Hydropower Prospects for Southcentral Alaska

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for

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Renewable Energy Committee

January 9, 2007

Today's Discussion

- Basic concepts
- Alaska's hydropower resource
- Existing development statewide
- Susitna project
- Chakachamna project

Characteristics of Hydropower

- Renewable energy
- High front end cost
- Low annual costs
- Long lead time for permitting and construction
- Long operational life (200 years or more)
- Can be very environmentally benign
- Can impart major environmental impact

Hydropower Concepts

- The hydropower formula
- Installed capacity
- Streamflow
- Storage
- Storage project
- Run of river project

The Hydropower Formula

- Power (watts) = 0.0847 x Q x H x e

  Where

  Q is streamflow measured in cubic feet per second (cfs)

  H is head measured in feet

  e is the overall efficiency of the plant, usually between 0.6 and 0.9

  0.0847 is a constant to convert ft-lbs of energy to watts of energy

Installed Capacity

- Installed capacity in the powerhouse
  - Usually two or more times greater than the average power capacity of the river
  - Allows the plant to operate in a peaking mode to follow the utility's daily or seasonal customer load demand

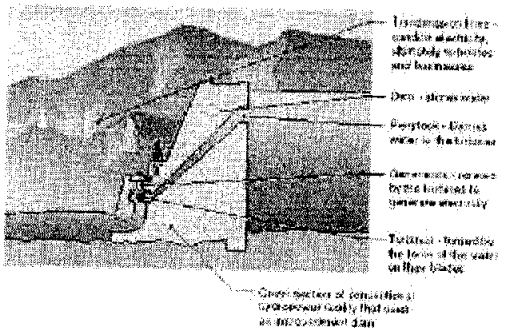
Quantifying Hydropower Potential

- Streamflow is generally measured in cubic feet per second (cfs)
- Storage behind the dam is generally measured in acre-feet (acft)
- One cfs flowing for an entire year will yield a volume of 724 (acft)

Storage Project

- Usually requires construction of a dam to store high flow events for release during periods of low flow
- High variation between winter and summer streamflow makes storage preferred alternative for most Alaska hydro projects

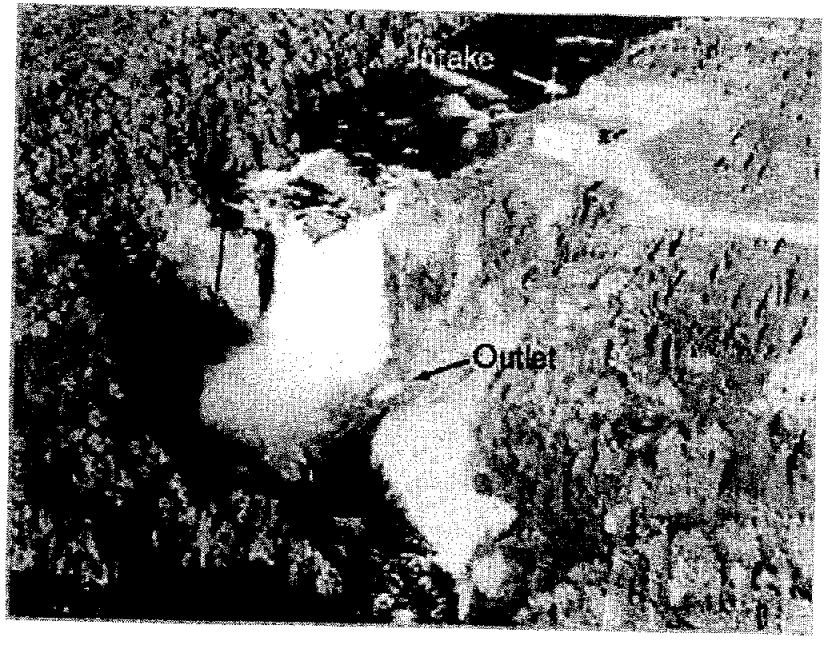
Generalized Storage Project



Run of River (ROR) Project

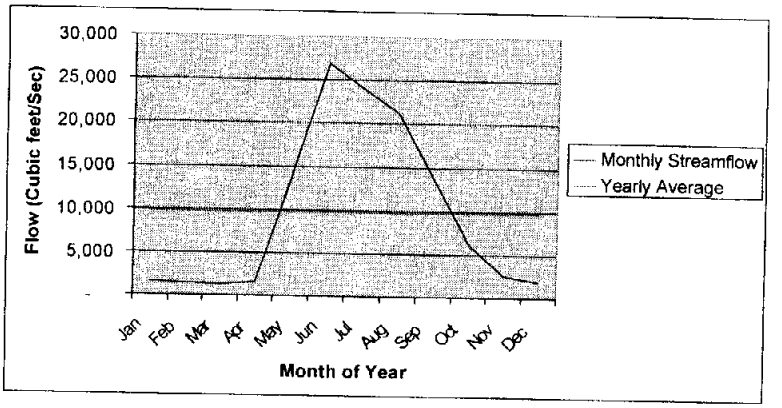
- Generally uses small diversion structure to divert streamflow directly into power plant
- No water storage
- ROR projects suited to more temperate environments, such as Southeast Alaska, where there is not as much variation in streamflow from one season to the next
- ROR facility channels portion of river through a canal or penstock.
- May not require dam

Example ROR Project

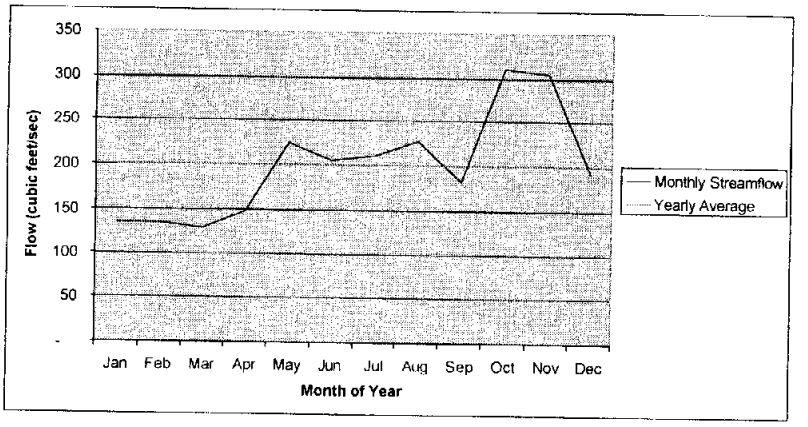


The Tazimina project in Alaska is an example of a diversion hydropower plant. No dam was required.

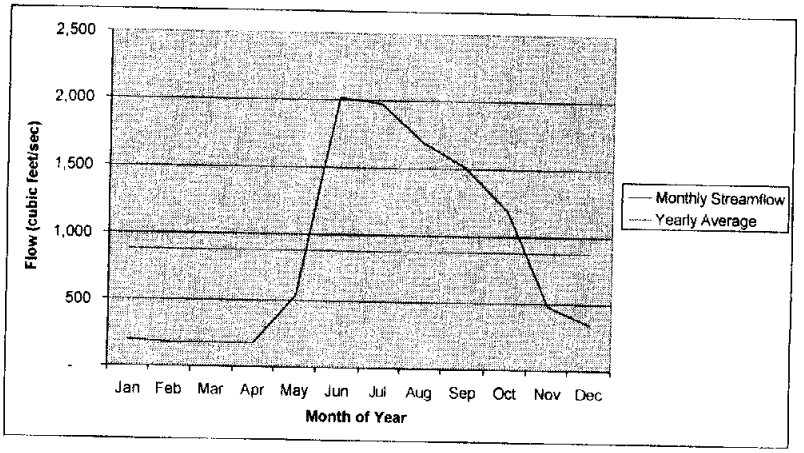
Susitna Streamflow



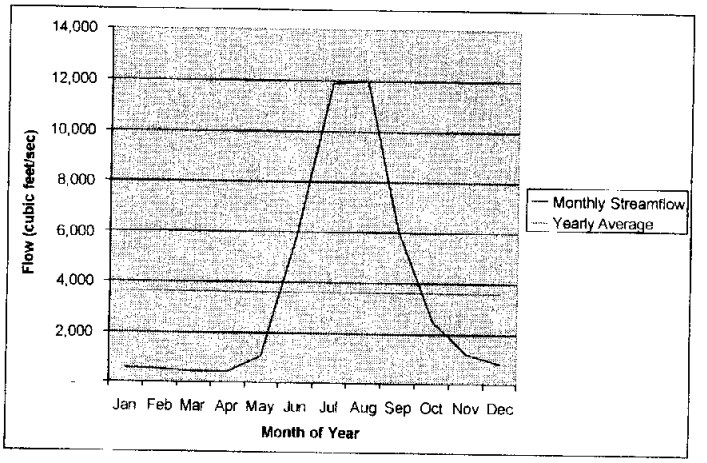
Ketchikan Creek Streamflow



Tazimina River Streamflow



Chakachatna Streamflow



Inventory of Alaska Hydropower Potential

- U.S. Bureau of Reclamation
- U.S. Army Corps of Engineers
- 256 sites with continuous power greater than 2500 KW
- 192 billion KWH energy potential
- 40% of the United States' untapped hydropower

Potential Major Alaska Hydropower Projects

Project Name	River System	Installed Capacity (Megawatts)	Energy (Million KWH/yr)
Holy Cross	Yukon	2,800	12,300
Ruby	Yukon	1,460	6,400
Rampart	Yukon	6,000	34,200
Porcupine	Porcupine	530	2,320
Woodchopper	Yukon	2,160	14,200
Yukon-Aaiya	Yukon	3,200	21,000
Susitna	Susitna	1,500	6,500
Chakachamna	Chakachatna	320	1,600
Wood Canyon	Copper	3,600	21,900
Stikine	Stikine	2,260	9,900

Note. Chugach Electric Energy Sales approximately 2,500 million KWH

Existing Hydropower -- Statewide

- 40 projects
- Most located in Southeast

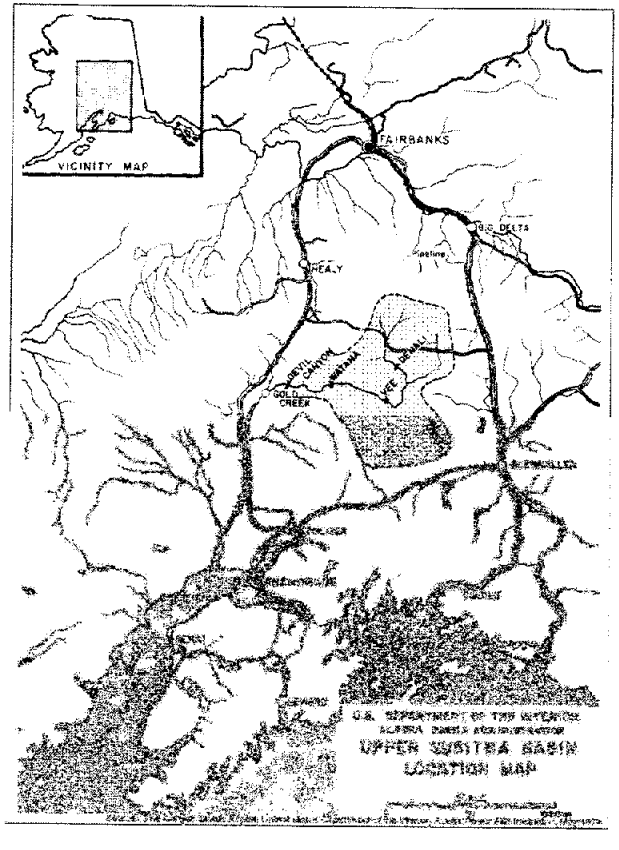
Existing Hydropower -- Southcentral

• Eklutna	37.5 MW
• Bradley Lake	90 MW
• Cooper Lake	5 MW

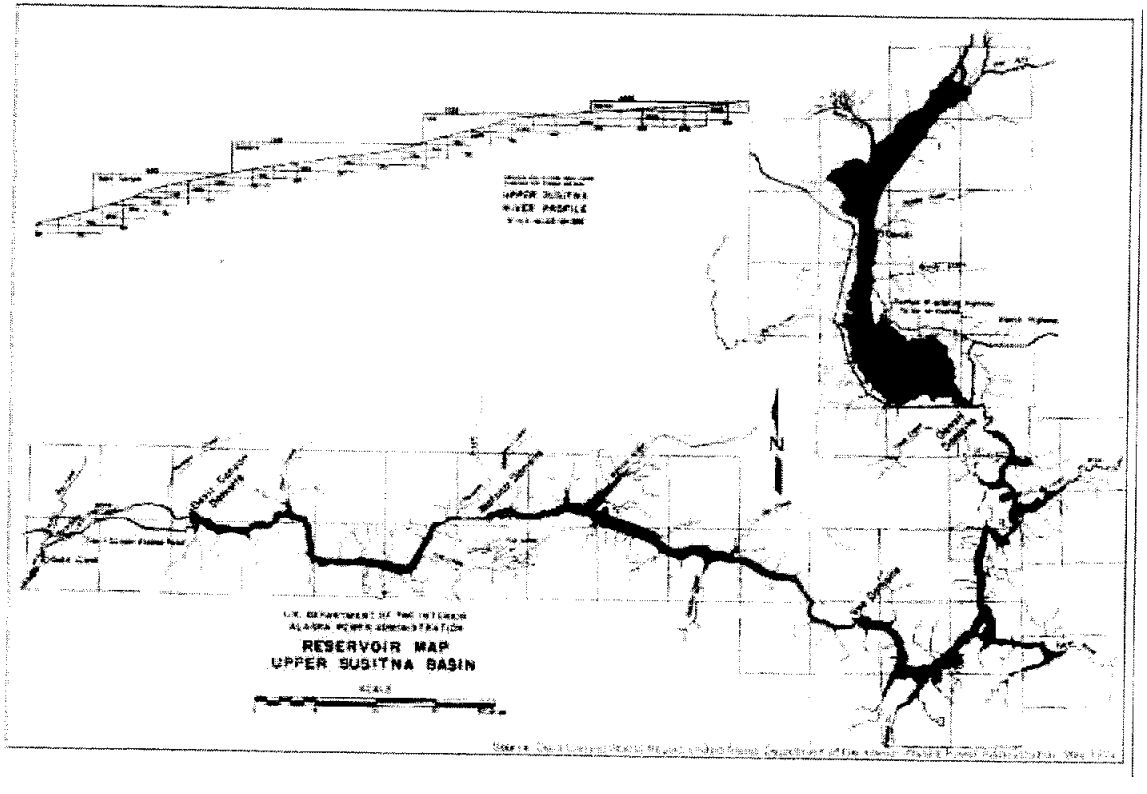
Susitna Hydropower Project

- Two high head dams on the Susitna river located 30 miles upstream from Talkeetna
- Total Cost $5.3 Billion (1985 dollars)
- 1,500 MW installed capacity and 6.5 billion KWH of energy
- Watana built first -- 870 foot high earth fill dam
- Devil Canyon built second -- 650 foot high concrete thin arch dam
- State expenditures for exploration and FERC licensing: $160 million, through the Alaska Power Authority
- License application withdrawn in 1985 when price of oil plummeted

Susitna Project Location



Susitna Four Dam Scheme



Results of Screening Process

Site[1]	Elimination Iteration[2] 1	2	3	4	Site[1]	Elimination Iteration[2] 1	2	3	4	Site[1]	Elimination Iteration[2] 1	2	3	4	Site[1]	Elimination Iteration[2] 1	2	3	4
Allison Creek					Fox	*				Love				*	Talachulitna River	*			
Beluga Lower		*			Gakona		*			Lower Chulitna				*	Talkeetna R. - Sheep	*			
Beluga Upper			*		Gerstle			*		Lucy	*				Talkeetna - 2				
Big Delta	*				Granite Gorge			*		McClure Bay			*		Tanana River				*
Bradley Lake			*		Grant Lake			*		McKinley River		*			Tanrlina				*
Brenner R. -Salmon	*				Greenstone			*		McLaren River	*				Tebay Lake		*		
Brenner R. -S.F.	*				Gulkana River			*		Million Dollar		*			Tiklanika		*		
Browne					Hanagita		*			Moose Horn	*				Tikel River	*			
Bruskasna					Healy		*			Nellie Juan River	*				Tokichitna				*
Cache					Hicks					Nellie Juan R. -Upper				*	Tokatlanika	*			
Canyon Creek	*				Jack River	*				Onio			*		Tustumena				*
Caribou Creek	*				Johnson				*	Power Creek		*			Vachon Island		*		
Carlo		*			Junction Island		*			Power Creek - 1	*				Whiskers				*
Carmacks (Duffy				*	Kashwitna River			*		Rampart		*			Wood Canyon		*		
Deshkashkat					Kasilof River		*			Sanford		*			Yanert - 2		*		
Dutton F.F.	*				Keetna					Sheep Creek			*		Yanert			*	
Dutton Hydrogen		*			Kenai Lake				*	Sheep Creek - 1	*								
Dutton W.F.	*				Kenai Lower			*		Silver Lake				*					
Eklutna	*				Kesiky River	*				Skwentna				*					
Eagl		*			Kiag Hyd	*				Snow			*						
Keffer			*		Klutina				*	Solomon Gulch			*						
Keasons Lake		*			Koksina					Stetkora Ranch	*								
Keasons Lake - 2	*				Lake Creek Lower		*			Strandline Lake									
Kenaan Creek	*				Lake Creek Upper				*	Susitna Lake	*								
Keiko River	*				Lane				*	Talamuitna			*						

[1] Power site selection unidentified.

[2] An asterisk (*) denotes site eliminated from further consideration.

Source: Exhibit E, Table E.25.1.

Short Listed Sites

Environmental Rating	Capacity (MW) 0-25	25-100	100
Good	Strandline Lake†[1] Allison Creek†[1] Tustumena Silver Lake	Hicks†[1] Snow†[1] Cache†[1] Bruskasna†[1]	Browne†[1] Johnson
Acceptable		Keetna†[1]	Chakachamna†[1]
Poor		Talkeetna-2†[1] Lower Chulitna	Lane Tokichitna

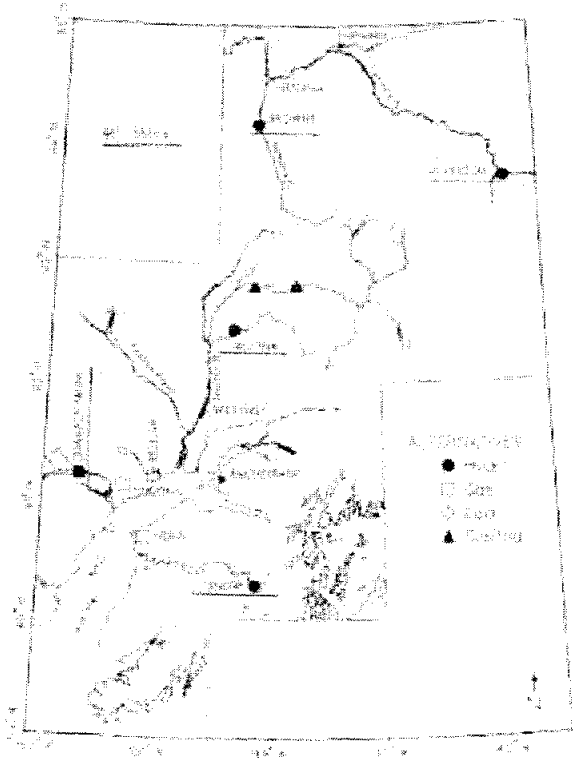
†[1] One of ten selected sites.

Source: Application Exhibit E, Table E.10.11.

Non-Susitna Basin Alternatives

Alternative Investigated	Estimated Total Cost of Project ($ million 1982)	Total Installed Capacity of Alternative (MW)	Average Annual Energy of Alternative (GWh)
Johnson	319	210	920
Chakachamna	905	333	1,300
Snow	305	100	375
Keetna	519	100	420
Browne	661	100	418

Hydro Alternatives



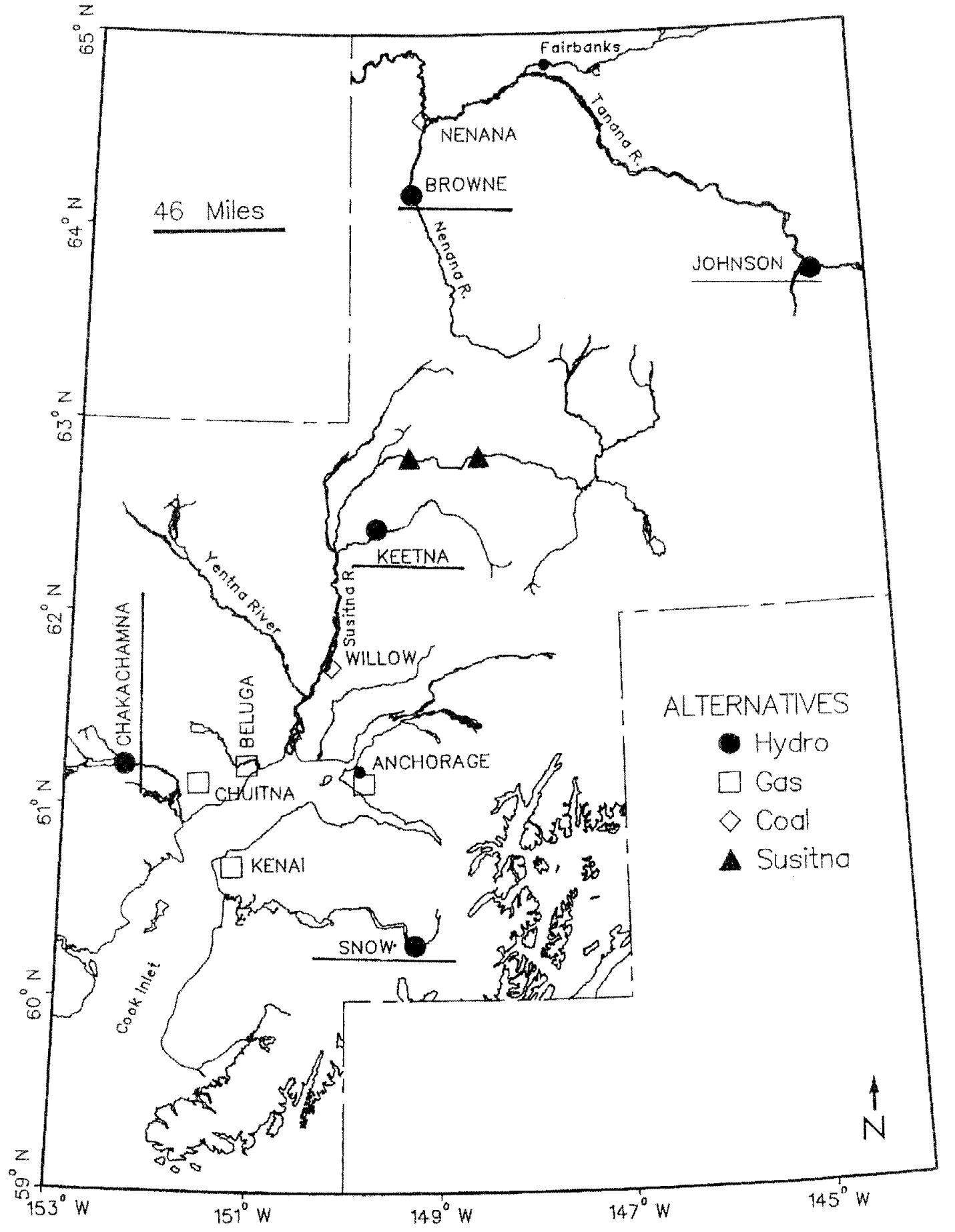
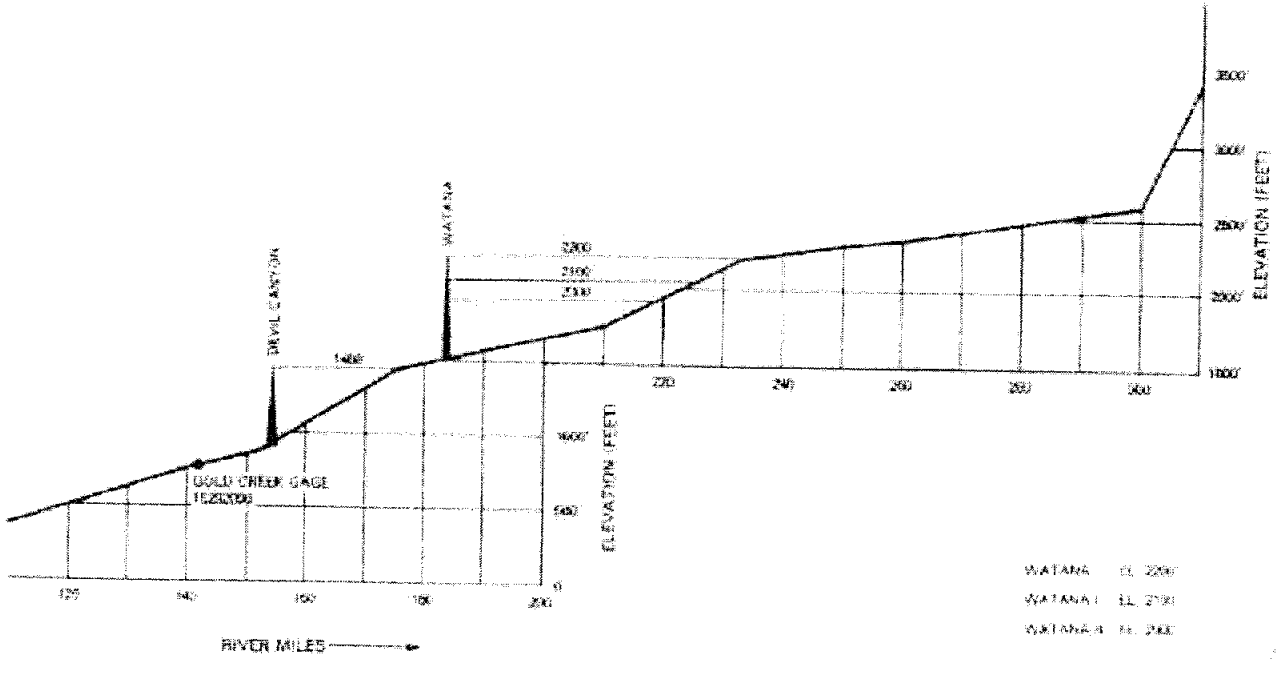
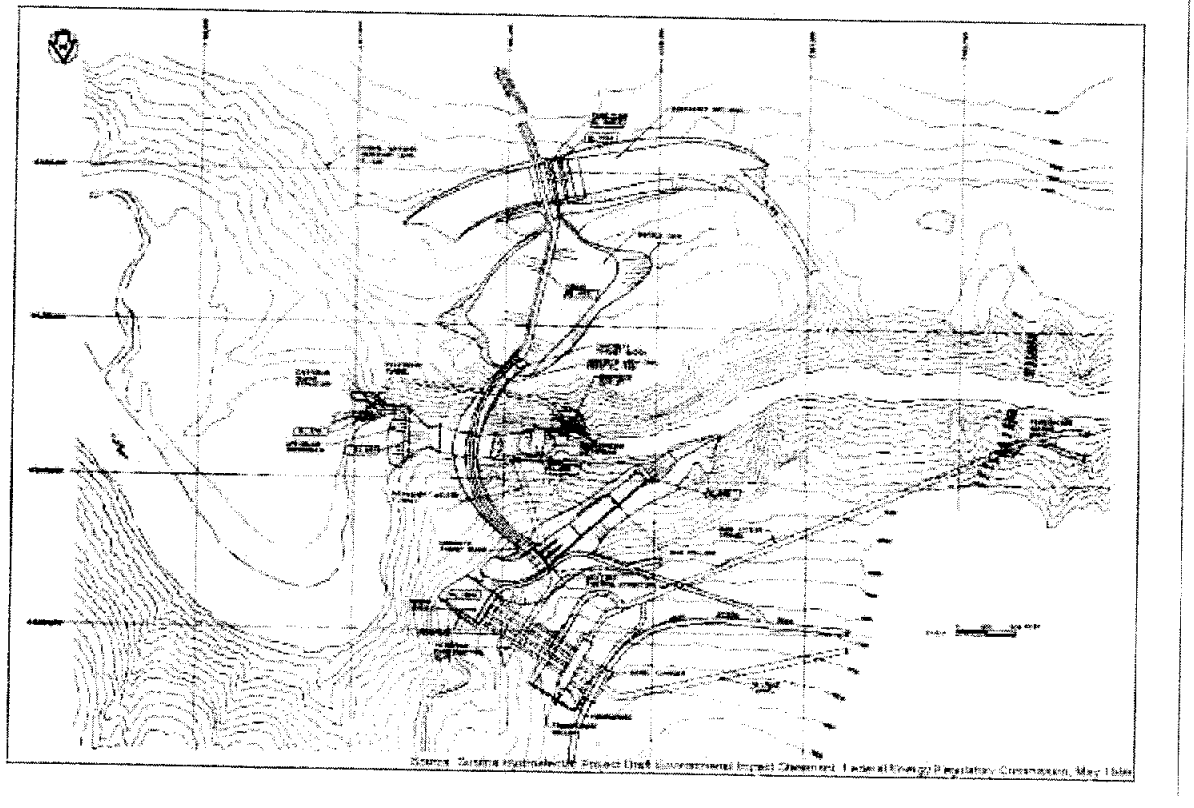


Figure 2-18. Location of Thermal and Hydroelectric Alternatives.

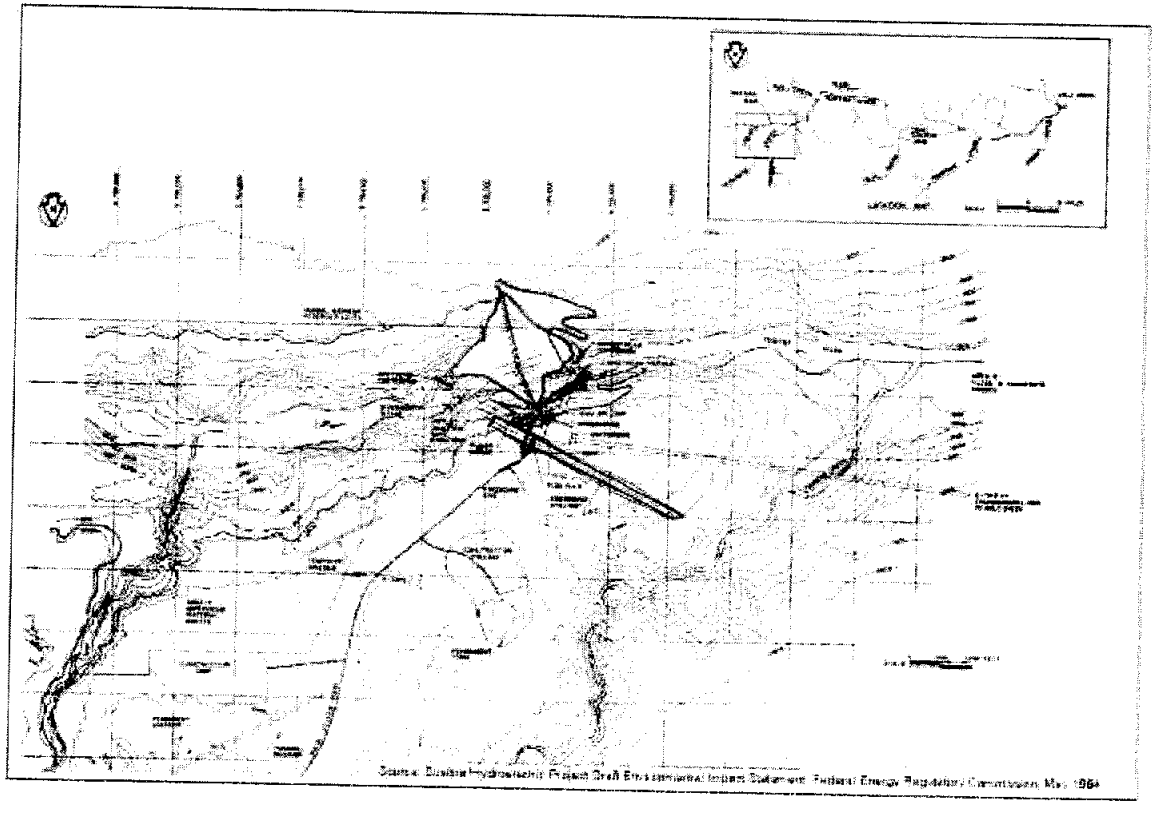
Profile: Watana-Devil Canyon Development



Devil Canyon Site Layout



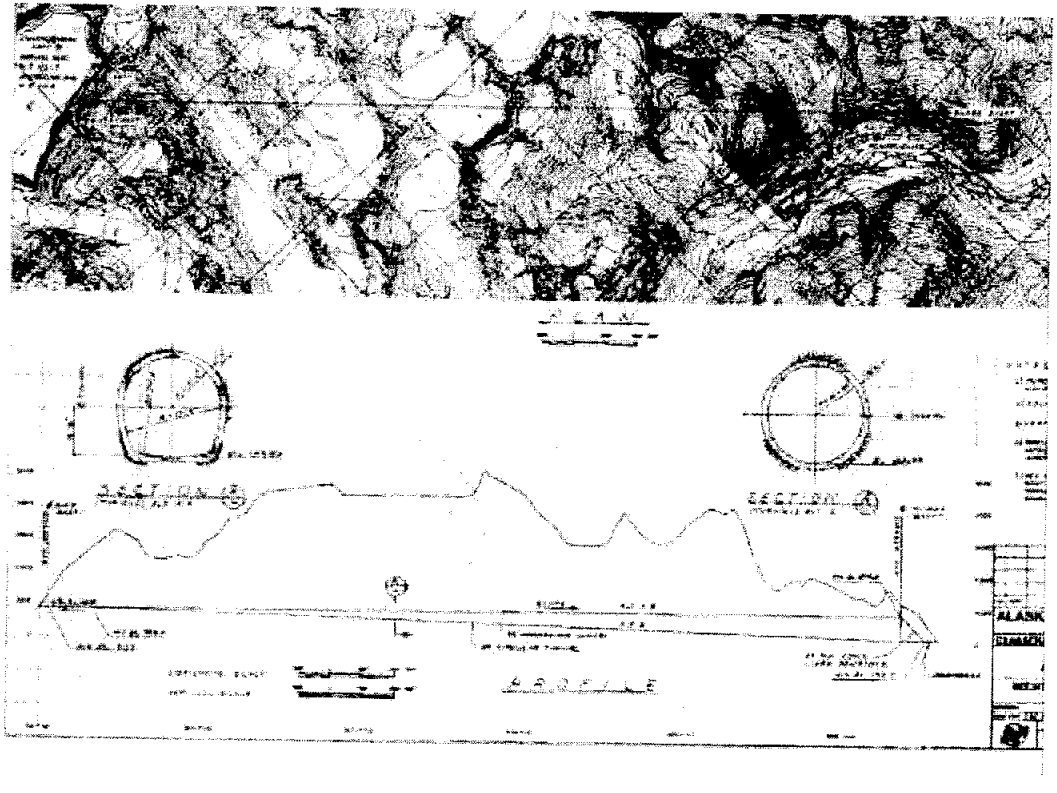
Watana Facilities Plan



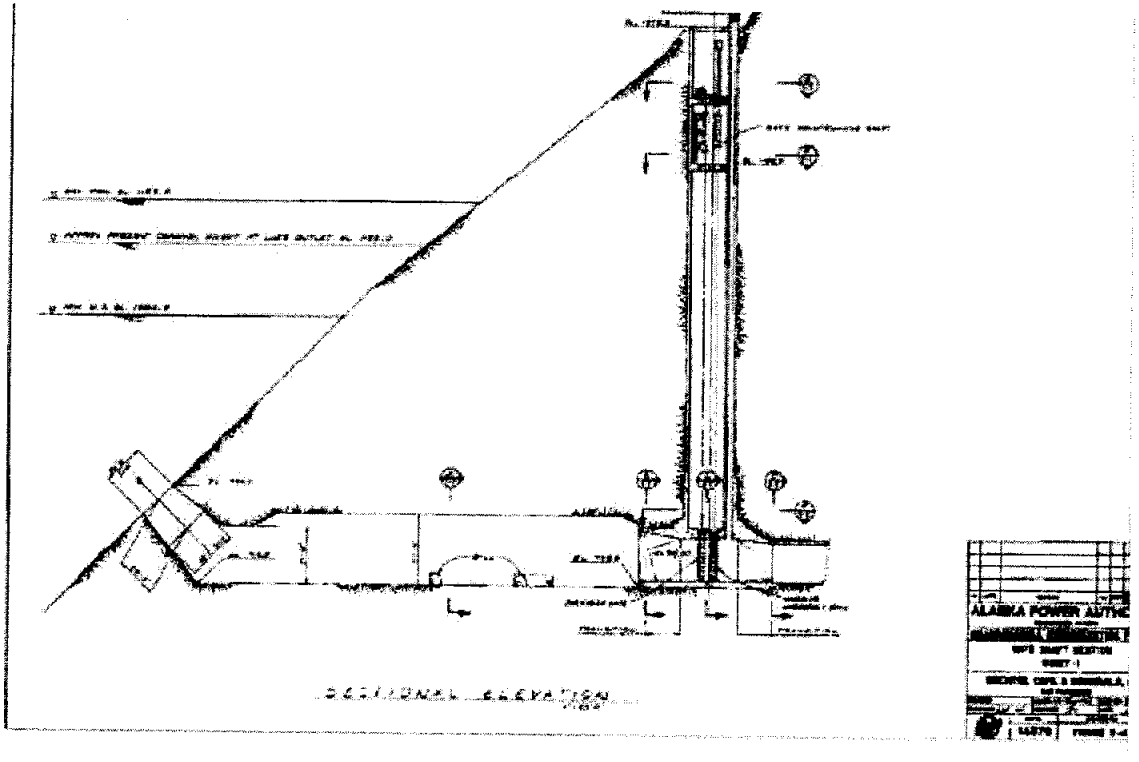
Chakachamna Hydro Power

- Studied by Alaska Power Authority in early 1980's
- Divert streamflow from Chakachatna River to a powerhouse on the McArthur River by way of a 10 mile 25 foot diameter power tunnel
- Minimal dam on Chakachamna Lake
- Installed capacity of 330 MW, generating 1.6 billion KWH annually
- Total cost of project in 1980 dollars = $1.0 billion
- Project is 40 miles from Chugach Electric power facilities at Beluga

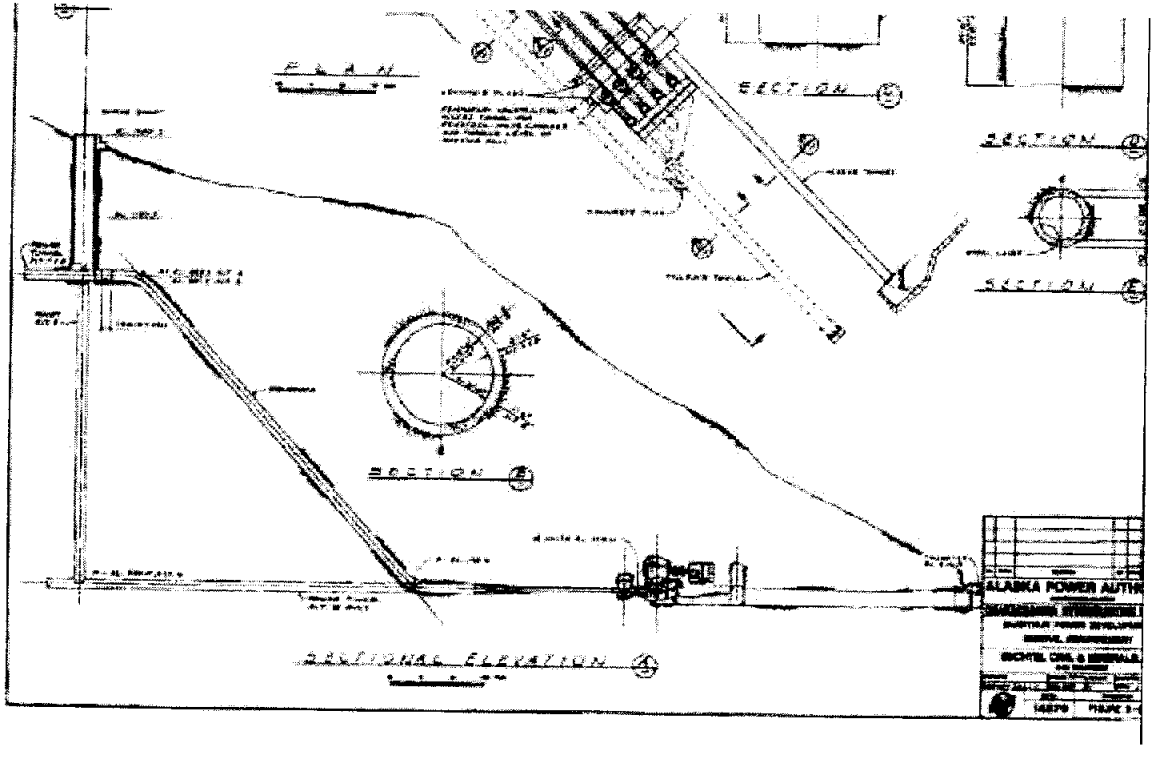
Chakachamna Selected Plan



Chakachamna Lake Tap Gate Shaft Inflow to Power Tunnel



McArthur River Underground Powerhouse (Chakachamna)



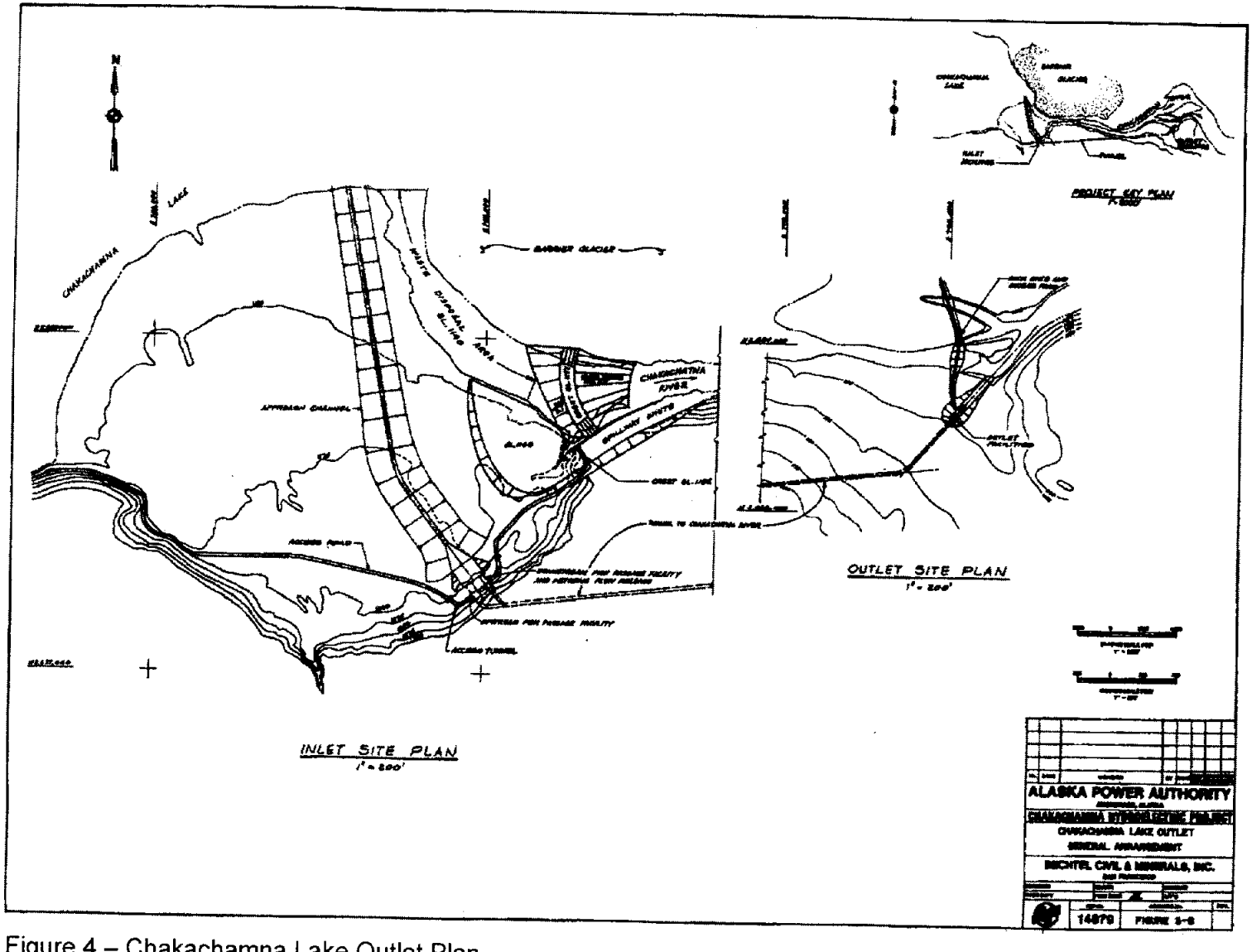


Figure 4 – Chakachamna Lake Outlet Plan