except fractured joints		M A F	Rock Quality			Topographic Condition	Not visited site	V-Shaped	
	Probably water/tight except fractured joints				Normal fault (NW-SE) intersect the Metaltli creek					Geologic Sketch
Permeability	Medium thickness of residual soil		M A I	Lithology & Age	Wackes with andesite flows (Oligocene), greywackes and shales (Cretaceous-Paleogene)		Damsite	Waterway/Power Tunnel	Good / Acceptable	
	River bed filled with some boulder and gravel				Probably watertight					Power House
Overburden	River bed filled with some boulder and gravel		M R S	Slope Stability	Probably stable except slumping soils and rocks after impounding		Reservoir	Dam Construction Material	Good	
	Overall				Common					Good

G E O L O G I C A L D A T A S H E E T

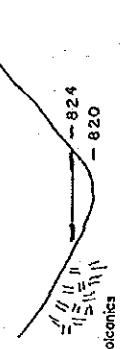
Region No.	III	I.D. No.	3-77-0-2	Scheme	P I L A	PANGASINAN	River Basin	AGNO	Stream	P I L A
Coordi- nates	15°44'37" N. LAT	120°15'20" E. LONG	Type of Development	DAM & RESERVOIR	Province	Dam/Weir Type	River Cross Section at Dam	River- bed EL.	86 m	Width 40 m
Topo. Map No. 1:50,000	No. 3067-III	Geo. Map SCALE	Length of Water Way	M. AREA	Reservoir	M. AREA	Dam Crest	EL.	189 m	Height 103 m

Geologic formation and Age of the Site	Zombales Ultramafics/Ultramafic and Mesic Plutonic rock (Cretaceous-Paleogene)		Some minor steeply dipping faults cut the ultra basic rocks		CONSTRUCTION MATERIALS	Location	1.5 Km. west of damsite
	Geologic Structure	Pre dominantly peridotite associated with late gabbro and/or diabase dikes. Generally thrustured or upfaulted into Tertiary and older rock formation		Rock Type & Age		Peridotite, gabbro, diabase (Cretaceous-Paleogene)	Rock & Course Aggre- gates
Geologic Structure	Numerous, minor steeply dipping faults cut the ultra basic rocks in many places		Overburden	Terrace deposits, Talus deposits	PROFILE OF DAM AXIS	Location	1-3 Km. downstream of damsite
	Rock Type and Age of Bed- rock	Peridotite associated with late gabbro and/or diabase dikes (Cretaceous-Paleogene)		Geologic Structure		_____	Material
Rock Quality	Both Abutments indurated with tight joints and slightly weathered		Rock Quality	_____	GENERAL ASSESSMENT	Location	3 Km. north-east of damsite
	Overall	Probably waterlight except fractured zone		Rock Type & Age		_____	Soil Type
Permeability	Probably waterlight except fractured zone		Geologic Structure	Numerous, minor steeply dipping faults cut the ultra basic rocks in many places	Damsite	Quality & Volume	Probably suitable
	Both Abutments	Medium thickness of residual soil		Lithology & Age		Peridotite, gabbro, diabase (Cretaceous-Paleogene)	Topographic Condition
Overburden	Medium thickness of residual soil		Slope Stability	Probably stable	Waterway/Power Tunnel	Geologic Sketch	
	Both Abutments	Probably waterlight		Sediment- ation			

G E O L O G I C A L D A T A S H E E T

Region No.	III	I.D. No.	3-77-O-5	Scheme	AGNO-1	Province	BENGUET	River Basin	AGNO	Stream	AGNO	
Coordi- nates	16°33'47" N, 120°47'55" E, LONG	Type of Development		Run of River	Dam/Weir Type	CONCRETE		River Cross Section	River-El.	820 m	Width	50 m
Topo. Map No.	3169-1	Geo. Map No.	1:250,000	Length of Water Way	Reservoir Area	—		at Section	Crest El.	924 m	Max. Height	7 m
Scale	1:50,000											

	Geologic Formation and Age of the Site UV, Pugo Formation (Cretaceous-Paleogene) Metamorphosed submarine flows largely sphyllite & basalts, some Karstophres and andesitic intercalated with sediments. N2 (Late Miocene to Pliocene Sedimentary Rocks) Conglomerate associated with thin interbeds of tuffaceous wacke, claystone and siltstone N1 (Early to Middle Miocene) Conglomerate, sandstone, wacke and volcanics intrusives (Neogene) Quartz diorite	No major fault Metamorphosed basalt and andesite (Cretaceous-Paleogene) Hard and indurated with slightly to moderately weathered Thin residual soil and debris	Geologic Structure Rock Type & Age Rock Quality Overburden	No major fault Metamorphosed basalt and andesite (Cretaceous-Paleogene) Hard and indurated with slightly to moderately weathered Enough thickness of tunneling No major fault Metamorphosed basalt and andesite (Cretaceous-Paleogene)	Rock & Coarse Aggregate Sand Material Earth Material Topographic Condition	Location Rock Type & Age Quality & Volume Location Quality & Volume Location Soil Type Quality & Volume Topographic Condition Not visited site (Overflight Survey) Metavolcanics	1.5 Km. south of weir Metamorphosed basalt and andesite Hard and indurated 0-2 Km. upstream of weir River deposits (sand and gravel)						
G E O L O G I C A L	CONSTRUCTION MATERIALS							PROFILE OF DAM AXIS			GENERAL ASSESSMENT		
D A M	CONSTRUCTION MATERIALS							PROFILE OF DAM AXIS			GENERAL ASSESSMENT		
S T R U C T U R E	CONSTRUCTION MATERIALS							PROFILE OF DAM AXIS			GENERAL ASSESSMENT		
P E R M E A B I L I T Y	CONSTRUCTION MATERIALS							PROFILE OF DAM AXIS			GENERAL ASSESSMENT		
O V E R B U R D E N	CONSTRUCTION MATERIALS							PROFILE OF DAM AXIS			GENERAL ASSESSMENT		



G E O L O G I C A L D A T A S H E E T

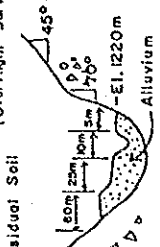
Region No.	III	I.D. No.	3-77-0-6	Scheme	AGNO - 2	Province	BENGUET	River Basin	AGNO	Stream	AGNO
Coordi- nates	16°37'25" N. LAT	120°49'47" E. LONG		Type of Development	RUN OF RIVER	Dam/Weir Type	CONCRETE	River Cross Section	River-bed	El. 1010 m Width	40m
Topo. Map No. 3189-1	Geo. Map No. 1:250,000	SCALE		Length of Water Way	8335 m	Reservoir Area		Max. Height	Crest El.	1013 m	6 m

	N1: Zigzag Series (Early to Middle Miocene) Conglomerate, wacks associated with basic to intermediate flows and pyroclastics, agglomerates. N2: (Late Miocene to Pliocene) Conglomerate associated sandstone interbedded volcanic rocks UV: Pugo Formation (Eocene-Cretaceous) Metamorphosed basalt and andesite intrusives (Neogene) Quartz diorite	No major fault Metamorphosed basalt and andesite (Eocene - Cretaceous) Rather hard Less than 1m. of near water edge, thickness increasing towards upper slopes	Geologic Structure Rock Type & Age Rock Quality Overburden	Geologic Structure Rock Type & Age Rock Quality Overburden	Geologic Structure Rock Type & Age Rock Quality Overburden	Geologic Structure Rock Type & Age Rock Quality Overburden	Geologic Structure Rock Type & Age Rock Quality Overburden	Geologic Structure Rock Type & Age Rock Quality Overburden	Geologic Structure Rock Type & Age Rock Quality Overburden	Geologic Structure Rock Type & Age Rock Quality Overburden	Geologic Structure Rock Type & Age Rock Quality Overburden
G E O L O G I C A L	D A T A	S H E E T	G E O L O G I C A L	D A T A	S H E E T	G E O L O G I C A L	D A T A	S H E E T	G E O L O G I C A L	D A T A	S H E E T

G E O L O G I C A L D A T A S H E E T

Region No.	III	I.D. No.	3-77-0-5	Scheme	AGNO-3	Province	BENGUET	River Basin	AGNO	Stream	AGNO
Coordinates	16°40'42" N. LAT	120°49'20" E. LONG		Type of Development	RUN OF RIVER	/Weir Type	CONCRETE	River Cross Section	River bed	EL. 1220 m Width	40 m
Topo. Map	No. 3170-II	Geo. Map	1:250,000	Length of Waterway	7585 m	Reservoir Area	—	Section of Weir	Crest EL.	1223 m Height	6 m

<p>Geologic formation and Age of the Site</p> <p>Ri: Zigzag Series (Early to Middle Miocene) Conglomerate, wacke intercalated with volcanic flow tuff, agglomerate and Pyroclastics</p> <p>Ni: (Late Miocene to Pliocene) Conglomerate associated sandstone interbedded volcanic rocks</p> <p>UV: Puga Formation (Eocene-Cretaceous) Metamorphosed basalt and andesite Intrusives (Neogene) Quartz diorite</p>	<p>Geologic Structure</p> <p>Horizontally bedded conglomerate Ambuklao Fault occur the site</p> <p>Rock Type & Age</p> <p>Conglomerate and sandstone interbedded volcanic flow (Late Miocene to Pliocene)</p> <p>Rock Quality</p> <p>Hard to rather hard but cut by N15°E parallel joint</p> <p>Overburden</p> <p>Less than 1m in thickness from riverbed up to 7m in high, after 7m overburden thickness increasing about 2m.</p>	<p>Geologic Structure</p> <p>Proposed tunnel would intersect N80°E Joints Ambuklao Fault running by parallel</p> <p>Rock Type & Age</p> <p>Quartz diorite, quartz gabbro (Neogene)</p> <p>Rock Quality</p> <p>Hard with some slightly weathered</p> <p>Overburden</p> <p>Enough thickness for tunneling</p>	<p>Geologic Structure</p> <p>Ambuklao Fault (trend N-S) occur along the Agno River</p> <p>Lithology & Age</p> <p>Agglomerate / volcanic breccia (Early to Middle Miocene)</p> <p>Permeability and Groundwater</p> <p>Water tightness</p> <p>Slope Stability</p> <p>Generally stable but locally several sliding scars appear</p> <p>Sedimentation</p> <p>Less to common</p>
CONSTRUCTION MATERIALS	PROFILE OF DAM AXIS	GENERAL ASSESSMENT	
ROCK & Coarse Aggregate	Topographic Condition	Damsite	Waterway/Power Tunnel
Sand	Visited Site	Power House	Reservoir
Material	Residual Soil (Overlight Survey)	Reservoir	Dam Construction Material
Location	Geologic Sketch	Excavation	Excavation
Rock Type & Age	Agglomerate / Volcanic Breccia	Excavation	Excavation
Quality & Volume	Alluvium	Excavation	Excavation
Location	Agglomerate / Volcanic Breccia	Excavation	Excavation
Soil Type	Agglomerate / Volcanic Breccia	Excavation	Excavation
Quality & Volume	Agglomerate / Volcanic Breccia	Excavation	Excavation
Location	Agglomerate / Volcanic Breccia	Excavation	Excavation
Soil Type	Agglomerate / Volcanic Breccia	Excavation	Excavation
Quality & Volume	Agglomerate / Volcanic Breccia	Excavation	Excavation
Location	Agglomerate / Volcanic Breccia	Excavation	Excavation



G E O L O G I C A L D A T A S H E E T

Region No.	III	I.D. No.	3-77-4-10	Scheme	PAMPANG	Province	NUEVA VISCAYA	River Basin	AMBAYAOAN	Stream	PAMPANG	
Coordinates	16° 14' 18" N. LAT	E. LONG	120° 48' 18"	Type of Dam/Weir	RUN OF RIVER	Dam/Weir Type		River-bed	El.	360m	Width	40 m
Topo. Map No.	1:50,000	Geo. Map No.	3168-1	Length of Water Way	5275 m	Reservoir Area		Crest	El.	364 m	Max Height	7 m
		SCALE	1:100,000									

Geologic formation and Age of the Site	Ceraballo Group (Cretaceous-Eocene) Formation: andesitic, pyroclastic rocks and andesitic lavas with sandstone and shale beds		Geologic Structure	Geologic lineament occur along the Ambaydoon river		CONSTRUCTION MATERIALS	Location	2 km. east of damsite	
	Schist (Pre-Tertiary) Intrusive rocks (Neogene) Quartz diorite			Rock Type & Age	Andesite (Cretaceous-Eocene)		Rock Type & Age	Andesite (Cretaceous-Eocene)	
Geologic Structure	Assumed fault (N45°W) intersect just upstream of damsite Dip: N45°E; N-W		Overburden	Talus deposits and residual		Sand	1-5 km. downstream from powerhouse site		
Rock Type and Age of Bedrock	Andesite (Cretaceous-Eocene)		Geologic Structure	Two assumed faults intersect the tunnel route, and faulted structure occur		Material	River deposits sand and gravel		
Rock Quality	Both Abutments: Probably hard to very hard mostly fresh rock with slightly weathered and jointed		Rock Type & Age	Andesite with sandstone and shale beds (Cretaceous-Eocene)		Earth Material	2 Km. east of damsite		
Permeability	Overall: Probably watertight except jointed weathered zone		Rock Quality	Hard to very hard		Topographic Condition	V-Shaped		
	Berh Abutments: Medium thickness of residual soil		Overburden	Enough thickness		Geologic Sketch			
Overburden	River Bottom: Riverbed filled with some boulder and cobble.		Lithology & Age	Andesite (Cretaceous-Eocene)		Dam Site	Good / Acceptable		
			Permeability	Probably watertight		Waterway/Power Tunnel	Acceptable		
GENERAL ASSESSMENT				Slope Stability		Power House	Good		
				Sedimentation		Reservoir	Good		
				Sedimentation		Dam Construction Material	Excellent		

G E O L O G I C A L D A T A S H E E T

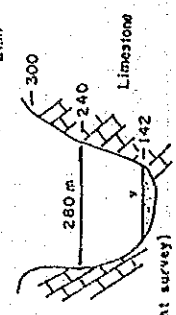
Region No.	IV	I.D. No.	4-7-0-1	Scheme	K A N A N	Province	Q U E Z O N	River Basin	A G O S	Stream	K A N A N
Coordi- nates	14° 44' 30" N. Lat	121° 31' 54" E. Long		Type of Development	D A M B R E S E R V O I R	Dam/ Reservoir Type	ROCK FILL	River bed	EL.	100m Width	20m
Topo. Map No. 1:50,000	No. 3364-III	Geo. Map SCALE	1:115,000	Length of Water Way		Reservoir Area	16.6 km ²	Dam Crest	EL.	254m Height	154m

Geologic formation and Age of the Site	Kpp: (Cretaceous-Paleogene) Graywackes, meta-shales, wackes with basalt conglomerate	Geologic Structure	Assumed fault (N-S) across powerhouse site	CONSTRUCTION MATERIALS	Location	1.5 Km. south of damsite	
	Bedding: N60-70°W Dip: 60-70°SW	Rock Type and Age of Bed-rock	Rock Type & Age	Graywackes, meta-shales wackes with basalt (Cretaceous-Paleogene)	Rock & Coarse Aggregate	Rock Type & Age	Graywackes (Cretaceous-Paleogene)
Rock Quality	Probably hard and sound rock partially folded and jointed, moderately weathered at left abutment	Rock Quality	Hard and sound (at right bank site)	Sand	Quality & Volume	Generally sound and hard	
Permeability	Probably impermeable except fractured joints, small conduits exist right abutment	Overburden	Talus deposits (partially)	Material	Location	1-5 Km. downstream from damsite	
	Overall	Geologic Structure		Earth Material	Quality & Volume	River deposits (sand and gravel)	
Overburden	Left Abutment	Rock Type & Age			Location	1 Km. east of damsite	
	Right Abutment	Geologic Structure			Soil Type	Residual soil of graywackes	
	Residual soil occur at top of abutment	Rock Quality			Quality & Volume	Probably suitable	
	Riverbed partially filled with limited gravel	Overburden			Topographic Condition	V-Shaped	
				PROFILE OF DAM AXIS			
				GENERAL ASSESSMENT			
				Damsite			Good
				Waterway/Power Tunnel			Good
				Power House			Good
				Reservoir			Good
				Dam Construction Material			Excellent

G E O L O G I C A L D A T A S H E E T

Region No.	IV	I.D. No.	4-7-0-2	Scheme	D A R A I T A N		Province	QUEZON	River Basin	AGOS	Stream	KALIWA
Coordinates	14°36'00" N. LAT	121°26'10" E. LONG		Type of Declaration	DAM & RESERVOIR		Dam/Weir Type		River bed	El. 142 m	Width	20 m
Topo. Map No. 1:50,000	No. 3263-1	Geo. Map SCALE	1:115,000	Length of Water Way			Reservoir Area	18.8 km ²	Dam Crest	El. 240 m	Height	98 m

Geologic formation and Age of the Site	(Oligocene-Miocene) Wackes, shales with conglomerate limestone, calcarenite dolite Kpp: (Cretaceous-Paleogene) Graywackes and Meta-shale interbedded spilitic basic flow and pyroclastics		Geologic Structure	Bedding: N-S		Rock & Coarse Aggregates	Location		1-2 km. south of damsite	
	Geologic Structure	Limestone (Oligocene-Miocene)		Rock Type & Age	Limestone (Oligocene-Miocene)		Location	1.5 km. north west of damsite		
Geologic Structure	Bedding: North - South Massive limestone with cavernous structure		Overburden	Talus deposits		Sand	Location		1-3 km. upstream from damsite	
Rock Type and Age of Bedrock	Limestones (Oligocene - Miocene)		Geologic Structure			Material	Quality & Volume		River deposits and Terrace deposits	
Rock Quality	Both abutments and coars		Rock Quality			Earth Material	Quality & Volume		Probably suitable	
Permeability	Probably high permeability due to Karatic limestones		Overburden			Topographic Condition	Quality & Volume		Probably suitable	
	Probably high permeability due to Karatic limestones		Geologic Structure	N-S Oriented		Topographic Condition	Quality & Volume		Probably suitable	
Overburden	Thick residual soil at high elevation		Lithology & Age	Limestone, wackes and conglomerate (Oligocene - Miocene)		Geologic Sketch	Quality & Volume		Probably suitable	
	The riverbed filled with some gravel and cobbles		Permeability and Groundwater	Probably low permeability except limestone areas		Geologic Sketch	Quality & Volume		Probably suitable	
Dam Construction Material	The riverbed filled with some gravel and cobbles		Slope Stability	Probably stable, except minor shallow slides which occurred on steep cultivated slopes areas		Topographic Condition	Quality & Volume		Probably suitable	
	The riverbed filled with some gravel and cobbles		Sedimentation	Common		Topographic Condition	Quality & Volume		Probably suitable	



G E O L O G I C A L D A T A S H E E T

Region No.	IV	I.D. No.	4-7-0-3	Scheme	UPPER AGOSI-M	Province	RIZAL	River Basin	AGOS	Stream	LENATIN
Coordi- nates	14°37'39" N. LAT	121°24'24" E. LONG		Type of Development	DAM & RESERVOIR	Dam/Weir Type		River- bed	EL.	180m Width	40m
Topo. Map Scale	No. 3263-1	Geo. Map Scale	1:115,000	Length of Water Way	1395 m	Reservoir Area		Dam Section	EL.	260m Height	80m

CONSTRUCTION MATERIALS	PROFILE OF DAM AXIS	DAM	GENERAL ASSESSMENT
<p>Geologic Formation and Age of the Site</p> <p>(Oligocene-Miocene) Wackes, shales with conglomerate, limestone, calcarenite and dolite</p>	<p>Geologic Structure</p> <p>Bedding: N-S/Steeply Folded limestone</p>	<p>Geologic Structure</p> <p>Bedding N-S</p>	<p>Rock & Coarseness</p> <p>Wackes, shales with conglomerate (Oligocene-Miocene)</p>
<p>Rock Type and Age of Bedrock</p> <p>Limestone (Oligocene-Miocene)</p>	<p>Rock Type and Age</p> <p>Limestone of intake site, wackes shales with conglomerate at outlet site (Oligocene-Miocene)</p>	<p>Rock Type and Age</p> <p>Limestone, wackes and conglomerates (Oligocene-Miocene)</p>	<p>Location</p> <p>1.5 Km. south west of damsite</p>
<p>Rock Quality</p> <p>Probably hard and slightly weathered</p>	<p>Rock Quality</p> <p>Hard, slightly weathered</p>	<p>Rock Quality</p> <p>Hard, slightly weathered with some open cracks and joints</p>	<p>Location</p> <p>1.5 Km. south west of damsite</p>
<p>Overall</p> <p>Probably high permeability due to Karstic, limestone</p>	<p>Overburden</p> <p>Thin to medium residual soil covered denth forest</p>	<p>Overburden</p> <p>Enough thickness</p>	<p>Location</p> <p>1.5 Km. downstream of damsite</p>
<p>Both Abutments</p> <p>The riverbed filled with some boulder and gravel</p>	<p>Slope Stability</p> <p>Probably stable except slumping of rocks and soils after impounding</p>	<p>Slope Stability</p> <p>Probably permeable at limestones area</p>	<p>Location</p> <p>1.5 Km. south west of damsite</p>
<p>River Bottom</p> <p>The riverbed filled with some boulder and gravel</p>	<p>Sedimentation</p> <p>Common</p>	<p>Sedimentation</p> <p>Common</p>	<p>Location</p> <p>1.5 Km. south west of damsite</p>
<p>Permeability</p> <p>Probably high permeability due to Karstic, limestone</p>	<p>Permeability and Groundwater</p> <p>Probably permeable at limestones area</p>	<p>Permeability and Groundwater</p> <p>Probably permeable at limestones area</p>	<p>Location</p> <p>1.5 Km. south west of damsite</p>
<p>Topographic Condition</p> <p>Not visited site (Overflight survey)</p>	<p>Topographic Condition</p> <p>V-Shaped</p>	<p>Topographic Condition</p> <p>V-Shaped</p>	<p>Location</p> <p>1.5 Km. south west of damsite</p>
<p>Geologic Sketch</p>	<p>Geologic Sketch</p> <p>Elim</p>	<p>Geologic Sketch</p> <p>Elim</p>	<p>Location</p> <p>1.5 Km. south west of damsite</p>
<p>Damsite</p> <p>Waterway/Power Tunnel.</p>	<p>Damsite</p> <p>Waterway/Power Tunnel.</p>	<p>Damsite</p> <p>Waterway/Power Tunnel.</p>	<p>Location</p> <p>1.5 Km. south west of damsite</p>
<p>Power House</p> <p>Good</p>	<p>Power House</p> <p>Good</p>	<p>Power House</p> <p>Good</p>	<p>Location</p> <p>1.5 Km. south west of damsite</p>
<p>Reservoir</p> <p>Acceptable</p>	<p>Reservoir</p> <p>Acceptable</p>	<p>Reservoir</p> <p>Acceptable</p>	<p>Location</p> <p>1.5 Km. south west of damsite</p>
<p>Dam Construction Material</p> <p>Good</p>	<p>Dam Construction Material</p> <p>Good</p>	<p>Dam Construction Material</p> <p>Good</p>	<p>Location</p> <p>1.5 Km. south west of damsite</p>

G E O L O G I C A L D A T A S H E E T

Region No.	IV	I.D. No.	4-7-0-4	Scheme	UPPER AGOS I-S	Province	R I Z A L	River Basin	A G O S	Stream	L I M U T
Co-ordinates	14°36'18"	121°24'30"		Type of Reclamation	DAM & RESERVOIR	Dam/Weir Type		River-bed	El.	180m	Width 40m
Topo. Map No.	3263-1	Geo. Map SCALE	1:115,000	Length of Water Way	500 m	Reservoir Area		Dam Section	Crest El.	260m	Height 80m

Geologic formation and Age of the Site	(Oligocene - Miocene) Wackes, shales with conglomerate, limestones, calcarenite and dolite		Geologic Structure	R S D O H		Geologic Structure	CONSTRUCTION MATERIALS		Rock & Coarse Aggregate	Location	2.5Km. ESE of damsite		
	Sedding: N-S / Steeply Folded limestones			M A R K			Rock Type & Age					Rock Type & Volume	
Geologic Structure	Limestone (Oligocene - Miocene)		Geologic Structure	M A R K		Rock Type & Age	PROFILE OF DAM AXIS		Sand	Location	1-3Km. downstream from damsite		
	Probably hard and slightly weathered, jointed, faulted with some open cracks and caves			K A V E R			Rock Quality					Topographic Condition	
Rock Quality	Both Abutments		Rock Quality	K A V E R		Overburden	GENERAL ASSESSMENT		Earth	Location	1.5Km. south west of damsite		
	Probably high permeability due to Karstic limestones			M A R K			Dam Site					Waterway/Power Tunnel	
Permeability	Overall		Permeability and Groundwater	M A R K		Lithology & Age			Geologic Sketch	Quality & Volume	Probably suitable		
	Thin to medium residual soil at top of abutments			M A R K			Limestone, wackes and conglomerate (Oligocene - Miocene)					Poor	
Overburden	River Bottom		Slope Stability	M A R K		Permeability and Groundwater			Dam Construction Material	Quality & Volume	Probably suitable		
	The riverbed filled with some boulder and gravel			M A R K			Probably permeable of limestone area					Acceptable	
		Sedimentation		M A R K									

G E O L O G I C A L D A T A S H E E T

Region No.	IV	I.D. No.	4-7-0-5	Scheme	UPPER AGOS - 2	Province	QUE ZON	River Basin	AGOS	Stream	K A N A N	
Coordinates	14° 48' 42" N, 121° 30' 42" E	Scale	1:50,000	Type of Development	DAM B RESERVOIR	Dam/Type	CONCRETE GRAVITY	River Cross Section at Dam/Weir	River Bed El.	166 m	Width	40 m
Pop. Map No.	3364-M	Geo. Map Scale	1:50,000	Length of Water Way	Reservoir Area	Reservoir	39.6 Km ²		Dam Crest El.	322 m	Height	156 m

<p>Geologic formation and Age of the Site</p> <p>Pg. Maybongin (Bayabas) Formation (Paleocene - Eocene) Largely graywacke sandstone and conglomerate pyroclastics mainly agglomerate and andesite</p>	<p>Geologic Structure</p> <p>Fault (NE-SW) occur right abutment</p>	<p>Geologic Structure</p> <p>Fault (NE-SW) occur right abutment</p>	<p>CONSTRUCTION MATERIALS</p> <p>Rock & Coarse Aggregate</p> <p>Rock Type & Age</p> <p>Graywacke sandstone (Paleocene - Eocene)</p> <p>Hard (at right bank site)</p>	<p>Rock & Coarse Aggregate</p> <p>Rock Type & Age</p> <p>Graywacke sandstone (Paleocene - Eocene)</p> <p>Hard</p>	<p>Location</p> <p>1.5 Km. south east of damsite</p>
<p>Geologic Structure</p> <p>Fault (NE-SW) occur right abutment</p>	<p>Geologic Structure</p> <p>Fault (NE-SW) occur right abutment</p>	<p>Geologic Structure</p> <p>Fault (NE-SW) occur right abutment</p>	<p>CONSTRUCTION MATERIALS</p> <p>Sand</p> <p>Material</p> <p>It will be manufactured from rock from quarry site</p>	<p>Sand</p> <p>Material</p> <p>It will be manufactured from rock from quarry site</p>	<p>Location</p> <p>5 Km. SSE of damsite</p>
<p>Rock Type and Age of Bed-rock</p> <p>Graywacke sandstone (Paleocene - Eocene)</p>	<p>Rock Type and Age</p> <p>Graywacke sandstone (Paleocene - Eocene)</p>	<p>Rock Type and Age</p> <p>Graywacke sandstone (Paleocene - Eocene)</p>	<p>Earth Material</p> <p>Residual soil of graywacke</p>	<p>Earth Material</p> <p>Residual soil of graywacke</p>	<p>Soil Type</p> <p>Residual soil of graywacke</p>
<p>Rock Quality</p> <p>Overall</p> <p>Hard to very hard, indurated with some joints</p>	<p>Rock Quality</p> <p>Overall</p> <p>Hard to very hard, indurated with some joints</p>	<p>Rock Quality</p> <p>Overall</p> <p>Hard to very hard, indurated with some joints</p>	<p>TOPOGRAPHIC CONDITION</p> <p>U-Shaped</p>	<p>TOPOGRAPHIC CONDITION</p> <p>U-Shaped</p>	<p>Topographic Condition</p> <p>U-Shaped</p>
<p>Permeability</p> <p>Overall</p> <p>Probably waterlightness except intensive weathering along the joints</p>	<p>Permeability</p> <p>Overall</p> <p>Probably waterlightness except intensive weathering along the joints</p>	<p>Permeability</p> <p>Overall</p> <p>Probably waterlightness except intensive weathering along the joints</p>	<p>Geologic Sketch</p>	<p>Geologic Sketch</p>	<p>Geologic Sketch</p>
<p>Both Abutments</p> <p>River Bottom</p>	<p>Both Abutments</p> <p>River Bottom</p>	<p>Both Abutments</p> <p>River Bottom</p>	<p>DAM SITE</p> <p>Damite</p> <p>Excellent</p>	<p>DAM SITE</p> <p>Damite</p> <p>Excellent</p>	<p>DAMITE</p> <p>Excellent</p>
<p>Overburden</p> <p>Thin residual soil</p>	<p>Overburden</p> <p>Thin residual soil</p>	<p>Overburden</p> <p>Thin residual soil</p>	<p>GENERAL ASSESSMENT</p> <p>Waterway/Power Tunnel</p> <p>Power House</p> <p>Reservoir</p> <p>Dam Construction Material</p>	<p>GENERAL ASSESSMENT</p> <p>Waterway/Power Tunnel</p> <p>Power House</p> <p>Reservoir</p> <p>Dam Construction Material</p>	<p>GENERAL ASSESSMENT</p> <p>Waterway/Power Tunnel</p> <p>Power House</p> <p>Reservoir</p> <p>Dam Construction Material</p>

GEOLOGICAL DATA SHEET

Region No.	IV	I.D. No.	4-115-1-1	Scheme	W A W A	Province	QUEZON	River Basin	MARIKINA	Stream	W A W A
Coordi- nates	14°43'30"	121°31'54"	Type of Development	DAM & RESERVOIR	DAM/ Type	CONCRETE GRAVITY	River Cross Section at Dam/ Weir	River bed El.	24 m	Width	20 m
Topo. Map 1:50,000	No. 3263-IV	Geo. Map SCALE	Length of Water Way	—	Reservoir Area	24.2 km ²	Dam Crest El.	160 m	Height	136 m	

GEOLOGIC FORMATION AND AGE OF THE SITE	Geologic formation and Age of the Site	Kinabuan Formation (Cretaceous) Altered spilittic basalt flows with intercalated highly indurated SS and chert Agout Formation (Early Miocene) Well bedded to massive limestones associated with thin siliceous layer. Medium Formation (Middle Miocene) Consists of three member, limestone member, volcanic member and clastic member	Geologic Structure	Bedding: N-S / 50° - 70° E	CONSTRUCTION MATERIALS	Location	1.5 Km. north of damsite and river bed of damsite	
	Geologic Structure	Well bedded to massive, associated many fractured joints, faults and coves. Right lateral fault occur on left bank saddle Montalban fault	Rock Type & Age	Clastic member (Middle Miocene) Bedded calcareous sandstone and silty shale	Rock & Coarse Aggregate	Rock Type & Age	Limestone and its rockfall and big boulder (Middle Miocene)	
	Rock Quality	Hard to very hard, rich open vertical joints, partly slightly weathered and fragile but fractures and/or faults are tight in deep portion	Rock Quality	Hard to rather hard (Left bank site)	Earth Material	Quality & Volume	Quality & Volume	Hard to very hard
	Permeability	High to very high, due to limestone cave except very tight fractures and fault	Overburden	River deposits (Terrace deposits and Alluvium)	Sand	Location	Location	Within 1 Km. from damsite
	Overburden	Very big rock fall and boulder overspread on the riverbed Thickness of river deposits is about 20m	Geologic Structure	—	Material	Quality & Volume	Quality & Volume	River deposits (sand and gravel)
	Both Abutments	Almost no residual soil	Rock Type & Age	—	Earth Material	Location	Location	—
	River Bottom	Very big rock fall and boulder overspread on the riverbed	Rock Quality	—	—	Topographic Condition	Topographic Condition	—
			Overburden	—	—	Geologic Sketch	Geologic Sketch	—
			Geologic Structure	Right lateral fault (trend NW-SE) occur along the Wawa river, Montalban Fault	—	Visited Site	Visited Site	—
			Lithology & Age	Limestone (Early Miocene), sandstone and silty shale (Middle Miocene), and altered spilittic basalt flows (Cretaceous)	—	Geologic Sketch	Geologic Sketch	—
		Permeability and Groundwater	Probably low permeability except limestone area	—	Damsite	Damsite	—	
		Slope Stability	Mostly stable except slumping residual soil and debris after impounding	—	Waterway/Power Tunnel	Waterway/Power Tunnel	—	
		Sedimentation	Common - Much	—	Power House	Power House	—	
				—	Reservoir	Reservoir	—	
				—	Dam Construction Material	Dam Construction Material	—	
				—	GENERAL ASSESSMENT	GENERAL ASSESSMENT	—	

