

ALASKA LEGISLATURE SPECIAL COMMITTEE / SUBJECT FILES 86/2

1002 SCOMM44: HOUSE POWER ALTERNATIVES STUDY COMM. 1979-80 1002

8. Scattered Railbelt Sites

Scattered sites and small basins within the Railbelt area include:

No.	Site	Stream	Firm	Capacity	Cost
			Energy GWH/yr	MW	Mills/KW
33	Kantishna River	Kantishna R.	394	82	22.2
34	McKinley River	McKinley R.	201	42	42.3
35	Chatanika River	Chatanika R.	32	7	63.0
36	Teklanika River	Teklanika R.	272	57	24.2
43	Totatlanika River	Totatlanika R.	114	24	33.1
44	Chena River	Chena R.	46	10	128.0
51	Nabesna	Nabesna R.	320	66	33.9
52	Chisana River	Chisana R.	797	170	21.8
53	Rock Lake	Ptarmigan Cr.	58	12	56.5
126	Deadman Creek	Deadman Cr.	165	34	22.7
131	McLaren River	McLaren R.	263	55	45.2
132	Boulder Creek	Boulder Cr.	35	7	55.6
142	Eagle River	Eagle R.	45	9	38.8
158 (51)	Lowe	Lowe R.	254	55	11.2
159	Allison Creek	Allison Cr.	18	4	19.5
160	Solomon Gulch	Unnamed	11	2	27.0
161	Silver Lake	Duck R.	48	10	15.6
Total			3,073	646	

Most of these sites are small ~~less~~ ^{under} less than 100 MW. Their scattered locations are not conducive to intertieing energy supplies of a large area such as the Railbelt. Several sites are in designated National Monuments or in proposed National Park areas. The Lowe site is in a canyon occupied by the Trans-Alaska oil pipeline and the only highway access to Valdez, and the route of a planned Valdez-Glennallen transmission line.

The Solomon Gulch project, ^{under} ~~proposed~~ for construction by the Copper Valley Electric Association at an estimated cost of 5.4 times the inventory cost, is an example of a rather expensive site that has been determined locally to be the best available alternative power source.

The Silver Lake site with an index cost of 2.5 times the Susitna index has a possibility of serving a part of the local power needs of the Valdez area, but would not be a significant^c alternative or contributor to meeting the larger Railbelt area needs.

ALASKA POWER
Inventory of Potential
size criteria is generally 2
sites in Alaska
(us power) and larger

No.	Power Site	Stream	USGS Map sheet	Drainage Area (sq. mi.)	Maximum Regulated Water Surface (ft.)	Average Head (ft.)	Average Annual Runoff (1000 AF)	Per Cent Regula- tion	Firm Energy (million Kwh)	Installed Capacity (1000 KW)	1/ (plant factor %)	Index Cost 2/
ARCTIC REGION												
1	Killik Bend	Colville R.	Killik R.	9,780	700	218	4,100	97	718	148	55	26.6
2	Awuna River	Awuna R.	Lookout Ridge	605	1,000	528	230	100	101	21	55	62.9
3	Kucher Creek	Colville R.	Killik R.	6,240	975	120	2,600	100	254	53	55	35.4
NORTHWEST REGION												
4 (1)	Agashashok	Noatak R.	Noatak A-2	12,700	150	132	7,500	100	820	186	50	8.7
5 (2)	Misheguk	Noatak R.	Baird Mtn. D-6	8,700	550	199	5,600	83	760	174	50	10.8
6 (3)	Nimukutuk	Noatak R.	Baird Mtn. D-3	7,000	750	166	4,500	100	612	140	50	12.7
7 (4)	Kobuk River	Kobuk R.	Baird Mtn. A-1	7,840	150	114	5,700	100	526	120	50	15.8
8	Kogoluktuk	Kogoluktuk R.	Shungnak D-2	412	400	129	351	100	37	8	55	27.2
9	Upper Kobuk River	Kobuk R.	Shungnak	2,970	375	62	2,200	99	114	23	55	39.5
10	Buckland River	Buckland R.	Candle D-5	2,410	130	103	930	100	79	16	55	42.0
11 (5)	Tuksuk Gorge	Tuksuk Channel	Teller A-2	4,275	190	187	1,880	100	289	66	50	19.0
12	Kuzitrin River (Bunker Hill site)	Kuzitrin R.	Bendleben A-6	1,790	150	95	860	100	67	14	55	49.4
13	Salmon Lake	Kruzganepe R.	Solomon D-6	107	500	155	267	70	24	5	55	126.0
14	Fish River	Fish R.	Solomon D-3	1,120	150	103	720	100	60	13	55	48.0
YUKON (INTERIOR) REGION												
15	Upper Chulitna River	Atchulitna R.	Holy Cross D-5	162	625	103	140	95	11	2	55	422.0
16 (6)	Holy Cross	Yukon R.	Holy Cross A-142	320,000	137	94	160,000	100	12,300	2,800	50	9.0
17	Kaltaq	Yukon R.	Nulato	296,000	200	117	137,000	100	13,100	3,000	55	
18 (7)	Dulbi	Koyukuk R.	Kanteel R. B-1	25,660	225	68	19,200	100	1,070	244	50	14.8
19	Fry Island	Koyukuk R.	Melozitna D-4	19,950	270	54	14,000	100	622	114	55	
20 (8)	Hughes	Koyukuk R.	Hughes A-3	18,700	320	49	12,300	100	482	110	50	11.2
21 (9)	Kanuti	Koyukuk R.	Hughes	17,970	500	166	11,900	100	1,611	368	50	12.2
22	Alatna River	Alatna R.	Hughes	2,860	723	109	2,000	100	175	36	55	23.1
23	Alatna River, Upper	Alatna R.	Survey Pass	1,325	1,050	158	920	100	123	25	55	64.5
24	Jim River	Jim R.	Bettles D-2	470	975	162	320	100	43	9	55	42.6
25	Jack White	Koyukuk R.	Bettles	4,350	800	136	3,000	---	315	65	55	18.1
26	John River	John R.	Wiseman A-4	2,695	800	107	1,900	90	149	31	55	38.8
27 (10)	Melozitna	Melozitna R.	Ruby D-6	2,659	550	270	1,400	91	282	64	50	11.2
28	Melozitna River	Melozitna R.	Melozitna B-4	2,020	700	129	1,100	100	117	13	55	48.5
29 (11)	Ruby	Yukon R.	Ruby D-5	256,200	210	72	109,000	100	6,400	460	50	3.9
30	Novitna River	Novitna R.	Ruby B-2	2,570	450	180	1,900	100	280	58	55	16.1
31	Vachon Island	Tanana R.	Kantishna R. D-3	44,500	350	96	26,000	96	2,050	426	55	29.0
32 (12)	Junction Island	Tanana R.	Kantishna R. D-1	42,490	400	114	25,000	100	2,330	532	50	15.1
33	Kantishna River	Kantishna R.	Kantishna R. B-1	5,440	500	95	5,200	99	394	82	55	22.2
34	McKinley River	McKinley R.	Mt. McKinley B-3	710	1,775	297	910	90	201	42	55	42.3
35	Chatanika River	Chatanika R.	Livengood A-4	770	500	91	420	99	32	7	55	63.0
36	Teklanika River	Teklanika R.	Healy D-6	520	1,800	457	728	100	272	57	55	24.2
37	Browne	Nenana R.	Fairbanks A-5	2,450	1,000	207	3,400	66	385	80	55	58.0
38	Walker Creek	Nenana R.	Fairbanks A-5	2,330	1,200	166	3,300	35	166	35	55	87.5
39	Yanert No. 2	Nenana R.	Healy C-4	1,190	2,200	232	1,670	93	298	62	55	37.2
40 (15)	Healy	Nenana R.	Healy D-4	1,900	1,700	291	2,675			130		
41 (14)	Carlo	Nenana R.	Healy C-4	1,190	1,900	166	1,670	83	840	30	50	10.7
42 (13)	Bruskansna	Nenana R.	Healy B-4	650	2,330	212	826			40		
43	Totatlanika River	Totatlanika R.	Fairbanks A-4	250	1,600	420	320	100	114	24	55	33.1
44	Chena River	Chena R.	Big Delta D-5	950	900	107	523	99	46	10	55	128.0
45	Salcha River	Salcha R.	Big Delta C-5	1,990	975	136	1,170	95	123	25	55	69.4
46	Tanana River (Little Delta)	Tanana R.	Big Delta B-6	18,080	900	107	14,500	25	315	65	55	43.1
47 (16)	Big Delta	Tanana R.	Big Delta A-4	15,300	1,100	99	12,500	98	987	226	50	16.8
48 (17)	Gerstle	Tanana R.	Mt. Hayes D-2	10,700	1,290	59	9,500	---	438	100	50	17.0
49 (18)	Johnson	Tanana R.	Mt. Hayes C-2	10,450	1,470	149	7,830	97	920	210	50	16.1
50 (19)	Cathedral Bluffs	Tanana R.	Tanacross B-6	8,550	1,650	146	5,800	100	693	158	50	15.3
51	Nabesna	Nabesna R.	Nabesna D-3	2,145	2,025	191	2,300	88	320	66	55	33.9
52	Chisana River	Chisana R.	Nabesna A-3	732	3,250	883	1,100	100	797	170	55	21.8
53	Rock Lake	Ptarmigan Creek	McCarthy D-1	93	3,600	514	140	98	58	12	55	56.5
54 (20)	Rampart	Yukon	Tanana B-3	200,000	665	445	81,000	100	14,700	5,040	75	2.0
55	East Fork Chandalar River, Afterbay	E.F. Chandalar R.	Chandalar	5,500	900	99	1,500	100	122	25	55	21.1
56	East Fork Chandalar River, Zimmerman Creek	E.F. Chandalar R.	Chandalar	5,500	1,100	169	1,500	100	210	44	55	29.3
57	East Fork Chandalar River, Little Rock	E.F. Chandalar R.	Christian	4,200	1,600	132	1,150	95	119	25	55	70.3
58	East Fork Chandalar River	E.F. Chandalar R.	Arctic	2,500	2,025	162	680	100	90	19	55	56.0
59 (21)	Porcupine	Porcupine R.	Coleer B-1	23,400	975	313	9,100	100	2,320	530	50	5.0
60 (22)	Woodchopper	Yukon	Charley R. B-5	122,000	1,020	300	57,600	100	14,200	2,160	75	4.5
61 (23)	Fortymile	Fortymile	Eagle B-1	6,060	1,550	324	3,230	84	723	166	50	8.9
62	No. Fork Fortymile	N.F. Fortymile	Eagle B-2	2,065	1,800	249	1,400	85	245	51	55	17.2
63	So. Fork Fortymile	S.F. Fortymile	Eagle A-2	2,800	1,775	228	1,500	88	245	51	55	24.9
64 (24)	Yukon-Taiya	Yukon	Skayway C-1	25,700	2,200	1,913	13,500	100	21,000	3,200	75	3.3

Would be inundated by a Tuksuk Gorge project, or would reduce Tuksuk to elevation 50 and 77 million Kwh.

An alternative to Holy Cross.

Alternative to Dulbi, cost was not calculated.

3/ Inventory plan is premised on development of Rampart.

Alternative site to Junction Island.

Alternative for upper Nenana River System. It would inundate Carlo and Bruskansna sites.

Assumes operation as a system.

Yukon-Taiya would reduce downstream potential.

No.	Power Site	Stream	USGS Map sheet	Drainage Area (sq. mi.)	Maximum Regulated Water Surface (ft.)	Average Head (ft.)	Average Annual Runoff (1000 AF)	Regulation	Energy (million Kwh)	Installed Capacity (1000 KW)	1/ (plant factor %)	Index Cost 2/
SOUTHEAST REGION												
65 (25)	Crooked Creek	Kuskokwim R.	Sleetmute D-6	31,100	500	352	32,400	100	9,400	2,140	50	5.0
66	So. Fork Kuskokwim River	S.F. Kuskokwim R.	McGuith A-1	870	2,000	174	840	60	72	15	55	112.0
67	Lake Kulik	Wind R.	Dillingham	216	123	30	3,800	100	95	20	55	40.6
68 (26)	Nuyakuk Lake	Nuyakuk R.	Dillingham D-6	1,530	342	176	4,300	90	555	127	50	15.9
69	Chikaminuk	Allen R.	Taylor Mtns.	286	630	262	800	90	154	32	55	22.8
70	Upuk Lake	Tikchik R.	Taylor Mtns.	100	830	170	280	100	39	8	55	46.6
71 (27)	Iliamna Lake	Kuichak R.	Dillingham A-2	6,440	150	114	14,600	100	1,370	311	50	11.1
72	Kakhonak Lake	Kakhonak R.	Iliamna B-4	145	300	200	275	100	45	9	55	53.8
73	Newhalen River	Newhalen R.	Iliamna D-6	3,319	325	74	6,675	100	411	85	55	11.9
74 (28)	Tazimina	Tazimina R.	Iliamna D-5	346	725	393	724	96	224	51	50	15.0
75	Kontrashibuna	Tanalian R.	Lake Clark A-4	200	510	226	461	99	83	17	55	17.8
76 (29)	Ingersol	Kijik R.	Lake Clark B-3	300	1,460	1,120	695	99	630	144	50	14.2
77	Alagnak River	Alagnak R.	Iliamna A-8	530	795	170	960	35	47	10	55	53.5
78	Nonvianuk Lake	Nonvianuk R.	Iliamna A-7	370	631	115	670	100	63	13	55	22.6
79 (30)	Kukakluk Lake	Alagnak R.	Iliamna A-7	480	825	326	870	100	232	53	50	10.9
80 (31)	Naknek	Naknek R.	Naknek C-2	2,720	150	124	4,600	100	473	108	50	13.2
81	American Creek	American Creek	Mt. Katmai D-4	100	1,625	861	180	95	120	25	55	22.7
82	Ukak River	Ukak R.	Mt. Katmai B-4	194	375	145	330	75	30	6	55	164.0
83	Contact Creek	Contact Creek	Mt. Katmai A-6	54	1,050	274	92	65	13	3	55	354.0
84	Becharof	Egegik R.	Naknek A-3	1,280	70	58	1,600	100	76	16	55	21.3
85	Ugashik Lakes	Ugashik R.	Ugashik C-3	830	50	33	1,100	100	30	6	55	50.2
SOUTHCENTRAL REGION												
86	Olga Bay	Olga Narrows	Kariuk A-1	335	70	64	710	100	37	8	55	68.6
87	Fraser Lake	Dog Salmon Creek	Kariuk A-1	72	353	302	130	100	32	7	55	33.0
88	Ayakulik	Ayakulik	Kariuk A-2	181	200	181	330	100	49	10	55	42.6
89	Kariuk Lake	Kariuk	Kariuk C-1	165	400	344	300	100	85	18	55	24.9
90	Terror Lake	Unnamed	Kodiak C-4	15	1,125	1,057	72	94	85	12	55	24.9
91	McNeil River	McNeil River	Iliamna A-4	102	150	112	180	50	8	2	55	145.0
92	Paint River	Paint R.	Iliamna A-4	205	150	115	370	80	28	6	55	115.0
93 (32)	Crescent Lake	Crescent R.	Kenai B-8	200	599	517	454	98	179	41	50	9.9
94 (33)	Chakachamna	Chakachamna R.	Tyonek A-7	1,120	1,127	793	2,460	100	1,600	366	50	6.5
95	Chuitna	Chuitna R.	Tyonek A-4	66	800	552	140	70	45	9	55	83.4
96	Lower Beluga	Beluga R.	Tyonek A-1	950	100	49	1,790	100	72	15	55	19.1
97 (34)	Coffee	Beluga R.	Tyonek A-4	860	210	109	1,800	100	160	37	50	11.5
98 (35)	Upper Beluga	Beluga R.	Tyonek B-4	840	375	142	1,800	100	210	48	50	11.1
99	Strandline Lake	Beluga R.	Tyonek B-6	54	1,300	852	115	100	81	17	55	30.8
100	Lake Creek (Lower)	Lake Creek	Talkeetna A-2	335	800	305	710	60	105	22	55	32.6
101	Upper Lake Creek	Lake Creek	Talkeetna B-3	85	1,400	560	180	90	74	15	55	20.3
102	Talchulitna River	Talchulitna R.	Tyonek C-4	360	700	231	720	100	137	28	55	41.6
103	Hayes, Skwentna R.	Skwentna R.	Tyonek D-5	1,730	575	187	3,500	80	429	89	55	72.8
104	Emerald	Skwentna R.	Tyonek D-8	370	1,900	366	790	74	177	37	55	69.7
105 (36)	Yentna	Tyonek C-2	Tyonek C-2	6,400	150	82	12,750		145			
106 (37)	Talchulitna	Skwentna R.	Tyonek D-4	2,250	350	124	4,500	79	1,390	75	50	10.1
107 (38)	Skwentna	Skwentna R.	Tyonek D-6	950	1,000	291	1,900		93			
108	Chulitna Creek	Chulitna Creek	Talkeetna B-1	240	800	198	380	40	25	5	55	50.9
109 (39)	Lower Chulitna	Chulitna R.	Talkeetna B-1	2,600	500	89	6,350	84	394	90	50	8.1
110 (40)	Tokichitna	Chulitna R.	Talkeetna C-1	2,560	725	186	6,700	85	806	184	50	8.8
111	Talkeetna River (sheep)	Talkeetna R.	Talkeetna Mt. B-6	1,790	605	91	4,400	50	149	31	55	40.4
112 (41)	Keetna	Talkeetna R.	Talkeetna Mt. B-6	1,260	950	286	1,690	82	324	74	50	11.3
113	Iron Creek	Iron Creek	Talkeetna Mt. B-5	210	1,750	750	400	60	147	31	55	63.9
114	Granite Gorge	Talkeetna R.	Talkeetna Mt. B-5	865	1,500	416	1,160	87	345	72	55	43.8
115	Greenstone	Talkeetna R.	Talkeetna Mt. C-5	790	1,575	304	1,150	65	246	51	55	18.6
116	Trapper	Talkeetna R.	Talkeetna Mt. C-5	760	1,700	245	1,140	94	216	45	55	68.6
117	Lucy	Chulitna R.	Talkeetna Mt. D-5	1,080	1,100	166	2,600	20	71	15	55	19.3
118	Coal	Chulitna R.	Talkeetna Mt. D-6	985	1,450	241	2,400	40	193	40	55	36.3
119	Ohio	Chulitna R.	Talkeetna Mt. D-6	916	1,500	224	2,220	35	144	30	55	21.0
120	Chulitna-Hurricane	Chulitna R.	Healy A-6	795	1,600	207	1,900	50	166	34	55	26.7
121	West Fork Chulitna	W.F. Chulitna R.	Healy A-6	355	1,900	287	640	45	68	14	55	33.4
122	East Fork Chulitna	E.F. Chulitna R.	Healy A-5	135	2,500	380	240	80	59	12	55	31.3
123 (42)	Whiskers	Susitna R.	Talkeetna B-1	6,320	490	59	7,500	100	368	84	50	11.5
124 (43)	Lane	Susitna R.	Talkeetna C-1	6,280	660	169	7,500	100	1,052	240	50	8.9
125 (44)	Gold	Susitna R.	Talkeetna Mt. C-6	6,160	850	189	7,327	100	1,139	260	50	13.1
126	Deadman Creek	Deadman Cr.	Talkeetna Mt. D-3	160	3,000	962	350	60	165	34	55	22.7
127 (45)	Devil Canyon	Susitna R.	Talkeetna Mt. D-5	5,810	1,450	575	6,840		738			
128 (46)	Matana	Susitna R.	Talkeetna Mt. D-4	5,180	1,905	425	6,040	100	7,000	478	50	6.3
129 (47)	Vee	Susitna R.	Talkeetna Mt. C-2	4,140	2,355	430	4,730		386			
130 (48)	Denali	Susitna R.	Talkeetna Mt. D-1	1,260	2,552	---	2,310		---			
131	McLaren River	McLaren R.	Gulkana D-6	485	2,875	263	1,410	85	263	55	55	45.2
132	Boulder Creek	Boulder Cr.	Healy B-1	42	3,575	917	67	70	35	7	55	55.6
133	Palmer	Matanuska R.	Anchorage C-6	2,070	400	166	2,918	20	79	16	55	195.5
134	Moose Creek	Matanuska R.	Anchorage C-6	2,070	500	166	2,918	25	100	21	55	124.2
135	King Mountain	Matanuska R.	Anchorage D-5	1,635	1,050	276	2,300	40	210	44	55	37.6

Would be reduced 11 million Kwh by development of Nuyakuk.

New mapping indicates Newhalen could be included on list of lower priced hydro.

Alternative to Fraser Lake.

Development of Upper Beluga would reduce energy 12 million Kwh.

Assumes operation as a system.

Alternative to Granite Gorge.

Would be inundated by development of Ohio site.

Would be inundated by development of Ohio site.

Assumes operation as a system.

Alternative to Palmer site.

No.	Power Site	Stream	USGS Map sheet	Drainage Area (sq. mi.)	Maximum Regulated Water Surface (ft.)	Average Head (ft.)	Average Annual Runoff (1000 AF)	Regulation	Energy (million Kwh)	Installed Capacity (1000 KW)	1/ (plant factor %)	Index Cost 2/	
136	Coal Creek	Katanuska R.	Anchorage D-4	1,128	1,300	291	1,600	60	307	64	55	78.5	Alternative to King Mtn. site.
137	Boulder Creek	Boulder Cr.	Anchorage D-4	90	2,600	1,317	82	80	69	14	55	57.0	
138	Rush Lake	Boulder Cr.	Anchorage D-4	89	1,950	892	78	79	45	9	55	92.7	
139	Furinton Creek	Katanuska R.	Anchorage D-4	1,082	1,450	291	1,500	90	324	67	55	108.1	Alternative to Hick site.
140	Hicks Site	Katanuska R.	Anchorage D-3	950	1,675	281	1,300	90	286	59	55	37.2	
141	Caribou Creek	Caribou Cr.	Anchorage D-2	260	2,450	527	220	93	90	19	55	21.7	
142	Eagle River	Angle R.	Anchorage B-7	194	450	167	397	82	45	9	55	38.8	
143	Sunrise	Hixmile Cr.	Seward D-7	238	450	327	350	55	52	11	55	122.2	
144	Lower Kenai	Kenai R.	Kenai B-3	1,650	160	84	4,300	88	263	55	55	18.2	
145	Moose Horn	Kenai R.	Kenai C-2	1,540	275	95	4,000	93	290	60	55	18.8	
146	Killey River	Killey R.	Kenai B-2	160	725	358	380	90	100	21	55	38.1	
147	Stelters Ranch	Kenai R.	Kenai B-1	849	500	199	2,600	97	403	84	55	17.9	
148	Kenai Lake	Kenai R.	Seward B-8	660	650	341	2,030	97	552	115	55	22.3	Alternative to Stelters Ranch site.
149	Crescent Lake	Crescent L.	Seward B-7	23	1,454	934	38	100	29	6	55	31.4	
150 (49)	Snow	Snow R.	Seward B-7	85	1,250	653	535	97	278	63	50	11.2	
151	Kasilof River	Kasilof R.	Kenai B-4	738	200	136	1,729	100	193	40	55	15.8	
152	Tustumena	Tustumena Glacier	Kenai A-2	57	1,496	1,100	133	85	102	21	55	17.1	
153	Sheep Creek	Sheep Cr.	Seldovia D-2	101	725	382	460	54	94	20	55	23.8	
154 (50)	Bradley Lake	Bradley Cr.	Seldovia D-3	88	1,195	1,155	445	93	410	94	50	8.0	Authorized Project.
155	Resurrection River	Resurrection R.	Seward A-7	141	425	233	600	75	86	18	55	58.5	
156	Nellie Juan River	Nellie Juan R.	Seward B-5	130	400	240	708	34	47	10	55	32.0	
157	Upper Nellie Juan	Nellie Juan R.	Seward B-6	35	1,189	421	190	90	57	12	55	17.6	
158 (51)	Lowe	Lowe R.	Valdez A-6	190	800	334	1,400	66	254	55	50	11.2	
159	Allison Creek	Allison Cr.	Valdez A-7	6	1,380	1,191	32	55	18	4	55	19.5	
160	Solomon Gulch	Unnamed	Valdez A-7	18	660	608	100	20	11	2	55	27.0	
161	Silver Lake	Duck R.	Cordova D-7	25	390	346	180	95	48	10	55	15.6	
162	Power Creek	Power Cr.	Cordova C-5	21	560	490	182	90	66	14	55	20.9	
163 (52)	Million Dollar	Copper R.	Cordova C-2	24,200	200	89	38,000	71	1,927	440	50	14.8	
164	Van Cleave	Unnamed	Cordova C-1	17	1,450	475	95	25	10	2	55	234.0	
165	Little Bremner River	Little Bremner R.	Valdez A-2	182	600	272	503	62	70	15	55	67.8	
166	Bremner R., Salmon Site	Bremner R.	Valdez A-1	660	525	166	1,100	30	86	18	55	46.7	
167	So. Fork Bremner River	S.F. Bremner R.	Cordova D-1	148	1,150	537	470	75	156	32	55	32.5	
168	Three Mile Canyon	Bremner R.	Cordova D-1	526	725	228	1,660	41	127	26	55	51.5	Alternative to Salmon site.
169	No. Fork Bremner River	N.F. Bremner R.	Bering Glacier	150	1,625	490	470	87	166	35	55	56.0	
170 (53)	Cleave	Copper R.	Valdez A-3	21,500	420	165	28,000	96	3,600	820	55	13.3	
171	Tsina	Valdez A-5	104	1,750	360	220	90	58	12	55	64.2		
172	Tiekel River	Tiekel R.	Valdez A-3	421	950	400	900	35	105	22	55	37.8	
173 (54)	Wood Canyon	Copper R.	Valdez B-2	20,600	1,400	950	26,700	100	21,900	1,600	69.4	3.2	
174	Hanagita Lake	Hanagita R.	McCarthy A-8	100	2,575	1,010	228	85	160	33	55	27.0	
175	Tebay Lakes	Valdez A-1	105	1,875	1,007	240	95	193	40	55	23.6		
176	Kuskulana River	Kuskulana R.	McCarthy C-8	260	2,050	508	550	50	114	24	55	66.9	
177	Young Creek	Young Cr.	McCarthy A-4	40	3,475	2,017	110	45	82	17	55	60.3	High Wood Canyon plan would reduce potential by about 5%.
178	Canyon Creek	Canyon Cr.	McCarthy A-4	100	3,100	1,308	270	45	131	27	55	46.1	
179	Kiagna River	Kiagna R.	McCarthy A-4	185	2,500	976	490	50	193	40	55	77.9	High Wood Canyon plan would reduce potential by about 10%.
180	Kotsina River	Kotsina R.	Valdez C-1	209	2,075	524	440	70	133	28	55	47.9	
181	Klutina	Klutina R.	Valdez D-5	670	1,800	335	950	100	263	54	55	17.6	
182	Tolsona Creek	Tolsona Cr.	Gulkana A-4	174	2,025	460	200	70	53	11	55	52.5	
183	Tazlina	Tazlina R.	Gulkana A-5	1,970	1,875	273	2,300	100	503	104	55	15.6	
184	Nelchina River	Nelchina R.	Gulkana A-6	820	2,250	285	940	99	219	45	55	53.3	
185	Lower Gulkana River	Gulkana R.	Gulkana B-3	1,850	1,700	232	2,000	11	42	9	55	84.8	
186	Upper Gulkana River	Gulkana R.	Gulkana B-3	1,770	1,850	124	1,900	23	45	9	55	86.8	
187	Gulkana River	Gulkana R.	Gulkana C-4	575	2,475	405	620	80	164	34	55	27.5	
188	West Fork Gulkana River	W.F. Gulkana R.	Gulkana C-5	398	2,375	192	440	100	69	14	55	58.7	
189	Summit Lake	Gulkana R.	Mt. Hayes A-4	83	1,210	500	88	100	36	6	55	19.9	
190	Gakona Site	Copper R.	Gulkana B-3	3,965	1,750	266	4,400	75	727	150	55	35.2	Alternative to Sanford site.
191	Sanford	Copper R.	Gulkana B-3	3,365	1,825	178	3,700	70	385	80	55	29.3	
192	White River	White R.	Bering Glacier A-4	29	375	282	210	80	39	8	55	51.3	

SOUTHEAST REGION

193	Aisek River	Aisek R.	Yakutat B-1	11,000	450	166	12,000	90	1,490	310	55	17.9	Major portion of reservoir area is in Canada.
194	Endicott River	Endicott R.	Juneau D-5	56	800	483	270	97	105	21	55	25.9	
195	Chilkoot	Chilkoot R.	Skagway B-2	130	175	136	780	90	78	16	55	35.8	
196 (55)	Chilkat	Chilkat R.	Skagway C-3	190	600	320	870	80	180	41	50	10.6	
197	West Creek	West Creek	Skagway C-2	40	800	625	268	75	105	21	55	25.9	
198	Goat Lake	Pitchfork Falls	Skagway C-1	4	2,915	2,017	30	95	46	10	55	16.5	
199	Lace River	Lace R.	Juneau D-3	363	200	166	2,300	97	298	62	55	51.8	
200	Unnamed Lake near Lace R.	Unnamed	Juneau D-3	3	3,160	3,003	20	100	48	10	55	19.4	
201	Antler River	Antler R.	Juneau D-3	5	1,950	1,813	29	100	43	9	55	17.8	
202	Nugget Creek	Nugget Cr.	Juneau B-2	16	725	607	151	40	30	6	55	52.9	
203	Carlson Creek	Carlson Cr.	Juneau B-1	24	450	344	246	66	46	10	55	27.5	
204	Boundary Lake	Boundary Cr.	Taku R. C-6	23	925	795	170	85	95	20	55	22.2	
205	Yehring Creek	Yehring Cr.	Taku R. B-6	16	1,100	1,077	112	26	26	5	55	29.0	
206 (56)	Lake Dorothy	Dorothy Cr.	Taku R. A-6	11	2,422	2,248	81	100	150	34	50	7.3	
207 (57)	Speel Division Snettisham Project	Speel R.	Taku R. A-5	194	325	273			275	63	50	8.1	

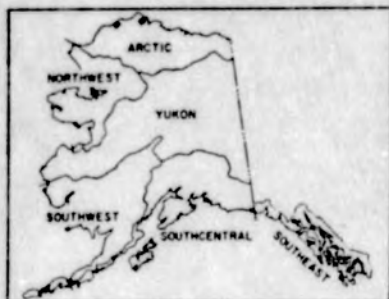
No.	Power Site	Stream	USGS Map sheet	Drainage Area (sq. mi.)	Maximum Required Water Surface (ft.)	Average Head (ft.)	Average Annual Runoff (1000 AF)	Cont. Regula- tion	Net Energy (million Kwh)	Installed Capacity (1000 KW)	1/ (plant factor %)	Index Cost \$/Kwh
208 (58)	Tease Creek	Tease Cr.	Taku R. A-5	11	1,100	1,034	110	75	70	16	50	14.9
209 (59)	Sweetheart Falls	Sweetheart Falls Cr.	Sumhum D-5	35	634	612	250	105	125	39	50	9.6
210 (60)	Houghton	Unamed	Sumhum D-1	39	550	457	370	98	136	31	50	11.0
211	Fa. sgut	Farragut R.	Sumhum A-3	64	525	493	480	56	163	37	50	13.8
212 (61)	Sc. rry Creek	Scenery Cr.	Sumhum A-3	21	957	620	147	90	67	15	50	10.8
213 (62)	Thomas Bay	Cascade Cr.	Sumhum A-3	19	1,514	1,442	160	86	166	38	50	8.1
214	Ruth Lake	Delta Cr.	Petersburg D-3	8	1,550	1,449	59	90	63	13	55	18.1
215 (63)	Stikine River	Stikine R.	Petersburg C-1	20,000	350	291	45,000	90	9,900	2,260	50	9.0
216 (64)	Goat	Goat Cr.	Bradfield Canal C-6	14	1,298	1,056	112	90	87	20	50	13.9
217	Katate River	Katate R.	Bradfield Canal C-6	73	650	249	594	82	99	21	55	18.3
218	Aaron	Aaron Cr.	Bradfield Canal C-6	81	300	187	652	56	58	12	55	86.0
219	Harding River	Harding R.	Bradfield Canal C-5	68	250	207	548	92	85	18	55	49.2
220	No. Bradfield River	N. Bradfield R.	Bradfield Canal B-5	150	250	157	1,200	61	131	27	55	71.0
221 (65)	Tyee Creek	Tyee Cr.	Bradfield Canal A-5	15	1,387	1,275	123	93	120	27	50	8.9
222	Anan Creek	Anan Cr.	Bradfield Canal A-6	27	325	230	200	89	33	7	55	34.4
223 (66)	Spur	Unamed	Bradfield Canal A-4	10	1,889	1,776	83	87	105	24	50	10.7
224	Saks Cove	Saks Cr.	Ketchikan D-4	22	675	621	150	93	72	15	55	18.7
225 (67)	Leduc	Leduc R.	Ketchikan	7	1,384	1,241	61	100	62	14	50	14.5
226	Chickamin River	Chickamin R.	Bradfield Canal A-2	562	325	228	4,800	82	727	150	55	26.1
227	Granite Creek	Granite Cr.	Ketchikan C-3	9	945	863	82	67	39	8	55	17.2
228 (69)	Punchbowl Creek	Punchbowl Cr.	Ketchikan C-3	14	650	622	126	99	64	15	55	10.6
229 (68)	Rudyard	Unamed	Ketchikan C-2	8	1,775	1,609	63	100	83	19	50	10.6
230	Wilson River	Wilson R.	Ketchikan B-2	70	400	166	560	93	71	15	55	30.7
231 (70)	Red	Red R.	Ketchikan A-2	44	400	347	410	89	104	24	50	12.2
232	Davis River	Davis R.	Ketchikan D-1	78	450	367	667	67	131	28	55	17.4
233	Kelp	Unamed	Sitka B-4	21	675	612	161	82	66	16	50	15.1
234 (75)	Takatz Creek	Takatz Cr.	Sitka A-3	11	1,040	991	129	87	97	20	50	12.5
235	Baranof Lake	Baranof R.	Sitka A-3	32	145	108	316	42	11	2	55	19.1
236	Carbon Lake	Unamed	Sitka A-3	27	300	260	350	65	49	10	55	24.8
237	Milk Lake	Unamed	Port Alexander D-3	11	700	666	167	36	33	7	55	19.0
238	Brentwood Creek	Brentwood Cr.	Port Alexander C-3	7	950	655	98	71	38	8	55	27.7
239 (74)	Deer	Unamed	Port Alexander C-3	7	374	339	114	96	31	7	50	14.8
240 (73)	Maksoutof River	Maksoutof R.	Port Alexander C-3	24	600	570	272	93	117	24	50	12.6
241	Plotnikof Lake	Unamed	Port Alexander D-3	20	350	315	24	76	44	9	55	17.7
242 (76)	Green Lake	Vodopad R.	Port Alexander D-4	29	400	353	212	84	52	11	50	12.4
243	Hasselborg Creek	Hasselborg Cr.	Sitka C-1	83	331	306	343	90	77	16	55	22.3
244	Thayer Creek	Thayer Cr.	Sitka C-2	61	407	377	252	100	78	16	55	22.1
245	Kathleen Creek	Kathleen Cr.	Sitka D-3	29	525	502	126	94	48	10	55	33.7
246	Towers Creek	Towers Cr.	Petersburg D-5	81	275	259	300	100	64	13	55	108.7
247	Orchard Creek	Orchard Cr.	Ketchikan D-5	60	200	170	420	75	44	9	55	17.8
248 (71)	Lake Grace	Grace Cr.	Ketchikan C-3	29	500	456	281	90	99	20	50	10.1
249	Manzanita Lake	Unamed	Ketchikan C-4	63	300	269	620	91	124	26	55	17.5
250 (72)	Swan Lake	Falls Cr.	Ketchikan C-4	36	326	275	336	91	69	15	50	12.8
251	Thorne	Thorne R.	Craig C-2	166	125	103	1,100	85	80	17	55	17.6
252	Reynolds Creek	Reynolds Cr.	Craig A-2	7	---	---	54	99	54	11	55	19.7

Three power plants and lakes involved.

Power site numbers refer to map locations.

Numbers in parentheses refer to the published list and map of lower priced hydroelectric potentials 2500 kw continuous power and larger.

- 1/ The size and cost of the power plants for the inventory study was based on 55% plant factor. The list of the 76 lower priced sites assumes 50% plant factor with no significant change in cost. There are exceptions for the larger sites which were considered base load plants. Specific plant factors are noted.
- 2/ The index cost is a relative comparison cost of energy at the power plant bus bar. Substation and transmission costs are not included.
- 3/ An alternative development of the Ruby site to elevation 325 would inundate the Rampart dam site. Power production at Ruby would increase to 14.2 billion kwh annually and 3,250,000 kw.



SUBREGIONS

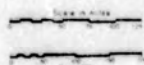


SOUTHEAST REGION

NOTE: Numbers refer to peak's listed on Inventory of Potential Hydroelectric Sites in Alaska 2500 ft or continuous power and higher.

UNITED STATES DEPARTMENT OF THE INTERIOR
ALASKA POWER ADMINISTRATION

INVENTORY OF POTENTIAL
HYDROELECTRIC SITES IN ALASKA



Hydroelectric Alternatives For The Alaska Railbelt

February, 1980

U.S. Department Of Energy

Alaska Power Administration

Juneau, Alaska, 99802



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**HYDROELECTRIC ALTERNATIVES FOR
THE ALASKA RAILBELT**

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PART I. INTRODUCTION

For the last several years, hydroelectric investigations for the Alaska Railbelt have focused on the Upper Susitna and Bradley Lake hydroelectric projects. Many other potential projects, larger and smaller, have been identified which are accessible to the Railbelt, thus there are important questions to ask as to how these projects were selected and whether some other project or group of projects might offer a more sensible hydroelectric development plan for the Alaska Railbelt.

This report provides a review of the data and studies that brought about the selection of the two projects, and a current appraisal as to whether that selection remains appropriate.

In Alaska the electric power demands are greater in the winter than in summer. This is due to the long winter nights and the cold dominated climate. Streamflow characteristics are opposite of the power demands. Streamflows are greater in summer when the power demands are less and subject to fall freeze up or very minimal flows in winter. Typically only about 20 percent of the average annual runoff occurs between October and May. Because of this need for firm energy, "run-of-the-river" (non-storage) sites were not considered as alternatives to Susitna.

In addition to references within the text, this report is based on those publications listed as references within the appendix.

PART II. SUMMARY

In connection with the power market analyses for the Corps of Engineers (Corps) 1979 supplemental feasibility studies of the Upper Susitna Project, Alaska Power Administration (APA) conducted a review of alternative potential hydroelectric development plans for the Alaska Railbelt. The purpose of the review was to examine whether selection of the Upper Susitna Project remains appropriate.

The principal findings are:

There are no hydro generation opportunities available to generate power in sufficient quantity to be alternative to the Susitna project. Small individual sites may be available, but would satisfy only a small portion of the market area demand. Other sites with apparently acceptable capacity and economic capability have been, or may be, precluded by restrictive land use designations such as national parks, national monuments, national wildlife refuges, and wild and scenic rivers.

PART III. PREVIOUS STUDIES

This section has a few notes on the principal investigations of alternative hydroelectric power projects for the Alaska Railbelt.

Except in Southeast Alaska, very little was known about the extent of Alaskan hydroelectric resources prior to World War II. During the war, and in the immediate post-war period, serious interest in the hydro developed. It appears that there were two primary motivating factors: (1) the world-wide search for large low-cost hydroelectric projects that could be used in aluminum production, and (2) intensive interest in providing a viable economy in the then Territory of Alaska.

Key events included initiatives by the Territorial government and private studies on both the Wood Canyon and Yukon-Taiya projects. A comprehensive inventory of Southeast Alaska hydroelectric resources was published by the Forest Service and Federal Power Commission in 1947 covering an accumulation of studies in that region since the early part of the century.

The Bureau of Reclamation conducted its first field reconnaissance of several Alaskan hydro projects in the fall of 1946. This led to a statewide reconnaissance completed in 1948, which first brought attention to the hydroelectric potentials of the Upper Susitna and other hydro projects in the Susitna River basin. That reconnaissance triggered the studies that led to authorization of the Eklutna Project in 1950, Reclamation's Susitna River basin investigations which were completed in 1953, U.S. participation in the first Canadian-U.S. investigation of the Yukon-Taiya Project, as well as investigation of several smaller projects in other parts of the State.

Reclamation's Susitna basin report recommended feasibility investigation for the Upper Susitna Project based on the results of comparative studies, including initial fish and wildlife evaluations, for more than 20 potential hydroelectric projects in the Susitna River basin. The detailed studies confirmed viability of the project, and Reclamation's 1960 feasibility report recommended project authorization. This process of statewide reconnaissance, a comprehensive river basin study, and then detailed investigations of specific sites brought about the initial Susitna Project construction proposal.

A separate series of regional water resources investigations by the Corps of Engineers brought about alternative strategy keyed to the Rampart Project on the Yukon River. Reconnaissance studies on Rampart in the late 1950's indicated an immense potential for low-cost power, leading to a determination that further action on the proposal for Susitna authorization be deferred pending completion of: (1) feasibility reports on Rampart by the Corps of Engineers, and (2) investigations by the Interior Department of the power market and natural resources aspects of Rampart. That action was set in the March 14, 1962 agreement between the Secretaries of Army and Interior.

At the time, Susitna and Rampart were the apparent alternatives for long-term major power supplies in the Railbelt. Interim solutions were also needed, and the options included a number of smaller projects, including Bradley Lake near Homer for which the Corps had completed its review report in 1961. Bradley Lake was authorized for construction in the 1962 Flood Control Act, and the aforementioned studies concerning Rampart proceeded.

As a part of the Interior Department Rampart investigations, the Bureau of Reclamation prepared a comprehensive inventory of statewide hydroelectric resources during the period 1962 to 1967 (APA has updated portions of that inventory since that time). The inventory benefited from a great deal of information that was simply not available for previous inventory and basic studies by the Corps and the Bureau:

- The extensive work on regional and basin studies had, by now, accomplished an essentially complete identification of available sites.
- Post World War II data collection efforts, principally in topographic mapping and hydroelectric data, provided a much firmer basis for assessing the potential.
- Individual project studies had been completed providing specific field information of reconnaissance or higher level for several potential projects.

The actual processes for conducting the inventory are discussed in more detail subsequently. They included a comprehensive search for physical potential based on all previous studies; an exhaustive examination of available mapping to identify new sites; screening processes to focus in on sites having apparent potential; inventory-grade site studies including hydrology, reservoir and power production studies, cost estimates, and field checks of the better sites on geologic; and engineering suitability.

The initial inventory results were summarized and published in the June 1967 Interior Department Report, Alaska Natural Resources and the Rampart Project. That report also summarized more detailed evaluations of the Susitna, Wood Canyon, Yukon-Taiya, and Woodchopper Projects which were found to be the principal major project alternatives to Rampart. These studies reaffirmed the previous general findings concerning Susitna and Bradley Lake.

Similar findings appeared in the 1969 and 1976 Alaska Power Surveys of the Federal Power Commission (FPC). The evaluation of hydroelectric resources for the two FPC reports was again premised on the statewide inventory.

For a time during the 1960's and early 1970's, natural gas and fuel oil dominated thinking in Alaskan power supply planning. Thus, while action on Upper Susitna was deferred pending the Rampart outcome, interest in smaller projects such as Bradley Lake was diminished because of the availability and low cost of natural gas. The Corps completed its report on Rampart in 1971 with the recommendation that the project not proceed. This led directly to the renewed interest in Upper Susitna. Further impetus to the hydroelectric initiatives came about with the 1973 oil embargo and the new round of project investigations was launched.

PART IV. HYDROELECTRIC POWER INVENTORY

The term "inventory" means different things to different people. The APA-USBR inventory included assessment of physical potential and screening and evaluation process to provide appraisals of engineering and geologic suitability, sizing studies to approximate the optimum levels of development, estimates of probable construction costs, and relative cost of power for the more promising sites. There are two published summaries of the inventory:

- The list of 76 "more economical" potential projects which, with minor variations, has appeared in numerous reports.
- A longer list of 252 sites for which inventory-grade plans and cost estimates were prepared during the inventory process. The list of 252 includes the 76.

The steps in the inventory were as follows:

1. The search for possible sites.
2. The screening to identify those with reasonable possibility of economic and engineering viability.
3. Specific site studies.
4. Field check of the promising sites.
5. Coordination.

The inventory process was designed specifically to examine projects with potential of 2,500 kW or more prime power capacity (equivalent to 22 million kilowatthours per year, or roughly one-half of 1 percent of the 1977 electric power use in Alaska).

Site Identification

This was accomplished by assembling information from all available previous studies supplemented by a careful map search to identify additional possible sites. The map search involved examination of each drainage area on the available topographic maps for possible dam and reservoir sites or diversion schemes that could possibly produce power. In all, some 2,000 sites were identified in this process.

Screening Processes

The screening processes used several techniques. Very rough estimates of power potential were prepared using regional interpretations of runoff characteristics, measured drainage areas, and estimates of available head based on the topographic maps. The initial group of around 2,000 sites was reduced to about 700 in this preliminary screening,

which eliminated the very small sites and those which, by judgment, would involve excessively expensive construction costs for the amount of power available.

The second level of screening produced rough indications of relative cost of major features--volume of dam or size and length of major waterways. This process identified projects for which excessive costs of obtaining necessary reservoir storage and head would rule out a significant chance of feasibility. The second screening left a residual list of 252 sites for which inventory-grade plans and estimates were prepared.

Site Studies

Inventory-grade plans and estimates were prepared for each of the 252 remaining sites. To assure a reasonable level of consistency, a series of procedures for sizing and cost estimating was developed.

As appropriate to each project, the following steps were followed:

1. Water supply available for power production was estimated using all available streamflow records supplemented by climate data and correlations.
2. Reservoir area-capacity values were determined by map measure.
3. Alternative plans for project development were determined using the topographic maps (i.e., alternative heights of dam or length of penstocks and waterways).
4. Preliminary estimates of reservoir sedimentation were developed.
5. Sizing studies were prepared to approximate the optimum scale of development for each project. This included evaluation of reservoir regulation capability (usually by mass diagram techniques) and comparison of project costs and firm power capability.

The site studies are quite accurate for those projects which had the benefit of considerable previous field data. For other projects, particularly those in remote areas of the State, the inventory-grade site studies are probably much less reliable. By judgment, the largest single variable is actual foundation conditions for major features, especially dams.

Some field reconnaissance work, including observations of surface geology, was accomplished for purposes of verifying the site studies. This focused on the projects that appeared to have good physical potential, but for which foundation information was lacking.

The inventory produced few surprises. It located a few new projects (relatively small) that had not been found in earlier studies. It

eliminated many projects that had been listed in earlier studies by reason of excessive costs or evident engineering or geologic problems. The net result was a reasonably consistent evaluation of the State's hydroelectric resources including appraisal of engineering and economic viability.

Coordination

A major step in the coordination was reconciliation of data and project assumptions arising from Bureau of Reclamation inventory studies and the series of Corps of Engineers river basin reports. This was accomplished on a project-by-project basis so that the end result of the inventory reflected the best available data on each site.

Portions of the inventory have been modified from time to time as new data became available through specific project studies or new mapping.

PART V. ALTERNATIVE HYDROELECTRIC PLANS

There are a number of significant new facts that are relevant to deciding which project makes most sense and when. Substantially better information is available on likely environmental aspects of the projects; construction costs and interest rates have risen dramatically, as have levels of demand for power; fuel costs have skyrocketed; major changes in land ownership and management are affecting the availability of individual projects.

As a part of the most recent round of Susitna investigations (1979 Supplemental Feasibility Report), APA again reviewed the available hydroelectric alternatives to see if a different selection of projects would be more appropriate under present conditions.

Considering present hydroelectric proposals, the current strategy involves development of the authorized Bradley Lake Project with power on line in about 1987, followed by Watana in 1994 and Devil Canyon in 1998. This timing is consistent with the APA mid-range power demand estimates. Actual timing would depend on load expectations at the time when construction decisions are reached on each unit of each project. For example, if lower load growth occurs through the 1980's, it would follow that construction start on Devil Canyon would be deferred somewhat.

The range of possible alternatives can be summarized about as follows:

1. Early construction of one of the major Alaskan hydro projects such as Wood Canyon or Rampart.
2. Pursue regional or river basin development using smaller individual projects and attempt to optimize development in each area.
3. Pursue a strategy of constructing the most economical smaller projects available anywhere in the Railbelt area.
4. A strategy of very small hydro projects (say small river basins, with project capacity up to about 30 MW, where minimal environmental costs are expected).

Each of these strategies is examined in subsequent parts of this report.

Bases of Comparison

There are four general bases of comparison:

1. Demand for the power (in lieu of the Upper Susitna Project, to what extent would the alternative strategy meet the needs).
2. Relative costs; i.e., would the alternative strategy result in lower or higher costs to the consumer.

3. Land use and management aspects as they affect availability of the alternative sites.

4. Environmental aspects, anticipated impacts.

Power Demands

The projected power demands (APA) for the Upper Susitna River Project market area (Anchorage-Fairbanks "Railbelt" area) are:

	1980		1990		2000	
	MW*	GWH**	MW	GWH	MW	GWH
High	890	3,930	2,360	10,680	4,650	20,940
Medium	830	3,660	1,590	7,080	2,850	12,740
Low	770	3,390	1,180	5,220	1,780	7,890

* MW (Megawatt) equals 1,000 kW

** GWH (Gigawatthour) equals 1,000,000 kWh

These projections include the total utility, industrial, and national defense needs, and are based on Institute of Social and Economic Research (ISER) 1978 population and employment estimates.

For the purposes of this study, it was assumed that the hydro strategy would focus on requirements between 1990 and 2000. Under the low and high load projections, alternative hydro plans were analyzed that would tie to those demands.

Costs

Estimates of the cost of power generation (mills per kWh) were prepared for each of the 252 sites. This is the index cost (last column) of the list of 252 sites, which is the basis of economic comparison of the sites (generation only--no transmission). (Costs are based on 1965 to 1966 prices, 50-year repayment at 3 1/8-percent interest rate, and complete utilization of average annual energy.)

The combination of the four Susitna River sites (127--Devil Canyon, 128--Watana, 129--Vee, 130--Denali) resulted in an index of 6.3 (mills per kWh). This is the basis of economic comparison of possible alternatives.

For information purposes, possible alternatives are discussed that are within twice the cost range of Susitna (12.6 mills per kWh). This is to allow some flexibility for contingencies and unknowns should more detailed consideration become warranted, and candidly, because very few sites are within the cost range.

Even though economic comparison is based on work that is several years old, it is concluded to be valid. More recent estimates of the Susitna River sites correspond generally with costs that would be obtained by

indexing earlier costs to present levels. More specifically, cost estimates for energy from the four Susitna River sites, by the Corps of Engineers in the December 1975 interim feasibility report Southcentral Railbelt Area, Alaska - Upper Susitna River Basin, are within 10 percent of the index cost escalated to 1975 by construction cost trends. Therefore, economic comparison of possible alternatives is based on relative costs from the list of sites rather than updating all costs on the list.

Land Use and Management

Of specific concern are present and pending designations of wilderness, national parks, refuges, and wild and scenic rivers since hydroelectric development is not compatible with such designations.

Environmental Aspects

Based on published materials of ADF&G, the Land Use Planning Commission, and others, we are able to offer general statements of likely major fish and wildlife implications of alternative hydroelectric projects, with particular reference to anadromous fish. Significant potential for impact lies with the Tanana, Yentna, Skwentna, and Talachulitna River basins.

In addition, the extreme recreation development and use of the Kenai River would likely preclude serious consideration of identified power-sites on that river.

Larger Capacity Single Sites

Aside from Upper Susitna, the best known major hydro potentials of Alaska are Rampart on the Yukon River, Wood Canyon on the Copper River, and the Yukon-Taiya diversion from the head of the Yukon in Canada to Tidewater near Skagway in Alaska. Yukon-Taiya and Wood Canyon each have a power potential about three times that of the Upper Susitna Project; Rampart is about five times as large as Susitna.

Other large projects of possible interest include Woodchopper and Ruby on the mainstem Yukon, and Porcupine which is on a major Yukon tributary.

A final large project--the downstream Holy Cross site--would be of interest only in connection with development of major upstream storage projects.

These large projects are not considered to be available alternatives in the time frame proposed for the Upper Susitna Project for a variety of reasons.

No.	Site	Stream	Firm Energy GWH/yr.	Capacity MW	Cost Mills/kWh
16 (06)	Holy Cross	Yukon R.	12,300	2,800	9.0
29 (11)	Ruby	Yukon R.	6,400	460	3.9
54 (20)	Rampart	Yukon R.	34,200	5,040	2.0
59 (21)	Porcupine	Porcupine R.	2,320	530	5.0
60 (22)	Woodchopper	Yukon R.	14,200	3,200	4.5
64 (24)	Yukon-Taiya	Yukon R.	21,000	3,200	3.3
173 (54)	Wood Canyon	Copper R.	21,900	3,600	3.2

On the cost aspect, several projects have potential equivalent to or lower than Susitna. Present and pending land use designations preclude consideration now of the mainstem Yukon sites as well as Wood Canyon; Yukon-Taiya is affected by legislation creating the Klondike Gold Rush National Park, although it should be noted that all of the field studies indicated the park and the hydro project were basically compatible.

On the demand side, the larger projects would substantially exceed anticipated Railbelt area demands through 2000 and beyond. However, they could be designed to serve larger power markets through interconnection with Canada.

Serious environmental problems have been documented with regard to Rampart, and Wood Canyon is known to have major anadromous fishery problems. Of the large projects, Yukon-Taiya would likely have the least severe environmental problems.

Combinations of Smaller Sites by Geographic Area

In addition to the larger capacity single sites discussed in the preceding section, combinations of individual, small capacity sites were also considered as possible alternatives. These sites were grouped by eight geographic areas and compared with the projected power demands and with the Upper Susitna Project generation capacity and 1966 cost criteria. The areas are listed on the following page:

	Area	Capacity MW	Firm Energy GWH/yr	% of Projected, Low Level, Power Demands			Weighted Cost Mills/kWh *
				1980	1990	2000	
1.	Matanuska River Basin	194	935	25	18	12	87.5
2.	Tanana River Basin	1,316	5,806	171	111	74	18.5
3.	Cook Inlet - West Drainage	533	2,347	69	45	30	10.3
4.	Skwentna-Yentna River Basin	509	2,312	68	44	29	29.6
5.	Talkeetna River Basin	237	1,107	33	21	14	40.4
6.	Chultina River Basin	345	1,542	46	30	20	12.3
7.	Kenai Peninsula	475	2,211	71	46	31	19.9
8.	Scattered Sites, Tributary to Railbelt	462	2,207	65	42	28	31.6

* Does not include transmission system cost.

Sites within the Nenana River Basin have also been identified in the past, but all are precluded by Mt. McKinley National Park.

A brief description of each area follows while specific information on each site may be found in the appendix.

1. Matanuska River Basin

This basin lies to the immediate northeast of Palmer, Alaska, and drains the southern slopes of the Talkeetna Mountains and the northern slopes of the Chugach Mountains. The basin contains primarily State and private lands, is bisected by the Glenn Highway, and is easily accessible to the Anchorage area.

The basin contains six small, potential hydroelectric sites that range in capacity from 9 MW to 67 MW with total generation capability of 935 GWh per year. Costs, not including provision for transmission, would be in the magnitude of 14 times that of the Upper Susitna Project.

The basin contains a variety of wildlife including moose, bear, caribou, and Dall sheep, as well as furbearers, waterfowl, and upland game birds. Five species of salmon are found in the basin, principally in the lower reaches, in addition to trout, grayling, whitefish, and burbot. The Alaska Coastal Zone extends into the basin and includes half of the sites, representing 78 percent of the potential capacity.

Even though no major environmental impacts have been identified, there is possibility for conflict. Principal, potential impacts include disruption of anadromous fish passage, loss of fish and wildlife habitat, and degradation of aesthetics.

2. Tanana River Basin

This basin is located in the east-central part of the State and stretches southeast from the Yukon River to Canada. Lands in the Tanana River Valley are principally State and private; however, there are several major Federal land withdrawals in the basin for military reservations, Mt. McKinley National Park, the Alaska Pipeline, and settlement of the terms of the Alaska Native Claims Settlement Act. The Richardson and Alaska Highways are located within the basin and provide access to Fairbanks and a number of smaller communities.

The basin contains seven potential hydroelectric sites that range in capacity from 25 MW to 532 MW with total generation capability of 5,806 GWh per year. Costs without provision for transmission, would be in the magnitude of 2.9 times that of the Upper Susitna Project.

The basin contains a wide variety of wildlife including moose, bear, caribou, Dall sheep, and one of the State's two bison herds, as well as furbearers and upland game birds. The Tanana River Valley provides extensive waterfowl nesting areas. Three species of salmon are present with the majority of spawning located in the lower half of the basin. Trout, grayling, whitefish, burbot, and sheefish are also present.

Principal potential impacts include major highway relocation; disruption of anadromous fish passage; loss of fish and wildlife habitat, particularly waterfowl; loss of bison calving grounds; and loss of recreation use of natural waters.

3. Cook Inlet-Western Drainage

This area is located immediately to the west of Cook Inlet between Tuxedni Bay on the south and Mt. Susitna on the north. Lower lying lands are mostly State and private while the higher elevation lands to the west and south are Federally withdrawn for the Lake Clark National Monument and settlement of terms of the Alaska Native Claims Settlement Act. The area lies within the Alaska Coastal Zone.

The area contains seven potential hydroelectric sites that range in capacity from 9 MW to 366 MW with total generation capability of 2,347 GWh per year. Costs, not including provision for transmission, would be in the magnitude of 1.6 times that of the Upper Susitna Project.

A variety of wildlife are found in the area including moose, bear, sea mammals, furbearers, upland game birds, and water fowl. Five species of salmon use the area and the Alaska Department of Fish and Game has identified several major salmon fishing areas along the shores of Cook Inlet. Whitefish and trout are also present. The area is scenic with the lofty, ice clad Mt. Spurr and other mountains forming a picturesque backdrop for the forest clad lowlands. Even though there is no road network, recreation use is heavy.

Principal, potential impacts include reduction in anadromous fish passage and habitat, conflict with bear in intensive use and denning areas, and degradation of aesthetics.

4. Yentna-Skwentna River Basin

This basin lies across Cook Inlet to the northwest from Anchorage and drains a large area into the lower reaches of the Susitna River. Lands are nearly all State and private with some Federal withdrawals at the higher elevations of the mountains to the west. The basin lies within the Alaska Coastal Zone. While there is no road network and access is by air and boat, recreational use is intense.

The basin contains eight potential hydroelectric sites that range in capacity from 15 MW to 145 MW with total generation capability of 2,312 GWh per year. Costs, without provision for transmission, would be in the magnitude of 4.7 times that of the Upper Susitna Project.

The basin supports numerous wildlife including moose, bear, Dall Sheep, furbearers, upland game birds, and migrating water fowl, as well as a significant part of the Cook Inlet anadromous fish resource. Five species of salmon are present and use the basin extensively. Trout, grayling, whitefish, burbot, and Northern Pike are also present.

Principal, potential impacts include loss of recreation use of natural waters; disruption of anadromous fish passage; loss of fish, wildlife, and waterfowl habitat; conflicts with bear denning and concentration use areas; and degradation of aesthetics.

5. Talkeetna River Basin

This basin lies to the east of the community of Talkeetna and drains the central and western portions of the Talkeetna Mountains. Lands are mostly in State ownership, while Federal land withdrawals lie along the northern rim of the basin and just east of the junction of the Talkeetna River and Iron Creek. There is no road network in the basin, and access is mostly by air.

The basin contains six potential hydroelectric sites that range in capacity from 5 MW to 74 MW with total generation capability of 1,107 GWh per year. Costs, without provision for transmission, would be in the magnitude of 6.4 times that of the Upper Susitna Project.

Wildlife in the basin include moose, bear, Dall Sheep, mountain goat, caribou, furbearers, upland game birds, and migratory waterfowl. Five species of salmon use the basin, principally below the confluence of the Talkeetna River and Prairie Creek. In addition, trout, burbot, grayling, and whitefish are found in various parts of the basin.

The major potential impacts would relate to disruption to, and possible loss of, anadromous fish and passage to spawning areas; loss of big game intensive use areas; and loss of the relatively unchanged, natural condition of the basin.

6. Chulitna River Basin

This basin lies to the southwest of Cantwell and drains the southeast slopes of Mt. McKinley into the Susitna River at Talkeetna. Lands at the lower elevations of the river valleys are mostly State and private, while Federal withdrawals cover the higher lands to the north and south. The Parks Highway and Alaska Railroad bisect the basin and provide easy access for the Railbelt population. The basin is quite scenic with Mt. McKinley serving as a spectacular backdrop.

The basin contains six potential hydroelectric sites that range in capacity from 12 MW to 184 MW with total generation capability of 1,542 GWh per year. Costs, without provision for transmission, would be in the magnitude of double that of the Upper Susitna Project.

Wildlife in the basin include moose, bear, caribou, Dall Sheep, furbearers, upland game birds, and migratory waterfowl. Four species of salmon are found in the basin in addition to trout, grayling, whitefish, and burbot.

No major environmental impacts have been identified; however, there is potential for disruption, and possible loss of the anadromous fish resource and degradation of aesthetics.

7. Kenai Peninsula

This area is just south of Anchorage and joins Cook Inlet on the west and the Pacific Ocean on the east and south. The area contains a significant part of the State's highway and road network and includes several of the State's larger communities. The majority of the lands are within Federal withdrawals for a national wildlife refuge, national forest, national monument, and settlement of terms of the Alaska Native Claims Settlement Act. State, and some private, lands are located around the western and southern rims of the Peninsula and in the Seward area. The area lies within the Alaska Coastal Zone.

The area contains 13 potential hydroelectric sites that range in capacity from 6 MW to 94 MW with total generation capability of 2,211 GWh per year. Costs, not including provision for transmission, would be in the magnitude of 3.2 times that of the Upper Susitna Project.

The area supports a wide variety of wildlife including moose, bear, Dall Sheep, mountain goat, caribou, sea mammals, furbearers, upland game birds, seabirds, and waterfowl. Five species of salmon are found within the area and several major salmon fishing areas along the shores of Cook Inlet have been identified by the Alaska Department of Fish and Game. The area is highly scenic, ranging from ocean fjords to rugged ice clad mountains. Recreation use is intensive.

Major potential environmental impacts would include disruption of the intense recreation use, reduction of anadromous fish resources, and degradation of aesthetics.

8. Scattered Sites, Tributary to Railbelt

These sites are scattered all the way from east of Fairbanks to Anchorage and the Valdez areas. The sites are generally small, widely separated, and interconnection would be extremely expensive. Lands involved include State, private, and Federal, dependent on the specific site location. In some cases, Federal withdrawals would preclude development.

Thirteen potential hydroelectric sites are included that range in capacity from 4 MW to 82 MW with total generation capability of 2,207 GWh per year. Costs, not including provision for transmission, would be in the magnitude of 5 times that of the Upper Susitna Project.

The general variety of wildlife found in the areas discussed previously is representative of these site locations. A number of the streams and rivers support salmon in addition to trout and other resident fish. No major environmental impacts have been identified; however, there is potential with each project, particularly those that involve the larger streams and rivers with anadromous fish, are in highly scenic areas, or would extinguish extensive wildlife habitat areas.

Combinations of the Most Economical Smaller Sites

The third approach to evaluating a possible alternative to the Susitna Project is to combine the economically best small sites from each of the geographic areas. Only one site (Chakachamma) is within the economic range of Susitna. Twelve sites are within twice the cost range, and are included in the following tabulation of the best small sites within the Railbelt area.

No.	Site	Stream	Firm Energy GWH/year	Capacity MW	Cost Mills/kWh
93	(32) Cresent Lake	Cresent R.	179	41	9.9
94	(33) Chakachamma	Chakachatna R.	1,600	366	6.5
97	(34) Coffee	Beluga R.	160	37	11.5
98	(35) Upper Beluga	Beluga R.	210	48	11.1
105	(36) Yentna	Yentna R.		145)	
106	(37) Talachulitna	Skwentna	1,390	75)	10.1
107	(38) Skwentna	Skwentna		98)	
(Yentna, Talachulitna, and Skwentna operated as a system)					
109	(39) Lower Chulitna	Chulitna	394	90	8.1
110	(40) Tokichitna	Chulitna	806	184	8.8
112	(41) Keetna	Talkeetna R.	324	74	11.3
150	(49) Snow	Snow R.	278	63	11.2
158	(51) Lowe	Lowe R.	254	55	11.2
Total			5,595	1,276	

The Lowe site has the severe disadvantage that it would block the major land access route to Valdez; it would also involve relocating the Trans-Alaska Oil Pipeline and a highway, and a planned transmission line between Valdez and Glennallen.

Sites that are in designated national monuments or are included in proposed Federal land withdrawals include Cresent Lake and Chakachamma in the Lake Clark area, and Tokichitna in the Denali area. These sites represent approximately half of the total potential power from the sites, leaving 685 MW capacity and 3,010 GWh energy.

Bradley Lake (no. 154--Kenai Peninsula) with an index cost of 8.0 is not included because it is already an authorized project (Corps of Engineers).

Another site, Lane (no. 124, 240 MW), with an index cost of 8.9 could also be included based on the less than 12.6 criteria. However, it is actually a part of the Susitna River system because it is immediately downstream from the Devil Canyon site.

Cost: This would involve smaller increments of new investment, at uniformly and progressively higher costs per installed kW. Transmission system needs would be substantially greater also.

The program would very quickly move into significant fisheries problems--by judgment substantially more significant than those of Upper Susitna. Expect significant impacts on game habitats, primarily moose.

The "Small" Hydro Approach

The existing hydroelectric projects near Anchorage (APA's Eklutna Project and Chugach Electric Copper Lake Project) are examples of smaller projects including relatively small drainage basins and generally favorable environmental aspects. If a large number of small projects (say size range up to 30 MW or so) with favorable environmental aspects could be located, an alternative small hydro approach would make a great deal of sense. The viability of the strategy depends on the extent of the resources of good small projects, their cost, availability, and cumulative environmental impacts.

Sites smaller than 2.5 MW would likely have to be fully automated operations because a significant part of the revenue would be required for personnel to attend the plant. For example, operation costs alone for a five-person staff would cost \$200,000 per year, which would amount to 4.5 cents per kWh for a 1-MW plant operating at 50 percent plant factor. Sites of 2.5 MW and smaller cannot support transmission lines for very long distances; hence, to contribute positively to a power system, sites have to be close to the power market or an existing grid power system. A 50-mile transmission line costing \$40,000 per mile would add 3.7 cents per kWh to the cost for a 1-MW plant.

To meet Railbelt power needs by small hydros alone in the 1990 decade, 200 of the 1-MW powerplant sites would need to be developed annually. It is doubtful that 1/10 to 1/20 of this number of sites would be available every year as an alternative to meet the full power needs of the Railbelt area.

The criteria and examination procedure for evaluating cumulative environmental effects of developing several small hydro project sites will be the same criteria and procedure used in evaluating larger powersites. Sites that need only relatively short access roads, short transmission lines, and small dams could meet the criteria. Conversely, development of dozens of the small sites that each need roads, transmission lines, and dams, or long roads and transmission lines, could have accumulative environmental impacts that may exceed the effect of a single large project. Logic suggests that several of the more economical smaller sites having a minimum of environmental effects could be constructed as supplemental local energy sources to large projects which meet major city utility requirements.

ALASKA POWER ADMINISTRATION
Inventory of Potential Hydroelectric Sites in Alaska
also criteria is generally 2500 MW (continuous power) and larger

No.	Power Site	Stream	USGS Map Sheet	Drainage Area (sq. mi.)	Maximum Regulated Water Surface (ft.)	Average Head (ft.)	Average Annual Regulation (1000 MW)	Flow (1000 MW)	Installed Capacity (1000 MW)	Energy (1000 MW)	Factor 1/2	Inbre
ARCTIC REGION												
1	Kiliik Bend	Colville R.	Kiliik R.	9,780	700	218	4,100	97	718	148	55	26.6
2	Anaia River	Lozokut Ridge	Anaia R.	6,605	1,000	520	2,100	100	101	21	55	62.9
3	Kuchik Creek	Colville R.	Kiliik R.	6,240	975	120	2,600	100	254	53	55	35.4
NORTHWEST REGION												
4 (11)	Agashashok	Noatak R.	Noatak A-2	12,700	150	132	7,500	100	820	186	50	8.7
5 (12)	Miluyak	Noatak R.	Baird Mtn. D-6	9,700	750	199	5,500	83	910	174	50	13.8
6 (13)	Miluyak	Noatak R.	Baird Mtn. D-3	9,700	750	166	4,500	100	813	140	50	12.7
7 (4)	Kobuk River	Kobuk R.	Baird Mtn. A-1	7,040	150	114	5,700	100	526	120	50	15.8
8	Kopliakut	Kobuk R.	Shungnak D-2	412	400	129	351	100	37	8	55	17.2
9	Upper Kobuk River	Kobuk R.	Shungnak D-2	2,970	275	62	2,200	99	114	23	55	35.5
10	Rockland River	Rockland R.	Candle D-5	2,410	130	103	930	100	79	16	55	42.0
11 (15)	Tukuk Gorge	Tukuk Channel	Teller A-2	1,790	150	187	1,880	100	289	66	50	19.0
12	Kuzitrin River	Kuzitrin R.	Bendiken A-6	4,275	190	95	860	100	67	14	55	49.4
13	Salamon Lake	Krugompa R.	Solomon D-6	107	500	155	267	70	24	5	55	126.0
14	Fish River	Fish R.	Solomon D-3	1,120	150	103	720	100	60	13	55	48.0
YUKON (INTERIOR) REGION												
15	Upper Chulitna River	Atchulitna R.	Holy Cross D-5	162	625	103	140	95	11	2	55	422.0
16 (6)	Holy Cross	Yukon R.	Holy Cross A-12	320,000	137	94	160,000	100	12,300	2,800	50	9.0
17	Kaiting	Yukon R.	Molato	296,000	200	117	137,000	100	13,100	3,000	55	
18 (7)	Dolbi	Koyukuk R.	Kanteel R. B-1	25,660	225	68	13,200	100	1,070	244	55	14.8
19	Fry Island	Koyukuk R.	Melozitna D-4	19,950	270	54	14,000	100	622	114	55	
20 (10)	Hupnes	Koyukuk R.	Hupnes A-3	18,700	350	49	12,300	100	482	110	50	11.2
21 (19)	Kanuti	Koyukuk R.	Hupnes	17,970	500	166	11,900	100	1,612	368	50	12.2
22	Alatina River	Alatina R.	Hupnes	2,860	725	109	2,000	100	175	36	55	23.1
23	Alatina River, Upper	Alatina R.	Survey Pass	1,325	1,050	158	920	100	123	25	55	64.5
24	Jim River	Jim R.	Bettles D-2	470	975	162	320	100	43	9	55	42.6
25	Jack White	Koyuk R.	Bettles	4,350	800	136	3,000	---	315	55	55	18.1
26	John River	John R.	Wiseman A-4	2,695	800	107	1,900	90	149	31	55	38.8
27 (10)	Melozitna	Melozitna R.	Ruby D-6	2,659	550	270	1,400	91	282	64	50	11.2
28	Melozitna River	Melozitna R.	Melozitna B-4	2,020	700	129	1,100	100	117	13	55	48.5
29 (11)	Ruby	Yukon R.	Ruby D-5	256,200	210	72	109,000	100	6,400	460	50	3.9
30	Howlita River	Howlita R.	Ruby B-2	2,570	450	180	1,900	100	280	58	55	16.1
31 (12)	Yukon Island	Tanana R.	Kantishna R. D-3	44,500	350	96	26,000	96	2,050	426	55	29.0
32 (14)	Junction Island	Tanana R.	Kantishna R. D-1	42,490	400	114	25,000	100	2,130	532	50	15.1
33	Kantishna River	Kantishna R.	Kantishna R. B-1	5,440	500	95	5,200	99	394	82	55	22.2
34	McKinley River	McKinley R.	McKinley B-3	710	1,775	297	910	90	201	42	55	42.3
35	Chatanika River	Chatanika R.	Livewood A-4	770	500	91	420	99	32	7	55	63.0
36	Toklanika River	Toklanika R.	Healy D-6	520	1,800	457	728	100	272	57	55	24.2
37	Broome	Heena R.	Fairbanks A-5	2,450	1,000	207	3,400	66	355	80	55	58.0
38	Walker Creek	Heena R.	Fairbanks A-5	2,310	1,000	166	3,300	35	166	35	55	87.5
39	Yanet No. 2	Heena R.	Healy C-4	1,130	2,200	212	1,670	93	298	62	55	37.2
40 (15)	Healy	Heena R.	Healy D-4	1,900	1,700	291	2,675	100	1,300	130	50	10.7
41 (14)	Carlo	Heena R.	Healy C-4	1,130	1,900	166	1,670	83	840	303	50	10.7
42 (13)	Brookanna	Heena R.	Healy B-4	650	2,130	212	650	100	114	24	55	33.1
43	Totlanika River	Totlanika R.	Fairbanks A-4	250	1,600	420	320	100	114	24	55	128.0
44	Chona River	Chona R.	Big Delta D-5	950	900	107	523	99	46	10	55	62.4
45	Salcha River	Salcha R.	Big Delta C-5	1,990	975	136	1,170	93	123	25	55	62.4
46	Tanana River	Tanana R.	Big Delta B-6	18,000	900	107	14,500	25	315	65	55	43.1
47 (16)	Big Delta	Tanana R.	Big Delta A-4	15,300	1,100	99	12,500	90	987	326	50	16.8
48 (17)	Grapple	Tanana R.	Healy D-2	10,700	1,290	59	9,500	---	430	100	50	17.0
49 (18)	Chamon	Tanana R.	Healy C-2	10,450	1,170	149	7,800	97	920	210	50	16.1
50 (19)	Chamon Bluffs	Tanana R.	Tanacross B-6	8,550	1,550	146	5,700	100	693	128	50	15.3
51	Heena River	Heena R.	Heena D-3	2,135	3,025	191	2,300	88	320	66	55	31.9
52	Chena River	Chena R.	Heena A-3	732	3,250	803	1,100	100	797	170	55	21.8
53	Rock Lake	Yukon	McCarty D-1	531	3,600	514	1,400	96	58	12	55	56.5
54 (20)	Kingfort	Yukon	Tanana B-3	200,000	665	445	81,000	100	34,200	5,040	75	2.0
55	East Fork Chandalar River, Atetbay	E.F. Chandalar R.	Chandalar	5,500	900	99	1,500	100	122	25	55	21.1
56	East Fork Chandalar River, Eismann Creek	E.F. Chandalar R.	Chandalar	5,500	1,100	169	1,500	100	210	44	55	29.3
57	East Fork Chandalar River, Little Rock	E.F. Chandalar R.	Christian	4,200	1,600	132	1,150	95	119	25	55	70.3
58	East Fork Chandalar River, Chandalar River	E.F. Chandalar R.	Arctic	2,500	2,025	162	680	100	90	19	55	56.0
59	Chandalar River, Chandalar River	Chandalar R.	Chandalar B-1	23,400	975	313	9,100	100	2,320	530	50	5.0
60 (12)	Chandalar River, Chandalar River	Chandalar R.	Chandalar B-5	122,000	1,020	300	57,000	100	14,200	2,160	75	4.5
61 (13)	Chandalar River, Chandalar River	Chandalar R.	Chandalar B-1	6,060	1,550	324	3,230	84	723	168	50	8.9
62	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	85	245	51	55	17.2
63	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
64	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
65	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
66	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
67	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
68	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
69	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
70	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
71	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
72	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
73	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
74	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
75	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
76	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
77	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
78	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
79	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
80	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
81	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
82	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
83	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
84	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
85	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
86	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
87	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
88	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
89	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
90	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
91	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
92	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
93	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
94	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
95	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
96	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
97	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
98	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
99	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9
100	Fort Fortynine	Fortynine R.	Fortynine	2,065	1,600	249	1,400	88	245	51	55	24.9

No.	Power Site	Stream	USGS Map sheet	Drainage Area (sq. mi.)	Maximum Regulated Water Surface (ft.)	Average Head (ft.)	Average Annual Runoff (1000 AF)	Per Cent Regulation	Firm Energy (million Fwh)	Installed Capacity (1000 KW)	1/ (plant factor %)	Index Cost 2/	
SOUTHWEST REGION													
65 (25)	Crooked Creek	Kuskokwim R.	Sheetmate D-6	31,100	500	352	32,400	100	9,400	2,140	50	5.0	
66	So. Fork Kuskokwim River	S.F. Kuskokwim R.	McGrath A-1	870	2,000	174	840	60	72	15	55	112.0	
67	Lake Kulik	Wind R.	Dillingham	236	123	30	3,800	100	95	20	55	40.6	
68 (26)	Muyakuk Lake	Muyakuk R.	Dillingham D-6	1,530	342	176	4,300	90	555	127	50	15.9	
69	Chikumiuk	Allen R.	Taylor Mtns.	286	630	262	800	90	154	32	55	22.8	Would be reduced 11 million Fwh by development of Muyakuk.
70	Upuk Lake	Tischik R.	Taylor Mtns.	100	830	170	280	100	39	8	55	46.6	
71 (27)	Iliamna Lake	Sulchak R.	Dillingham A-2	6,440	150	114	14,600	100	1,370	313	50	11.1	
72	Kakhonak Lake	Kakhonak R.	Iliamna B-4	145	300	200	275	100	45	9	55	53.8	
73	Nevhalen River	Nevhalen R.	Iliamna D-6	3,119	325	74	6,675	100	411	85	55	11.9	New mapping indicates Nevhalen could be included on list of lower priced hydro.
74 (28)	Taximina	Taximina R.	Iliamna D-5	346	725	393	724	96	224	51	50	15.0	
75	Kottrashibuna	Tenalian R.	Lake Clark A-4	200	510	226	461	99	83	17	55	17.6	
76 (29)	Ingersol	Kijik R.	Lake Clark B-3	300	1,460	1,120	695	99	630	144	50	14.2	
77	Alagnak River	Alagnak R.	Iliamna A-8	530	775	170	960	35	47	10	55	53.5	
78	Novianuk Lake	Novianuk R.	Iliamna A-7	370	631	115	670	100	63	13	55	22.6	
79 (30)	Kukukluk Lake	Alagnak R.	Iliamna A-7	480	825	326	870	100	232	53	50	10.9	
80 (31)	Naknek	Naknek R.	Naknek C-2	2,720	150	124	4,600	100	471	108	50	13.2	
81	American Creek	American Creek	Mt. Katmai D-4	100	1,625	861	180	95	120	25	55	22.7	
82	Ukak River	Ukak R.	Mt. Katmai B-4	194	375	145	330	75	30	6	55	164.0	
83	Contact Creek	Contact Creek	Mt. Katmai A-6	54	1,050	274	92	65	13	3	55	354.0	
84	Becharof	Egegik R.	Naknek A-3	1,280	70	58	1,600	100	76	16	55	21.3	
85	Ugashik Lakes	Ugashik R.	Ugashik C-3	830	50	33	1,100	100	30	6	55	50.2	
SOUTHCENTRAL REGION													
86	Olga Bay	Olga Narrows	Karluk A-1	335	70	64	710	100	37	8	55	68.6	Alternative to Fraser Lake.
87	Fraser Lake	Dog Salmon Creek	Karluk A-1	72	353	302	130	100	32	7	55	33.0	
88	Ayakulik	Ayakulik	Karluk A-2	181	200	181	330	100	49	10	55	42.6	
89	Karluk Lake	Karluk	Karluk C-1	165	400	344	300	100	85	16	55	24.9	
90	Terror Lake	Unnamed	Kodiak C-4	15	1,325	1,057	72	94	85	12	55	24.9	
91	McNeil River	McNeil River	Iliamna A-4	102	150	112	180	50	8	2	55	145.0	
92	Paint River	Paint R.	Iliamna A-4	205	150	115	370	80	28	6	55	115.0	
93 (32)	Crescent Lake	Crescent R.	Kenai B-8	200	599	517	454	98	179	41	50	9.9	
94 (33)	Chakachamna	Chakachamna R.	Tyonek A-7	1,120	1,127	793	2,460	100	1,600	366	50	6.5	
95	Chuitna	Chuitna R.	Tyonek A-4	66	800	552	140	70	45	9	55	83.4	
96	Lower Beluga	Beluga R.	Tyonek A-3	950	100	49	1,790	100	72	15	55	19.1	
97 (34)	Coffee	Beluga R.	Tyonek A-4	860	210	109	1,800	100	160	37	50	11.5	
98 (35)	Upper Beluga	Beluga R.	Tyonek B-4	840	375	142	1,800	100	210	48	50	11.1	
99	Strandline Lake	Beluga R.	Tyonek B-6	54	1,300	852	115	100	81	17	55	30.8	Development of Upper Beluga would reduce energy 12 million Kwh.
100	Lake Creek (Lower)	Lake Creek	Talkeetna A-2	335	800	305	710	60	105	22	55	32.6	
101	Upper Lake Creek	Lake Creek	Talkeetna B-3	85	1,400	560	180	90	74	15	55	20.3	
102	Talachulitna River	Talachulitna R.	Tyonek C-4	360	700	231	720	100	137	28	55	41.6	
103	Hayes, Skwentna R.	Skwentna R.	Tyonek D-5	1,730	575	187	3,500	80	429	89	55	72.8	
104	Emerald	Skwentna R.	Tyonek D-8	370	1,900	366	790	74	177	37	55	69.7	
105 (36)	Yentna	Yentna R.	Tyonek C-2	6,400	150	82	12,750			145			
106 (37)	Talachulitna	Skwentna R.	Tyonek D-4	2,250	350	124	4,500	79	1,390	75	50	10.1	Assumes operation as a system.
107 (38)	Skwentna	Skwentna R.	Tyonek D-6	950	1,000	291	1,900			98			
108	Chulitna Creek	Chulitna Creek	Talkeetna B-1	240	800	198	380	40	25	5	55	50.9	
109 (39)	Lower Chulitna	Chulitna R.	Talkeetna B-1	2,600	500	89	6,350	84	394	90	50	8.1	
110 (40)	Kochichitna	Chulitna R.	Talkeetna C-1	2,560	725	186	6,200	85	806	184	50	8.8	
111	Talkeetna River (sheep)	Talkeetna R.	Talkeetna Mt. B-6	1,790	605	91	4,400	50	149	31	55	40.4	
112 (41)	Keetna	Talkeetna R.	Talkeetna Mt. B-6	1,260	950	286	1,690	82	324	74	50	11.3	
113	Iron Creek	Iron Creek	Talkeetna Mt. B-5	210	1,750	750	400	60	147	31	55	63.9	
114	Granite Gorge	Talkeetna R.	Talkeetna Mt. B-5	865	1,500	416	1,160	87	345	72	55	43.8	
115	Greenstone	Talkeetna R.	Talkeetna Mt. C-5	790	1,575	304	1,150	65	246	51	55	38.6	Alternative to Granite Gorge.
116	Trapper	Talkeetna R.	Talkeetna Mt. C-5	760	1,700	245	1,140	94	216	45	55	68.6	
117	Lucy	Chulitna R.	Talkeetna Mt. D-5	1,080	1,100	166	2,600	20	71	15	55	19.3	
118	Coal	Chulitna R.	Talkeetna Mt. D-6	985	1,450	241	2,400	40	193	40	55	36.3	Would be inundated by development of Ohio site.
119	Ghio	Chulitna R.	Talkeetna Mt. D-6	916	1,500	224	2,220	35	144	30	55	21.0	
120	Chulitna-Hurricane	Chulitna R.	Healy A-6	795	1,600	207	1,900	50	166	34	55	26.7	Would be inundated by development of Ohio site.
121	West Fork Chulitna	W.F. Chulitna R.	Healy A-6	355	1,900	287	640	45	68	14	55	33.4	
122	East Fork Chulitna	E.F. Chulitna R.	Healy A-5	135	2,500	380	240	80	59	12	55	31.3	
123 (42)	Whiskers	Susitna R.	Talkeetna B-1	6,320	490	59	7,500	100	368	84	50	11.5	
124 (43)	Lane	Susitna R.	Talkeetna C-1	6,280	660	169	7,500	100	1,052	240	50	8.9	
125 (44)	Gold	Susitna R.	Talkeetna Mt. C-6	6,160	850	189	7,327	100	1,139	260	50	13.1	
126	Deadman Creek	Deadman Cr.	Talkeetna Mt. D-1	160	3,000	962	350	60	165	34	55	22.7	
127 (45)	Devil Canyon	Susitna R.	Talkeetna Mt. D-5	5,810	1,450	575	6,840			738			
128 (46)	Matana	Susitna R.	Talkeetna Mt. D-4	5,180	1,905	425	6,040	100	7,000	478	50	6.3	Assumes operation as a system.
129 (47)	Vee	Susitna R.	Talkeetna Mt. C-2	4,140	2,355	430	4,730			386			
130 (48)	Donali	Susitna R.	Talkeetna Mt. D-1	1,260	2,552	---	2,310			---			
131	McLaren River	Gulkana D-6		485	2,875	263	1,410	85	263	55	55	45.2	
132	Boulder Creek	Boulder Cr.	Healy B-1	42	3,575	917	67	70	35	7	55	55.6	
133	Palmer	Matanuska R.	Anchorage C-6	2,070	400	166	2,918	20	79	16	55	195.5	
134	Morse Creek	Matanuska R.	Anchorage C-6	2,070	500	166	2,918	25	100	21	55	124.2	Alternative to Palmer site.
135	King Mountain	Matanuska R.	Anchorage D-5	1,635	1,050	776	2,300	40	210	44	55	37.6	

No.	Power Site	Stream	USGS Map sheet	Drainage Area (sq. mi.)	Maximum Regulated Water Surface (ft.)	Average Head (ft.)	Average Annual Runoff (1000 AF)	Per Cent Regulation	Firm Energy (million Kwh)	Installed Capacity (1000 KW)	1/ (plant factor %)	Index Cost 2/	
136	Coal Creek	Matanuska R.	Anchorage D-4	1,128	1,300	291	1,600	80	307	64	55	78.5	Alternative to King Mtn. site.
137	Boulder Creek	Boulder Cr.	Anchorage D-4	90	2,600	1,317	82	80	69	14	55	57.0	
138	Kush Lake	Boulder Cr.	Anchorage D-4	89	1,950	892	78	79	45	9	55	92.7	
139	Purinton Creek	Matanuska R.	Anchorage D-4	1,082	1,450	291	1,500	90	324	67	55	108.1	Alternative to Hick site.
140	Hicks Site	Matanuska R.	Anchorage D-3	950	1,675	281	1,300	90	286	59	55	37.2	
141	Caribou Creek	Caribou Cr.	Anchorage D-2	260	2,450	527	220	93	90	19	55	21.7	
142	Eagle River	Eagle R.	Anchorage B-7	194	450	167	397	82	45	9	55	38.8	
143	Sunrise	Sixmile Cr.	Seward D-7	238	450	327	350	55	52	11	55	122.2	
144	Lower Kenai	Kenai R.	Kenai B-3	1,650	160	84	4,300	88	263	55	55	18.2	
145	Moose Horn	Kenai R.	Kenai C-2	1,540	275	95	4,000	93	290	60	55	18.8	
146	Killey River	Kenai R.	Kenai B-2	160	725	358	380	90	100	21	55	38.1	
147	Stelsters Ranch	Kenai R.	Kenai B-1	849	500	199	2,600	97	403	84	55	17.9	
148	Kenai Lake	Kenai R.	Seward B-8	660	650	341	2,030	97	552	115	55	22.3	Alternative to Stelsters Ranch site.
149	Crescent Lake	Crescent L.	Seward B-7	23	1,454	934	38	100	29	6	55	31.4	
150 (49)	Snow	Snow R.	Seward B-7	85	1,250	653	535	97	278	63	55	11.2	
151	Kasilof River	Kasilof R.	Kenai B-4	738	200	136	1,729	100	193	40	55	15.8	
152	Tustumena	Kenai A-2	Tustumena Glacier	57	1,406	1,100	133	85	102	21	55	17.1	
153	Sheep Creek	Sheep Cr.	Seldovia D-2	101	725	382	460	54	94	20	55	23.8	
154 (50)	Bradley Lake	Bradley Cr.	Seldovia D-3	88	1,195	1,155	445	93	410	94	50	8.0	Authorized Project.
155	Resurrection River	Resurrection R.	Seward A-7	141	425	233	600	75	86	18	55	58.5	
156	Nellie Juan River	Nellie Juan R.	Seward B-5	130	400	240	708	34	47	10	55	32.0	
157	Upper Nellie Juan	Nellie Juan R.	Seward B-6	35	1,189	421	190	90	57	12	55	17.6	
158 (51)	Lowe	Lowe R.	Valdez A-6	190	800	334	1,400	66	254	55	50	11.2	
159	Allison Creek	Allison Cr.	Valdez A-7	6	1,380	1,191	32	55	18	4	55	19.5	
160	Solomon Gulch	Unnamed	Valdez A-7	18	660	608	100	20	11	2	55	27.0	
161	Silver Lake	Duck R.	Cordova D-7	25	390	346	180	95	48	10	55	15.6	
162	Power Creek	Power Cr.	Cordova C-5	21	560	490	182	90	66	14	55	20.9	
163 (52)	Million Dollar	Copper R.	Cordova C-2	24,260	200	85	38,000	71	1,927	440	50	14.8	
164	Van Cleve	Unnamed	Cordova C-1	17	1,450	475	95	25	10	2	55	234.0	
165	Little Bremner River	Little Bremner R.	Valdez A-2	182	600	272	503	62	70	15	55	67.8	
166	Bremner R., Salmon Site	Bremner R.	Valdez A-1	660	525	166	2,100	30	86	18	55	46.7	
167	So. Fork Bremner River	S.F. Bremner R.	Cordova D-1	148	1,150	537	470	75	156	32	55	32.5	
168	Three Mile Canyon	Bremner R.	Cordova D-1	526	725	228	1,660	41	127	26	55	51.5	Alternative to Salmon site.
169	No. Fork Bremner River	N.F. Bremner R.	Bering Glacier	150	1,625	490	470	87	166	35	55	56.0	
170 (53)	Cleave	Copper R.	Valdez A-3	21,500	420	165	28,000	96	3,600	820	55	13.3	
171	Taina	Taina	Valdez A-5	104	1,750	360	220	90	58	12	55	64.2	
172	Tiekel River	Tiekel R.	Valdez A-3	421	950	400	900	35	105	22	55	37.6	
173 (54)	Wood Canyon	Copper R.	Valdez B-2	20,600	1,400	950	26,700	100	21,900	2,600	69.4	3.2	
174	Hanagita Lake	Hanagita R.	McCarthy A-8	100	2,575	1,010	228	85	160	33	55	27.0	
175	Tebay Lakes	Tebay R.	Valdez A-1	105	1,875	1,007	240	95	193	40	55	23.6	
176	Kuskulana River	Kuskulana R.	McCarthy C-8	260	2,050	508	550	50	114	24	55	66.9	
177	Young Creek	Young Cr.	McCarthy A-4	40	3,475	2,017	110	45	82	17	55	60.3	High Wood Canyon plan would reduce potential by about 5%.
178	Canyon Creek	Canyon Cr.	McCarthy A-4	100	3,100	1,308	270	45	131	27	55	46.1	
179	Kiagna River	Kiagna R.	McCarthy A-4	185	2,500	970	490	50	193	40	55	77.9	High Wood Canyon plan would reduce potential by about 10%.
180	Kotsina River	Kotsina R.	Valdez C-1	209	2,075	524	440	70	133	28	55	47.9	
181	Klutina	Klutina R.	Valdez D-5	670	1,800	335	950	100	263	54	55	17.6	
182	Tolsona Creek	Tolsona Cr.	Gulkana A-4	174	2,025	460	200	70	53	11	55	52.5	
183	Tazlina	Tazlina R.	Gulkana A-5	1,970	1,875	273	2,300	100	503	104	55	15.6	
184	Nelchina River	Nelchina R.	Gulkana A-6	820	2,250	285	940	99	219	45	55	53.3	
185	Lower Gulkana River	Gulkana R.	Gulkana B-3	1,850	1,700	232	2,000	11	42	9	55	84.8	
186	Upper Gulkana River	Gulkana R.	Gulkana B-3	1,770	1,850	124	1,900	23	45	9	55	86.8	
187	Gulkana River	Gulkana R.	Gulkana C-4	575	2,475	405	620	80	164	34	55	27.5	
188	West Fork Gulkana River	W.F. Gulkana R.	Gulkana C-5	398	2,375	192	440	100	69	14	55	58.7	
189	Summit Lake	Gulkana R.	Mt. Hayes A-4	81	3,210	500	88	100	36	8	55	19.9	
190	Gakona Site	Copper R.	Gulkana B-3	3,965	1,750	266	4,400	75	727	150	55	35.2	Alternative to Sanford site.
191	Sanford	Copper R.	Gakona B-3	3,365	1,825	178	3,700	70	385	80	55	29.3	
192	White River	White R.	Bering Glacier A-4	29	375	282	210	80	39	8	55	51.3	

SOUTHEAST REGION

193	Alsek River	Alsek R.	Yakutat B-1	11,000	450	166	12,000	90	1,490	310	55	17.9	Major portion of reservoir area is in Canada.
194	Endicott River	Endicott R.	Juneau D-5	56	800	483	270	97	105	21	55	25.9	
195	Chilkoot	Chilkoot R.	Skagway B-2	130	175	136	780	90	78	16	55	35.8	
196 (55)	Chilkat	Chilkat R.	Skagway C-3	190	600	320	870	80	180	41	50	10.6	
197	West Creek	West Creek	Skagway C-2	40	800	625	268	75	105	21	55	25.9	
198	Goat Lake	Pitchfork Falls	Skagway C-1	4	2,915	2,017	30	95	46	10	55	16.5	
199	Lace River	Lace R.	Juneau D-3	363	200	166	2,300	97	298	62	55	51.8	
200	Unnamed Lake near Lace R.	Unnamed	Juneau D-3	3	1,160	3,003	20	100	48	10	55	19.4	
201	Antler River	Antler R.	Juneau D-3	5	1,950	1,813	29	100	43	9	55	17.8	
202	Nugget Creek	Nugget Cr.	Juneau B-2	16	725	607	151	40	30	6	55	52.9	
203	Carlson Creek	Carlson Cr.	Juneau B-1	24	450	344	246	56	46	10	55	27.5	
204	Boundary Lake	Boundary Cr.	Taku R. C-6	23	925	795	170	85	95	20	55	22.2	
205	Yehring Creek	Yehring Cr.	Taku R. B-6	16	1,100	1,077	112	26	26	5	55	29.0	
206 (56)	Lake Dorothy	Dorothy Cr.	Taku R. A-6	11	2,422	2,348	81	100	150	34	50	7.3	
207 (57)	Speel Division Donnellan Project	Speel R.	Taku R. A-5	194	325	273			275	63	50	8.1	

No.	Power Site	Stream	USGS Map sheet	Drainage Area (sq. mi.)	Maximum Regulated Water Surface (ft.)	Average Head (ft.)	Average Annual Runoff (1000 AF)	Per Cent Regulation	Firm Energy (million kwh)	Installed Capacity (1000 KW)	1/ (plant factor %)	Index Cost 2/
208 (58)	Tease Creek	Tease Cr.	Taku R. A-5	11	1,100	1,034	110	75	70	16	50	14.9
209 (59)	Sweetheart Falls	Sweetheart Falls Cr.	Sundum D-5	35	684	612	250	100	125	29	50	9.6
210 (60)	Houghton	Unnamed	Sundum D-3	39	550	457	370	98	136	31	50	11.0
211	Farragut	Farragut R.	Sundum A-3	64	525	493	480	56	163	37	50	11.8
212 (61)	Scenery Creek	Scenery Cr.	Sundum A-3	21	957	620	147	90	67	15	50	10.0
213 (62)	Thomas Bay	Cascade Cr.	Sundum A-3	19	1,514	1,442	160	88	166	38	50	8.1
214	Ruth Lake	Delta Cr.	Petersburg D-3	8	1,550	1,449	59	90	63	13	55	18.1
215 (63)	Stikine River	Stikine R.	Petersburg C-1	20,000	350	291	45,000	90	9,900	2,260	50	9.0
216 (64)	Goat	Goat Cr.	Bradfield Canal C-6	14	1,298	1,056	112	90	87	20	50	13.9
217	Katate River	Katate R.	Bradfield Canal C-6	73	659	249	594	82	99	21	55	18.3
218	Aaron	Aaron Cr.	Bradfield Canal C-6	61	300	183	652	56	58	12	55	86.0
219	Harding River	Harding R.	Bradfield Canal C-5	68	250	207	548	92	85	18	55	49.2
220	No. Bradfield River	N. Bradfield R.	Bradfield Canal B-5	150	250	157	1,200	61	131	27	55	71.0
221 (65)	Tyee Creek	Tyee Cr.	Bradfield Canal A-5	15	1,387	1,275	123	93	120	27	50	8.9
222	Anan Creek	Anan Cr.	Bradfield Canal A-6	27	325	230	200	89	33	7	55	34.4
223 (66)	Spur	Unnamed	Bradfield Canal A-4	10	1,889	1,776	83	87	105	24	50	10.7
224	Saks Cove	Saks Cr.	Ketchikan D-4	22	675	621	150	93	72	15	55	18.7
225 (67)	Leduc	Leduc R.	Ketchikan	7	1,384	1,241	61	100	62	14	50	14.5
226	Chickamin River	Chickamin R.	Bradfield Canal A-2	562	325	228	4,800	82	727	150	55	26.1
227	Granite Creek	Granite Cr.	Ketchikan C-3	9	945	863	82	67	39	8	55	17.2
228 (69)	Punchbowl Creek	Punchbowl Cr.	Ketchikan C-3	14	650	622	126	99	64	15	55	10.6
229 (68)	Rudyerd	Unnamed	Ketchikan C-2	8	1,775	1,600	63	100	81	19	50	10.6
230	Wilson River	Wilson R.	Ketchikan B-2	70	400	166	560	93	71	15	55	30.7
231 (70)	Red	Red R.	Ketchikan A-2	44	400	347	410	89	104	24	50	12.2
232	Davis River	Davis R.	Ketchikan D-1	70	450	367	667	67	131	28	55	17.4
233	Kelp	Unnamed	Sitka B-4	21	675	612	161	82	66	16	50	15.1
234 (75)	Takatz Creek	Takatz Cr.	Sitka A-3	11	1,040	991	129	87	97	20	50	12.5
235	Baranof Lake	Baranof R.	Sitka A-3	32	145	108	316	42	11	2	55	19.1
236	Carbon Lake	Unnamed	Sitka A-3	27	300	260	350	65	49	10	55	24.8
237	Milk Lake	Unnamed	Port Alexander D-3	11	700	666	167	36	33	7	55	19.0
238	Brentwood Creek	Brentwood Cr.	Port Alexander C-3	7	950	655	98	71	38	8	55	27.7
239 (74)	Deer	Unnamed	Port Alexander C-3	7	376	339	114	96	31	7	50	14.8
240 (73)	Maksoutof River	Maksoutof R.	Port Alexander C-3	24	600	570	272	93	117	24	50	12.6
241	Plotnikof Lake	Unnamed	Port Alexander D-3	20	350	315	24	76	44	9	55	17.7
242 (76)	Green Lake	Vodopad R.	Port Alexander D-4	29	400	353	212	84	52	11	50	12.4
243	Hasselborg Creek	Hasselborg Cr.	Sitka C-1	83	331	306	343	90	77	16	55	22.3
244	Thayer Creek	Thayer Cr.	Sitka C-2	61	407	377	252	100	78	16	55	22.1
245	Kathleen Creek	Kathleen Cr.	Sitka D-3	29	525	502	126	94	48	10	55	33.7
246	Towers Creek	Towers Cr.	Petersburg D-5	81	275	259	300	100	64	13	55	108.7
247	Orchard Creek	Orchard Cr.	Ketchikan D-5	60	200	170	420	75	44	9	55	17.8
248 (71)	Lake Grace	Grace Cr.	Ketchikan C-3	29	500	456	281	90	99	20	50	10.1
249	Manzanita Lake		Ketchikan C-4	63	300	269	620	91	124	26	55	17.5
250 (72)	Swan Lake	Falls Cr.	Ketchikan C-4	36	326	275	336	91	69	15	50	12.8
251	Thorne	Thorne R.	Craig C-2	166	125	103	1,100	85	80	17	55	17.6
252	Reynolds Creek	Reynolds Cr.	Craig A-2	7	---	---	54	99	54	11	55	19.7

Recent calculations indicate Farragut could be included on list of lower priced hydros.

Three power plants and lakes involved.

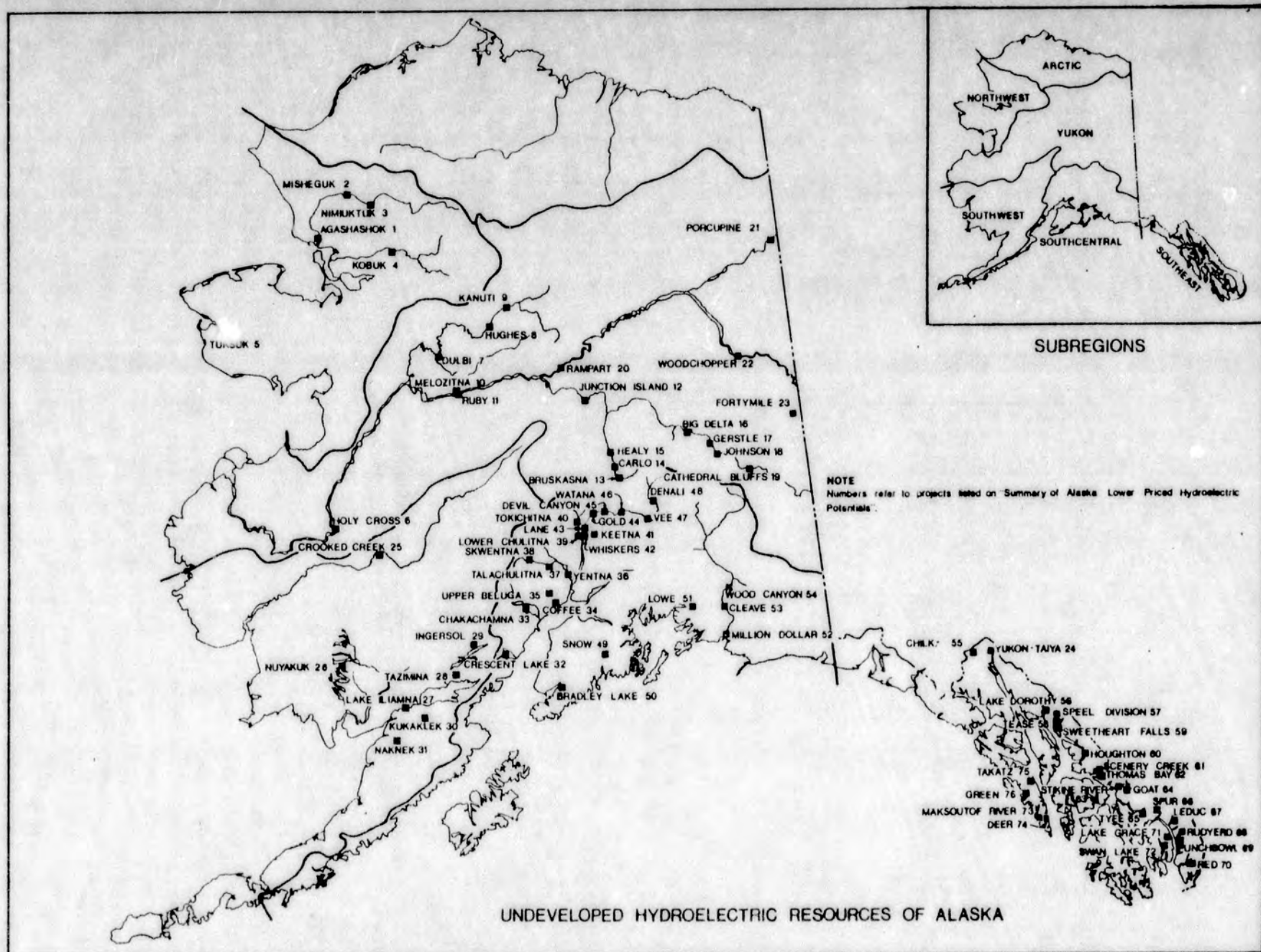
Power site numbers refer to map locations.

Numbers in parentheses refer to the published list and map of lower priced hydroelectric potentials 2500 kw continuous power and larger.

1/ The size and cost of the power plants for the inventory study was based on 55% plant factor. The list of the 76 lower priced sites assumes 50% plant factor with no significant change in cost. There are exceptions for the larger sites which were considered base load plants. Specific plant factors are noted.

2/ The index cost is a relative comparison cost of energy at the power plant bus bar. Substation and transmission costs are not included.

3/ An alternative development of the Ruby site to elevation 325 would inundate the Rampart dam site. Power production at Ruby would increase to 14.2 billion kwh annually and 3,250,000 kw.



APPENDIX C
Description of Small Capacity Sites
Within Geographic Areas

Following are tabulations of parameters of sites within each of the geographic areas examined, and descriptions of some of the particular factors of each area. The site number refers to the list of 252 sites while the number in parentheses refers to the list of (best) 76 sites. The comparison is to a 1966 Susitna Project energy cost index of 6.3 mills/kWh and generation capability of 6,100 GWh/year (range from 2,670 to 10,260 GWh/year).

1. Matanuska River Basin

No.	Site	Stream	Firm Energy GWh/year	Capacity MW	Cost Mills/kWh
133	Palmer	Matanuska R.	79	16	195.5
134	Moose Creek	Matanuska R.	100	21	124.2
	(Alternative to Palmer)				
135	King Mountain	Matanuska R.	210	44	37.6
136	Coal Creek	Matanuska R.	207	64	78.5
	(Alternative to King Mountain)				
137	Boulder Creek	Boulder Cr.	69	14	57.0
138	Rush Lake	Boulder Cr.	45	9	92.7
139	Purinton Creek	Matanuska R.	324	67	108.1
	(Alternative to Hicks)				
140	Hicks Site	Matanuska R.	286	59	27.2
141	Caribou Creek	Caribou Cr.	<u>90</u>	<u>19</u>	21.7
	Total (excluding Palmer, King Mountain, and Hicks)		935	194	

The small Caribou Creek site, which has the lowest index cost, was determined to be unfeasible because it is located in a broad glaciated valley with poor foundation, and probable severe reservoir sedimentation.

2. Tanana River Basin

No.	Site	Stream	Firm Energy GWH/year	Capacity MW	Cost Mills/kWh
31	Vachon Island	Tanana R.	2,050	426	29.0
	(Alternative to Junction Island)				
32	(12) Junction Island	Tanana R.	2,330	532	15.1
45	Salchia River	Salchia R.	123	25	69.4
46	Tanana River	Tanana R.	315	65	43.1
	(Little Delta)				
47	(16) Big Delta	Tanana R.	987	226	16.8
48	(17) Gerstle	Tanana R.	438	100	17.0
49	(18) Johnson	Tanana R.	920	210	16.1
50	(19) Cathedral Bluffs	Tanana R.	693	158	15.3
	Total (excluding Vachon Island)		5,806	1,316	

Three of the sites--Vachon Island, Salchia River, and Tanana River (Little Delta)--are significantly more costly than the others. All sites except Salchia River involve regulation of the main stem of the Tanana River.

Additional geologic investigation after development of cost estimates revealed that Cathedral Bluffs would require extensive foundation treatment, which is not reflected in the cost estimate.

3. Cook Inlet - Western Drainage

There are several sites west of Cook Inlet, all but one of which are smaller than 50 MW.

No.	Site	Stream	Firm Energy GWH/year	Capacity MW	Cost Mills/kWh
90	(32) Crescent Lake	Crescent R.	179	41	9.9
94	(33) Chakachamma	Chakachatna R.	1,600	366	6.5
95	Chuitna	Chuitna R.	45	9	83.4
96	Lower Beluga	Beluga R.	72	15	19.1
97	(34) Coffee	Beluga R.	160	37	11.5
98	(35) Upper Beluga	Beluga R.	210	48	11.1
99	Strandline Lake	Beluga R.	81	17	30.8
	(Upper Beluga would reduce Strandline Lake energy 12 GWH/year)				
Total			2,347	533	

Two of the sites, Chuitna and Strandline Lake, are very costly. Chakachamma has an index cost comparable to Susitna (6.5 versus 6.3). Chakachamma could supply 60 percent of the low estimate 1990-2000 power requirement, 30 percent of the medium estimate, and 15 percent of the high estimate. Part of Lake Chakachamma is included in the recently designated Lake Clark National Monument, and it may not be available for development. Crescent Lake is also in the Lake Clark National Monument.

4. Yentna-Skwentna River Basin

No.	Site	Stream	Firm Energy GWH/year	Capacity MW	Cost Mills/kWh
100	Lake Creek (Lower)	Lake Creek	105	22	32.6
101	Upper Lake Creek	Lake Creek	74	15	20.3
102	Talachulitna River	Talachulitna R.	137	28	41.6
103	Hayes, Skwentna R.	Skwentna R.	429	89	72.8
104	Emerald	Skwentna R.	177	37	69.7
105	(36) Yentna	Yentna R.		145)	
106	(37) Talachulitna	Skwentna R.	1,390	75)	10.1
107	(38) Skwentna	Skwentna R.		98)	
(Yentna, Talachulitna, and Skwentna operated as a system)					
Total			2,312	509	

The cost of the Yentna-Skwentna system includes 70 miles of access road. This system is the lowest cost potential hydro development other than authorized projects and those that would be precluded by land use designations. The capacity of the system would be 318 MW.

5. Talkeetna River Basin

No.	Site	Stream	Firm Energy GWH/year	Capacity MW	Cost Mills/kWh
108	Chunilna Creek	Chunilna Cr.	25	5	50.9
111	Talkeetna R. (Sheep)	Talkeetna R.	149	31	40.4
112	(41) Keetna	Talkeetna R.	324	74	11.3
114	Iron Creek	Iron Creek	147	31	63.9
115	Greenstone (Alternative to Granite Gorge)	Talkeetna R.	246	51	38.6
116	Trapper	Talkeetna R.	216	45	68.6
Total (excluding Granite Gorge)			1,107	237	

Most of the sites in this basin require large dams (from 300 to 565 feet high and more than 3,000 feet long).

6. Chulitna River Basin

No.	Site	Stream	Firm Energy GWH/year	Capacity MW	Cost Mills/kWh
109	(39) Lower Chulitna	Chulitna R.	394	90	8.1
110	(40) Tokichitna	Chulitna R.	806	184	8.8
117	Lucy	Chulitna R.	71	15	19.3
118	Coal	Chulitna R.	193	40	36.6
119	Ohio	Chulitna R.	144	30	21.0
(Would inundate Coal and Chulitna-Hurricane)					
120	Chulitna-Hurricane	Chulitna R.	166	34	26.7
121	W. Fork Chulitna	W.F. Chulitna R.	68	14	33.4
122	E. Fork Chulitna	E.F. Chulitna R.	59	12	31.3
Total (excluding Coal and Chulitna-Hurricane)			1,542	345	

Two sites (Coal and Chulitna-Hurricane) are eliminated by a more economical third site (Ohio) which would involve the same reach of river. Only the Lower Chulitna and Tokichitna sites are near the economic range of Susitna. Part of the Tokichitna reservoir would be included in the new Denali National Monument.

7. Kenai Peninsula

The Kenai Peninsula has several sites, most of which are small and at best marginally economical.

No.	Site	Stream	Firm Energy GWH/year	Capacity MW	Cost Mills/kWh
143	Sunrise	Sixmile Cr.	52	11	122.2
144	Lower Kenai	Kenai R.	263	55	18.2
145	Moose Horn	Kenai R.	290	60	18.8
146	Killey River	Killey R.	100	21	38.1
147	Stelsters Ranch	Kenai R.	403	84	17.9
148	Kenai Lake	Kenai R.	522	115	22.3
(Alternative to Stelsters Ranch site)					
149	Crescent Lake	Crescent L.	29	56	31.4
150	(49) Snow	Snow R.	278	63	11.2
152	Tustumena	Tustumena Gla.	102	21	17.1
153	Sheep Creek	Sheep Cr.	94	20	23.8
154	(50) Bradley Lake	Bradley Cr.	410	94	8.0
(Authorized Project)					
155	Resurrection R.	Resurrection R.	86	18	58.5
156	Nellie Juan River	Nellie Juan R.	47	10	32.0
157	Upper Nellie Juan	Nellie Juan R.	57	12	17.6
Total (excluding Kenai Lake)			2,211	475	

For comparison purposes Bradley Lake energy cost on a January 1977 price basis is 36 mills per kWh compared to the index cost of 8.0. This factor of 4.5 includes several plan modifications and refinements to reduce costs. Bradley Lake is an authorized Corps of Engineers project with final planning, design, and construction funding pending. It is a supplement to the Susitna Project and not a significant alternative.

An average of two to five of these sites would have to be developed each year to meet the Anchorage-Kenai area projected power growth of 200 MW annually during the 1990's. Environmental impacts for development of the Kenai River sites would be significant, primarily due to extensive fishery.

8. Scattered Sites Tributary to Railbelt

Scattered sites and small basins tributary to the Railbelt area include:

No.	Site	Stream	Firm Energy GWH/year	Capacity MW	Cost Mills/kWh
33	Kantishna River	Kantishna R.	394	82	22.2
34	McKinley River	McKinley R.	201	42	42.3
35	Chatanika River	Chatanika R.	32	7	63.0
36	Teklanika River	Teklanika R.	272	57	24.2
43	Totatlanika River	Totatlanika R.	114	24	33.1
44	Chena River	Chena R.	46	10	128.0
51	Nabesna	Nabesna R.	320	66	33.9
126	Deadman Creek	Deadman Cr.	165	34	22.7
131	McLaren River	McLaren R.	263	55	45.2
132	Boulder Creek	Boulder Cr.	35	7	55.6
142	Eagle River	Eagle R.	45	9	38.8
158 (51)	Lowe	Lowe R.	254	55	11.2
159	Allison Creek	Allison Cr.	18	4	19.5
161	Silver Lake	Duck R.	48	10	15.6
Total			2,207	462	

Most of these sites are small--less than 100 MW. Their scattered locations are not conducive to intertieing energy supplies of a large area such as the Railbelt. Several sites are in designated national monuments or in proposed national park areas. The Lowe site is in a canyon occupied by the Trans-Alaska Oil Pipeline and the only highway access to Valdez, and the route of a planned Valdez-Glennallen transmission line.

The Silver Lake site, with an index cost of 2.5 times the Susitna index, has a possibility of serving a part of the local power needs of the Valdez area, but would not be a significant alternative or contributor to meeting the larger Railbelt area needs.

BCF

UNITED STATES GOVERNMENT

Memorandum

RECEIVED

TO : T. R. Cantine, Chief, Project Development, 1969 DATE: September 4, 1969
Alaska Power Administration, Juneau, Alaska

FROM : Regional Fish & Wildlife Administrator, BCF,
Juneau, Alaska

SUBJECT: Initial evaluation of project effects on fish and wildlife

CODE	INIT	DATE
100	N	9/10/69
700	F	9/5
720	AL	9/5
730	BCF	9/5
740	BCF	9/8
900		

The attached table presenting our appraisal of the effects of project development on fish and wildlife resources was prepared in response to Gary Long's request this week. The projects are those listed in the F.P.C. Alaska Power Survey, July 1966. 7

We judged effects to be significant where we would anticipate recommending major mitigation facilities or where losses, even though infeasible to mitigate, would be large. Minor effects are those which possibly would not justify additional mitigation features beyond those which could be accommodated in design and operation of the project at little or no additional cost. For example, we judged the minimum flows required for movement of fish below the mainstem Susitna River dams to fall in this category, which may or may not be correct. Negligible effects are those which would not justify project modification. We reported "effects unknown" in these cases where we did not have sufficient knowledge of the project area to even speculate on possible project effect.

Thus, because of the lack of project data and our lack of information on fish and wildlife resources in the project area in many cases, this evaluation of project effects should be considered very preliminary.

M. A. Monson
Melvin A. Monson

Attachment



Initial Evaluating Effects of Project Development
on Fish and Wildlife

Project	Significant effects		Minor effects		Negligible effects		Effects Unknown	
	fish	wildlife	fish	wildlife	fish	wildlife	fish	wildlife
1. Agashashok	x	x						
2. Misheguk							x	x
3. Nimiuktuk							x	x
4. Kobuk River	x	x						
5. Tuksuk	x	x						
6. Holy Cross	x	x						
7. Dulbi							x	x
8. Hughes							x	x
9. Kanuti	x	x						
10. Melozitna	x	x						
11. Ruby	x	x						
12. Junction Island							x	x
13. Healy					x			x
14. Carlo					x			x
15. Bruskasna					x			x
16. Big Delta							x	x
17. Gerstle							x	x
18. Johnson							x	x
19. Cathedral Bluffs							x	x
20. Rampart	x	x						
21. Porcupine	x	x						
22. Woodchopper	x	x						
23. Fortymile							x	x
24. Yukon-Taiya	x					x		
25. Crooked Creek	x	x						
26. Nuyakuk	x			x				
27. Lake Iliamna	x							x
28. Tazimina							x	x
29. Ingersol	x			x				
30. Kukaklek	x							x
31. Naknek	x							x
32. Crescent Lake	x					x		
33. Chakachamna	x					x		
34. Coffee	x			x				
35. Upper Beluga	x			x				
36. Yentna	x	x						
37. Talachulitna	x	x						
38. Skwentna	x	x						
39. Lower Chulitna	x							x
40. Tokichitna							x	x
41. Keetna	x							x
42. Whiskers	x							x

Initial Evaluating Effects of Project Development on Fish and Wildlife

[illegible]

APPENDIX E

Sample of Inventory-grade Hydroelectric Site Study

This appendix is included to provide a typical example of the data developed for a potential site included on the list of 76.

The appendix includes discussions on topography, geology, hydrology, estimates of power, descriptions of engineering features, and cost estimates.

Project Snow

Location

The dam would be on the Snow River, river mile 8, latitude 60° 18'N, longitude 149° 16'W. The powerplant would be on the northeast shore of a small unnamed lake at latitude 60° 17'N, longitude 149° 19'W.

Topography

Damsite topography is available to the scale of 1:2,400 with 10-foot contours from the USGS river sheet "Snow River, Alaska." Reservoir topography is shown on the above sheets to the scale 1:24,000 with 20-foot contours.

Geology

A U.S. Bureau of Reclamation geologist conducted a surface geology reconnaissance of this site in June 1965.

The Snow River, at the damsite, flows in a deep, narrow gorge incised in bedrock on the floor of a steep-walled, U-shaped, glacial valley. Graywacke and slate are well exposed in the near-vertical abutments although thin overburden mantles portions of the upper left abutment. The beds strike nearly due north, normal to the canyon, and dip steeply upstream. Insofar as could be determined from the very brief aerial reconnaissance, geologic conditions are favorable for construction of a concrete dam at this site. However, a thorough ground examination is necessary to adequately appraise the foundation. A tunnel along the right valley wall would penetrate rock similar to that exposed at the damsite.

Construction materials could be obtained from the alluvial and glacial deposits along the lower reaches of the river near its confluence with South Fork Snow River 2 to 3 miles downstream of the site.

Hydrology and Power Estimates

Drainage Area. The damsite has a tributary drainage area of 85 square miles. The mountainous basin lies north of Seward in the Kenai Mountains. The lower elevations support the growth of timber and other vegetation while the upper elevations contain numerous glaciers and the vegetal cover is sparse to non-existent.

Water Supply. Streamflows of the Snow River have been measured at a point upstream from the proposed damsite. The records from this gage "Snow River near Divide" are available from December 1960 to July 1965. These records were extended by a correlator with the records from the gage "Trail River near Lawing." The Trail River records are available from May 1947 to the present time.

The average annual streamflow at the damsite was estimated at 535,000 acre-feet, based upon the extensive Snow River gage records.

Power Estimates. The reservoir, with normal maximum water surface at elevation 1,200, would contain a total of 152,000 acre-feet of storage. The active storage capacity of 151,000 acre-feet would be sufficient to provide 75 percent regulation of the flows of the Snow River for power production. Average tail water elevation was assumed at elevation 500, yielding a new average head of 620 feet. The proposed development with an overall efficiency of 80 percent would be capable of producing 23,300 kilowatts of continuous power. The installed capacity would be 42,400 kilowatts with an assumed load factor of 55 percent.

Plan

Three alternates were estimated with normal maximum water surface elevations of 1,150, 1,200, and 1,250 feet. Elevation 1,200 was determined to be the optimum water surface elevation.

A concrete arch dam would be built with the crest at elevation 1,210 and the base at elevation 900, for a maximum structural height of 310 feet, and a height above the river of 250 feet. The crest length would be about 820 feet.

The powerplant would be connected to the reservoir by 10,000 feet of 11-foot-diameter tunnel and 2,000 feet of 8-foot-diameter surface penstock.

The powerplant would house two generators of 21,200 kW each for a total installed capacity of 42,400. The generators would be driven by Francis-type turbines operating at 400 r.p.m. under an average head of 620 feet. Average tail water would be at about elevation 500.

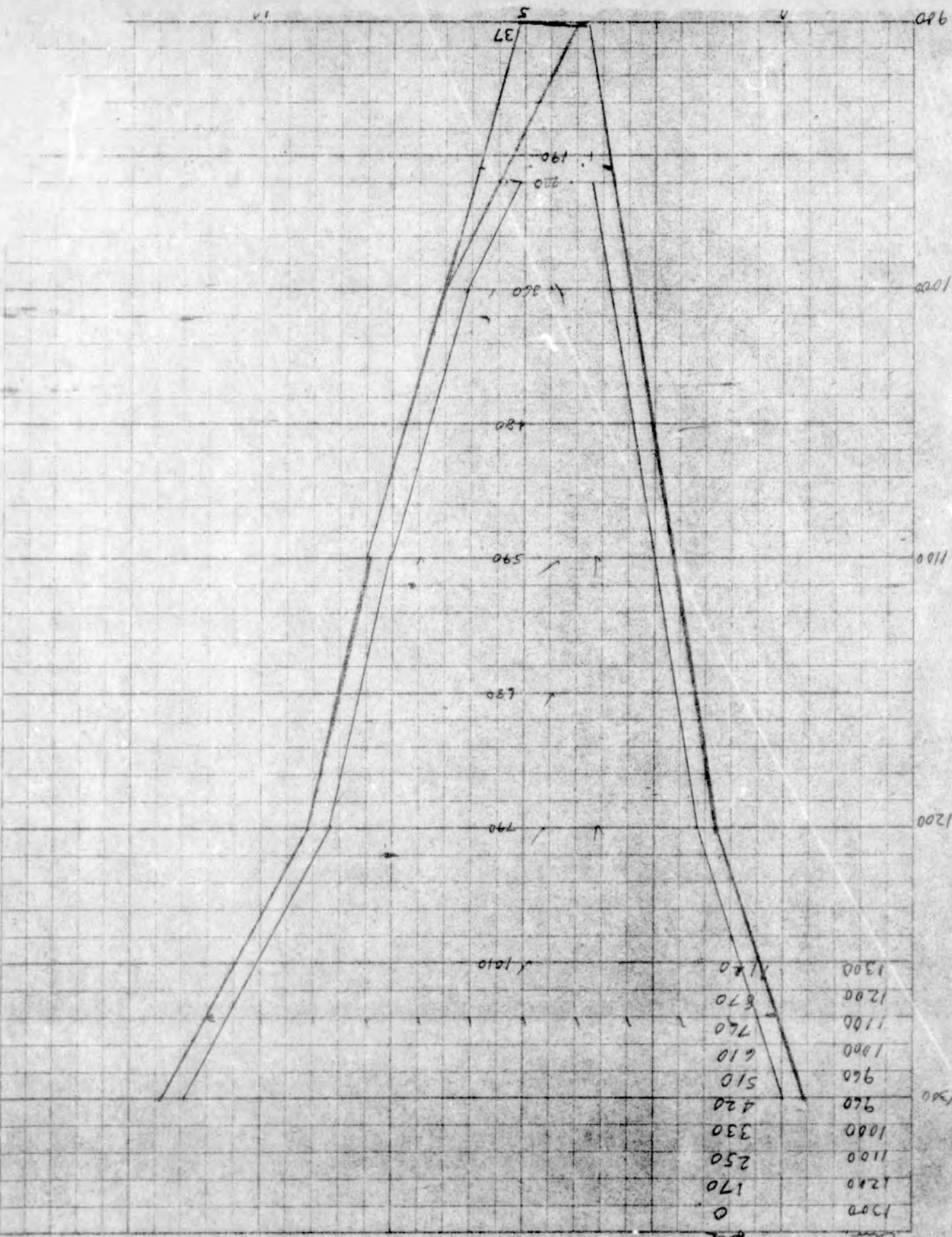
The estimated construction cost of the major features of the selected plan based upon January 1967 prices are as follows:

Dam	\$23,500,000
Powerplant	6,800,000
Tunnel	6,500,000
Penstock	3,300,000
Roads	1,300,000
Log Boom	600,000
General Property	1,600,000
Miscellaneous	4,400,000
TOTAL	<u>\$48,000,000</u>

Cost per installed kW = \$1,130

Remarks

The U.S. Geological Survey discussed this project in a report, Preliminary Report on the Waterpower Resources of Snow River, Nellie Juan Lake, and Lost Lake, Kenai Peninsula, Alaska, dated February 1961. This report discusses the geography, climate, water supply, and possible plan of development for this project. A cost analysis was not included.



COMPUTATION SHEET

7-1654
11-58
Bureau of Reclamation

BY *PH* DATE *12/14/64* PROJECT *San Juan River*

CHKO BY DATE FEATURE *San Juan River*

OFFICE DETAIL

SHEET NO. OF

JOB NO.

FILE NO.

COMPUTATION SHEET

BY CW DATE _____ PROJECT Snow SHEET No. _____ OF _____
 CHKD BY _____ DATE _____ FEATURE _____ JOB No. _____
 OFFICE _____ DETAIL Dam Estimate FILE No. _____

W.S. El.	Crest El.	L ₁	H	El. of L ₂	L ₂
1150	1160	700	260	939	220
1200	1210	820	310	947	240
1250	1260	1050	360	954	250

W.S. El. 1150, Crest El. 1160, L₁ = 700, H = 260, L₂ = 220

$$V_1 = 2 \times 10^{-6} (260)^2 220 \left[\frac{(260 + 0.8 \times 700)^2}{700 - 220} \right] = 29.75 (1400) = 41,600 \text{ cu yds}$$

$$V_2 = 4 \times 10^{-4} (260) 700 (260 + 1.1 \times 700) = 72.8 (1030) = 75,000 \text{ cu yds}$$

Using Takatz Prices

$$F.C. = \frac{116,600}{29,000} \times 4,430,000 \times \frac{34}{50} = \$12,100,000$$

W.S. El. 1200, Crest El. 1210, L₁ = 820, H = 310, L₂ = 240

$$V_1 = 2 \times 10^{-6} (310)^2 240 \left[\frac{(310 + 0.8 \times 820)^2}{820 - 240} \right] = 46.1 (1610) = 74,180 \text{ cu yds}$$

$$V_2 = 4 \times 10^{-4} (310) 820 (310 + 1.1 \times 820) = 101.6 (1212) = 123,200 \text{ cu yds}$$

Using Takatz Prices

$$F.C. = \frac{197,380}{29,000} \times 4,430,000 \times \frac{34.25}{50} = \$19,580,000$$

W.S. El. 1250, Crest El. 1260, L₁ = 1050, H = 360, L₂ = 250

$$V_1 = 2 \times 10^{-6} (360)^2 250 \left[\frac{(360 + 0.8 \times 1050)^2}{1050 - 250} \right] = 64.8 (1300) = 84,240 \text{ cu yds}$$

$$V_2 = 4 \times 10^{-4} (360) 1050 (360 + 1.1 \times 1050) = 151 (1515) = 228,765 \text{ cu yds}$$

Using Takatz Prices

$$F.C. = \frac{345,000}{29,000} \times 4,430,000 \times \frac{31.25}{50} = \$32,000,000$$

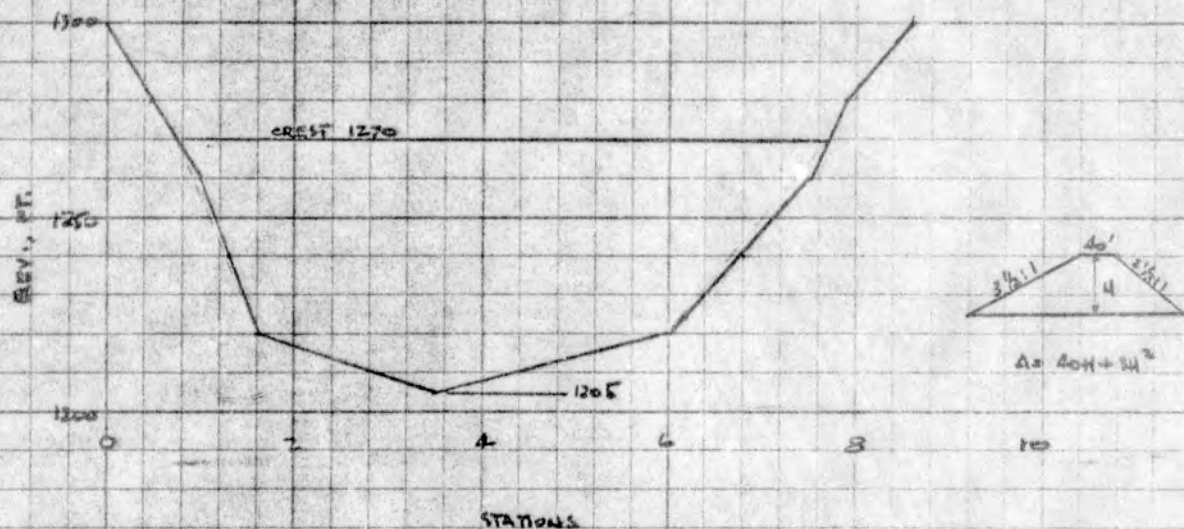
COMPUTATION SHEET

3P3 897747

BY CEE DATE 4-5-66 PROJECT SNOW SHEET No. OF
CHKD BY DATE FEATURE INVENTORY JCB No.
OFFICE JUNEAU DETAIL DKE COS FILE No.

DIKE REQUIRED IN SADDLE SE OF DAM. SADDLE ELEV. 1205 (SEE RIVER SHEET).

ELEV.	STA.
1300	0
1280	0+50
1260	1
1240	1+30
1220	1+60
1205	2+50
1170	6+00
1240	6+80
1260	7+50
1280	7+90
1300	8+60



STA.	H	40H	3H ²	AREA	A/E AREA	DISTANCE	VOLUME
0+70	0	0	0	0	4750	90	427,000
1+60	50	2000	7500	9500	12,588	190	2,390,000
3+50	65	2600	12,675	15,275	12,588	250	3,140,000
6+00	50	2000	7500	9500	4750	170	810,000
7+90	0	0	0	0.39			
FIELD COST = 588 x 50,000 = 1,330,000						Total (ft ³)	6,767,000
						Total (c.y.)	250,000

COMPUTATION SHEET

GPO 537747

BY WJH DATE 1/14/64 PROJECT Four Forest FEATURE Journal cut DETAIL D = 670 OFFICE Rm 6W1
 SHEET NO. OF JOB NO. FILE NO. cut 1 f = 2.000

$$\text{length} = 10,000'$$

$$4 \text{ sig } 12' \quad h_2 = 10 \times 1.7 \times .59 = 10.0'$$

$$\text{An ell. long cut} = 7.0 \times 670 \times \frac{11}{11} \times .746 \times 8.760 \times .012 = 33,400/\text{yr } 7.0 \text{ cut}$$

$$70 \text{ K } 1. \text{ K} = 4,770$$

$$2 \text{ sig } 11' \quad h_2 = 17 \times 1.0 = 17.0'$$

$$\text{length} = 11.9 \times 4,770 = 56,860$$

$$11.5' \text{ cut}$$

$$5 \text{ sig } 10' \quad h_2 = 17.0 \times 1.7 = 28.9'$$

General Journal cut

$$1. 12' \quad \text{cut} = 10,000 \times 1.25 \times 6.19 \times 1.20 \times 1.05 \times .04 = 390,000/\text{yr}$$

$$= 614 \text{ K } 1. \text{ K} = 630$$

$$39,000/\text{yr}$$

$$2 \text{ sig } 11' \quad \text{cut} = 630 \times 557$$

$$= 351,000/\text{yr}$$

$$39,000/\text{yr}$$

$$3 \text{ sig } 10' \quad \text{cut} = 630 \times 504$$

$$= 318,000/\text{yr}$$

1. 11' 11'

420

$$\text{Total cut} = 10,000 \times 1.25 \times 557$$

$$= 5,400,000$$

COMPUTATION SHEET

BY HL DATE 1/18/65 PROJECT Snow Basin SHEET No. OF
CHKD BY DATE FEATURE Penstock Cost JOB No.
OFFICE Rev Cost DETAIL Summary of Full Cycle FILE No.
for 52,000 KW Plant

A. Penstock (24 8')	$h_f = 2,000 \times 1.7 \times 2.8$	$= 16.3'$	
Full Cost	$= 2,000 \times 1.20 \times 1.25 \times 700 \times 1.30$	$= 2,740,000$	ok
B. Dam		$= 29,900,000$	
C. Tunnel		$= 7,000,000$	
D. Powerplant		$= 2,000,000$	
E. Gen Prop	$52,000 \times 20 \times 1.25$	$= 1,300,000$	ok
F. Roads 3 mi @	$300,000 \times 1.25$	$= 1,100,000$	ok
G. Clearing	$1,000 \times 500 \times 1.25$	$= 600,000$	ok

Subtotal = 50,800,000

10% Misc = 5,100,000

55,900,000

Cost Cost = 67,100,000

Invest Cost = 70,500,000

Annual Energy Output = 25,400,000 Kwh.

50yr Value = 29,770

Annual O&M = $52,000 \times 2.25 \times 2.40 = 286,000$

50yr Costs

Capital = $70.5 \times 4.66 = 329$

O&M = $.286 \times 117.1 = 34$
363

Mill Rate = $\frac{363}{29,770} = 12.2$

all superseded except
Penstock & roads & dam & tunnel!

COMPUTATION SHEET

BY SH DATE 8/1/65 PROJECT Snow
CHIEF BY _____ DATE _____ FEATURE Powerplant Costs
OFFICE Rw GWL DETAIL _____

SHEET No. _____ OF _____
JOB No. _____
FILE No. _____

$$1. \quad 1150 \quad n = \frac{24.2 \times 535}{\sqrt{\frac{9,350}{24.2}}} = 661 \quad \underline{24,600}$$

$$2 \text{ units of } 9,350 = 18,700$$

$$\frac{KVA}{RPM} = 35$$

$$\text{Full Cut} = 20 \times 1,750,000 = \underline{35,000,000}$$

Using Gravel Costs

$$F.C. = \frac{1,750}{2040} \times 3,220,000 = \underline{\$2,760,000}$$

$$2. \quad 1200 \quad n = \frac{24.9 \times 535}{\sqrt{\frac{21,150}{24.9}}} = 456 \quad \underline{24,450}$$

$$2 \text{ units of } 21,150 = 42,300$$

$$\frac{KVA}{RPM} = 105$$

$$\text{Full Cut} = 20 \times 3,600,000 = \underline{72,000,000}$$

Using Gravel Costs

$$F.C. = \frac{3,600}{2040} \times 3,220,000 = \underline{\$5,680,000}$$

$$3. \quad 1250 \quad n = \frac{25.6 \times 535}{\sqrt{\frac{28,800}{25.6}}} = 408 \quad \underline{24,400}$$

$$2 \text{ units of } 28,800 = 57,600$$

$$\frac{KVA}{RPM} = 160$$

$$\text{Full Cut} = 20 \times 4,750,000 = \underline{95,000,000}$$

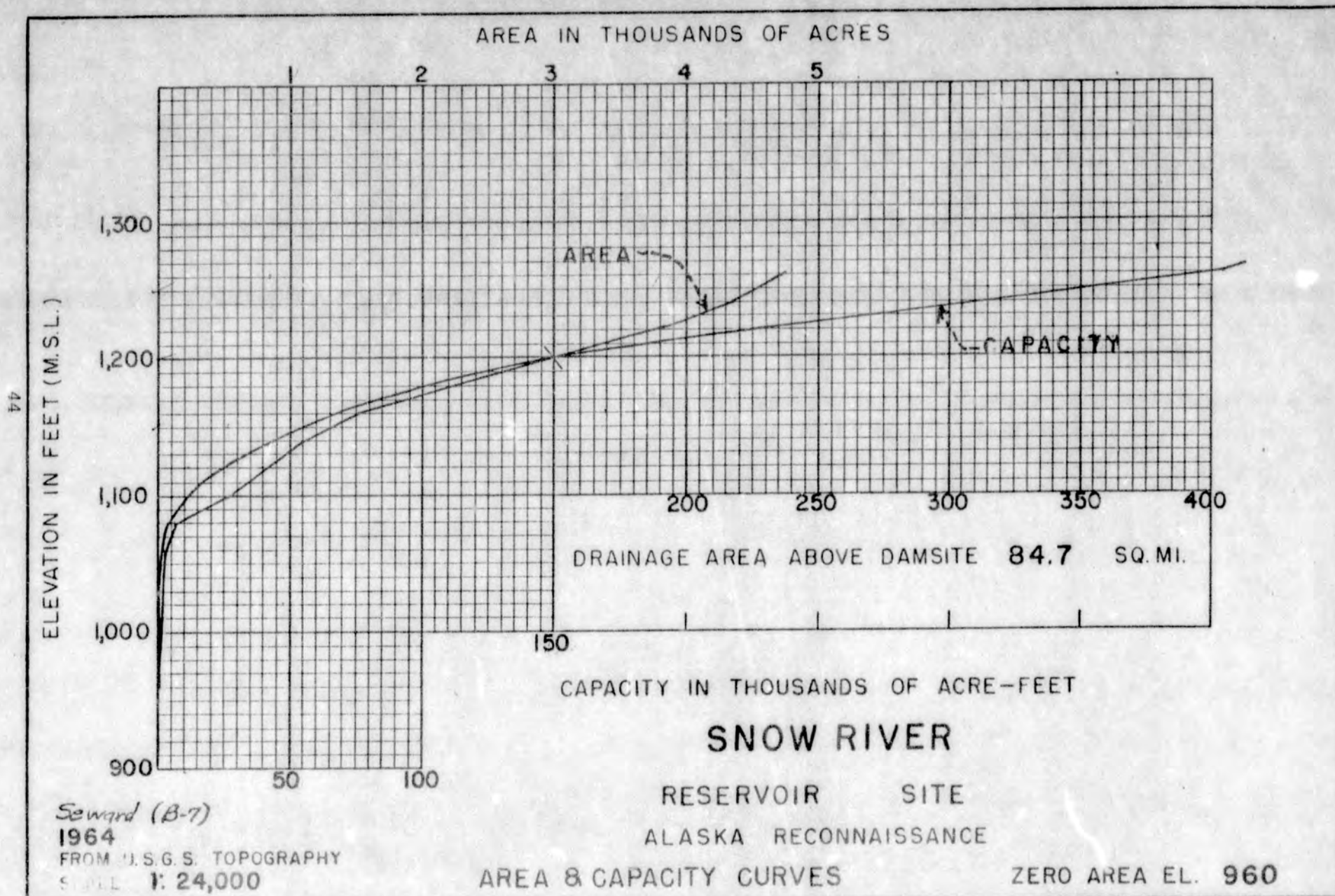
Using Gravel Costs

$$F.C. = \frac{4,750}{2040} \times 3,220,000 = \underline{\$7,490,000}$$

COMPUTATION SHEET

BY CAL DATE _____ PROJECT Snow SHEET No. _____ OF _____
 CHKD. BY _____ DATE _____ FEATURE _____ JOB No. _____
 OFFICE _____ DETAIL Summary FILE No. _____

W.S. El.	1150	1200	1250
Installed	18,700	42,300	57,600
Prime	10,300	23,300	31,700
Costs (Base)			
		<u>USE</u>	
Dam (Contract)	12,100	19,580	33,000
Dike (CGLEst)	—	—	1,300
Tunnel (RWSSLEst)	5,400	5,400	5,400
Penstock (RWSSLEst)	2,740	2,740	2,740
Powerplant (RWSSLEst)	2,760	5,680	7,490
Roads (SSLEst)	1,100	1,100	1,100
Clearing (SSLEst)	400	500	600
Genprop (SSLEst)	1,300	1,300	1,400
Sub total	25,800	36,300	53,030
10% Misc.	2,580	3,630	5,303
F.C.	28,380	39,930	58,333
C.C.	24,000	47,900	70,000
CC/inst.kw	1820	1133	1215
I.C.		50,300	
So. gr.		234,000	
Om & R	$2.25 \times 42,300 \times 2.90 \times 117.1 =$	32,400	
	kw hr/yr	266,400	
Energy =	$23,300 \times 8760 \times 117.1$	23,900,000	
			= 11.15
2 1/2 % interest			



COMPUTATION SHEET

BY _____ DATE _____ PROJECT Snow River SHEET No. _____ OF _____
 CHKD BY _____ DATE _____ FEATURE _____ JOB No. _____
 OFFICE _____ DETAIL _____ FILE No. _____

Sediment load by Flow-duration method is 1.2 AF/mi²/yr.

$84.7 \times 1.2 \times 50 = 5,100 \text{ AF/50 year}$ -- studies
 Colorado 300 ppm -- sediment is negligible

Water Supply ②

Front R. 181 mi²
 1948 1002.2

①

Snow R.

99.3 mi²

②

diagram
 x 100

9 523.2

1950 1005.5

1 522.7

2 499.1

3 811.0

4 549.1

5 563.6

6 469.1

7 578.1

8 622.0

9 509.4

1960 597.3

1 676.3

2 478.2

3 532.6

4 591.4

531.0

463.4

428.6

596.5

78.5

96.8

80.5

101.1

61-64 Tot 2278.5 201.95 88.63

Avg

505,000

48-64 Tot 9675.8

17-yr Ave 569.2

504.5

88.63

Assume area at gage is 80 mi²

Runoff at dam = $\frac{84.7}{80} \times 504.5 =$

535,000 AF/yr.

Using Records in 62 & 63, Cooper estimated 490,000 AF/yr.

Could increase this to 535,000 based upon above.

Corresponding increase in power production would be about 5%, but change is not warranted.

Dec 8/26/65

COMPUTATION SHEET

GPO 857747

BY _____ DATE _____ PROJECT Snow SHEET No. _____ OF _____
CHKD. BY _____ DATE _____ FEATURE _____ JOB No. _____
OFFICE _____ DETAIL _____ FILE No. _____

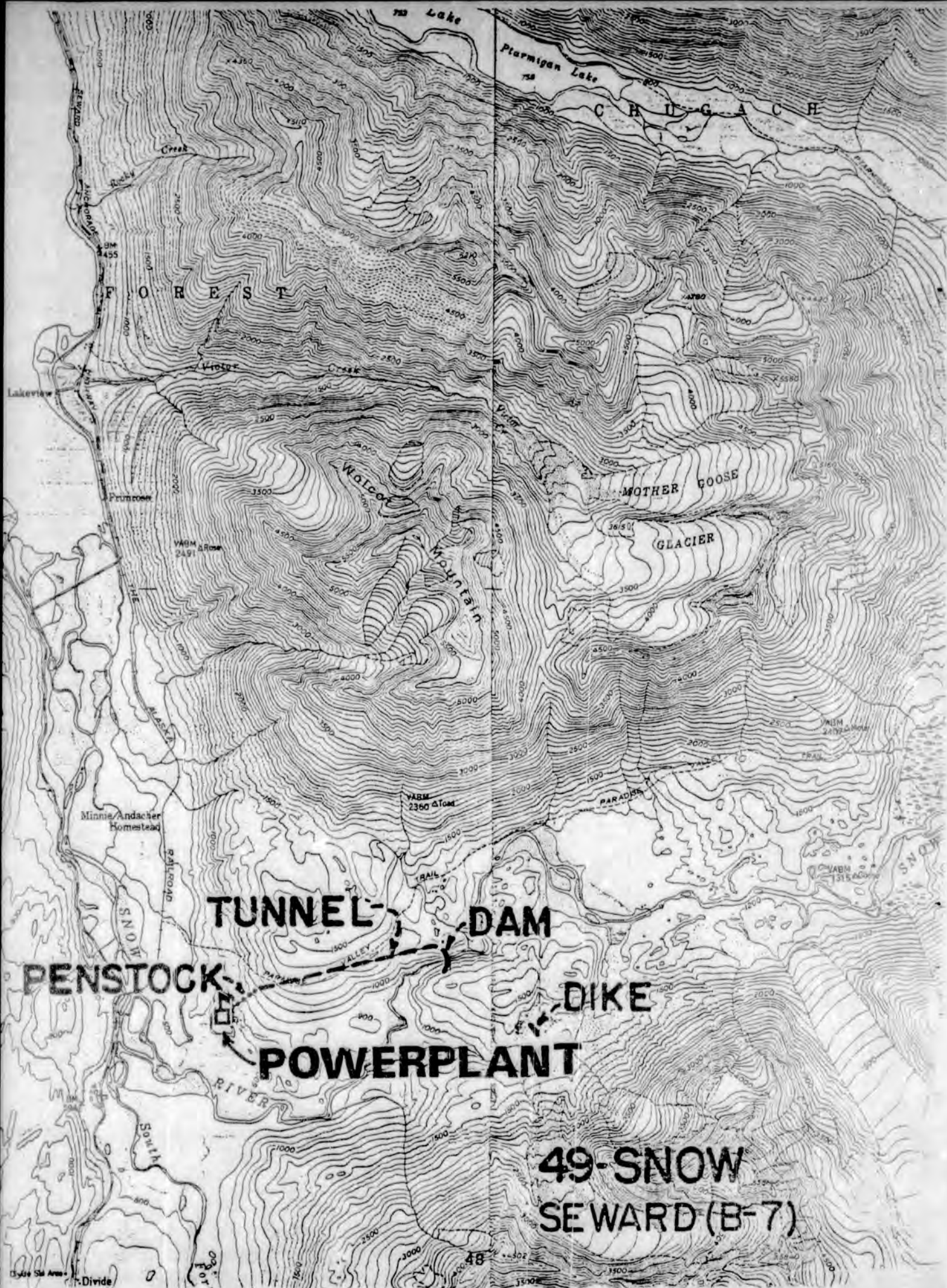
Av. R.O. is 535,000 AF/yr or 738 cfs.

Altitude W.S.	1150	1200	1250
Active capacity	59,000	151,000	354,000
To regulation	12.1	33.8	79.3
To release	35	75	97
regulated volume AF	187,000	401,000	519,000
LFs	258	554	716
Av. head (Coopers 12/25/44 comp)	587	620	653
Friction KW = 0.0678 QH	10,300	23,300	31,700
Installed KW @ 55%	18,700	42,300	57,600

Av. of Kinair R & Bradley R. storage release diagram

Run-off of Snow River near Divide (30-2435)

Unit 1000 Ac-ft. Drainage Area 99.8 Sq.Miles[illegible]



APPENDIX F

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M E M O R A N D U M

SUBJECT: Susitna Alternatives Study

DATE: September 13, 1979

TO: Brian Rogers

FROM: Glenda Straube

I've been investigating the possibility of a small scale hydroelectric project in connection with the Chena River Flood Control Project. This idea was introduced to the Federation for Community Self-Reliance by Jim Weedener. It seems that Mr. Weedener's interest stems from a desire to stop subdivisions in the area.

According to Dr. Robert Carlson of the Institute of Water Resources, Larry Katkin (local geologist who has worked on Chena Project), Robert Huffman of GVEA and David Ulbrich (engineer for the Corps)-----the possibility of this project is slim.

There a number of reasons why this may be impossible: due to the high porosity of the earth making empondment difficult, necessity of building a birm between the Chena and Tanana Rivers and subsequent environmental impact and acquisition of more land, the flooding of such a large area including Eielson, inadequate head, and not economically feasible.

If the Corps had taken small hydroelectric power seriously at the time of the original studies, it might have been possible to build the Control Project in such a way as to allow for hydroelectric power. Huffman thought the Corps did little about this because it wouldn't be a large enough project for them.

Unless Mr. Weedener or the Federation comes up with additional information to the contrary, I would shelve this idea. It would be interesting, though, to get a copy of the original feasibility studies on the Flood Control Project and see why and if the Corps goofed on this. I'll give Mark Wittow the name of the person in Anchorage who was responsible for the original Corps work, if Mark wants to follow up on this.

cc: Mark Wittow

Man's name is Tom Murray at Elmendorf
752-3925

9-17

Never

considered -

no water impoundment
in present plan

HYDROELECTRIC POWER DEVELOPMENT -- WATANA AND DEVIL CANYON
A Potential Power Project of the Army Corps of Engineers

By direction of Congress, the Corps' Alaska District is studying the feasibility of developing the hydroelectric potential of the Upper Susitna River as a means of supplying energy for the rapidly expanding power demand of the South-central Railbelt Area of Alaska.

The District prepared a feasibility report in 1975 which included a recommendation for construction of dams at Devil Canyon and Watana. The report was forwarded to Washington, D.C. for review and public comment. Subsequently Congress authorized \$25 million to be spent for Phase I Advanced Engineering and Design of the project, but funds for this have not been provided. The authorizing legislation also provided the option of a State-Federal joint venture whereby the State would provide project funding, and the Corps of Engineers would do the work. After project completion, the dams would be owned and operated by the State.

On September 28, 1977 the Corps delivered to the State a study outline that detailed the cost and established schedules for the several years of additional planning required prior to any final determination regarding project construction.

At the direction of the Office of Management and Budget the Corps has now begun intensive effort to obtain more information to verify the benefit/cost feasibility indicated in the 1975 report. This information is needed before OMB can recommend proceeding with Advanced Engineering and Design. Geological exploration is under way at Watana now. Drilling equipment and related materials have been moved by cat train over snow and frozen ground to the Watana area. Two tracked cargo vehicles and drums of fuel have been air-dropped to that area, and helicopters are used to relocate equipment at the work site to minimize any adverse effect on the terrain. Drill crews lodge at Talkeetna and commute to and from river by helicopter. Exploratory holes are being drilled to determine the nature of the underlying structure at the damsite. The data being collected will update the construction cost estimate. That estimate combined with a revised economic analysis will be used to compute a new benefit/cost ratio. The District will complete the supplement report by January 1979 and submit the document for referral to OMB.

The plan, as presently conceived, is a two-dam system which would inundate some 50,500 acres including an 82-mile reach of the Susitna River upstream from Devil Canyon Dam. The canyon reservoir would have a water surface of about 7,550 acres at normal full-pool elevation. It would extend upstream about 28 miles, confined within the canyon. Reservoir width would vary from about 1/4 to 3/4 mile. Watana Dam, about 2 miles above the Devil Canyon reservoir, would inundate about 43,000 acres at normal elevation. It would extend some 54 miles upstream from the dam and would average 1-1/4 miles in width.

Power distribution would require transmission lines from Watana to Anchorage and Fairbanks. The transmission corridor would be about 365 miles long and average 200 feet in width. The total right-of-way would cover about 8,100 acres.

This system would provide at least 6.1 billion KWH of energy annually, equivalent to consumption of some 10.7 million barrels of oil per year.

MARCH 1978

02E80 25ND77
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 MR BRIAN ROGERS
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NEW TIMES

An American way of death: hunters who will never return



For the surprise of his life: leave a cradle on the doorstep.

The Chivas half-gallon Cradle, or pouring stand, is a most loving way to baby his Chivas. It's designed to dazzle anybody, especially the man who thought he had everything.

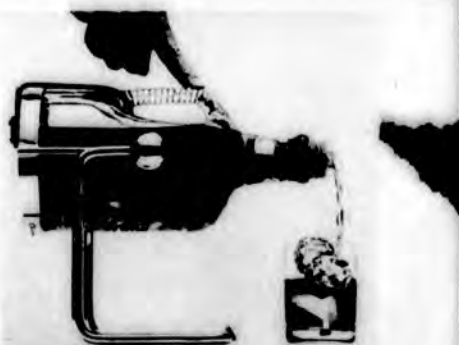
It's economical, too, since it eliminates costly spilling of the Chivas. Just tilt and pour neatly.

To get the personalized Cradle, send \$9.98*—

together with the name you want imprinted on the nameplate (no more than 20 letters, please)—to Chivas Regal Cradle-L, P.O. Box 5061, Smithtown, New York 11787.

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THE ARMY CORPS OF ENGINEERS: FLOODING AMERICA IN ORDER TO SAVE IT

The ever-expanding Corps thinks of itself as the Big Levee, standing between us and the waters of retribution. But it more closely resembles a giant bulldozer out of control, burying villages, disfiguring the landscape and possibly bringing closer the very floods it is meant to prevent

By Michael Parfit

Water. The blood of nourishment, the knife that builds and destroys; the magic element that binds the classic four—earth, water, air and fire, the subject of more range wars and poems than should be remembered. But in this nation, where distrust of military control is as traditional as independence, the agency with the most power over how and where we use our water is a branch of the armed forces that former Supreme Court Justice William O. Douglas once called public enemy number one, the U.S. Army Corps of Engineers.

Like a sandbar growing under a muddy river, the Corps of Engineers has built grain upon grain of authority into an empire of power on which we all, sooner or later, may run aground. Like the sandbar, the Corps is not a flamboyant presence; it works with the quiet serenity of confidence. Few people even know what it is, but it touches every life. Consider its reach.

Across the dry-grass country of eastern Washington, a barrel-bellied fish truck runs a 270-mile route along what used to be the Columbia River, hauling the last young chinook salmon to the sea. Here is the remnant of what was once the grandest drama of nature, the annual return of 40-pound sea monsters to the mountain creeks where they were born. Their ancestors, seen in Idaho's Lemhi River, 800 miles from the coast, once encouraged a pair of weary travelers, Meriwether Lewis and William Clark, to continue west. But a century and a half later the linear efficiency of Lewis and Clark's own branch, the Corps of Engineers, has so changed the basic nature of the Columbia and Snake rivers that young salmon, longing for salt water and finding nitrogen poisoning instead, have to be bused downstream.

On the coast of Alabama, in the thriving port of Mobile, a 96-foot diesel patrol boat mutters slowly down a grey-water channel. On one shore a crew of cranes picks over dead warships, and on the other the huge green skeleton of a stacker-reclaimer towers above a mound of Alabama coal. Among the docks welders hiss and sparkle, and the air is full of the sound of horns and hammering. Tugs push tows of barges, six at a time, each full of coal, gravel, grain or oyster shells; a ship loaded with bananas creeps up the channel. On the boat a young representative of the Alabama State Docks smiles at all the activity. "We're the biggest, most influential industry in the state," he boasts. "And we're basing all our expansion on the

construction of the Tennessee-Tombigbee waterway." Which is being built by the Corps of Engineers.

In a green field in Missouri, a young woman of 24, wearing a bikini, deepens a tan while baling hay on her 500-acre farm. In this Ozark valley she is a rare sign of youth and hope; all around her other farms deteriorate, paint on clapboard houses wrinkles with age and flakes away, because this valley has been under the shadow of a proposed dam for 30 years, and when you know your land is destined to be flooded, the spirit you draw from it dies. Like everyone else, the young woman knows about the dam, but she fights its demoralizing effect with activity. Two years ago she even replaced her outhouse with indoor plumbing. Her neighbors are less sanguine. "What's the use?" they say; the dam is being built by the Corps of Engineers, and the Corps seldom loses.

On Nantucket Island, Massachusetts, a man gazes out across his shore-front property, past the harbor waters at the narrow neck of sand he and his fellow conservationists have saved from developers, and wonders when—and if—permission will ever come through to install a folding aluminum dock he bought for an inboard motorboat. Both dock and boat have been in storage for over a year, waiting on Corps officers hundreds of miles away in Boston to determine the dock's impact on navigation. "I feel a little like Kafka wrestling a paper octopus," the conservationist muses. "How did the Army come to have the last word in matters *this* small?"

In a 100-year-old home in the garden district of New Orleans, in a high-ceilinged living room whose shuttered windows let in cool layers of light from a hot day, a bearded, balding English professor worries about a swamp with the melodious name of Atchafalaya. This great breeding-nesting-multiplying patch of muck at the bottom of the Mississippi basin, boiling with life, is scheduled to be turned into a channel in the name of flood control. What strikes the professor on his wry bone is that the channel may, by draining parts of the swamp, allow people to build pretty, low, ranch-style homes in an area designated as a floodway, into which the excess waters of the Mississippi will one day be diverted, sure as fate. "Either there's something wrong with my logic or there is something wrong with their logic," he says rhetorically, confident of himself. "They," of course, are the Corps' engineers.

In a large lecture hall at Idaho State University in Pocatello, Idaho, a dozen ranchers and farmers listen as a man in a green suit with silver eagles on his lapels explains a new program. What it means is this, he tells them: we will now have the authority over all kinds of development in the nation which involve moving earth in and around water. This means we will control the construction of bridges, channels, canals, culverts, dams, dikes, docks, landfills; almost everything to do with the relationship of water and earth except irrigation itself. You will have to come to us for permission. Is that clear? The man in the green suit—a colonel in the U.S. Army Corps of Engineers—leans forward as if to stress his sincerity, and speaks the favored word of the Corps, invested by now with an ominous ring: "But," he says, "we will be *reasonable*."

What, exactly, is this reasonable agency with all this quiet power? In common usage, "The Corps" means the Civil Works Branch of the Army Corps of Engineers, which includes a military construction and combat arm. The Civil Works Branch is an organization of about 30,000 civilian technicians directed by about 300 Army officers. Since the officers float back and forth between the military and civil sides of the Corps, most of those now in charge of Corps activities served in command positions in Vietnam. The Corps does not actually build its facilities—the jobs are contracted out—but it designs them and supervises their construction and, most importantly, it is also responsible for evaluating the projects it proposes. It is this

self-supporting capacity, plus the mutually satisfying relationship between the Corps and Congress, that has permitted the Corps to grow almost at will from a small agency with \$75,000 to spend in 1824 to today's mammoth. In fiscal 1977 the Corps will spend almost \$2.5 billion, much of it on projects that are destructive, wasteful and, possibly, dangerous.

The Corps' most visible responsibilities are its public works projects—dams, barge canals and flood channels—but it is also involved in flood plain analysis and management, emergency flood relief and cleanup, hydrological research, harbor maintenance, recreation and regulation. Although Corps statistics are impressive—it has built over 400 reservoirs, 25,000 miles of inland and intracoastal waterways, 750 large and small harbors, and 16,000 miles of flood control levees, flood walls and channels—the story they tell is too sterile to show the Corps' full impact. The Corps is, more simply, the nation's largest engineering agency, the nation's largest recreation agency, the nation's largest dam-

In fiscal 1977, the Corps will spend almost \$2.5 billion, much of it on projects that are destructive, wasteful and, possibly, dangerous

building agency, and the agency most responsible for what the face of America, reflected in her waters, will look like in 50 years. Yet even this kind of description does not properly describe the influence of the Corps: the only way to begin to understand is to see it at work.

The basic Corps of Engineers unit is the district, of which there are 38, covering the nation. This is the gut level, the place where everything happens. One of the Corps' greatest assets—or liabilities, depending on whom you talk to—is the autonomy of the individual districts.

"We have an awful lot of independent authority in the field," Brigadier General Drake Wilson, the Corps' deputy director for civil works and a former district engineer himself, told me in Washington. "So the district engineer can set the whole tone of the organization. You just kind of feel free like you can do what you want to do. It's a wonderful job."

"What the hell that really means," said a Corps critic, Oliver Houck, general counsel for the National

Wildlife Federation, "is that they're running an organization they don't control."

One of the districts is headquartered in St. Louis, Missouri. There, on a stifling summer day, I found myself in an elegant room while two Corps PR men, Kenneth Long and Mel Doernhoefer, pummeled me with information on one of their projects, Meramec Park Lake, a reservoir just being started about 65 miles southwest of St. Louis. It was a strange experience, a disturbing introduction to the reasonableness of the Corps of Engineers.

In the twilight of the big room, the two men showed me slides of trash on the Meramec River, insinuated that it was caused by canoeing recreation, and promised their dam would eliminate such littering. They told me that Meramec River floods cost an average of \$3 million a year and then gave me a report that claimed the dam, which offers only partial flood protection, would provide annual flood control benefits of \$4,245,000. They boasted that the lake would draw 3.8 million visitors a year and introduced me to a recreation specialist who, when asked where all those people will come from, answered, "these are latent people who, right now, barbecue in their back yards or swim in the county pool." The figures, he admitted, were based on studies made in 1961.

The statistics went on without relief. Then Long and Doernhoefer started to talk about caves, and I remembered with pleasure a visit of the day before to the silent depths of Onandaga Cave, which would be flooded by the dam.

Onandaga Cave is among the most magnificent caves in the United States, and you wander through it entranced. In vast, cool spaces arms of stone reach up and down for each other as if in patient yearning, and drops of water tap you on the shoulder like children whom you can never find. A small stream, the Lost River, flows through the cave, its waterfalls amplified by canopies of onyx and its reflections, in the semi-dark, giving an impression of endless depth. But today, high above your head in many of the rooms, are small red lines, lines that mark the eventual surface of Meramec Park Lake.

My reverie about Onandaga was interrupted by the penetrating voice of Kenneth Long. The beauty of the cave, he was saying, would be enhanced by putting most of it under the reservoir's fluctuating pool. "Some of the rooms already have water in them," he said. "It's better that way." As he spoke, Long tore small pieces off a Styrofoam cup, which squeaked in his short fingers

like a mouse in pain.

Two days earlier I had talked to a big, red-bearded man of 34 named Don Rimback who has self-educated himself in the dynamics of Missouri's caves with the passion of a fanatic. He had explained the significance of Onandaga Cave: it is a symbol of the geology of the Meramec Dam region, which is as holey as an old tin bucket.

"There are nine miles of surveyed cave passages within three miles of the dam site," Rimback had said. "These things are railroad tunnels." The Corps, Rimback had said, had failed to fully explore known caves in the dam abutments, and is asking for, at least, cost overruns which would give its benefit-cost ratios the significance of confetti. Speaking with the anger and frustration

money as a good rural school and whose only purpose was to promote the controversial dam) came complete, he added, preening environmentalist feathers, with a tertiary sewage treatment system. And look, he said, showing a slide of a shake-roofed building standing in a grove above the 12,600 acres of forest and meadows the dam would flood, "When we built it we saved the trees."

On Kenneth Long's desk stood a small statue of a fist, its middle finger raised to the public in an unmistakable salute.

A few days later, I floated part of the Meramec River, and began to understand a bit of the motivation which leads to such relentless pursuit of projects like Meramec Park Lake. There's the

ways soothed with its perspective. It was reversed: I would outlive the river. But there was another reaction in me, more disturbing than this shuffling of destiny: I found myself strangely fascinated with wondering what the scene would look like when it was the bottom of a lake, peeled of sycamore and alder and drowned in cold, green darkness. I once saw the remains of a village revealed by low water in another Corps lake, the stone buildings grey with algae, silt piled in the yards and bedrooms like volcanic ash or fallout, and now, floating the Meramec in thick green forest, with small-mouth bass darting away from the canoe's shadow, I began to drown in that image of power.

How would it be, I wondered, to be able to draw a small line in pencil on the tablecloth of the earth; let's see, right about *here*, and create, from a river, a 12,600-acre lake? Magnificent! What an art: rich with function, heavy with dimension and importance, monumental in duration. You cannot belittle the men of the Corps of Engineers, even with their own figures; this is water they manipulate. Like no one else, they have their fingers on the pulse of geologic time, the ability to apply the tourniquet or the leech.

And as I drifted on the river, that power backed up against my mind, the pressure building. In spite of all the consequences, if I were here, and had the chance—the stones and soil to draw across the flood—would I even hesitate to move to change the world? Bring on the cats, the scrapers, the chains to tear the woods apart! Let me watch what I can do, watch as the spadefuls gather, as the water stalls and sighs and bubbles, and as the logs collect in the corners like straw, like sawdust in the river's eye.

Meramec Park Lake, which will be the subject of a referendum early next year, is a glimpse of the Corps which, however enlightening, remains just a small piece of a large puzzle. In its entirety the Corps is an intimidating subject; its roots show up in too many pipes and sewer lines. This spring the Corps reported to Congress that 63 Corps projects were involved in various kinds of court action. It follows that most Corps conflicts, like the Meramec Park Lake controversy, are intensely local, and that few individuals are watching, opposing, or supporting the entire national scope of the Civil Works Branch. This works to the Corps' advantage: in 1971, for instance, while environmentalists were praising Richard Nixon for stopping the Cross-Florida Barge Canal, Nixon was

PHOTOGRAPH COURTESY OF THE ARMY CORPS OF ENGINEERS



Corpsmen at work: by studying this detailed model of the Mississippi River at Vicksburg, Miss., engineers hope to learn the way of water to tame it forever.

of a man forced to watch his daughter raped, Rimback had compared Meramec to Teton Dam, a Bureau of Reclamation project whose failure may be partly blamed on abutment fissures far smaller than the ones he sees at Meramec.

And now, as I listened to Doernhoefer rebut: "We have found no formations which could not be handled by engineering techniques," I felt a prickle of apprehension. It was the power of the net these men were weaving, not with lies, but with distortions; the power to mislead and to confuse.

Kenneth Long, smiling as warm as an Ozark Cave salamander, explained that the first thing the Corps did with money appropriated for the dam was to build a \$1.5-million visitor center. This center (which cost as much taxpayer

money, of course, the maintenance of Corps' and contractors' jobs, but there's something more, which involves the old antagonistic relationship between humanity and nature, and the desire for power.

The Meramec is a gentle stream, shallow enough in most places to walk across, yellowish green and murky, not with silt but with phytoplankton. For a languid half day I floated and paddled down 10 miles, in and out of sun and shade and cool water, past pale limestone cliffs and the hidden mouths of caves, and always with an eerie sense of trespassing on condemned ground, of dancing with a ghost. I became disoriented: this natural world no longer symbolized the long, steady throw of time, the continuity of the earth's pace that has al-

approving the construction of the Tennessee-Tombigbee Waterway, a similar Corps project in Mississippi and Alabama.

So it is important to look at the Corps not only on its most intimate levels, down in the districts, but also in its broadest implications. The Corps' significance may be most sharply appreciated out on the cutting edge of its projects, but its power, influence and durability are based on its organic functions and alliances, not on the success or failure of one or two dams.

One of the Corps' most significant functions is its responsibility for flood control. The devastating Mississippi and Ohio river basin floods of the late 1920s and early '30s resulted in a series of laws which made the Corps our flood control agency, setting up much of the power it holds today. Almost every Corps project, other than harbor dredging, contains some provisions, and some claimed benefits, for flood control. The Corps is making us all an implied promise of protection; it has become the big levee, stout and concrete hearted, standing between us and the waters of retribution.

The irony is that the levee leaks, and the promise may be false.

In 1973 the Mississippi, in whose basin the Corps has been dredging, leveeing, damming and channelizing longer than anywhere else, reached flood stages higher than those ever recorded, while the actual flow rate was 35 percent less than the previous record, set in 1844. In an August 1975 article in *Science* magazine, C.B. Belt Jr., an associate professor at St. Louis University, charged that "The 1973 flood's record was man-made." Belt blamed the record flood on levees and navigation works, and wrote that "Additional channel constriction and levee building will cause further problems."

The Corps' own brochure, *Flood Plain—Handle With Care*, points out that although "The Federal government has invested over \$9 billion in flood control projects since 1936 . . . it is estimated that flood damages have been increasing each year since 1936 and that flood losses now come to almost \$2 billion annually." The Corps blames this increase on careless community planning, but others put at least part of the blame back on the shoulders of the Corps' own promise.

"No dam is designed or able to hold all floods," professors Roger W. Findley and Bruce M. Hannon wrote in a paper reprinted in June in the Congressional Record, "but the impression of permanent protection encourages devel-

opment of downstream areas. When the uncontrollable storm hits, it must be passed through the dam and the built-up flood plain is inundated with resulting high damages."

Dams, magnificent monuments that they are, may permanently change the face of the earth, but in terms of flood protection they are relatively short-term ventures, mainly because they are constantly filling with silt. The rate at which they become useless varies with the silt load of the river they plug, but some reservoirs, claims Raphael G. Kazmann, a noted hydrological engineer at Louisiana State University, are losing as much as one-eighth of their capacity every 50 years. What this means is not that we'll suddenly be looking at a silt plain where once there was a lake, but just that the reservoir's capacity to handle extreme floods is steadily diminished, leading with certainty to the day when the storm of the century comes boiling over the dam. Surprise!

"Under any circumstances,"

How would it be, I wondered, to be able to draw a small line in pencil on the tablecloth of the earth; let's see, right about here, and create a 12,600-acre lake? Magnificent!

Kazmann writes, "there would seem to be an element of entrapment by the federal construction of projects that purport to reduce or eliminate floods permanently. . . . A . . . parallel might be drug addiction—which gives the addict the temporary illusion of power and well-being, requires ever-increasing doses to maintain the feeling, and finally destroys him physically."

But the Corps remains addicted for two reasons. First, it has been promising flood protection for so long that the public believes it; certainly much of the nation's economic development would have proceeded differently and perhaps not as fast if the Corps had not been saying, in the words of Oliver Houck, "You can build in the wetlands, guys, because we're here." Look at New Orleans, dozing in the sun below the lip of the Mississippi, waiting for the 200-year flood that could come tomorrow. Second, since the Corps has not been blamed for the inevitable floods that disregard its structures or are partially caused by them, it has been able to say, again in Houck's

words, "Well, My God, think what it would have been if we weren't here." Because of this win-either-way approach, which Houck calls "a wonderful doublespeak in 1984 terms," whenever a new flood catastrophe occurs, the public comes clamoring to the Corps.

So, as of last spring's report to Congress, the Corps was building 69 flood control reservoirs and 76 local protection projects, at a total estimated cost of \$7.4 billion.

None of these flood control projects involves the production of electricity from falling water, which is another major Corps function. In addition to the projects mentioned above, the Corps is building 28 hydroelectric dams, at a total estimated cost of \$5.7 billion.

Such dams are usually considered multi-purpose structures, providing, for instance, flood control and recreation as well as power, and relying on all purposes to come up with a favorable benefit-cost ratio. Although the same hydrological problems associated with flood control dams exist on power dams, you can legitimately argue that from a pure pollution standpoint falling water beats coal or plutonium as a source of power. The problem is that we have already used up most of our best hydropower sites, so the trend in hydropower construction is to build pump-storage reservoirs that actually offer a net loss of power for the convenience of meeting peak power demands. The economics of hydropower dams also require that you justify them with other purposes or you come up with something grossly uneconomical. Often, purposes that mesh on paper conflict in practice.

For proper flood control, for instance, you want to maintain a lake at relatively low levels, which lowers the power production, but for recreation you want to have a lake neither as high as the power potential demands or as low as optimum flood control demands. In addition, a recreation lake should have a nice, consistent shoreline, but meeting peak power demands requires a fluctuating water level that creates muck banks and discourages spawning fish. Adjusting just these three purposes requires the coordinated hand and timing of a juggler, but the Corps frequently throws an anvil into the act: navigation.

Navigation is the oldest civil works activity, going directly back to the Corps logjam work on the Mississippi. The Corps' current role here is divided between maintaining harbors and sea channels, and building and maintaining a remarkable network of inland waterways which has made seaports out of cities

like Lewiston, Idaho, and Tulsa, Oklahoma. The Corps' harbor-dredging operation is seldom criticized, but its inland waterways are another matter.

Attempting to maintain a constant running channel in a sediment-bearing stream like the lower Mississippi cannot only increase flood problems, but is, as Raphael Kazmann writes, "a systematic attempt to replace the potentially steady state conditions of water and sediment movement by a condition of hydrologic nonequilibrium." Like trying to balance a seal on a ball.

Comparing us to King Canute, who got wet when he commanded the tide to stay out, Kazmann says that no matter how vigorously we legislate the construction and maintenance of river channels, "Political decisions not in accord with the laws of hydrology and geomorphology are sooner or later subject to final reversal by highest authority and appropriate penalties will be paid."

The best example of an ongoing navigation project is the Tennessee-Tombigbee Waterway, which will be a 253-mile long, nine-foot deep barge shortcut from Tennessee to the Gulf of Mexico. The Tenn-Tom, as it is nicknamed, belongs to the Corps' Mobile, Alabama, District, which began construction in 1972 and estimates that it will cost at least \$1.3 billion. This estimate includes a \$545 million overrun last year—incredible if it were not so consistent with Corps history. The Tenn-Tom, which involves more earth moving than did the Panama Canal, is the biggest Corps project now underway.

Down in the small, college town of Starkville, Mississippi, I found Dr. Glenn Clemmer in a room full of dead fish. Clemmer is an ichthyologist, a fish zoologist, and the fish were all specimens in glass jars, stacked to the ceiling of his storeroom on shelves. They gleamed pale gold through isopropyl alcohol and watched us with a million little eyes.

Clemmer, 36, is one of the few down-home opponents of the Tenn-Tom project, but he has begun to acquire allies. He and other members of his organization, CLEAN (Committee for Leaving the Environment of America Natural), have at least managed to persuade farmers of the 12-county area in which the Corps is planning to buy full title or easements on 104,800 acres of land that patriotism doesn't require them to sell out cheap. Since Corps negotiators tend to soften up landowners with handsome verbal offers that can be adjusted at contract time, Clemmer said, CLEAN has

persuaded the farmers to carry tape recorders instead of shotguns for protection.

Clemmer would like to see the project killed. As he likes to say, "We can waste \$100 million or we can waste \$2 billion." But what would you do with the unfinished waterway? He laughed. "Oh, we could get people with shovels and we could do a fantastic hiring job of filling it back in."

Tenn-Tom is as modern a project as you'll find, and the Corps is happy to tell you that it reflects all the latest attitudes. "We were doing most of the design on Tenn-Tom after 1972," said Gen. Wilson, who was Mobile district engineer before his recent rotation to Washington, "so the National Environmental Policy Act was in effect, and new environmental awareness was upon us, so we were trying to do everything as well as we could. I believe we worked hard at it. For instance, we designed buffer zones to hide the disposal areas so the traffic-way of the waterway would remain aesthetically pleasing."

The Tenn-Tom is supposed to cost \$1.3 billion, but the cost overrun last year was \$545 million—incredible if it were not so consistent with Corps history

thetically pleasing."

Among the other items of similar environmental significance, Clemmer pointed out with a kind of sorrowful glee, is that in those earth disposal areas, where the Corps will fill and level off 43 small valleys, the Corps has provided for the seeding of new growth by designing a series of "perch wires." Perch wires are, in Corps words: "Artificial perching sites constructed of posts placed approximately 20 to 50 feet apart with wire strung between. Desirable plants will be propagated under the perch wires as a result of seed that is disseminated within bird excrement."

Meanwhile, Tenn-Tom is going to cause some genuine problems along the lines of Kazmann's analysis. In addition to the obvious ecological devastation wrought by changing a river into a series of slack-water lakes and by dumping a mountain's worth of dirt, the canal is likely to have a profound effect on ground water. An article in the Corps' own magazine, *Water Spectrum*, says that in some areas the water table may be

lowered as much as 100 feet, and in others raised so much that "the . . . levels may claim some land now being farmed."

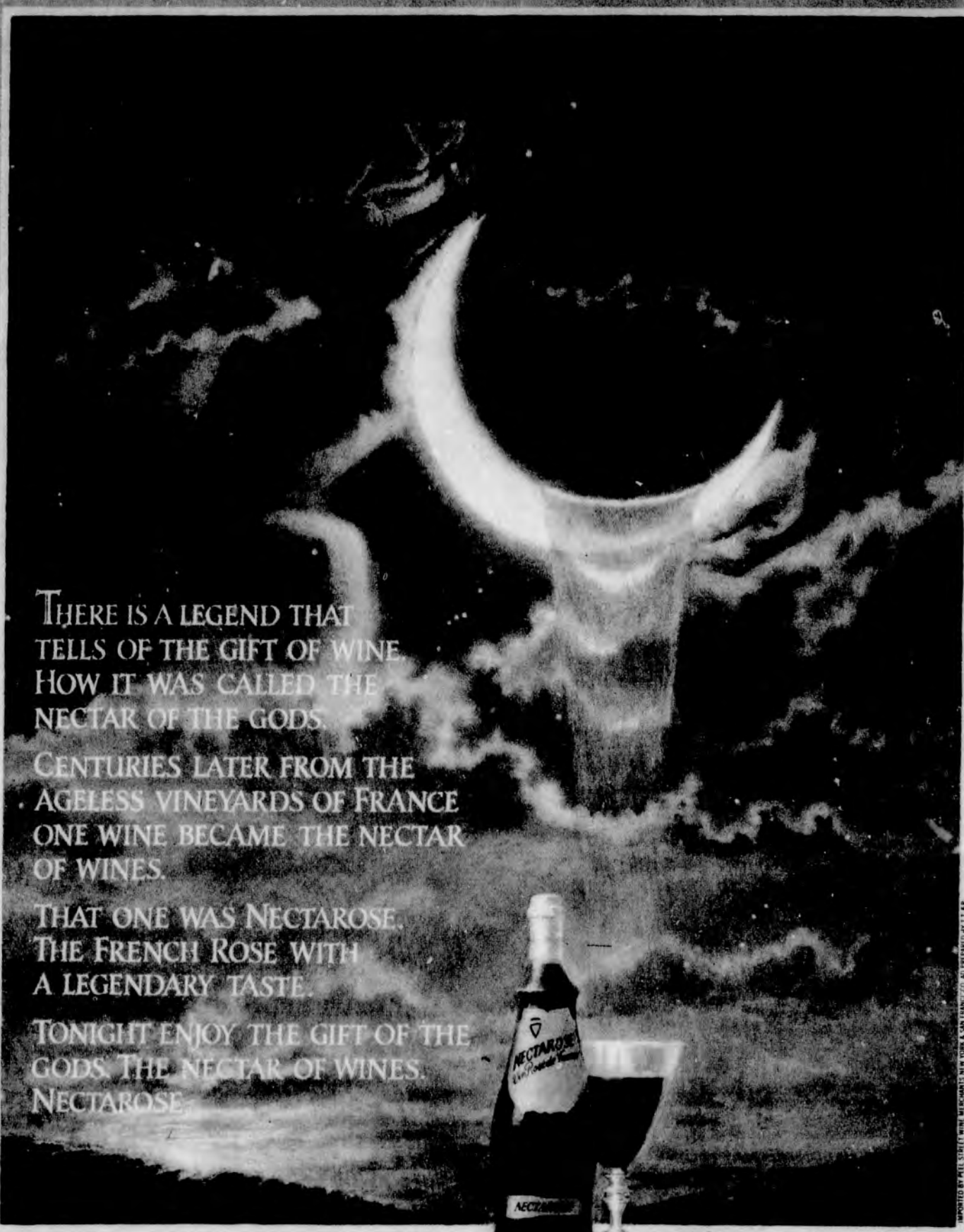
But Tenn-Tom is particularly fascinating for its economics. Congress requires that the Corps prepare a benefit-to-cost analysis of each of its projects, and a project that costs more than it is worth seldom gets funded. But the way the Corps comes up with its figures has been subject to both amused ridicule and attack, and Tenn-Tom is no exception.

Tenn-Tom is not a flood control structure. Nor will it provide hydroelectric power. Instead, by using some Tennessee River water, it will actually reduce power generated by that river downstream. It is purely a navigation channel; other benefits such as recreation are incidental. The primary commodity which will float down the Tenn-Tom to the Gulf will be high-sulfur, strip-mined coal. Here's the kicker: much of that coal will be shipped to Japan.

Since Tenn-Tom does not provide a new, vital service, its benefits are computed on its value as a barge shortcut from Knoxville or Chattanooga to the Gulf. The estimated annual benefits of \$66 million are figured mostly on the time barge operators will save over the traditional route down the Mississippi. And though it will cost at least \$1.3 billion to build the canal, and about \$6 million a year to maintain it, the barge operators will pay no user fees. So Tenn-Tom, like all other Corps waterways, is basically a massive subsidy of the barge industry. "Using the money this way," Clemmer said, "is like helping the Rockefellers get more servants."

Ignore, however, the question of whether it is of national benefit to subsidize barge traffic to a far greater extent than we subsidize railroads or even truck operations, and look farther into the benefit calculation, which yields a meager 1.1 to 1 margin. At its heart is a discount rate—the interest charged to the cost of money—of 3¼ percent. Although use of this rate is legal (it was the one in effect at the time Tenn-Tom was authorized in 1946), it is entirely unrealistic. It's a bit like justifying a horse on a dog-food budget. And Tenn-Tom is not an oddity. Since projects are often authorized years before they are funded, the Corps always seems to be working with antiquated interest formulas. In this case, as in many, the 3¼ percent rate is vital to the project; at a more modern rate of 6½ percent, say, the ratio might drop below the balance.

It is possible that the favorable



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ratio of 1.1 to 1 may collapse of its own accord if the project experiences another horrendous overrun like this year's \$545 million adjustment. But the Corps is prepared. Last spring, aware that it had an economically marginal project under construction, the Corps produced, like a magician under duress, a new, more glamorous rabbit.

Today all discussion of Tenn-Tom includes an additional project, the enlarging and streamlining of the old canal between the end of Tenn-Tom and Mobile. This yields a slightly more substantial benefit-cost ratio of 1.3 to 1, and this is the ratio now used by waterway promoters. However, the additional project, which the Corps calls Plan C, has never been authorized by Congress, has never been funded, and its feasibility has never even been officially studied. It's a kind of floating wild card whose figures, a Corps spokesman hedged, "are subject to some change."

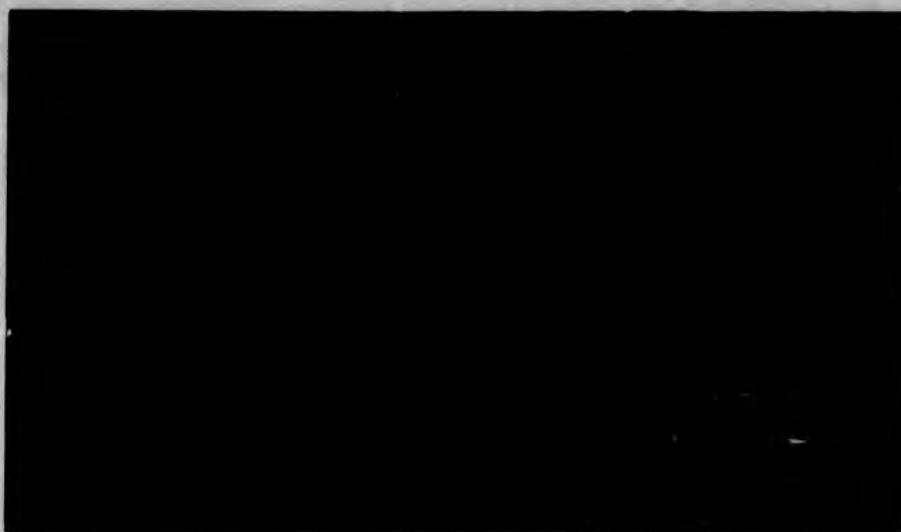
But there is an additional subtlety here. Although the Corps says it just thought of the new expansion this year, it doesn't look quite that innocent. It looks more like the Corps designed Tenn-Tom to create a bottleneck and force extra construction. The Tenn-Tom locks are being built to allow eight barges through at a time; the old locks downstream can only handle six at a time, forcing barge operators to change the size of their tows halfway to the Gulf. You can bet they'll lobby for expansion.

This leapfrogging design technique is not unique to Tenn-Tom either. In another controversy, involving the St. Louis District, conservationists are accusing the Corps of doing exactly the same thing: designing a lock and dam replacement on the Mississippi at Alton, 30 percent deeper than others in its series with a long-term purpose of forcing the similar expansion of the whole system.

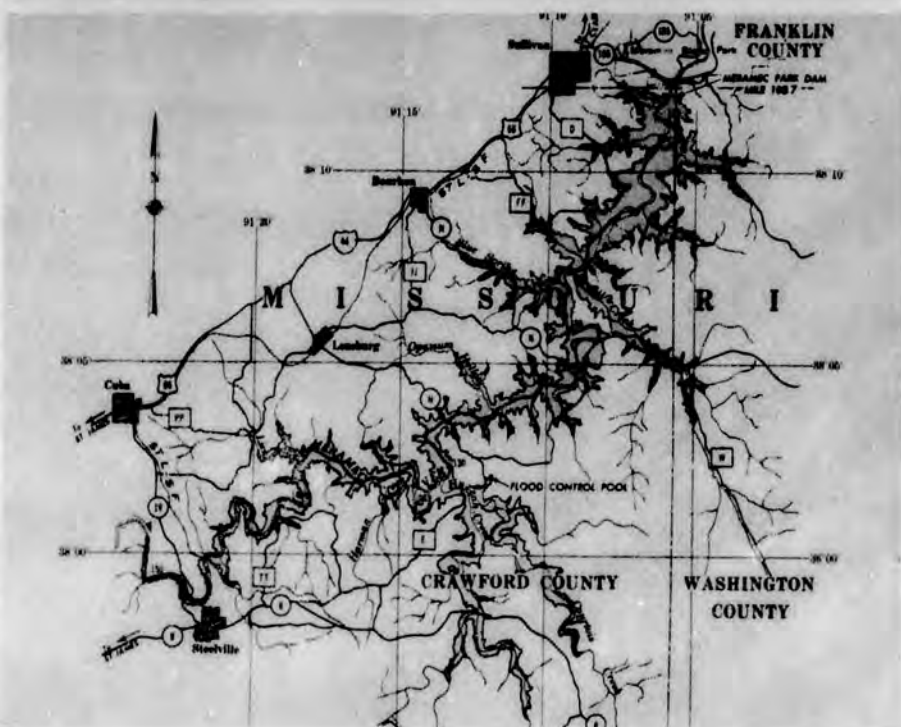
"You can see," Clemmer said, "this is the same old group."

But what if Tenn-Tom, like other Corps projects, is destructive? What if it, like others, is based on faulty economics? What if Tenn-Tom is, as *Forbes* magazine called it, a "boondoggle" of enormous proportions? Does that really matter? Don't public works projects have a primary purpose beside which all this niggling is irrelevant: to provide jobs?

Bruce M. Hannon and Roger H. Bezdek, another University of Illinois professor, have an answer. In a paper printed in *Engineering Issues*, a publication of the American Society of Civil Engineers, Hannon and Bezdek say, yes, Corps projects do provide jobs, but less per dollar spent than many other possi-



PHOTOGRAPH BY MICHAEL PARETT



COURTESY OF THE ARMY CORPS OF ENGINEERS



PHOTOGRAPH COURTESY OF THE ARMY CORPS OF ENGINEERS

The Meramec Park Lake project: above, the Meramec River as it looks today and, bottom, the construction under way along its banks; middle, the projected park itself—the area to be flooded is blue, with the original river barely visible as thin lines. Some 12,000 acres of sycamore and alder and 35 miles of Meramec riverbed, not to mention one of the country's most unique cave formations, will be drowned in cold, green darkness forever.

ble investments.

Hannon and Bezdek compared Corps projects with five alternatives—tax relief, National Health Insurance, Social Security benefits, railroad and mass transit construction, and waste treatment construction—and found that each alternative would offer more jobs, although a shifting in types of jobs was inevitable.

Tenn-Tom is also a good example of Corps employment impact. In the 12-county area directly affected by the waterway, 40 percent of the population is black. In the same area, blacks make up a disproportionate percentage of all poor people. However, a June 1, 1976 work force profile of employment on the Tenn-Tom lists only 144 blacks out of a total of 591 project workers—24.4 percent. Wendell Paris, chairman of the Minority Peoples Council on the Tennessee-Tombigbee Waterway, calls these statistics examples of "blatantly racist employment policies." Even if they are merely the reflection of the makeup of the people trained in skills the construction of canals demands, those percentages indicate that if the primary purpose of Tenn-Tom is to provide jobs for people who need them, it is failing.

Finally, Tenn-Tom offers a lesson in Corps dynamics. Consider: it is the largest public works project underway in the United States. It will also affect the home districts of, among others, Senator John Stennis (D-Miss.), chairman of the Senate appropriations subcommittee on public works; Representative Joe Evins (D-Tenn.), chairman of the House appropriations subcommittee on public works; and Representative Robert Jones (D-Ala.), chairman of the House public works and transportation committee. The relationship is no coincidence.

"Any attempt to focus on the Corps without realizing the indispensable part played by special interest groups and the Congress is not going to get the full story," said Brent Blackwelder, a founding staff member of the Washington-based Environmental Policy Center. "You can view them as a triangle; they all need each other."

The special interest groups are the barge operators, the big realtors, the contractors and the dredgers, who use their influence with the Congress and the Corps to promote projects, often forming organizations like the Meramec Basin Association or the Tennessee-Tombigbee Water Development Authority to promote and lobby. These groups can think up new projects or resurrect projects that the Corps has tabled. Such as Tenn-Tom.

"In 1946, Tenn-Tom was authorized but on a very shaky basis," General Wilson said. "Then the proponents kept trying to get it restudied, and in 1966 it was restudied and the new report showed a better benefit-cost ratio." With a little help from our friends.

The relationship with Congress is just as comfortable. Public works projects have been accepted as pork barrel nourishment for incumbents so long that it embarrasses no one. Victor V. Veysey, Assistant Secretary of the Army for Civil Works, as well as former congressman from California, had the best explanation. "There has been a very close association between congressmen and public works projects for the simple reason that they are very tangible projects," Veysey said. "They may be disliked by some but on every project there is a large group who are strong, strong supporters. They're tunnel vision and if the congressman gets their project moving, he's their man. It's a great political base."

The congressman gets the political base, the Corps gets its money. Because of this relationship, the Corps, even in years of fiscal restraint, gets more money than it asks for

Everything in this arrangement is mutually satisfying. The congressman gets the political base, and the Corps gets its money. In fact, because of this relationship, the Corps, even in years of fiscal restraint, usually gets more money than it asks for. This year it requested about \$2.2 billion; it got almost \$2.5 billion. The Mobile District asked for \$84 million for Tenn-Tom; it got \$104 million. The Corps made no requests for new construction starts; Congress gave it funds for 25.

The Corps protests that Congress pushes farther than it wants to go, but, in effect, it guides the hand that feeds it. Appropriations hearing records are thick with generals pointing out to congressmen that because of administration budget restraints the funds requested for a particular project are less than what the project could most effectively use, and hinting that every year we dawdle below capacity we lose more to inflation.

A telling example of Corps-Congress relationships appears at the end of Vol. I of those hearings. Evins and Jai-

mie Whitten (D-Miss.) had been interviewing Major General Francis P. Koisch, division engineer for the lower Mississippi Valley, a division Oliver Houck calls "a little kingdom," and they wound up the session with this:

Mr. Evins: [To Koisch] We wish you good luck. You have a very important division and a tremendous workload. This committee is backing you and supporting you. We wish you good luck.

Mr. Whitten: Mr. Chairman, you left out the word, push. We are pushing you.

Mr. Evins: We will add that.

In the Corps headquarters in Washington's Forrestal Building, the corridors are dimly lit by a select few of the available overhead lights, a tribute to the sudden obsolescence of a wasteful design. Here the military presence of the Corps dominates. Officers stride up and down the halls, and the brims of hats gleam with golden braid, symbolizing the ranks of major and above.

But the olive drab patina of the Corps is hard to interpret. The Corps answers more directly to Congress than to anyone in the Pentagon save Veysey, and, after all, there are only 300 uniformed men in the entire Civil Works Branch. So the importance of the military presence is uncertain.

The late Arthur E. Morgan, first chairman of the Tennessee Valley Authority and lifetime Corps critic, blamed a lack of "ethical character and . . . engineering competence" in the Corps on the "fundamental character and structure of the U.S. Military Academy," which, he said, trains people to obey orders and to act quickly, but does not allow the "high degree of independent, critical and creative thought" demanded by good civil engineering. But others, including Brock Evans, head of the Sierra Club's Washington office and a member of a Corps advisory committee, have said that the organization's civilians run the show and use the military people, who seldom spend more than three years in any particular district and who rotate between the military and civil works branches, as point men.

Brent Blackwelder of the Environmental Policy Center uses stronger language. "The entrenched civilians run the ball game in a kind of faceless way," he said, "using the military dressing to terrorize people."

Nevertheless, the officers do set the policy, and when you talk to environmentalists in the field the standard comment on whether or not the Corps is responsive to their requests is "It all de-

depends on who is the district engineer."

The Corps is effective, according to Oliver Houck, "to the extent that the military guy in charge is young, bright and responsive to new breezes."

Whether the military or civilian people run the Corps, however, it is apparent that they don't differ much in philosophy. Both want to do a job. General Wilson explained:

"When we go out on a district assignment we're mission-oriented; production-oriented," he said. "I guess that's one aspect of the military training that you can take in either a negative or positive fashion. We get our greatest satisfaction from doing something, and so if we get directed to study something, we try to find a way to do what the proponents want."

Several environmentalists expressed a curious attitude toward the military structure of the Corps. One lawyer who had just finished telling me how useless the public hearing process is because it gives the uninformed masses the same right to testify as his organization, which has so much more substance to offer, said he felt the military structure was valuable because it permitted swift change. You give an order and—Ten-hut!—it's done. It's a bit like praising totalitarianism for its efficiency.

One thing that was almost as much in evidence in the Forrestal Building as military trappings was talk of a New Corps. The Corps is becoming more responsive to environmental needs, people said, and the project they pointed out as an example of this New Corps was the Charles River Natural Valley Storage Area, near Boston.

The Charles River project is special because it is a nonstructural approach to floods. "Nonstructural," which is used as a kind of floating noun, is state-of-the-art flood control: instead of building a partially-effective dam, you restrict flood plain construction to allow flooding without damage, and you take advantage of natural storage areas such as swamps to absorb excess water. Environmentalists have been advocating this approach for years, and now the Corps appears to be embracing it. "Only after we have thoroughly exhausted all other alternatives, in particular those labeled nonstructural solutions, will the public accept structural solutions," General Morris wrote in 1975. "As a result, I see the Corps role in flood control changing significantly."

But Oliver Houck demands evidence on the bottom line. "Just how much bullshit is their nonstructural ap-

proach?" he asked. "How many people and how much money does the Corps have in nonstructural? That one question is the most important inquiry about the Corps." And the bottom line is not so promising. On a national scale, the Corps commitment to nonstructural solutions is still insignificant. The total estimated cost for the Corps' three such projects—in Wisconsin, Arizona and Massachusetts—is \$41 million, less than 2 percent of this year's budget. And the 1977 Corps budget request asked for no new money for the Charles River project, indicating at least a low priority. (Congress later gave the project \$1 million, so it continues.) It is more likely that the nonstructural approach, at least so far, is more useful for public relations than as a genuine alternative to traditional dams, levees and channels.

But by far the most controversial evidence of change in the Corps is its new authority to regulate dredging and filling in all the nation's waters. This responsibility rambled through Congress throughout the summer striking sparks,

"The entrenched civilians run the ball game in a kind of faceless way, using the military dressing to terrorize people"

but causing no action. It has been praised as a sign of a Corps environmental renaissance and attacked as an infringement of states' rights. But one thing is certain: the new role will give the Corps more power.

The brief history of the regulatory law is one of shifting and tangled alliances. When Congress was working on amendments to the Water Pollution Control Act in 1972, environmentalists lobbied for the Environmental Protection Agency (EPA) to have control over everything being put into water, including earth. But industrial interests argued that the Corps should regulate dredging and filling operations, since it had expertise in those areas. (And since it was already their friend.) So Congress gave the authority to the Corps in a section now notorious as "404."

Yet the Corps, strangely reluctant to extend the authority to its legal limits, applied the law only to its traditional area of control: navigable waters. Then, stranger still, the Natural Resources Defense Council and the National Wildlife Federation went to court and, in March

1975, won a judgment requiring the Corps to expand its authority to all the waters of the United States, which includes all but the smallest lakes and streams. By next July, if Congress does not intervene, the Corps will regulate dredging and filling in all lakes larger than 5 acres and all streams flowing faster than 5 cubic feet per second. This covers almost all water-related construction up to the point of irrigation.

So why have the environmental organizations supported this growth of court power with such vigor? Because they feel that some control of water-oriented development is better than none. Groups like the National Wildlife Federation have been worried for a long time about the fate of the nation's wetlands, those incredibly rich places which nurture much of our wildlife and which support most of the seas' bounty. At least 51 million of the nation's 127 million acres of wetlands have already been destroyed by dredging and filling according to estimates by the NWF, and the current rate of consumption by a land-hungry nation is over 800 acres a day. Although the Corps' new role covers more than just swamps, it would have its largest effect on wetlands, and environmental organizations figure that some control is better than none. "We may have to police it ourselves," one environmental leader said, "but at least they can't ignore us." And though the Corps record in regulatory operations has been poor—it has not yet denied one single ocean dumping permit in the three years it has had that responsibility—environmentalists were heartened this spring when the Corps denied a developer's application to fill 3,000 acres of mangrove swamps on an island off Florida's gulf coast.

So if there is any uncomfortable feeling among environmentalists that perhaps we are giving the Corps—and the military side of the bureaucracy—too much power over a vital domestic resource, nobody shows it. In fact, with the regulatory program still in its embryonic stage, relations between the two sides of what used to be a war are practically cordial. The feeling among environmentalists seems to be fatalistic. There's no way to stop the Corps, so let's bend its purpose. "It gives them a chance to change around," said Ron Outen, until recently a lobbyist for the NRDC's environmental lobby. "It's good for the Corps to do this kind of thing, otherwise they're going to build dams."

So the Corps of Engineers keeps growing; this time with the help of the organizations which have fought it so bitterly in the past. If the regulatory pro-

gram just enacted functions as its proponents envision, the Corps will have reached a dramatic new level in its scope of authority over the nation's waters.

And the Corps seems destined to grow bigger still. Among the proposals being advanced for changes in the present responsibilities of the Corps, few seek to diminish its role. One of the most significant of these is a proposal to get the Corps into the railroad-building business. Hannon and Findley argue that the Corps could subsidize railroads in the same way it subsidizes barge operators, by building and maintaining their roadbeds.

After the waterways, the railroads. And beyond, General Wilson himself speaks from time to time of the Corps building the nation's sewage-treatment facilities and rehabilitating strip-mined lands. It is hard to imagine that he conceives of such options as substitutes for traditional dam and waterway construction, but rather as a broadening of power.

There are ways, however, of significantly changing the color and power of the Corps without entirely deflating it or damaging those programs—such as flood relief—which the Corps does well. One, of course, would be to eliminate the specter of a military organization controlling our water by giving the Corps a general discharge from the Army and turning it totally civilian, as Hannon and Findley suggest. The other would be equally important: to separate the justification of Corps projects from their execution. It is the Corps' control over all phases of a project, from evaluation through construction, that keeps bad projects like Meramec Park Lake alive on transfusions of in-house justification.

"The planning and evaluation functions which [the Corps] currently performs . . . should be reassigned," Hannon and Findley write, "to avoid the bootstrap or solution-in-search-of-a-problem approach so common with mission-oriented planning and construction agencies."

One of the most vocal critics of the Corps in recent months has been none other than Jimmy Carter, who successfully fought off a Corps dam plan in Georgia when he was governor. A year ago, Carter said, "The Army Corps of Engineers ought to get out of the dam building business. At a time when the whole country is concerned about inflation and high taxes, we don't need to spend tens of millions of dollars for the purpose of perpetuating the Army Corps of Engineers."

But the Corps of Engineers is tenacious, largely because it does not present a solid target; the Corps is many little soldiers in a field of tall grass. And what is worse, they wear your own uniform, they smile, and they say, "Let's be reasonable, let's be reasonable," until all hostility is gone. "The trouble with the Corps," one opponent said in frustration, "is you can't get a grip on it. There's nobody to hate."

High above Independence Avenue, in the Forrestal Building, is the most reasonable man of all, Lieutenant General James W. Morris, Chief of Engineers. Morris is the epitome of the Corps officer: West Point educated, Vietnam hardened, gifted with silver hair, blue eyes and the ability to communicate, empathize, compromise and get what he wants. An aide remembers with pride the time General Morris earned a standing ovation from a group of people whose land he was about to condemn. Now General Morris knows it is time for the Corps to concede in rhetoric what it cannot give up in real change. The Corps, he said, is like a heavy truck which came to an unmarked turn in the middle of the night of 1970, the turn of environmental consciousness and law, "rocked around on one wheel and then the other, and finally got straightened out."

"I just have an enthusiasm that we're on the right track," he said. "We're going to build waterways, but they're going to be the best waterways in the world. It's the same challenge, but we'll do it in a way that it becomes a plus in our natural treasury of resources. Many of our projects now instead of having adverse environmental impacts will have favorable environmental impacts. I would like in a hundred years from now for people to look back at the critical period between 1970 and 1980 and say, of all the agencies, thank God for the Corps of Engineers, because they got it right."

It all sounded so hopeful up there in the quiet office, far from the Meramec Park Lake and the Tennessee-Tombigbee Waterway, far from Don Rimbach's fury and Glenn Clemmer's wry regret. It seemed so full of promise. But there is the ultimate threat; most dangerous because it is clothed in smiles. With sincerity and good will, men like General Morris slowly gather power over our land and our precious waters, and with them, one by one, the grains of our freedom. And we let them do it with scarcely a murmur of protest. Because we trust them. We trust because General Morris is a reasonable man. We trust because they are all, all reasonable men. ●

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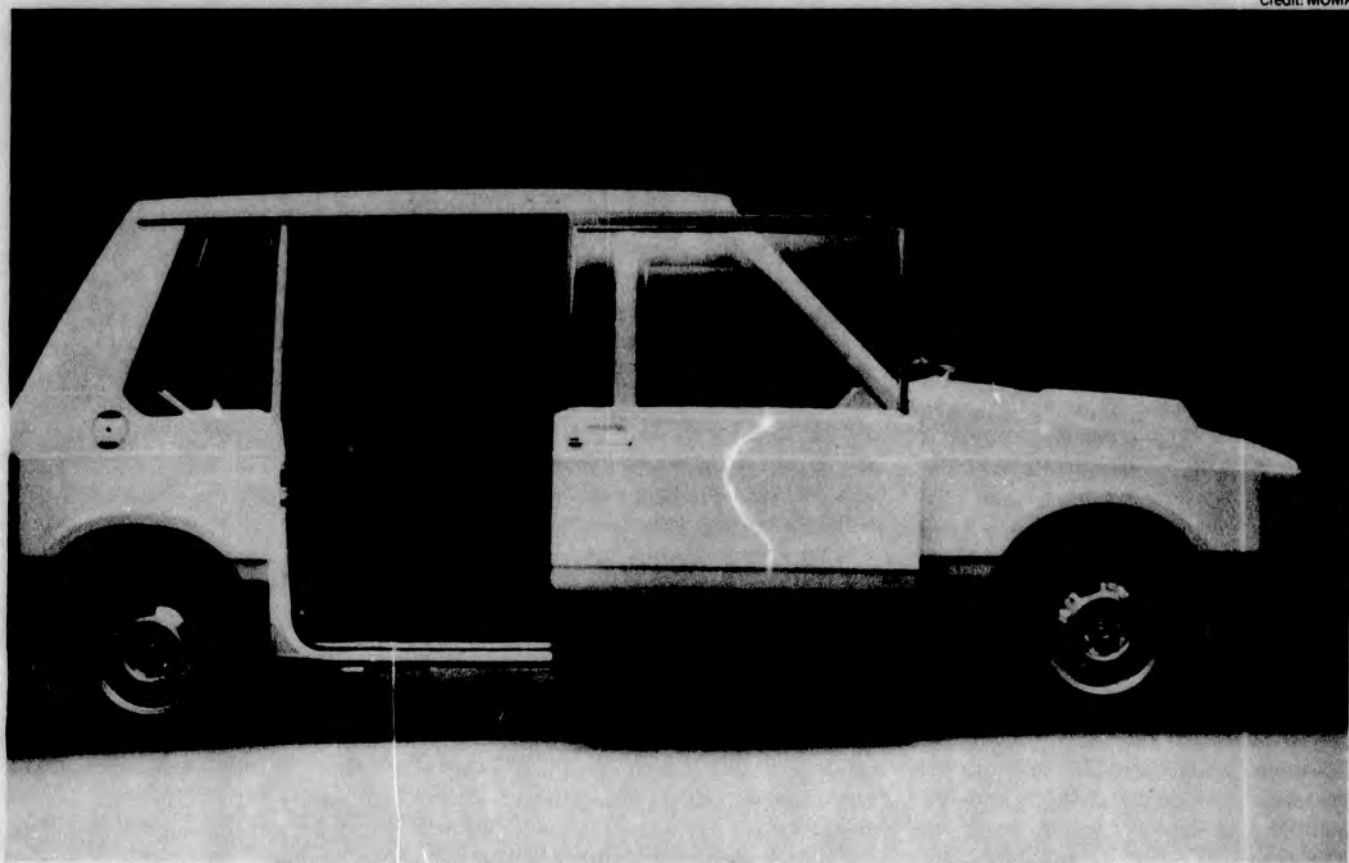
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ulate and imaginative people who read TIME regularly, even pie in the sky is food for thought.

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The Weekly Newsmagazine

A CLOSE-UP ON THE THE BULLDOZING OF CORPS NEW BURLINGTON

New Burlington was a comfortable Ohio farming village on the banks of Caesar Creek. For years its 400 residents had heard rumors of a Corps of Engineers project, but no one dreamed of what would happen once it really started

By John Baskin

Memorandum

From: Maj. Gen. R.H. Groves, division engineer, North Atlantic Division, Army Corps of Engineers

Subject: Improper Terminology

1. I am observing a growing trend in the use of the verb "to feel." Please avoid its use in any paper that you may prepare for my signature. Any action that I take is supposed to be objective, emotionally sterile and totally devoid of all feeling. In my official capacity, I am capable of believing or sensing, but never feeling.

2. Please see that your work for me is purged of this offensive word.

Within months after her house in

the village was taken by the Corps of Engineers, Merle McIntire was dead. Those closest to her, who knew of her resolve to die before she had to move, were not surprised. Although she was very old, her health was good. She just did not wish to live anymore. She was lying on her back when they found her, in the snow. Her hands were folded primly across her chest. She was on her way to the graveyard. She said so in a note she left.

Mrs. McClure was dead, too. She and her granddaughter had lived in the lower end of New Burlington, in a house so filled with plants it seemed it might explode. Just before she had to move, she showed a plant to a visitor. "Do you think," she asked, "that the Resurrection lily will live transplanted?"

In her new home in nearby Xenia, Mrs. McClure slept in a chair beside a window. When she awakened, she found she had been crying. "I don't know where I am," she said. "I have no idea. I don't see anything I know."

Abby Currie had an auction before she moved. Then she called the veterinarian to put her cat to sleep. The rest home prohibited cats.

Lawrence Mitchner was last. In his eighties, he lived alone in what had once been the village undertaker's par-

lor. A Quaker pacifist, he refused induction into World War I and spent part of the war in Leavenworth. Lawrence refused to talk to the Corps. When the engineers wrote, he tore the letters up without reading them. He told his neighbors he would never move.

The engineers moved around him. They bought the entire village and soon there were only a few houses left, foundations, steps and sidewalks which led to nowhere. Then the vandals came. They stole lumber, bricks, doorknobs, stripped the fruit trees, and took the ivy off Mrs. Louie Wills' chimney. Lawrence shuttered himself in his house and stopped answering the door.

Farmers asked the engineers about Lawrence. We'll leave him alone as long as we can and if we have to, they said, we'll move him out. *But we hope he'll die first.*

Don Haines, who had moved, but commuted 25 miles every day to farm his old land under a Corps deadline, remembered combining oats one night. "I looked across the creek to where the village was and there was nothing. No landmarks, no houses, nothing but Lawrence's light in all that dark space . . ."

And then Lawrence Mitchner was dead, too.

The Caesar Creek Lake project was not the U.S. Army Corps of Engineers' largest project, nor its most spectacular. The Caesar Creek Gorge itself was not of the same impressive natural pageantry as, say, the Red River Gorge in Kentucky. And New Burlington's comfortable but modest houses were not on the National Register of Historic Places.

It was a small, obscure village in the Ohio countryside that lived a bit too much in the past and was forced too quickly into a future it could barely envision. Yet it would be difficult to find anywhere a Corps project which contained more of the elements of abusive power and overwhelming arrogance, nor one which seemed so flawed from concept to finish.

The Caesar Creek project was a project that demonstrated perfectly that any national insanity might be perpetrated so long as the proper channels of bureaucratic legerdemain were followed. The Corps, masters at that too, merely transferred an inside engineering skill to the paperwork: it was, after all, an expert at channelization. And over the years, this latter skill had far surpassed the former. The Corps was much more adept now at bulldozing through appropriations committees, the fine areas of environmental law and the opposition.

The Army Corps of Engineers first came to New Burlington more than forty years ago. Its ostensible purpose was to build a dam for flood control. Not for New Burlington, however, which had its own sporadic problems with flooding. The dam would be, the engineers said, flood control for the little river towns on the forty-odd-mile stretch of the Little Miami River into Cincinnati, and for the Ohio River itself.

But it was a spurious project. When costs rose, water quality and recreation benefits were tacked on. The flood-control "reservoir" had become a "lake" and the engineers were promising all things to all men, even though there were strong indications of serious problems in all its varied parts, which never added up to any concise whole. The project seemed more and more to resemble an old hooker wearing a lot of paint, standing for good effect under a dim streetlight.

Still unfinished by late-1976, construction costs had nearly tripled the engineers' original estimate. Conservation-

ists contended that the Little Miami River, one of Ohio's few remaining scenic rivers, would be seriously damaged by the dam on its important upriver tributary. They contended, as did various government agencies, that the lake's benefits were highly overstated, and that the life of the project was only half as long as the Corps said it was. The Ohio Environmental Protection Agency indicated the quality of water would likely deteriorate, and that the lake would be polluted. And in the final Environmental Impact Statement done by the Corps, the engineers revised their earlier floodwater reductions in downstream Cincinnati: what had been labeled "a substantial amount" was now down to a maximum of three inches and, possibly, none at all.

As for New Burlington, the tiny farming village of less than 400 people and no particular note, it would be sacrificed for the greater good: New Burlington would be flooded forever.

Plans were made for Caesar Creek as early as 1928. The lake was authorized in 1938, a year after the Ohio River flood which left 100,000 people

"When the Corps first sets foot on your land, they should inform you of your rights, just like a criminal," says one angered landowner

homeless. The project was on, then off. After severe flooding along the Little Miami River in 1959, it was on, and this time it was obvious it would stay on, although funding wasn't available until 1962.

And before that time, most of the villagers had never seen any of the engineers. The printer's wife saw two men surveying the stream behind her house but soon she had forgotten that initial moment of panic. For dinner was ready, and work was waiting. So the village accepted the rumors, assimilated them and lived on, vaguely worried, the demanding moment absorbed by time and duty. Now that time was over.

The Army engineers would soon begin a rural pacification program in the unincorporated village of New Burlington (a village not so hugely unlike how some might imagine a Vietnam hamlet for, after all, rural people in the world have more affinity with each other than city people). In perhaps a decade or more, which is to say, *today*, the villages could look backward and see that they and their neighboring countrymen had

been merely coordinates on a map that featured New Burlington as a military objective.

Corps appraisers went to work in 1967. Stated policy was to pay "fair market value," which meant, according to the Corps, "the price the property would bring in a sale between a willing seller and a willing buyer." But what the Corps did was set a buying pattern which manipulated the market. In fact, the Corps helped create a small pocket of low-priced property which was surrounded by one of the hottest real estate areas in the nation.

One professional appraiser, Don Sigg, who worked for both the Corps and later did private appraisals for landowners, said he knew the Corps had urged New Burlington people, over a period of years, not to improve or maintain their homes—then it bought the 80 homes of the village as a "depressed area." Frank Lundy, a bottomland farmer, said that in the late 1930's he was advised not to improve his farm. Said project manager Earl Murphy: "I've heard that it is a depressed area." The Corps, too, had its own version of "blockbusting." It made sure villagers would not act in concert by working quickly with those residents who were most vulnerable—the short-time residents who had few deep attachments or family ties, and the widows.

One of the first negotiations was with the village's oldest widow, Mrs. Louie Wills, 94. Murphy's buyers offered her \$5,300 for her modest house. But she and her husband had paid \$7,500 for it 13 years before. There were two more offers, reaching \$6,000, and a letter from Murphy containing an ultimatum: "... if we do not receive the enclosed offer forms, duly signed, within the next 15 days ... prompt action will be taken to complete acquisition by filing a declaration of taking in a condemnation proceeding ..."

Farther along in the letter, Murphy told Mrs. Wills that his comments were presented only as explanation and were "in no way intended as a threat." Mrs. Wills, however, saw it differently. "I've never been to court even to pay a traffic ticket," she said. "I expect when you go into court with the government, you get into it ...". She sold, and moved in with her daughter.

Don Collett, owner of the village hardware store, was surprised to learn the Corps did not pay anything for an established business. "Run a farmer out," said Collett, "he'll harvest his crop and go. Come next spring, he'll put in corn somewhere. A businessman starts out on another corner, he don't know whether

John Baskin's book New Burlington: The Life and Death of an American Village was published earlier this year by W.W. Norton & Company.



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A town sentenced without trial: (counterclockwise) the detritus of New Burlington; a scavenger with wrecking bar; Merle McIntire and great-granddaughter outside her abandoned house; Merle's grandson salvaging the lumber inside.

his corn's going to come up or not"

Collett, who had recently built a new brick ranch house in the upper part of the village, also didn't like the way negotiations went when the appraisers looked at his home. "They told me," he said, "that I was *overdeveloped*. They said if I was going to live in New Burlington I couldn't have things my neighbors didn't. They said the house wasn't worth as much here as it would be in the suburbs of Dayton"

George Marburger had a stranger

complaint: "I made arrangements to buy another place and while waiting for the money from the Corps, I decided to go ahead and make the down payment. So I borrowed \$10,000 for a down payment thinking I could pay it back as soon as the Corps deposited my money. But they lost my file and I couldn't get *any* money. So the man sued me because I couldn't buy. I ended up losing the down payment"

Early in 1976, Marburger was preparing, at last, to move. In transactions with the Corps, he claimed he lost 70

acres of land, doubled his indebtedness, suffered a nervous breakdown and subsequently lost his job, and had been separated from his wife and children (who were now back with him). His wife said his health, job and the separation were because of the stress of negotiating with the Corps.

"I have been," said Marburger, "treated worse than any dog."

A final outrage to the villagers was that before they could close sales with the Corps, they had to pay a deposit

for streetlights, an assessment for the remaining time on the township's contract with the power company. It meant that villagers were paying for a service they would never receive.

And while Corps negotiators and appraisers were often guilty of evasion and deceit, most of what they did was construed as legal. Whether it *should* have been was another matter. On at least two points, however, the Corps violated explicit rules set up by itself. One such violation was that they refused to allow landowners to introduce into the negotiations their own privately-obtained appraisals.

A second violation was that buyers had been known to offer less for property than the Corps' appraised value. Said Murphy: "Nobody knows, anyway, whether we start lower [than the appraisal] or higher because nobody knows what the appraisal is." Then he added, "We hardly ever buy anything below the appraised value."

If so, it was not because the buyers didn't try. But initial offers to landowners were never in writing so it was one man's word against the government. Until the passage of the "Muskie Bill" in 1971, landowners could not find out the appraisal figure without going to court. Even court was no solution for Roger and Alma Plummer, one of the few landowners in the project area to request a jury trial. The Plummers lived on the lower end of the project area in a 130-year-old brick house of Federal architecture which placed it on the historic register. They owned 150 acres of bottomlands along Caesar Creek, about a mile and a half above the dam site.

Corps appraisers came in 1968. Three years later, their final offer was \$56,000. The Plummers refused it and asked for a jury trial. Early in 1971, Congress passed the Uniform Relocation Assistance and Real Property Acquisition Policies Act—the "Muskie Bill." Its provisions set up fair guidelines for the Corps to follow in buying property and helping people relocate. Merely its passage stated that previous practices had not been fair. Plummer read about the new bill in a farm journal, and asked his negotiator. The negotiator said he didn't know anything about it.

Most of New Burlington was bought before the bill's passage and only a few villagers qualified for help in relocating. "The Corps told us," said Plummer, "and it was printed in their pamphlets, that they would start buying at the dam site and work upstream. But then they went 15 miles to the top of the project and bought as much of New

Burlington as they could. I think they did this because of the Muskie Bill. They knew it was going to pass and they said, 'Let's grab this town before we have to pay relocation expenses . . .'"

In 1971, the Corps condemned the Plummer farm. Final figure: \$61,400—\$409 an acre. Published surveys of Corps' prices paid for farmland during the four previous years showed an average of \$548 an acre. And surveys of open market sales within a ten-mile radius of the project during the first eight months of 1971 showed average per-acre price was over \$900.

Plummer had three independent appraisals made. They averaged above \$100,000. He went into county records and checked seven comparable farm sales within five miles of his own farm. They averaged \$950 an acre. He and his wife began looking for another farm. They looked at 25 farms before they found one under \$1,000 an acre.

Meanwhile, the Corps made a pre-trial offer of just over \$74,000. Plummer refused it and hired Bowling Green, Ohio, condemnation experts, Hanna & Hanna. "The Corps told me," said Plummer, "that I could get a hearing before a three-man commission [a second method of contesting the Corps' appraisal] right away. But a jury trial would take awhile. You have to wait until they take you to court, so they used this as a wedge against me, trying to pressure me into signing. They let me wait about two years." In 1975, the Plummers were finally allowed into court.

During the trial, the Corps' chief witness said, as an expert, that Plummer was giving inflated comparable prices. Before Plummer could check his figures—which proved himself correct—the Corps' attorney used this in his closing argument to, as attorney Harold Hanna put it, "impugn the credibility of Mr. Plummer." Said Plummer: "To the jury, listening to this 'expert' witness, it just looked like everything I had said was a lie . . ."

Consequently, the jury awarded the Plummers \$65,000—almost matching the Corps' 1971 appraisal figure. The Corps' lawyer said the error of the witness was "inadvertent" and his testimony given "in complete good faith."

Said Plummer, angered, frustrated, and by now, cynical: "When the Corps first sets foot on your land they should inform you of your rights, just like a criminal . . ."

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around New Burlington remained unorganized, incredulous. Conservative Republicans for the most part, they could not believe what an agency of their own government was doing to them. They responded as might a man with his artificial leg caught in a steel trap: the dismay came late.

"I just lost hope," said Alma Plummer, "and my innocence. All the power was on one side. We had nothing. I never thought I'd protest any government policy. Then I found I was a protestor. I have since said the Pledge of Allegiance but I stopped at the last four words. I could not say 'with justice for all.' The people of Caesar Creek did not receive justice . . ."

There was finally some organization in 1972, when the Caesar Creek Preservation Association was formed. But it was like bringing in a specialist in time for the autopsy. Much of the 10,000 acres in the project area had been acquired, the dam was under construction—and less than six people were left in the village of New Burlington.

The following summer, Ohio's attorney general, William Brown—with the CCPA and other conservation groups as intervenors—filed suit to halt construction. Brown charged that the Environmental Impact Statement (EIS) filed by the Corps was inadequate, that the Corps had disregarded environmental laws, and that cost-benefit ratios justifying the project were highly overstated.

Construction was halted for a month, then U.S. District Judge Carl Rubin (who had incensed conservationists by saying that he liked to scuba-dive and "I can't very well do that in Caesar Creek") granted exceptions to the injunction and most of the work continued as usual. The Corps did, however, prepare an updated EIS. It was as thick as the Cincinnati phone directory and its table of contents alone was longer than the October 1970 draft.

Massiveness, however, did not mean accuracy. Indeed, there was a question, entertained by some who might also be called expert, asking whether an accurate EIS could ever be properly done. One of those who suggested such was Dr. Sture F. Anliot, professor of biology at Wilmington College, who read the updated EIS to find that 70 pages of it had been picked up from his book on the flora of Glen Helen—a nature preserve over 30 miles north of Caesar Creek.

"People have been led to think," said Anliot, "that we can come up with an accurate EIS. It is possible to do a

very good one but no one is willing to pay the price. And predicting environmental consequences is very tentative. There is a lot we don't know. What will occur is often speculative. The Corps here put together something and called it an impact statement. But it wasn't. A good one here would have showed the project shouldn't have been built . . ."

The EIS defied any order. It was an unruly basket of comment on history, land use, effect on taxes and the environment. There was no logical sequence to its facts, and all facts that should have been present were not. As presented by the Corps, the EIS was a weapon of bureaucratic verbiage, a language so thick and heavy as to tunk the brain pan in passing and render insensible all but the most tenacious.

But with the updated EIS, which was amended into a final updated EIS, some things emerged, among them that:

- The Ohio Environmental Protection Agency said flood control, recreation, and water quality benefits were overstated, and the National EPA called it "a bad project."

"I just lost hope," explained one woman. "I still say the Pledge of Allegiance, but not 'with justice for all.' Caesar Creek did not receive justice. . . ."

- Between all the demands for the lake's water, there were discrepancies which meant that one or more of the demands could not be met.

- The Federal Water Pollution Control Agency said lake benefits would last only 50 years, not 100 as the Corps contended.

- There would be serious pollution problems in the lake itself.

In the spring of 1975, Brown, who had promised conservationists he would not abandon court action against the Corps, made a deal with the engineers and dismissed his case. He agreed to drop the case if the Corps made changes in how water was released from the dam, in an attempt to lessen pollution.

Since the state was principal litigant, the intervening conservation groups were unable to proceed on their own. Mike Fremont, president of Rivers Unlimited, alleged that the promised changes were inconsequential. He contended the state had misled the conservationists and said they had been "sold out."

Said Fremont: "It was an incredible breach of faith. We were sick. We never knew what happened for sure. Political unwisdom, a payoff somewhere, an attempt to get the conservation vote. But there was no question in our minds that we had a good case . . ."

It is now the fall of 1976. New Burlington is gone, and so are most of the people along Caesar Creek. The dam is almost finished and private timber companies are clear-cutting in the pool area. Many of the farmers who were forced to sell have moved into small brick ranch houses on lots where they can be seen in warm weather wearing old field clothes, pattering incongruously about their small, tidy yards. In many of the houses are sentimental oil paintings of the farmhouses, barns and fields they once owned.

Inflated development prices threaten the remaining farmers and some of them believe it is the beginning of the end of farming in the counties of the lake project. Antique dealers, a pro-dam lobby, consider prosperity in the nearby town of Waynesville where there are 21 of them in a four-block area. For the most part, the artifacts of a previous life in the Caesar Creek area can be found in a saccharine enterprise called "Pioneer Village." It is suggestive of a time to be when all but the current, designed moment will be viewed through glass.

Vernon Stiles, nearing 80, who received \$8,000 for his two-story, nine-room house on a three-quarter acre plot in New Burlington (the Corps settled with the Stiles on their 41st wedding anniversary) is now making house payments. The widows—those who survived—are scattered, to rest homes, trailer parks and homes of sons and daughters.

There has been illness, suicide, death, isolation and the disintegration of families. The distribution of blame in such acid human events is an inexact science. Yet there is no doubt the Corps serves as a catalyst. It is a mercenary force on the American landscape ("except for the Soviet Union," said former Senator Eugene McCarthy, about the Corps, "they are the toughest foreign power we have to deal with"), operating at small profit and awesome damage.

And the old people of New Burlington continue to worry about their graveyard which is on a hill above the demolished village. The engineers say it will not be touched. The villagers themselves are not certain. They think that even in death they might not be safe from the Corps of Engineers. ●

DEWAR'S PROFILES

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SHERYL HANDLER

HOME: Cambridge, Massachusetts

AGE: 29

PROFESSION: Urban and natural resource analyst

HOBBIES: Horseback riding, skiing, scuba diving, piano, oriental and primitive art collecting.

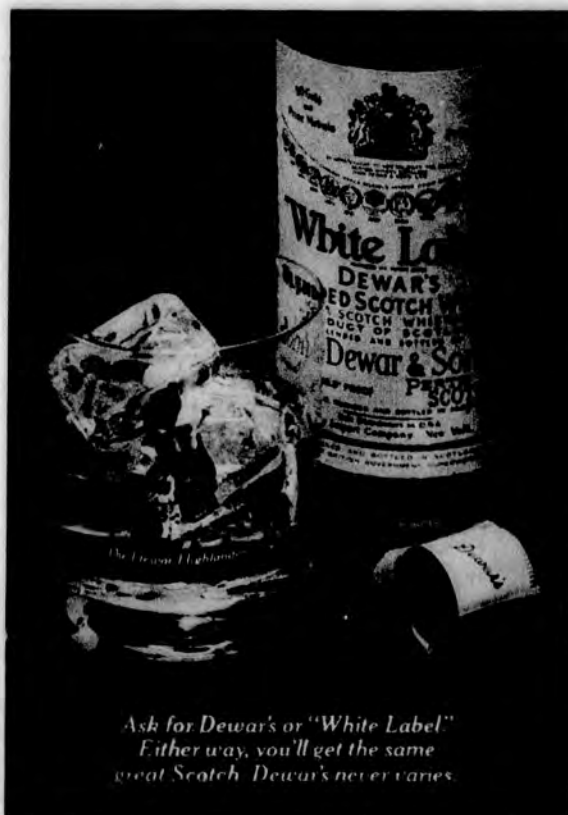
MOST MEMORABLE BOOK: "Kristin Lavransdatter" by Sigrid Undset

LAST ACCOMPLISHMENT: Founded nonprofit corporations which provide resource management and urban development services to governments the world over.

QUOTE: "My feminine instinct to shelter and nurture contributes to my professional perspective. Instinct, as much as analysis, is required to rationalize the use of natural resources with economic growth."

PROFILE: She has a unique ability to mobilize experts in many different fields to attack the problems of people from areas as diverse as small New England towns and large Asian cities.

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